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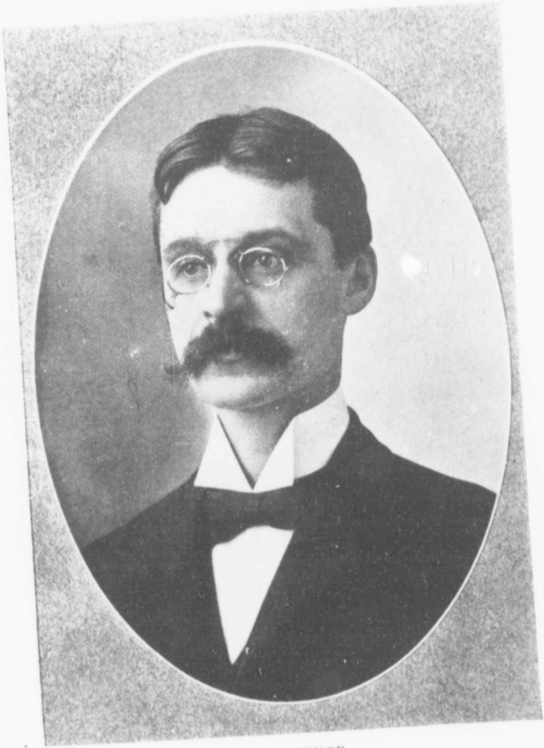

THE AUTHOR.

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MEDICINE SURGERY AND HYGIENE IN THE CENTURY

BY

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PREFACE.

Probably no department of science has been attended with results so beneficent to the human race as medicine. None, certainly, has made more remarkable progress during the nineteenth century, and medical science has now become so important a factor in the daily life of the people that a record of its progress, written in untechnical and popular language, seems not only timely but necessary.

The influence of scientific medicine upon public health has been most strangely marked. By its disinterestedness, by its unselfishness and by its sincerity the medical art, as practised by its noblest representatives, appeals to the purest and the most exalted feelings of mankind. In every scene, from act to act, and until the dark curtain slowly falls upon the drama of life, the physician is present and plays a leading part.

The history of medicine is a branch of learning to which considerable attention has been paid by the Germans. Shulze, Hensler, Osiander, Sprengel, Haeser and Baas have all written voluminous works upon the subject, and in the present outline the last of these has sometimes been consulted; while, among the French and English historians, Cabanis, Le Clerc, Peisse, Freind, Wise, Moir, Bettany, Berdoe, Park and other occasional writers have also been drawn upon.

In giving a plain and untechnical account of the progress of medicine and surgery, the writer has often found it convenient to quote directly from the representative medical authors of the time, though frequently abridging the original text, and simplifying or modifying terms as best suited the purpose of the present sketch. To avoid the confusion, however, which would follow the constant repetition of authorities in the body of the narrative, it has been thought that the following general acknowledgment would be sufficient; more especially as the works of the authors referred to are not likely to be of particular interest to the general reader.

For the first half of the century a large number of the earlier medical works were examined, and much information was obtained from Allen's, from Cullen's and from Watson's Practice of Physic, from Heberden's Commentaries, from Mason Good's Study of Medicine, from Latham's works, from the treatises of Marshall Hall on Nervous Diseases and Murchison on fevers, and from Beaumont's observations upon the stomach of Alexis St. Martin. Cooper's and Chelius's surgery, Brodie's surgical works, Simpson's works and Todd's Cyclopædia of Anatomy and Physiology, together with the works of Bichat, Dupuytren, Louis, Andral, Trousseau, Rayer, Fourcroy, Rokitansky, Haase, Schleiden and Schwann also repaid a careful perusal.

For the latter part of the century the "Systems" of medicine and surgery have been examined in turn, beginning with Reynold's and Holmes' and concluding with those of Allbutt, Treves and others. The very numerous standard text-books also, upon general medicine and surgery, as well as the specialties of each, together with those works which treat of the allied sciences, anatomy, physiology, chemistry, materia medica, nursing and sanitary science, have been followed wherever they could be of service. The *Lancet*, the *British Medical Journal*, the *Canadian Journal of Medicine and Surgery*, and many other medical periodicals have likewise been consulted.

Finally, the writer's best thanks are due to Albert Britnell, Esq. ,whose extensive knowledge of bibliography, both ancient and modern, has proved of the utmost assistance, and also to the curators and librarians of the various technical collections where he has applied.

E. H. B. STAFFORD.

TORONTO, CANADA.

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MEDICINE, SURGERY AND HYGIENE IN THE CENTURY.

CHAPTER I.

THE HEALING ART IN MYTHOLOGY.

THE Countess of Chinchon, the wife of the Governor of Peru, was attacked with a severe fever for which no remedy could be found. When the news of her malady had reached the ears of the Corregidor of Loxa, he hastened to her house, bringing with him the bark of a certain tree which was said to grow in the dense forests of the Andes, far up among the mists of the mountains. The bark was very bitter to the taste, but its administration was followed by the speedy and complete recovery of the Countess. In use among the natives up to that time, it henceforth became known through her to the world, and at the present day still bears the Spanish lady's name.

She would smile, perhaps, if she could return to the world, after the lapse of nearly three hundred years, to find the simple bark, gathered by the Incas among the hills, metamorphosed in the chemical laboratories of our day to a powder as light and as soft as snow. She would wear too a perplexed frown, perhaps, if she could glance within the ponderous tomes of modern science where her own name occurs over and over in various Latinized modifications. The bark of the Corregidor has become a factor in civilization, his friendly call a part of history and the lady's name a term in the nomenclature of science.

In the winter of 1535 Jacques Cartier, the French explorer, was in camp by the frozen St. Lawrence, with his ships drawn up on the shore and a stockade built around them. The drifting snow gathered over the ships, and the masts and spars and cordage were covered with icicles. The French sailors, accustomed to a more temperate climate, and poorly supplied with provisions, grew weak and sickly during the dragging months of the long Canadian winter. At last a malignant form of scurvy broke out among them, and a large number died of that distressing disease. The frozen ground rang metallic to the mattocks of the survivors when they attempted to bury the dead, and the corpses of their comrades were accordingly hidden in the snow drifts. To the camp of Cartier at this time there came a native Indian woman who told them of a certain evergreen tree called the Annedda. A decoction of the leaves of this shrub restored the French sailors to health.

The History of Medicine is largely made up of incidents as trivial apparently as the foregoing. But there is always the same underlying spirit of compassion, the same unselfish desire to alleviate the pain of others; whether it be Susruta in the sunlight of Hindostan, treating a child for the venom of a serpent; or Machaon on the field of Troy binding poppy leaves about the temples of a warrior who has fallen valiantly and been despoiled of his arms; or the young Athenian physician with his hand raised in taking the oath of Hippocrates; or Harvey before the College of Physicians at London, explaining for the first time the mystery of the circulation of the blood; or Hermann Boerhaave at Leyden raising his hat at the mention of Sydenham's name; or Pasteur in his laboratory at Paris studying the nature of bacteria; or the brilliant London or New York surgeon of to-day standing in the crowded hospital theatre in the midst of an operation where life and death lie closely touching the opposite sides of his shining knife. In whatever age or among whatever races, the same principle is to be found, and it is in this noble principle that all the glory of medical history lies.

The written history of medicine covers between three and four thousand years; and though there may at first appear to be something repellent in a study which makes death and disease its object, a closer view of the subject dispels any such notion. Suffering is one of the prices which we pay for life. Absolute happiness, or immunity from all forms of suffering, may usually be associated with mental alienation, and is exceptional in the sane. Beginning with the dawn of civilization, at first handed down by word of mouth from one to another, a little later referred to incidentally in the earliest known inscriptions, and at last, thirty-three centuries ago, committed formally to the first written book upon the subject, the story of the medical art may be fittingly designated as the Romance of Pain.

Laws and Faiths have changed from time to time, and have been different among different races; but through all the centuries the healing art has held the same undeviating course. At times its advance has been slow, at times it has been at a standstill; but even then the same broad principles have governed it. It is wholly cosmopolitan. It has never fallen into absolute decay. Its best representatives have always been unselfishly devoted to the art for its own sake, finding in its practice their best, and too often their only reward. The healing brotherhood, like a mystic order, have been present in all the great events of history. They have followed the red trail of armies, and in the tumult of battlefields have pursued their duties, unmolested by friend or foe. Where the black cloud lowered over the cities of the Plague it was the physician who penetrated unafraid into the deathly stillness. The mystery and the horror of death and disease have always been his companions.

During the Nineteenth Century more progress has been made in every branch of the medical art than had been accomplished by all the ages that preceded.

At first glance there seems something marvellous in a development so rapid and so unparalleled; but upon closer scrutiny the apparent disparity between the advance made by the present century and that made by all that went before is found to be superficial. The present has been an epoch of striking results: the past of patient and hopeful preparation. As great honor is due therefore to the faithful forerunners as to those whose fortunate destiny it has been to reap the visible reward.

Looking back, indeed, the chief cause for wonder is not that the earlier students of medical science failed to make the discoveries made during the present century, but that they succeeded in making even the advances which they did with the meagre facilities at their command. They were handicapped not only by the imperfect tools at their disposal but also by the gross superstitions of the times in which they lived—superstitions so great that at one time it was regarded as a serious crime to examine a dead body for the purpose of anatomical investigation.

The pagan world regarded the destruction of the body as preventing the happiness in the spirit world of its tenant. Hence the Egyptians sought, by embalming, to ensure its permanent existence. Hence the Greeks and Romans invoked the most direful curses upon those who should disturb its tomb. Thus the Latin poet exclaims:

> Res ea sacra, miser; noli mea tangere fata:
> Sacrilegæ bustis abstinuere manus.

So deeply seated in the minds of men was this superstition regarding disease, that even in the present century, when vaccination was first introduced, and was found to be a preventive against smallpox, many voices were raised against its use on the plea that epidemics of the sort were sent by the Deity as a punishment to the race for their sins, and that any attempt to prevent the inroads of the scourge was an impious circumvention of divine Providence. Indeed, as late as 1850, when chloroform was beginning to be used to alleviate the pains of childbirth, one learned professor of medicine declared that the anguish thus obviated was "a desirable, salutary and conservative manifestation of life force." Another denounced the soothing of the pangs by artificial means as "an unnecessary interference with the providentially arranged process of labor;" while still another physician condemned the use of an anæsthetic "merely to avert the ordinary amount of pain which the Almighty has seen fit—and most wisely, we cannot doubt—to allot to natural labor."

When members of the medical profession itself could show such narrow prejudice against so useful an innovation it is not at all surprising to hear a conscientious divine of the same period anathematizing chloroform as "a decoy of Satan, apparently offering itself to bless women," but "which will harden society and rob God of the deep earnest cries which arise in time of trouble for help."

Disease no less than health is governed by certain fixed laws of nature; and when these are even dimly comprehended it is in a measure possible to understand the relation which disease bears to the habits of life at a given time. The diseases of an age, or of a region, form, to a great extent, an index to the vices, and often to the customs, of that particular period or place. Diseases do not necessarily form a mixed group, existing unchanged from century to century, but may be rather resolved into certain clearly defined elements, which are capable of innumerable combinations. Hence some forms of disease, familiar at one time, have gradually become less common, and eventually have almost disappeared; while other diseases, formerly unknown, have seemed to take their place.

This fact leads to the natural conclusion that if it be possible to suppress certain forms of disease by a modification in the habits of living, and at the same time to produce other forms of disease by new conditions of civilization, that it rests to a great extent with the human race what diseases they shall have, and, indeed, whether they shall have certain forms of disease at all. When disease is at last traced back to its ultimate causes it will be found possible to limit the maladies of the race to those which result from accident and those which result from the unavoidable decline of old age.

Meanwhile though great headway has been made toward this end it is safe to say that through the perspective of another century the present epoch of scientific progress will be looked upon as forming the apparent beginning of scientific knowledge; though the actual beginning was with the first dawn of human intelligence, when the simplest rules of self-preservation, founded upon observation, formed the first system of medicine—a system "which may," remarks a writer of the earlier part of the century, "boast of having had an origin, that well deserves to be called noble; for, the earliest practice of it arose from the most generous sentiment which nature has implanted in the heart of man; that sympathetic benevolence, which leads us to pity the misfortunes which we behold, and inspires us with an anxious desire to alleviate them. He who first saw his fellow creature suffer could not fail to participate in the pain, and endeavor to find out the means of affording relief. Opportunities of exercising this useful inclination were never wanting.

"In the first ages of the world, man in his destitute state was under the necessity of earning, by force, or stratagem, a subsistence which was always uncertain, and in the combats into which this sort of life drew him, he frequently met with wounds, and other injuries. The consequence was, that he began at a very early period to pay attention to the mode of curing such accidental hurts. Wars, by multiplying wounds, at the same time increased the necessity for assistance, and enhanced its value. Kings themselves then did not disdain to dress wounds, and several of the warriors sung by Homer, derived not less renown from their skill in surgery, than their valor in war. Such were Chiron, Machaon, and Podalirius.

"In fact, among the ancients, the profession of medicine and surgery constituted a sacred kind of occupation, and the practice of it belonged only to privileged persons. Æsculapius was the son of Apollo. In the armies, the highest princes gloried in dressing the wounds of those who had fought the battles of their country. Amongst the Grecians, Podalirius, Chiron, and Machaon were not only distinguished for their valor, but also for their skill in surgery, as we learn from the poem of the immortal Homer. The value which was placed upon the services of Machaon by the Grecian army may well be conceived from the anxiety which they evinced to have him properly taken care of, when he was wounded in the shoulder with a dart. 'O Nestor, pride of Greece, (cries Idomeneus), mount, mount upon thy chariot! and let Machaon mount with thee! Hasten with him to our ships; for, a warrior who, as he, knows how to relieve pain, and cure wounds, is himself worth a thousand other heroes.' Hippocrates was one of the first citizens of Greece; he nobly refused all the rich offers of several kings, enemies of his country, to entice him into their service; in particular, he disdained to accept those of Xerxes, whom he regarded as a barbarian.

"In the poems of the Iliad and Odyssey, we find certain traditions respecting the state of the art before the establishments of the republics of Greece, and even until the time of the Peloponnesian war. There it appears, that surgery was almost entirely confined to the treatment of wounds, and that the imaginary power of enchantment was joined with the use of topical applications.

"In the cures recorded in the sacred writings of the Christian religion, the intervention of a supernatural power is always combined with what is within the scope of human possibility. The same character evinces itself in the infancy of the art in every nation. The priests of India, the physicians of China and Japan, and the jugglers of the savage or half civilized tribes of the new and old continents, constantly associate with drugs and manual operations certain mysterious practices, upon which they especially rely for the cure of their patients. Such was also, no doubt, the character of the medicine of the Egyptians in the remote times, previous to the invention of the alphabet.

"It is curious, however, to find from some late observations made by the men of science, who accompanied the French expedition to Egypt in 1798, that amongst the ruins of ancient Thebes there are documents, which fully prove, that surgery in the early times of the Egyptians had made a degree of progress, of which few of the moderns have any conception. It is noticed by Larrey in his *Memoirs of Military Surgery* that, 'when the celebrated French

General Desaix had driven the Mamalukes beyond the Cataracts of the Nile, the Commission of Art had an opportunity of visiting the monuments of the famous Thebes, and the renowned temples of Tentyra, Karnack, Medynet Abou, and Luxor, the remains of which still display their ancient magnificence. It is upon the ceilings and walls of their temples that basso-relievos are seen representing limbs that have been cut off with instruments very analogous to those which are employed at the present day for amputations. The same instruments are again observed in the hieroglyphics; and vestiges of other surgical operations may be traced, proving, that in those remote periods, surgery kept pace with the other arts, which had already attained a high degree of perfection.' "

In ancient Egypt Thuti (Thot), a god represented sometimes with the head of an ibis, sometimes with that of a dog, enjoyed great respect and was regarded as the inventor of art in general, and especially of the healing art. By many he is regarded as the Egyptian Æsculapius, though he enjoys many peculiarities in common with the Greek Hermes and the Phœnician Esmun. He is supposed to have been the author of the oldest Egyptian medical works, whose contents were first engraved upon pillars of stone. Subsequently collected in the book Ambre, they form a part of the so-called "Hermetic Books," from whose prescriptions no physician might deviate, unless he was willing to expose himself to punishment in case the patient died. This punishment was threatened because the substance of the medical, as well as the religious works of the Egyptians was given, according to their view, by the gods themselves, and a disregard of their prescriptions would be nothing less than sacrilege.

The medical knowledge of the ancient Egyptians was tolerably extensive, and, gauged by the measure of those early ages, by no means unimportant. The highest class of priests officiated as physicians of the higher science, conjurations, dissolving the charms of the gods by prayer, interpretations of the revelations received by the sick and the like; while ordinary medicine was practised by priests of the lowest grade, the Pastophori. In consequence of the strict division of castes which stamped its impress upon all the arrangements of the ancient Egyptians, the adoption of the medical profession was permitted to the sons of physicians only.

The pathological knowledge of the ancient Egyptians comprised a knowledge of fever and of diseases of the eyes, in the treatment of the latter of which the Egyptian physicians enjoyed special reputation throughout all antiquity, and must therefore be regarded as the earliest oculists. When we consider the method in which the operation of embalming was performed, it is manifest that the custom could result in no extensive anatomical knowledge. They were acquainted, however, with a considerable number of drugs, and had numerous formulæ for their preparation.

The non-Semitic people of Accad are considered the oldest representatives of a civilization, which, in the remotest ages, had its seat in the central portion of Western Asia. Their culture was subsequently entirely adopted by the Semitic races. Upon this primæval seat of civilization developed, after the disappearance of the Accadians, the states of the Babylonians, Assyrians and Syrians. The Zend-Avesta is regarded as a work which originated substantially with the guild of the Chaldeans, but which was committed to writing by Zara Thustra, who is said to have lived about B. C. 2500, but more probably in the age of Darius Hystaspes. Subsequently lost, but afterwards collected from memory, it now contains, in its present form, a medical portion which is preserved in the section Vendidad. "Some are cured by the knife," claims this ancient authority, "others by the Word. For by the Celestial or godlike Word diseases are most surely cured." Magicians too were regarded as the most excellent physicians. Besides these, there were herb-doctors and knife-doctors.

In Hindostan the first known writing on medicine is of uncertain date, as, indeed, are all the foregoing, but notwithstanding the disputes of the philologists, which have extended, unhappily, to medical as to all other branches of literature, the Hindu work in question may be considered of great antiquity. This is the Yajur-Veda, one of the sacred books of the Brahminical religion; the Sanscrit term implying virtually "The Science of Living." Its object was to describe the means of retaining health, the causes of various diseases and the method of curing them. Medicine in India, as in Egypt, was closely connected with theology and was practised wholly by the priestly order. In some of the Shastris it is recorded that the Yajur-Veda consisted of one hundred sections of one thousand stanzas each. God, pitying the weakness and suffering of mankind, and recognizing the impossibility of their ever learning so large a work, abridged it, and divided it into six parts, dealing separately with surgery, diagnosis, anatomy, therapeutics, antidotes and local diseases.

The entire original work no longer exists, but fragments are still found in the writings of commentators. The works of Charaka and Susruta are supposed to be commentaries of the Yajur-Veda. The faculties of these sages were said to have been supernaturally developed to enable them to understand the sacred scroll and to distinguish the peculiarities of disease and the qualities of medicine. Thus enlightened, they gained much distinction by the cures which they performed, and enjoyed vigorous health to a very old age. They also prepared the works called by their own names, which were read before the assembled sages of the time, and gave such satisfaction that "with a voice which reached to heaven" they proclaimed their admiration of the authors.

The Charaka is considered the most ancient and the most celebrated Hindu medical work extant, and is arranged in the form of dialogues between the master and his pupils. The author's want of exact anatomical knowledge, however, often rendered his manner of treating the subject obscure.

To increase the importance of these great medical systems a fanciful mythological origin is ascribed to them. That of Susruta is thus related: When the Vedas were lost in the deluge they were recovered by the great serpent Ananta, upon whose thousand heads the world rests. At the churning of the ocean by the gods and demons, in searching for the waters of immortality, the ocean was converted into milk, and then into butter, from which precious gifts were derived. Among these was Dhanwantaree, the physician of heaven, and possessor of the water of life drunk by the immortals. Admitting that the Yajur-Veda was too voluminous to be recollected by the present degenerate race, he recommended Susruta, who had been selected to visit him, to abridge it and arrange it into parts so as to be easily understood.

The works of Charaka and Susruta are the groundwork of the more recent medical systems, in all of which the authors have adhered to the arrangement and the general details of the originals. These great Sanscrit medical classics display upon examination a maturity of knowledge that is remarkable when the time in which they were written is considered.

In the parts devoted to what in the present day is known as medical ethics it is seen that at that time they entertained the same lofty conception of the duties and responsibilities of the physician which has ever been characteristic of the healing profession. They possessed, moreover, no mean knowledge of anatomy when one takes into consideration the superstitions against touching the body of the dead then in vogue, and displayed considerable ingenuity in the use of drugs.

Some of these, indeed, must have proved rather expensive to the patient, for not only were gold and silver prescribed for internal use, but diamonds also, and pearls, which last recalls the precious draught which Cleopatra long afterwards prepared for the Roman triumvir. Their drugs were derived from the vegetable, animal and mineral kingdoms, and where the preparation of mineral salts and metals for medical use is described the fact is brought out that it was in Hindostan, and not, as some have thought, in Arabia, that chemistry had its birth. The Hindus, moreover, made use of their chemical knowledge to prepare drugs for the alleviation of disease, while the Arabians, copying their methods, degraded chemistry to the most sordid ends — their sole object being to discover some secret by which the baser metals might be transmuted into gold, or to hit upon that mysterious Elixir which has perplexed the ages, the elixir whereby perennial youth and immortality might be enjoyed. Considerable ingenuity was displayed by the Hindus in the preparation of the alkalies and the metals, many being in use among them as medicines which hold a place in the pharmacopœias of the present day, including iron, mercury, arsenic, and antimony.

In general medicine Charaka and Susruta held the humoral theory. There were three humors in number, air, bile, and phlegm, and any disproportion in their production led to disease which could only be cured by readjusting the condition of the humors. In surgery the early Hindus were very proficient, and indeed, exhibited a skill and daring far beyond that of the native Indian surgeons of the present day. Susruta gives a full description of the surgical praxis of his time, and describes a number of operations, including paracentesis and lithotomy and plastic operations. The preparation for the practice of medicine was very practical. The learners first gained dexterity in the use of the instruments upon dead animals or inanimate objects. Primitive dentistry was also practised in Hindostan at this early period.

CHAPTER II.

INTRODUCTORY HISTORICAL SKETCH.

PARTICULAR attention has been given in the foregoing chapter to the rise of Oriental medicine ; for it is strongly probable that the medicine of the Greeks was derived to some considerable extent from Asiatic sources. The healing art no doubt existed from a very early period in the Hellenic states, as would be indicated by the Homeric poems already referred to. The first formal medical treatise, however, of Greek authorship was written by Hippocrates, a native of the island of Cos, in the fifth century before Christ. This landmark of medical literature must not be looked upon so much as the original work of a single man, as the classification and summing up and forming into a system of the medical knowledge of the time.

The work of Hippocrates is striking by its artistic balance and completeness; a characteristic which becomes all the more patent when the spurious portions which crept into the earlier editions are excluded. He is free from the mysticism of a priesthood and from the vulgar pretensions of a mercenary craft. He recognizes disease as a process governed by natural laws just as life is. The actual scientific knowledge of the Hippocratic school was very limited. In anatomy and physiology very little progress had been made. Its most valuable contribution to medical science was a large mass of recorded observations in individual cases and in epidemics of disease.

In the works of Hippocrates again recurs the humoral theory of disease; there being, according to him, four humors: blood, phlegm, yellow and black bile. Another doctrine of Hippocrates was the healing power of nature. The crises of various forms of disease were to him a matter of great importance, and he laid great stress upon foretelling them with precision. The pulse is not referred to by Hippocrates. His followers attached great weight, however, to the diet, varying it according to the disease.

After the conquests of Alexander the Great, Greek science became widely known throughout the world and other centres of medical thought succeeded that of Hippocrates. In anatomy the Alexandrian school surpassed its Greek original. Here the careful dissection of the human body, which is referred to in the Sanscrit works, but does not appear to have been extensively practised by the Greeks, was assiduously carried out, being somewhat favored, no doubt, by the Egyptian custom of disembowelling and embalming. Herophilus was by the ancient world placed only second to Hippocrates. He wrote extensive researches in anatomy and used drugs and bleeding. Erasistratus, his contemporary, seems to have been independent in his views, and is the author of the first rational, though necessarily very imperfect, theory of inflammation.

The Romans cannot be said to have possessed an independent school of medicine. Beyond certain religious superstitions, passed down from the Etruscans, they seemed to have lived without medical knowledge until a later period of their history, when the medical art was introduced by Greek physicians from the mother country. The work *De Medicina* of Celsus, who probably lived in the first century of the present era, is manifestly a compilation from earlier works.

Pliny, in his *Natural History,* gives a full summary of the domestic medicine of the period. At a time, however, when the medical profession had been degraded by charlatanism, and divided into a number of conflicting sects, Galen, one of the greatest medical writers after Hippocrates, gathered together the scattered threads of medical learning, and embodied them in his work, from which the greater part of modern European medicine may be said to have been derived. The humoral theory of Hippocrates was elaborated by Galen with unfortunate ingenuity, and his use of drugs was largely influenced by these theories. The very completeness of his system appealed to the intellectual habits of his time, was gradually accepted, and enjoyed a great, though not exclusive, predominance until the fall of Roman civilization.

The most eminent of the early Greek physicians at Rome was Asclepiades, a friend of Cicero. He rejected the *vis medicatrix naturæ*, or healing power of nature, pointing out that nature in many cases, far from helping, actually marred the cure. Among the many pupils who more or less closely followed his theories was Themison, who gave permanence to his teachings by forming them into a system of medical doctrine, and founding on this basis a school which lasted for some centuries in successful rivalry with the Hippocratic teachings. This system was known as Methodism, and its adherents as Methodists. Through subsequent centuries certain theories of the Methodists recur again and again in one form or another.

A writer of a somewhat later period was Aretæus, the Cappadocian, who deserves mention on account of the accuracy of his descriptions and the literary purity of his style. It is uncertain to what time he belongs, but his date is fixed as late as the third century of the present era. Paulus Ægineta lived probably about the beginning of the seventh century. He was specially skilled in surgery. A celebrated physician of the Byzantine school was Oribasius, the court physician of Julian, the Apostate.

The rise of the Mohammedan Empire deeply influenced the history of medicine. As the superior culture of the Greeks had asserted its supremacy over the Romans at the time of the conquest, so again the learning of the Romans began to flourish in the chief seats of Moslem power. At Damascus Greek medicine was cultivated; while in Bagdad, under the rule of Haroun al Raschid and his successors, a still more flourishing school arose where numerous translations of Greek medical works were made. In the tenth century Rhazes, a physician in Bagdad, followed the doctrines of Galen and Hippocrates.

Avicenna has always been regarded as the chief representative of Arabian medicine. In Mohammedan Spain, he was less regarded than in Christian Europe, where his works superseded for a time even those of Hippocrates and Galen. Their formal and cyclopædic character was the principal cause of their ascendency.

During the Middle Ages a centre of medical teaching, as well as of medical healing, arose at Salerno, to which William of Normandy, afterwards king of England, at one time repaired and was restored to health. The influence of the Arabian school became felt at last even at Salerno; but with the founding of the universities at Montpellier, Oxford and elsewhere, and the revival of learning a new period was at hand.

In the early part of the sixteenth century Paracelsus expounded the mysterious connection which he claimed to exist between the remedy and the essence of disease. The therapeutic resources of Paracelsus included a large number of metallic preparations.

He doubtless derived much advantage from his knowledge of chemistry, though the science was not as yet altogether disentangled from the secret traditions of alchemy, and was often mixed with imposture. The revolt of Paracelsus against the prevailing systems anticipated in a measure the scientific truths of later times.

Though physicians practised in England from the earliest times, the first English name of any moment in the history of medicine is that of Thomas Linacre, who was physician to Henry VIII., the preceptor of Sir Thomas More and the intimate friend of Erasmus, who frequently borrowed money from him. He pursued his studies and obtained his degree at Padua. Afterwards, as the king's physician, he numbered among his patients Cardinal Wolsey and the Bishop of Winchester. The aversion to the study of the Bible which Chaucer mentions as a characteristic of the physician who took part in the Canterbury pilgrimage cannot, it seems, be applied to Linacre; for, about the commencement of the king's reign, he took up the study of theology and obtained the rectory of Mersham in Kent; becoming eventually the canon and prebend of Westminster.

He does not appear to have gained any striking distinction in theology. In 1517 his Latin translation of Galen's works was published at Paris and dedicated to Henry VIII. Linacre's most important service to medicine was undoubtedly the founding of the Royal College of Physicians, the first medical corporation in England.

In 1628 appeared William Harvey's treatise on the Motion of the Heart and the Blood, which marked an era in the development of medical science. A controversy followed, and Harvey was at the time popularly believed by the uneducated to be crack-brained. He lived, however, to see his discovery accepted by anatomists, both at home and abroad, its merits being recognized in France by Descartes among the first.

The Iatro-chemical school, as it was called, aimed, unlike the Iatro-physical school (which explained the functions of the body on solely mechanical principles), to reconcile the new views in physiology and chemistry with medicine, and owed something to Van Helmont and Paracelsus, though taking in the main an independent position. One of its founders, Francis de la Boë, known better as Sylvius, was a professor at Leyden, where he attracted students from all over Europe. He attempted to reconstruct medical practice upon the new basis of the circulation of the blood and the more recent views of chemistry.

Thomas Sydenham, often called the British Hippocrates, was educated at Oxford and Montpellier. Believing that a disease is nothing more than an effort of nature to restore the patient, he had the rare merit of never permitting himself to be enslaved by his own theories, or to be biassed by either the chemical or the classical systems which then divided the medical world. His principles were welcomed as a return to nature by those who were weary of theoretical disputes. In his methods of thought he was influenced not a little by Locke, the philosopher.

None of the writers mentioned, however, founded a school of medical doctrine, but Hermann Boerhaave, who was for many years a professor of medicine at Leyden, where he exerted a greater influence than any who preceded or who followed him, was the organizer of the modern method of clinical teaching. The best known parts of Boerhaave's system are his doctrine of inflammation, of obstruction and of plethora.

The rival systems in the medicine of the eighteenth century were those of Haller and Morgagni which, though they did not extinguish the spirit of system-making, opened up paths of investigation which eventually superseded all previous systems. These were physiology, in the present sense, dating from Haller, and morbid anatomy from Morgagni. Two other systems of the eighteenth century were those of Cullen and Brown, which enjoyed a great reputation at the time, though contributing very little to the real progress of medicine.

Before the theoretic tendency of the eighteenth century was quite exhausted it displayed itself in a system, which, though in some respects isolated in the history of medicine, stands nearest to that of Brown. This was Hahnemann's doctrine of Homœopathy which based medicine entirely upon a knowledge of symptoms, regarding all investigations of the causes of symptoms as useless. According to

Hahnemann all chronic maladies result either from three diseases, psora (the itch), syphilis or sycosis, and maladies produced by medicine. Seven-eighths of all chronic diseases were, he claimed, caused by itch driven inward. He also developed a theory that medicine gained in strength by being diluted in water. He diluted his tinctures, therefore, in the proportion of one to fifty. This dilution, containing one-fiftieth of the original strength, was again diluted one in fifty; and this proceeding was repeated thirty times, at which point the greatest strength or potentiality was supposed to be obtained. Whatever the effect might be of medicines whose strength had been augmented in this manner, the effect of the practice upon general medical usage was to lead to a greater simplification in prescription-writing. Homœopathy was, however, but an episode.

The iatro-physical and iatro-chemical schools, into which medical learning was divided during the eighteenth century, had each in the long contention done good service in advancing the knowledge of anatomy and chemistry, and making possible the great advances which were to be made in the following century.

In England especially there had been a rapid development of anatomical knowledge and surgical methods. To Bell of Edinburgh, and afterwards to John Hunter, surgery owes a great deal. Though in the older writers surgery was usually treated along with medicine, properly so called, the art of surgery was in reality a somewhat later development and the profession a separate one from that of the physician.

The barber's vocation originally embraced a considerable knowledge of surgical handicraft, and even when the surgeon had ceased to be a barber, he was still looked upon as the assistant of the physician. To him the universities granted a separate degree, that of Master of Surgery, so that even to the present day, it is in England customary for the physician only to assume the title of doctor.

In 1785 Hunter first tied the femoral artery for an aneurism in the leg. The contributions of this great surgeon to the healing art can scarcely be estimated. His love of anatomy, both human and comparative, seems to have been insatiable, and it was his custom to dissect for many hours every day.

In the meantime chemistry had been rapidly developing, and in 1774 Dr. J. Priestley accidentally discovered that the red oxide of mercury evolved a gas when heated. This gas (which was oxygen) being superior, even to air, as a supporter of combustion, was regarded by him as dephlogisticated air. The incombustible part of the atmosphere he supposed to be saturated with phlogiston. The phlogiston involved in the burning of combustibles was supposed to unite with the atmosphere or the dephlogisticated air contained therein. With the discovery of oxygen may be dated the birth of modern chemistry.

Hence the rival schools may be said to have each served its purpose; and though the term iatro-physical and iatro-chemical are almost forgotten to-day, modern anatomy and modern chemistry may be traced back to them; and in the union of anatomy and chemistry with physiology to form the medical art of the nineteenth century, with its long and brilliant career, the contending factions of a century that has passed into silence may be said at last to be happily merged.

We now approach a new era in medicine, the most remarkable that the world has ever seen, and illustrating, perhaps, a progress more thorough, more rapid and more triumphant than has ever been observed in any other branch of learning. One word, however, before turning to other matters, touching the social position of the physician at the close of the eighteenth century.

In the *Epistre de Othea* of the fifteenth century there is an engraving representing the interior of a doctor's house. Enormous quartos, the works, doubtless, of Galen and Hippocrates, lie upon the shelf, and open upon the bench. The patient, hat in hand, either from awe or bodily pain, presents a very sorry appearance, while the physician, clad in black gown and hat, with his scrip at his waist, holds a phial in his hand. For centuries the physician went about in a garb peculiar to himself. The professional uniform had fallen almost entirely into desuetude in the eighteenth century, though there was probably then, as there is now, certain slight mannerism of dress in which the physician may have differed somewhat from men of other callings. The history of medicine had for so many centuries been associated with one form and another of imposture, that the profession was regarded by the majority (when in health) with a certain feeling of contempt.

This feeling was also due partly to the fact that in the outskirts of the medical profession there had always been present a horde of charlatans. This fact does not indicate so much an uncontrollable propensity upon part of the mendacious to become charlatans, as a singular weakness for impostors of the sort in a certain class of the community. Even at the present day legitimate medicine can make only limited and conditional promises. In despair, therefore, the man who is doomed turns to any one for comfort or reprieve, and believes eagerly the preposterous falsehoods of the unscrupulous.

The hypochondriac also, unwilling to give a thought to anything but his own bodily symptoms, speedily imagines that he is stricken with all manner of diseases, and not only believes the charlatan when he solemnly declares him to be at the edge of the grave, but has indeed long insisted upon this himself, and being dismissed by the conscientious physician as perfectly sound, resorts to the quack for congenial company. Upon patients of this sort the most wonderful cures are of course effected; and intelligent people, unfortunately, being unacquainted with the facts, are often deluded.

These facts sufficiently explain the pungent and immortal satires against the medical profession which appeared a couple of centuries ago. They were no doubt founded in great part upon truth; and, as one follows the career of the great Doctor Sangrado in the pages of Le Sage, he can, making allowance for a certain amount of exaggeration, gather some idea of what medical practice then was, and what is still more important, of the state of popular credulity at that time.

Molière may be regarded as the keenest satirist whom the medical profession has ever met. His wit is all-compelling and his ridicule, charged with a certain amount of truth, is effective without being bitter, and has probably given the most amusement of all to the members of the very profession which he satirized. First in the short three-act comedy, *Le Médecin Malgré Lui* (the Doctor by Compulsion), he describes the gradual development of the unhappy Sganarelle, at first not willingly, and afterwards with great willingness, to the dignity of a physician. Afterwards, in *La Malade Imaginaire,* a patient familiar to all physicians is described. Argon is, as a matter of fact, being systematically defrauded by the unscrupulous Purgon and by the Diafoirous family, father and son. The custom then in vogue of keeping all science hidden from the eyes of the common people by writing it in a foreign language not only defeated its purpose by associating the idea of learning in the common mind with catches from unknown languages, but placed an easy instrument of fraud in the hands of impostors. One of Sganarelle's first scientific flights, when trying his wings in medicine, was to utter all the Latin words he could remember, upon which his patients were convinced that he was a very learned man. From Greek and Latin to mere dog-Latin and unintelligible gibberish was an easy step, and *La Malade Imaginaire* closes with a chorus in this impressive tongue, sung by black-robed physicians.

Though in medical literature there is more of the achievements of the physician than of the physician himself, there are to be found in the pages of the novelists pictures of the physician of the time as he really was that are more true to life than the representations of Le Sage and Molière, though perhaps less amusing.

Miss Ferrier, a writer of the beginning of the century, described in her earliest work an English physician under the name of Dr. Redgill. The man is shallow, pompous, and a gourmand. He is indifferent to all the better traditions of his profession and an unblushing parasite, selfish, indolent and sycophantic. Thackeray has provided similar portraits of members of the theological profession of the same time. Not originally, perhaps, but certainly in the closing years of the eighteenth century, the professions were all parasitical to a most unfortunate extent, occupying by courtesy a position of familiarity with the wealthy and the powerful, but in reality being retained in the houses of the great in a capacity little better than that of a body attendant or servant.

It is told how Boerhaave, with a dignity which was not at all unbecoming so great a man, refused to make any distinction in his patients, and kept Peter the Great waiting all night for his turn to consult him. A large majority of the physicians of the time never rose, however, much above the level of a Redgill.

Miss Edgeworth also dwells at considerable length upon certain types of medical men of her time; and while Erasmus Percy may be regarded as a physician of the best class, it is not difficult, reading between the lines, to draw an inference as to the place which the physician held in the opinion of his contemporaries. It was not at all unreasonable, therefore, that men of parts, when free to choose, should have embraced some other profession, leaving that of medicine to inferiors.

Almost a century after, Lauder Brunton, in reviewing the progress made by the medical profession in England, dwells for a space upon this fact, and attributes some of the most brilliant conquests of the healing art in recent years to the improved intellectual and moral status which had, for half a century, been gradually taking place in the ranks of the profession. To an art with so splendid a prestige, and at the same time so rich in the promise of honor and fame, any man might gladly dedicate his life.

A profession which could attract to itself, as it has, so many of the best minds of the time, could hardly fail to realize in turn the rapid development with which it has on every side been crowned during the present century. Here, as so often happens in other situations in the world, the two factors have acted and reacted upon each other to the ultimate benefit of both the science and those who followed it.

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CHAPTER III.

THE DISCOVERY OF VACCINATION.

VARIOLA, or smallpox, has been present in the human race from the remotest times, but when or where it originated is unknown. It made its appearance in Hindostan at a very early period, and committed great ravages there. Indeed, the first Hindu goddess represented as being interested in medicine was Seetullah, the wife of Siva, who was named the goddess of smallpox. One of the first accurate descriptions of the disease is that of Rhazes, an Arabian physician of the tenth century. Having spread over the eastern hemisphere this plague was carried by the Spaniards to America, soon after its discovery, and in 1527 it raged in Mexico, the victims of the disease numbering into the millions.

In England at the close of the eighteenth century there were three thousand deaths by smallpox to every million inhabitants; and in France thirty thousand were said to have perished by this disease every year. In the Russian empire two millions of the inhabitants were cut off by it in a single year. In Berlin one-tenth of the entire death rate was from smallpox alone, and in parts of Asia whole settlements were abandoned. The disease attacked the highest and lowest in rank, there being no means by which even royalty could be protected.

Before the disease was brought under restraint not a decade passed without the appearance of a fearful epidemic of smallpox. It had become a permanent scourge which never entirely ceased in any one year, and every three or five years swelled into an overwhelming epidemic. In the country the mortality was, strangely enough, even greater than in the city. Washington Irving has described the horrors wrought by it among the North American Indians.

The disease, furthermore, was not perfectly understood, for until the present century it was customary to group diseases of this sort under the general term of fevers, and the malignance and loathsomeness of the malady prevented its being studied with the care and thoroughness which is now possible. The appalling proportion of those who succumbed caused no less dread than the subsequent disfigurement and frequent loss of sight of those who survived. Of new-born children one-third died of smallpox before the first year and one-half before the fifth.

Lady Mary Montagu, during her stay in Constantinople, where her husband was acting as British Ambassador, became acquainted about 1710 with the custom common in the East, and known to have been in practice in Hindostan and China from the earliest antiquity, which consisted of inoculating the healthy with the virus of smallpox as a preventive against that disease. She succeeded, though not without considerable opposition, in introducing the custom into England. It was found that after inoculation with the virus of the disease the patient usually had as a result a very light attack and enjoyed subsequent immunity.

As a grave offset to this advantage it was only too soon observed that those who came in contact with patients thus inoculated acquired the disease in its severe form. Hence, while there was some advantage to the person inoculated, in getting off more lightly than he would had the disease been contracted in the usual way, there was the greatest danger to those with whom he came in contact; and to the very practice of inoculation was due, no doubt, to a very great degree, the constant presence of the disease in the community.

The first years of the nineteenth century witnessed the establishment of a practice which was destined in a very short time to almost totally suppress among civilized races one of the most dreaded plagues of history. The honor of being to so vast an extent the benefactor of the human race is due to the immortal Jenner, whose first careful investigation of the matter dates from about the year 1775. He did not mature his theories until 1798, when he published the results of his observations to the world in a modest pamphlet. During the first few years he met with vigorous opposition, but he lived to see the practice which he had inaugurated become general throughout the world.

Edward Jenner was a country doctor practising in Gloucester in England, in which surroundings his attention was early called to certain apparently insignificant phenomena which never would have come under his notice in a city. It had long been observed that both cows and horses suffered from a disease very similar to smallpox. In cows this disease was known as vaccinia. A similar disease known as equinia mitis, or grease, was found among horses. From cows and horses attacked with the respective diseases those who came in contact with them were frequently infected. The disease as noticed among cows and horses was much less virulent, and the effects upon persons who contracted it from them were neither so severe nor so frequently fatal as smallpox. Again, when milkmaids received infection from milking cows, or when farriers were attacked with grease through contact with affected horses, the disease did not manifest any peculiarities of smallpox, but in the human patient preserved all the characteristics seen in the cow or horse.

Jenner's attention was early arrested by this fact. Upon inquiry he discovered that those who had had cowpox enjoyed immunity afterwards from smallpox. There were, however, exceptions to the general rule, and for many years he carried on his inquiries and experiments before he had reached a definite decision as to the advisability of substituting the virus from the cow suffering from vaccinia for that of a human being suffering from smallpox.

The exact stage of the disease in the cow when it was best to extract the virus for communication to the patient was a point that greatly perplexed him; for at some stages of the disease the virus, when inoculated, proved futile; and even when the right time has been properly chosen, a great deal, he found, depended upon the methods used in applying it, and if any error were committed the results proved unsatisfactory.

For a quarter of a century, therefore, Jenner pursued his investigations with this great problem ever in his mind. He more than once mentioned the matter to his former teacher, the distinguished Hunter, who, though not particularly impressed with the idea, did not damp Jenner's enthusiasm by suggesting doubts or difficulties. Others, however, were not so considerate, and at the Medico-Convivial and Convivio-Medical societies to which he belonged his perpetual harping upon the subject grew at length so distasteful to the other members that they threatened grimly to expel him if he continued to harass them further with so unprofitable a subject.

From the laity he probably met with even less encouragement, but he continued his experiments, and on the 14th of May, 1796, inoculated with cowpox virus James Phipps, a boy about eight years of age. Six weeks later the boy was inoculated with variolous matter, but no smallpox followed, showing that he had become immune. The discovery was now complete, but desiring to act without precipitation, and unable to repeat the experiment until 1798, owing to the temporary disappearance of vaccinia from the dairies, it was not till the 21st of June of that year, having meanwhile repeated his inoculations with the utmost care, that his unpretentious, but now classical monograph entitled *An Inquiry into the Causes and Effect of the Variolæ Vacciniæ* appeared. The vaccine he preserved upon silk threads saturated therewith, and in this way he also sent it to others.

In the autumn of the same year Jenner met with one of the first supporters of vaccination in the person of the celebrated physician and man of science, Henry Cline, who, as fate would have it, was the first man in London to perform vaccination; though Jenner had waited in the city for three months without succeeding in finding any one who would consent to undergo the operation. Cline warmly advocated the principle, and brought it before the notice of the medical profession. Very soon, as the discovery began to attract attention, there appeared two factions, one opposing vaccination, the other advocating it. At the head of the latter was a certain Dr. Pearson, who, perceiving its utility, endeavored in a most brazen manner to pre-empt the discovery for himself.

Though the introduction of the practice was attended by many failures through the carelessness of the operators, the results were in the main so striking that the practice gradually won its way, and, visiting London in 1800, Jenner was presented to the King, Queen and the Prince of Wales. Their encouragement materially aided the spread of vaccination in England. It was introduced almost simultaneously into the United States by Dr. Waterhouse of Boston, and on the Continent of Europe, where it was first diffused by Dr. De Carro of Vienna. On account of the war between England and France it was somewhat later in reaching Paris.

But as soon as its profound importance was once clearly recognized, it spread rapidly over France, Spain and Italy. In 1803 a special expedition was sent out by Spain for the purpose of introducing vaccinia into all the Spanish possessions in the old and new world. This expedition returned in three years, having circumnavigated the globe and succeeded beyond its utmost expectations. In Holland and Geneva clergymen from their pulpits exhorted their parishioners to be vaccinated. In Sicily, South America and Naples religious processions were formed for the purpose of receiving it. The anniversary of Jenner's birthday, or of the successful vaccination of James Phipps, was for many years celebrated as a festival in Germany, and in Russia the Czarina caused the first child operated upon to receive the name of Vaccinoff and to be educated at the public expense.

After the lapse of a hundred years when the loathsome and once almost universal plague of smallpox is almost a thing of the past, occurring at long intervals only, and in isolated cases, it is difficult to understand the passionate enthusiasm which the great discovery elicited at the time. An enthusiasm which caused vaccination to spread over the entire world in the amazingly short period of six years; it being gratefully accepted by people of the most diverse climes, habits and religions.

A grant of £10,000 was voted by the British parliament to Jenner in 1802, which was not paid until 1804, and then with very heavy deductions in the shape of fees to the civil officials. From abroad, meanwhile, honors began to shower upon him. Jenner having on one occasion made a personal petition to Napoleon for the release of a prisoner who was a friend of his, and who was in the hands of the French, Bonaparte was about to refuse the application, when Josephine uttered the name of Jenner. The Emperor paused and exclaimed, "Oh, we can refuse nothing to that name." In 1806 a further grant of £10,000 was proposed by the Chancellor of the Exchequer, which was afterwards raised to £20,000, a very indifferent remuneration indeed to a man who had made not only the world of his own time but posterity his debtor.

Jenner declined to the last to make his residence in London; though his great fame would have rendered such a change very remunerative. To repeat his own words which bear the stamp of true greatness, "Shall I," he asks, "who even in the morning of my days sought the lowly and sequestered paths of life—the valley and not the mountain; shall I, now my evening is fast approaching, hold myself up as an object for fortune and for fame? Admitting it as a certainty that I obtained both, what stock shall I add to my little fund of happiness? My fortune, with what flows in from my profession, is sufficient to gratify my wishes; indeed so limited is my ambition, and that of my dearest connections, that were I precluded from future practice I should be able to obtain all I want. And as for fame, what is it? a gilded butt, forever pierced with the arrows of malignancy."

Of maligning tongues he was soon aware. The Royal Jennerian Society which had been formed for the propagation of vaccination had but a short existence owing to the dissensions of some of the members. Not only in the ranks of the profession but also among the common people he found a strong opposition. The latter, indeed, regarded the innovation with superstitious terror, believing that the most grotesque results would follow the inoculation of the virus of the cow. In one of the caricatures of the time by Gillray, published in 1802, there is shown a doctor's office where a number of patients, recently vaccinated, serve to illustrate the Circean changes which have straightway taken place. One is appalled at the horns, similar to a cow's, which have appeared upon his head. Upon another man lately vaccinated a small cow's head is seen growing out of the arm. The nose of another is metamorphosed into the head of a cow, and a similar bovine phenomenon is observed in the ear of another, while from the mouth of a fourth the head of a cow is issuing. Upon the wall hangs the picture of a cow which is represented as being raised on a pedestal with certain devotees kneeling about it in the act of worship.

That anything so crude should have exerted any real influence seems incredible, until one recollects the profound ignorance of the masses at that time. Moreover, there were selfish ends at work also which readily account for vaccination having met with so much antagonism. The practice of inoculation, which had been superseded by vaccination, was by no means a simple process, but entailed a preparatory treatment of several weeks, during which the patient was alternately bled and purged until he was reduced to a suitably weak state, being fed meanwhile upon various nauseous drugs which were supposed to exert a benign influence upon the blood. This process of preparation was of course carried through under the direction of the physician, and the revenue which physicians obtained from this source alone was, no doubt, very considerable.

Vaccination, on the other hand, was then, as it is now, exceedingly simple, and required the attendance of the physician if at all for a few moments only. Thousands, moreover, were vaccinated by women and others not members of the medical profession. As a consequence the income of one physician who gave up inoculation for vaccination fell in one year from £1,000 to £100, and hence, it is not difficult to understand the interested motives which led large numbers of the profession to combat an innovation, which, though of the greatest benefit to mankind, bade fair to cut down their incomes.

From the clergy, also, there was a loud protest against vaccination as opposed to the designs of Providence. One enlightened opponent to the practice exclaims as follows: "Providence never intended that the vaccine disease (vaccinia or cowpox) should affect the human race, else why had it not before this time visited the inhabitants of the globe? Notwithstanding this the vaccine virus has been forced into the blood by the manufacturing hand of man, and, supported not by science or reason, but by conjecture and folly only, with a pretence of exterminating the smallpox from the face of the earth." He goes on to denounce "the puerility and the impropriety of introducing vaccination with a boasted intention not only to supplant, but also to change and alter, and in that way prevent the established law of nature. The law of God prohibits the practice; the law of man and the law of nature loudly exclaim against it."

In similar diatribes had the practice of inoculation been denounced by the pulpit and the profession when introduced less than a century before. Indeed, no great innovation for the social or physical improvement or amelioration of the conditions of mankind has ever escaped in England the censure of the commonalty.

The selfish pusillanimity with which Jenner was treated by his own countrymen has already been illustrated by the course of the government, which, after having voted him a grant, delayed its payment for two years, and then deducted a thousand pounds to satisfy a horde of nameless officials. The delay on the same occasion is not difficult to explain either; for the government did not wish to be precipitate, and as long as there was the remotest chance of Jenner's discovery proving a failure the grant was withheld. Gifts bestowed in this manner lose all their value—as gifts. Much in the same spirit, when somewhat later the freedom of the city of Dublin was conferred upon him, a demand for five pounds as admission fees was promptly exacted. Academic insolence was not far behind, when, in 1813, the degree of M. D. having been voted to Jenner by the University of Oxford, the London College of Physicians refused to admit him to membership unless he passed a preliminary examination in classics.

A singular meanness of soul was exhibited by the people of one parish in the neighborhood of Cheltenham, who for a long time refused to be vaccinated, but subsequently, in a single year, arrived in large numbers to claim vaccination from Jenner, who, from the first, had offered to vaccinate gratuitously all poor persons who applied to him. Further inquiry brought out the fact, however, that it was not scientific enlightenment which had induced the people of that neighborhood to seek *en masse* for vaccination; but a consideration with them far more potent, namely, the cost of the coffins and the burial expenses of those who had died of smallpox. This so exercised the parish officials that, for the most contemptibly sordid motives, they urged vaccination as a last resort upon the people, as a possible means of cutting down the parish expenses.

Abroad, however, he met with the honor and veneration which was his right. In 1804 one of the most beautiful of the Napoleon series of medals was struck in commemoration of the Emperor's estimate of the value of vaccination. When the great war was over, and the allied sovereigns visited London, Jenner was, by their special request, introduced among others to the Emperor of Russia and the King of Prussia.

Among the innumerable testimonials of appreciation which Jenner received was one from the Chiefs of the Five Nations of Canadian Indians, the Mohawks, Onondagas, Senecas, Oneidas and Cayugas. Their address ran as follows: "Brother, our Father has delivered to us the book you sent to instruct us how to use the discovery which the Great Spirit made to you, whereby the smallpox, that fatal enemy of our tribe, may be driven from the earth. We have deposited your book in the hands of the man of skill whom our Great Father employs to attend us when sick or wounded. We shall not fail to teach our children to speak the name of Jenner, and to thank the Great Spirit for bestowing upon him so much wisdom and so much benevolence. We send with this a belt and string of wampum, in token of our acceptance of your precious gift; and we beseech the Great Spirit to take care of you in this world, and in the land of spirits."

Edward Jenner died in 1823, and was buried at Berkeley.

At the close of the eighteenth century the whole world was circled by a dreadful disease which neither care nor skill could stay. Wave after wave of epidemic swept over the countries of Europe and through Asia and the half-civilized regions of America. Men died by hundreds of thousands. More were swept away by smallpox during the century than had fallen in the battles of a hundred years of war. Benumbed by the fearful havoc, people had at last grown accustomed to the frequent visitations of the scourge, and waited in dull expectation for the inevitable.

A simple country doctor, practising in the rural districts of Gloucester, observed certain coincidences which caused him to think. Others had noticed the same things, but saw no significance in them. The one man, however, pondered over the matter for a quarter of a century, and experimented in private, discussing the subject freely meanwhile with the few who had patience to listen. In the last years of the century he had matured his theories and at length published them to the world. In his own land, and by his own countrymen, his message met with neglect, but being put to the test, the results were so striking that within the first three or four years of the ensuing century his new found sytem had been spread over the inhabited world. The results were marked and instantaneous. At first the full significance of his discovery seemed incredible, and then, as its breadth of meaning dawned upon the mind of humanity, the chorus of gratitude and admiration and love, rising from every part of the world, swelled into a tumultuous voice of tribute such as perhaps no man ever before had received.

Courted and honored by the royalties of Europe and the greatest and most powerful people of every land, the inventor still retained the simple bearing of a truly great man. Though his name had become immortal, he seemed to the last to regard the tribute of the time as rather to his discovery than to himself. Above all sordid or selfish aims, he remained to the last in the quiet country home where he had toiled and thought and found greatness. Unspoiled by flattery and unembittered by envy, he lived to see the discovery which had occupied his best years wipe from the face of civilization one of its darkest blots. Hardly understanding at any time the full significance of his fame, and valuing it as little, he lived to see the golden results of his toil, and perhaps knew at last, though it was not for him to boast of it, that he had done more for his kind than had ever been done in all the ages by either arms or discovery or policy.

It was not until some years after his death that a law was passed prohibiting the inoculation before in practice. This, with the vigorous insistence upon vaccination, prompt isolation of individual cases, and more stringent laws of quarantine, has so operated that smallpox has now become so rare that very few have ever seen a case. Nevertheless, any neglect of the practice is always rapidly followed by epidemics of the old disease with all its original horror—as witness the outbreak of smallpox in the city of Montreal in the year 1885, where some thousands died among the French population; those people, for some unaccountable reason, having so great a repugnance to the beneficent practice of vaccination, that upon the occasion referred to, the militia had to be called out to enforce vaccination among them, and to suppress the rioting of the ignorant citizens.

Surely this would be a sufficient demonstration that the causes of the disease are still present, and are only kept off by the systematic practice of vaccination. Yet in the year 1898, exactly a hundred years after the publication of Jenner's *Inquiry,* a work of Alfred Russel Wallace appeared, in which he condemns vaccination in a most intemperate manner in a very lengthy chapter entitled "Vaccination a Delusion—its Penal Enforcement a Crime."

There is something almost senile in the care with which he analyzes the original cases put forward by Jenner in his pamphlet. As if vaccination depended upon the few scattered cases enumerated by the original discoverer, and not upon a century of successful use. Quite as weak is his plea that because the Black Death had disappeared from Europe under improved sanitary measures; so smallpox, in a similar manner and quite independent of vaccination, had also disappeared.

Furthermore, the parallel mentioned by Dr. Wallace between the prevalence of smallpox and other zymotic diseases, though no doubt just enough, cannot be taken as a serious reason for the discontinuance of vaccination in face of the epidemic among the French of Montreal, at which time the English inhabitants, who were vaccinated, and who lived in the same city and in the same streets, were unaffected.

Undesirable results have no doubt frequently followed what is known as "arm to arm vaccination," which consists of using the virus from the arm of one already vaccinated to vaccinate another. Certain diseases have sometimes been communicated in this way. The practice is very rarely followed now, however, as the vaccine virus, prepared with all antiseptic precautions from the healthy cow, is always readily obtainable.

To repudiate in detail the attacks of the anti-vaccinationists would prove idle in this place. In the work of Dr. Wallace referred to a considerable space is also devoted to bewailing "The Neglect of Phrenology" and "The Opposition to Hypnotism." This would indicate that all Dr. Wallace's grievances are much of a kind. To his strictures against vaccination, however, the usage of a hundred years is sufficient answer.

CHAPTER IV.

THE INVENTION OF THE STETHOSCOPE.

"NOTHING good is done in a hurry," observes Hermann Baas in his *History of Medicine,* referring to the discovery of Leopold Auenbrugger. After seven years of testing and experimenting, this physician wrote in 1761 his treatise entitled *A New Invention for the Percussion of the Human Thorax by which the More Obscure Internal Diseases of the Chest may be Detected.* In this work he explained a new method by which, upon percussion of the chest, the condition and position of the lungs and the heart might be approximately ascertained.

Auenbrugger, the inventor of this method, was an unpretentious Viennese practitioner, and during the greater part of his lifetime remained unnoticed, misunderstood and even designedly opposed. His invention, as far as its influence upon the general world of medicine goes, belongs properly to the nineteenth century, though published in the eighteenth, for it remained quite unknown for nearly fifty years, until Corvisart in 1808, by translating the obscure *Inventum Novum* into French, drew Auenbrugger's name from the oblivion into which it had so unjustly fallen.

"I know very well," Corvisart observed, "how little reputation is allotted to translators and commentators, and I might easily have elevated myself to the rank of an author if I had elaborated anew the doctrine of Auenbrugger and published an independent work on percussion. In this way, however, I should have sacrificed the name of Auenbrugger to my own vanity, a thing which I am unwilling to do. It is he, and the beautiful invention which of a right belongs to him, that I desire to recall to life."

Before the invention of Auenbrugger, the means of diagnosis of internal diseases was limited almost exclusively to simple observation. The customary usage, when a physician was called to see a patient, was to look at the tongue, feel the pulse, and prescribe a dose of medicine. Boerhaave used the thermometer in taking the temperature, and some of the older physicians had made a diagnosis of tympanites and ascites (gas or fluid in the abdomen respectively) by means of the sound elicited when the parts affected were gently tapped with the finger; but no system of diagnosing the diseases of the great viscera by physical means of the sort had ever been attempted before. As soon as the Viennese physician's invention became known to the scientific world through Corvisart's translation, the practice became general in examining diseases of the chest.

These affections apply to the heart and the lungs. There are quite a number of them, of which the most important are pneumonia, or inflammation of the lungs; pulmonary tuberculosis, or consumption, and pleurisy; hypertrophy of the heart and an inflammation of the walls of the pericardium in which the heart is enclosed, similar to that which occurs in the pleura in pleurisy.

Though in all those diseases there is constitutional disturbance, pain in the part affected, and symptoms peculiar to each affection, the physician still remained much in the dark as to the exact condition of the diseased organ at a specified time.

When in percussion a slight tap was made upon the chest wall of a man whose lungs were in a healthy condition, Auenbrugger noticed that the sound was resonant; while when a similar tap was made over a lung diseased by pneumonia or consumption the sound elicited was not resonant but dull and dead.

At first view this seems a very simple method, but upon careful study it is capable of great elaboration. By practice the ear becomes so sensitive as to be able to discriminate between the faintest shades of difference in the sound elicited.

To take a simple example. In pneumonia both lungs are seldom affected, and usually only a portion of one lung. As the disease progresses the part of the organ affected becomes engorged with blood and as a consequence loses the spongy quality which characterizes it when in health. Indeed it may be said to be partially solidified.

In the patient there are all the signs of a high fever. Indeed, pneumonia was at one time called lung fever, and was treated accordingly. By the use of Auenbrugger's invention of percussion the physician, being called to such a case, sees the signs of fever, and is at once apprised of the pain in the chest. The last he has bared at once and either with his finger, or with a very light mallet made for the purpose, goes over the whole region, tapping lightly over every portion. Over one lung there is a clear resonance when he taps, and upon percussing the other he finds the same resonance present over the lower portion, perhaps, or the upper portion, as the case may be. Over one region, however, there is a dull sound when he taps. By listening intently and moving from place to place he can eventually define the exact area of the part of the lung affected.

Again, not only does this measure give a clue to the exact region affected, but upon still closer study it is found that the sounds vary slightly in different stages of the same disease. Moreover, certain processes of disease possess a distinguishing characteristic which practice will enable the physician eventually to recognize.

In consumption, as in pneumonia, the whole lung tissue is not attacked at one time, else, indeed, the patient would not survive as long as he does, but one particular spot will first be affected from which the process of disease gradually spreads to the healthy tissues. As the chances of recovery very largely depend upon the extent of lung tissue invaded, it is of great importance to be able to answer this question.

The doctors of a preceding age came, as has been said, with bland and courtly manners, felt the pulse, looked at the tongue, wound their watches and went their way, after having soothed the patient and his friends with a few oracular platitudes or alarmed them with a sphinx-like silence. By means of percussion the affected part could be defined and to some extent the nature of the invasion conjectured. The physician's visit was not a mere farce.

To add further examples: In pleurisy, which consists of an inflammation of the serous sac in which, during the act of breathing, the soft lung gently shrinks and expands, one of the first phenomena, after the onset of the disease, is the presence of a fluid in the cavity. Sometimes this gathers there to such an extent that the lung is pushed out of its proper position and pressed into so diminished a compass that the patient breathes with the greatest difficulty. Here, too, by percussion, the amount of fluid present can be accurately ascertained, for upon percussing the chest wall there is a decided dullness over the region invaded by the effusion.

In emphysema, on the contrary, a disease wherein the air cells of the lungs are greatly dilated so that the organ contains far more air than in health, the sounds upon percussion, far from being dull, are more resonant than usual. This condition is known as hyper-resonance, while in consumption one of the first signs is defect of resonance on and above the clavicle, or collar bone.

In following the course of this disease the invention of Auenbrugger has been developed to its furthest limit. In recent consolidation of the lung in consumption the percussion note often has a tubular or tympanitic (drumlike) quality. In older cases, however, where there have been extensive changes in the apex or base, " wooden dullness " is sometimes heard. When a lung cavity with thin walls has been formed at the apex of the lung, percussion gives the " cracked pot " sound. It goes almost without saying that to gain skill in detecting the process of the disease by these means infinite practice is necessary before the ear is sufficiently trained to discriminate between the qualities of sound found in the various conditions, but when the physician has become familiar with the method, he is able by this simple measure to gain an insight into the condition of the organs of the chest such as was impossible in any preceding age.

Nothing is more true than that one invention leads to another. This has never been more amply illustrated than in the present century when each discovery seemed only to prepare the way for another still more wonderful. Such was the case in Auenbrugger's discovery of percussion.

A German writer, who eventually wearies one with the peevish ill temper in which he refers to anything that is French, complains that Laënnec discovered the principle of auscultation purely by accident, whereas it is to be presumed, one may suppose, that Auenbrugger laboriously evolved the theory of percussion out of his inner consciousness. To cavil in this way is ludicrous. All discoveries are accidental. If they were not some clever man might sit down and make discoveries at will until the whole field was exhausted. The philosopher's stone was never found, however, and so man must live by the sweat of his brow, and make his discoveries by accident. These accidents occur in the life of everybody, but it is only the man of genius who has the insight to see in a matter, apparently trivial, a great underlying principle, and to follow it to the end, step by step, and to disentangle every knot until at last it is his great fortune to be able to cast light upon something which was before obscure.

To accomplish this was the destiny of René Théodore Hyacinthe Laënnec. Born in Bretagne in 1781, he was placed in the care of an uncle who was a physician. His education was neglected. Instead of schools there were, during the Reign of Terror, hospitals and camps, to which the feeble young lad always accompanied his uncle, and these formed the means of preparing the youthful Laënnec for his future profession.

He made in La Société de l'Ecole his first experiments with the stethoscope in 1816, and published, three years later, his work *De l'Auscultation Médiate, ou traité du Pronostic des Maladies des Poumons et du Cœur, Etabli Principalement a l'Aide de ce Nouveau Moyen d'Exploration,* where he thus describes the occasion which led to the discovery of auscultation:

"In 1816 I was consulted by a young woman laboring under general symptoms of diseased heart, in whose case percussion and the application of the hand [palpation] were of little avail on account of the great degree of fatness. I happened to recollect a simple and well-known fact in acoustics, and fancied it might be turned to some use on the present occasion. The fact I allude to is the great distinctness with which we hear the scratch of a pin at one end of a piece of wood on applying our ear to the other. Immediately on this suggestion, I rolled a quire of paper into a kind of cylinder, and applied one end of it to the region of the heart and the other to my ear, and was not a little surprised and pleased to find that I could thereby perceive the action of the heart in a manner much more clear and distinct than I had ever been able to do by the immediate application of the ear."

"To Hippocrates, the Father of Medicine," Begbie remarks, "and to Aretæus, among the ancients, Laënnec confesses that he was alone indebted for any information on the subject, which he has so signally made his own. He expressly states that Hippocrates practised immediate auscultation, and, in proof of his having made trial of this means of diagnosis, he refers to the well-known passage in the treatise *De Morbis,* a work which there is good reason for believing, though not composed by Hippocrates himself, was written by either one or more of his contemporaries, or by some among his immediate descendants in the school of Cos, in which it is made clear that Hippocrates fell into error in supposing his ability to distinguish between the presence of water and of pus in the chest, by the peculiar sound heard on applying the ear. It is in the same chapter, and in close relation to the same subject, that Laënnec makes the remarkable statement—a statement which cannot be read without feelings of admiration for the candor and modesty of that distinguished man—that he had read the passage in Hippocrates many years before the commencement of certain experiments in physics, which suggested to him the idea of mediate auscultation, but he never entertained the idea of repeating the experiment of Hippocrates; it passed entirely into forgetfulness; he simply regarded it as one of the errors into which that great man had fallen. But the passage came to his mind when he commenced his researches, and he felt surprised that its consideration had not proved suggestive to some readers. The error made by Hippocrates, Laënnec further remarks, might have led him to the discovery of many valuable truths. He concluded a remarkable passage in the following words: 'But Hippocrates stopped with an incorrect observation, and his successors overlooked its import. This, at first sight, may appear surprising, nevertheless, nothing is more common. No man is permitted to embrace all the relations and consequences of the most simple fact, and the secrets of Nature are more frequently disclosed by accidental circumstances than they are wrested by scientific efforts.' "

The famous work of Laënnec was speedily translated into all the languages of Europe, but from the year 1820 his feeble body yielded more and more to the disease, the knowledge of whose pathological anatomy he had most promoted. He died of phthisis in 1826 at the early age of forty-five, though not until he had completely performed his life's task.

He affected indifference to his splendid services to medicine, but prided himself particularly upon his skill in riding. Being frail and delicate in person, and one, therefore, from whom the more violent of manly sports had always been precluded, this gratification in a not very extraordinary accomplishment may be regarded as a very natural weakness on his part.

In England the use of the stethoscope was promptly adopted, though in America there was for some time a prejudice against it. Oliver Wendell Holmes wrote long afterwards a humorous poem, worthy of comparison with Butler's "Elephant in the Moon," in which he describes the experiences of a young physician, in whose stethoscope a fly had become imprisoned. The buzzing of the fly led to the most appalling diagnoses in a number of very interesting cases.

Laënnec's instrument in the progress of time underwent many modifications and combinations. The stethoscope with which he made his first observation was about ten inches long with a diameter of about four inches, and contained in its thoracic extremity an obturator upon which he laid great stress. Afterwards the obturator was omitted as useless. Various materials also were tried in its manufacture, ranging from fir-wood to silver and hard rubber. Then it was made shorter and smaller in diameter, and the ear plate, originally fastened to the body, was made removable, and either flat or concave; then two cones of different sizes were fitted to the body proper for auscultation of the lungs and vessels. The stethoscope which the old-time physician of fifty years ago carried about in his hat was of a light wood, highly polished, and consisted of a hollow cylinder a little larger than a pen handle, and five or six inches in length, expanding at one end in a round plate which was pressed against the chest of the patient about to be examined, while at the other end there was a smaller expansion to fit the ear of the physician.

At present the stethoscopes commonly in use are binaural. Two small curved steel tubes with ivory tips to fit into each ear, joining two flexible tubes of rubber which meet together and are fitted to a single concave disc of hard rubber which is applied to the chest. Many inventions upon the same principle as the stethoscope have also been made public from time to time, but none has yet surpassed it in general use.

Laënnec investigated auscultatory phenomena and regarded them as pathognomic signs of perfectly definite morbid conditions of the viscera, and formed empirical categories of sounds, but in 1839 Joseph Skoda issued his famous work on Percussion and Auscultation, where, in a more scientific manner, he formed his memorable physical rules upon the basis of the principles of acoustics. Percussion and auscultation must necessarily be practised together. The former indicates the physical condition of the organ under examination, whether normal or solidified, or in any other way affected; while auscultation, as will be presently more fully explained, indicates the action of the organ. The first tells of its condition, the second shows how it is performing its functions.

Since the time of Laënnec and Skoda, great progress has been made in auscultation; but the original discovery remains, nevertheless, one of the most important in medicine, and many forms of thoracic disease are now capable of being detected with absolute certainty by comparative tyros, which would have defied the skill of a Sydenham or a Cullen.

In using the stethoscope it is necessary to have the patient sitting or lying in a comfortable position with the chest either bare or very thinly covered. Upon listening with the instrument over the trachea or throat and the upper and middle portion of the chest one hears a blowing sound. This is made by the air passing to and fro with the breathing in the larger air passages, and is known among physicians as the tubular or bronchial sound.

The bronchial tubes, passing downwards from the trachea, or windpipe, divide and divide again, much as the branches of a tree, growing smaller and smaller with each division. Hence, a little further down the chest, and on both sides, the blowing sound from the larger air passages ceases almost altogether, and one hears the sound of the lung tissue itself as the myriad air cells softly expand with the incoming air. It is a much softer sound than the former, more gradual, of lower pitch, mainly inspiratory with the indrawing of the air, and almost immediately followed by a shorter and far less distinct expiration.

The sound is called the "vesicular murmur" and is produced in the smaller bronchial tubes and the minute air cells by their expansion and contraction. It is not exactly alike at different parts of the lungs, but is usually heard more clearly in the upper portion, and much better from the front than from the back, where a great mass of tissue intervenes between the lung and the surface. The vesicular murmur is most marked at the moment when the air cells fill with air.

When one sits beneath a tree in the silence of evening, a breath of air often passes overhead through the still foliage causing a very soft rustling sound, which begins at one side and sweeps slowly through the whole mass of leaves, followed by silence. Through the lung, as one listens with a stethoscope, a similar murmur seems to pass, followed by a very faint blowing sound as of the dying breeze, and then all is silence for a space; followed again, as the patient repeats his inspiration, with the same phenomenon already mentioned.

In some diseases of the lung tissue there is a complete suppression of this murmur, or its place may be taken by what is called bronchial respiration, or there may be a marked change in the character of the murmur. It may become unusually intense, the rhythm may be different or it may be changed in some characteristic; as, for example, when it loses its softness. Sometimes the murmur is so greatly increased as to resemble the loud breathing of a child. It may on the other hand be very feeble and indistinct or even be entirely absent. It is occasionally in disease divided and jerky, or there may be some alteration in the relation which inspiration has to expiration. Finally it may be "harsh," which is in reality a union of the vesicular and bronchial sounds.

The purely bronchial sounds already referred to undergo also, in the process of disease of the lung, the same modification as the vesicular murmur, in respect to rhythm and intensity. A very important variety of bronchial respiration is the "cavernous respiration" sometimes noticed. At times this indicates the presence of a cavity formed in the lung during consumption. Sometimes there are cavities, however, when no cavernous respiration can be discovered, and, on the other hand, there is a sound similar to this sometimes noticed not due to the cavity at all, but to the peculiar physical condition of the lung examined.

Hence in the practice of auscultation one must proceed with great caution, as there is much that may prove confusing and misleading. Hollow spaces of any kind, from abscesses or from bronchial dilatation, give rise to it. Amphoric respiration (from *amphora,* a vase) has been applied to a blowing respiration engendered in a large cavity with firm walls. It may be humming and of low pitch or decidedly ringing and metallic, a somewhat imperfect imitation of the sound produced by blowing into an empty jar.

So far we have dwelt mostly upon modifications of the sounds which may be heard in the healthy lung. These changes in sound are produced by changes in the tissues following disease. In some affections, however, there are new, or adventitious sounds which have no analogue in the healthy state, and which cannot, therefore, be considered modifications of the normal respiration. The râles are of this sort, and also the sound known as crackling, and the friction sounds. Nearly all râles are sounds generated in the air tubes by the passage of air through them when they are contracted, or when they contain fluid exudations. When produced by the contraction of the passage the râles are dry; when by the presence of fluid, moist. These râles may obscure, or entirely take the place of the normal murmur. The dry râles are capable of still another division, for they are sibilant in character, as one would naturally expect when the air passage affected is a narrow one; and sonorous when the calibre of the passage is greater. When there is a moist râle, due to fluid in the bronchi, it is known as a " large bubbling " when occurring in the larger air passages; a " small bubbling " when occurring in the smaller, and a " crepitant " when taking place in the terminal air cells.

This crepitation is a very fine sound, or more correctly, a series of sounds, not unlike that caused by throwing salt upon the fire. It is noticed most frequently in the first stage of pneumonia. The crackling sound is usually associated with phthisis; while the friction sounds are observed in cases of pleurisy, and is produced by the contact of the roughened surfaces of the inflamed pleura during breathing.

A full description of the physical signs noticed in the various diseases of the lung, as indicated by the practice of percussion and auscultation, would fill a volume, and the merest outline must suffice. The results of auscultation when applied to the heart are quite as interesting. The heart, it must be remembered, is an organ for regulating, as well as for forcing the flow of the blood. It contains four very important valves. Diseases of the heart consist either of inflammation of the lining of the sheath in which it lies, enlargement or degenerative changes of the heart tissue itself, or of the valves. When the valves are thrown out of their exact adjustment the gravest symptoms follow. These are known as valvular diseases, and in detecting the presence of these, Laënnec's principle of ausculation is of the utmost value.

In health two sounds only are heard over the heart. The first over the left ventricle near the apex is dull, heavy and prolonged. Over the right ventricle it is clearer, shorter and of higher pitch. The second sound of the heart is sharper and more accentuated. As long as the heart beats they can be heard plainly by the stethoscope. In the presence of valvular diseases there can also be heard new sounds known as valvular murmurs. The nature of the disease of the valve, as well as the particular valve affected, can be ascertained by the stethoscope. There are given parts upon the chest easily reached by counting the ribs and using other landmarks, where each valve can be heard. The nature of the disease of a particular valve is learned by noting the relation which the valvular murmur bears to the heart sounds. Stenosis, or partial closure of the valve, is said to exist when the passage is much narrowed, and the blood passes through with much difficulty. The murmur caused by stenosis is heard before the heart beat. When the valve is so imperfect as to remain open and allow the blood to rush back again into the chamber which it has just left, the back flow causes a murmur of regurgitation which is heard of course after the first sound of the heart.

CHAPTER V.

ENGLISH SURGEONS.

English surgery during the earlier years of the Nineteenth Century was dominated to a remarkable degree by the teachings of two masters of the art who had died towards the close of the century preceding.

Percival Pott, who was for many years the principal surgeon to St. Bartholomew's Hospital, wrote extensively upon various surgical subjects, and was especially celebrated for the mildness and humanity of his treatment. He was the inventor of many useful surgical instruments, and his name is at the present day still identified with a particular form of fracture which often occurs at the ankle joint. He was, without doubt, esteemed the leading English surgeon of his time. Dying, full of honors, in 1788, the leadership fell, by right of succession, to John Hunter, one of the most remarkable personalities in the annals of surgery, who died shortly afterwards in 1793.

Hunter was not a surgeon in the narrow sense of the word, however, for to surgery he added anatomy, both human and comparative, and is known to have dissected more extensively than any other man of his time. In physiology he also took a keen interest, and through an interesting experiment, which consisted of cutting off, by a ligature, the blood supply from the antlers of a deer, arrived at the theory of collateral circulation, the importance of which can hardly be estimated until the wide range of operations affected by the principle is taken into consideration. In his experiment he found that immediately upon the operation the antler became cold; while in the course of a few weeks there was a return of the animal heat. Upon examination of the part it was found that certain small arteries in the vicinity of the ligature had in the meantime enlarged to so great an extent as to be capable of again carrying on the circulation interrupted by the ligation.

From the case in point Hunter was able to deduce the general principle of the reparative powers of nature in such forms of injury; and if the supply of blood, he argued, could be thus diverted in the case of the deer, it could be diverted in a similar manner should he tie a human artery for aneurism. The theory was eventually put into practice with the most brilliant results; for in 1785 Hunter tied the femoral artery successfully, and in 1815 Sir Astley Cooper tied the aorta, the principal artery of the body, upon an occasion when the life of the patient was in the extremest peril. This incident out of many will serve to indicate the man's breadth of mind. It is a keynote to his whole remarkable career.

Eventually the subject of anatomy became almost an obsession with the great surgeon. His mania for collecting specimens and anatomical preparations grew so strong that everything else became subservient to it. He turned his house into a museum of dead, and his garden into a menagerie of living animals. His friends upon every side were importuned and persecuted unceasingly to furnish material. His demands, for example, upon Edward Jenner, for hedgehogs alone, were sufficient to have almost depleted the country of that animal.

At a time when it would be scarcely correct to say that there was a science of physiology ; a time when the microscope had not yet revealed the minute formation of animal structures, and when anatomical knowledge was far from accurate; the fierce, eager enthusiasm of Hunter, in a subject which had perhaps never before received such searching and sturdy handling, did a great deal to advance scientific knowledge. And though Surgery has passed through many changes, and reached a height during the past century which would have been incredible to John Hunter ; the magic of his name is almost as potent to-day as it was at the time of his death.

Two of his pupils, Sir Astley Cooper and John Abernethy, maintained the prestige of British surgery after Hunter had ceased from his labors.

"To perform an operation," Hunter would say, "is to mutilate a patient we cannot cure, it should therefore be considered as an acknowledgment of the imperfection of our art." Though almost always successful in his operations, he was not especially dexterous or elegant. In the days before the use of chloroform, or other anæsthetics, special importance was attached to speed, as a matter of course, by which the patient's pain might be rendered as short as possible. Hunter's aversion to operating, while there remained any hope of saving the limb by skilful treatment, marked a tendency which gained ground more and more with his successors, in marked contrast with the reckless empiricism of the earlier surgery.

At the present day one is likely to overlook the artificial line of demarcation which at that time separated the physician from the surgeon, rendering each a member of an entirely independent profession. That this was most unfortunate and tended to retard the development of both, can be readily seen. For a broken bone or the cut of a sword no physician would dream of giving the patient a pill or a mixture, and so the surgeon must needs be called in, and, by manual means, set the bone or dress the wound.

The old term Chirurgeon, indeed, signifies "handwork," and hence the expression "Craft of Surgery" is not inapplicable. But where formerly the word surgery, or Chirurgery, was at first used merely to indicate a means of treating disease, the term had arbitrarily come by general usage to signify a species of diseases; as if some diseases were surgical, because they could be treated by manual application and instruments, and others medical, because they could not be reached by the hand or treated by the use of instruments.

This is after all but one principle of disease, and in the earliest periods the same men cultivated the whole field of medicine. About the middle of the twelfth century, however, the Council of Tours prohibited the ecclesiastics from taking part in any bloody operation. Surgery was then rejected by the Universities under the empty pretext "*Ecclesia abhorret a sanguine,*" often expressed in its decrees, but never acted upon, except in this instance.

The surgeon subsequently, as Cooper remarks, "became little better than a sort of professional servant, or lacquey, to the physician, the latter alone not only having the sole privilege of prescribing internal medicines, but even that of judging and directing when surgical operations should be performed. Then the subordinate surgeon was only called upon to execute with his knife or his hand duties which the more exalted physician did not choose to undertake; and in fact he visited the patient, did what was required to be done and took his leave of the case, altogether under the orders of his master."

This was not a condition of things calculated to further the development of this most important branch of the healing art, for no man who had any respect for himself, or real ability, would submit to the indignities of such a calling. Even long after the abuses had been set right, the stigma of earlier associations clung to the vocation of the surgeon. Indeed, for two or three centuries following the Council of Tours there was a vague sense of degradation attached to the practice of surgery. A fact which can be understood all the more readily at the present time, perhaps, when it is remembered that the surgeon of those days was also a barber, or, to speak more correctly, that the barbers of that time practised surgery. The sign of the barber's calling, still in use, originated with the early barber-surgeons, who usually had a pole placed before their door, to which was attached strips of cloth which they used for bandaging wounds. The transition from a convenient contrivance of this sort to an ornamental sign, designed to attract the attention of passers-by, can be readily followed.

At the beginning of the present century, however, the surgeon had almost regained all the honor and dignity, of which he had formerly been deprived; and the craft of surgery, under the teachings of the great surgeons already mentioned, was giving marked promise of the brilliant future which the close of the century has so amply realized.

At that time one of the most important problems of surgery was undoubtedly the control of hæmorrhage. The fear of profuse bleeding retarded the improvement in surgery for ages. The ancients, indeed, having no means at their command by which to stop bleeding, were afraid to cut out the most trivial tumor. They generally performed operations slowly and imperfectly, by means of burning irons, or arterial ligatures, which are now executed quickly and safely with a knife. If the old surgeons ventured to amputate a limb they only did so when it had mortified, by dividing the dead parts. So great was their apprehension of bleeding, that they only dared to cut parts which could no longer bleed.

Not only was hæmorrhage feared as a consequence of surgical operation, but it was itself, also, one of the most alarming accidents which surgery was called upon to relieve. J. L. Petit, the inventor of the screw-tourniquet for compressing arteries during operation, published several memoirs upon hæmorrhage in 1731, in which he stated that bleeding was arrested by the formation of two clots—one outside the vessel, which he called the *couvercle,* or cover, and the *buchon,* or plug, within the vessel. Morand admitted the formation of the coagula, but insisted upon the importance of the changes which take place in the artery itself. Kirkland, in 1763, showed that hæmorrhage was lessened upon the fainting of the patient, and demonstrated the fact that an artery contracted up to its nearest collateral branch.

It was not until 1805, however, that Dr. J. F. D. Jones of Jersey, by a series of admirably conducted investigations, finally determined the mode in which the arrest of hæmorrhage takes place. "No subject in surgery," Erichsen remarks in this connection, "affords stronger evidence of the advantages of the application of 'Experimental Pathology' to practice than this, as our knowledge of it has been wholly gained by experiments on the lower animals; and by the sacrifice of the lives of a few dogs, donkeys and calves, those of hundreds—probably of thousands—of human beings are annually preserved."

The blood, upon being driven from the heart, courses along the aorta, and from this branches are given off upwards, to the head and arms, and downwards, to the abdominal viscera and the lower extremities. Branching and rebranching, the size of the arteries becomes smaller and smaller, until at last it is too minute to be observed by the unaided eye. These are called the capillaries. Having become so small that even the blood cells have to bend upon their minute discs in passing, the tubes next begin to become larger, though changing somewhat in texture, until the blood is carried back to the heart by the vena cava, the chief vein in the body. The term vein is often used in a general sense to indicate any canal for carrying blood, but it is a confusing practice from the scientific standpoint. The vessels carrying blood *away* from the heart are called arteries, those which return it *to* the heart, veins. The impulse from the heart's beat, or pulse, is not felt in the veins, for it is impossible that it should be conveyed through the microscopical capillaries. Hence in returning to the heart, the blood is propelled by the pressure of surrounding muscular tissue. The veins themselves are also constructed in a manner to facilitate the blood's return, by a system of valves, which, like the locks in a canal, allow the blood to pass freely towards the heart, while preventing its flow in the other direction.

In view of these facts it is plain that upon opening a vein, either with intention or by accident, the hæmorrhage would not be severe; for there would be but slight force from behind to urge the fluid out. Venous blood is of a purple color, and when a vein is opened it slowly oozes out in an even and unbroken stream. Upon opening an artery, however, the case is altogther different. The arterial blood is of a bright scarlet color, and feeling the direct impulse of the heart, spurts from the vessel *per saltum,* in a very rapid manner; a fine jet of blood in an operation often flying as high as the ceiling, or suddenly reddening objects at a considerable distance. When an artery of any size is opened with a sharp instrument, so that the opening is even and not ragged, the rush of blood is alarming, and the wounded person will very soon die unless the flow can be arrested. The accident is generally so sudden, moreover, that those about are often in a panic, and the proper measures are not taken to assist nature to close the wound; for this, as Jones showed, after careful study of the matter, is what nature immediately attempts to accomplish.

Many methods have been in vogue for the suppression of hæmorrhage. The Arabians, in order to stop the hæmorrhage after the amputation of a limb, were in the habit of plunging the raw and bleeding stump into boiling pitch. Jones began by making a study of the artery itself in the lower animals, and found that it was a tube consisting of three layers. The innermost coat he found to be extremely thin and smooth. It is elastic and firm in the longitudinal direction, but so weak in the circular as to be very easily torn by the slightest force applied in that direction. The middle coat is the thickest of all, he discovered, and is composed of muscular fibres all arranged in a circular manner. They differ, however, from common vascular fibres in being more elastic. Having no longitudinal fibre, this coat yields readily to any force applied in the circumference of the artery. The outer coat is remarkable for its whiteness, density and elasticity. When an artery is surrounded by a tight ligature its middle and internal coats are as completely divided by it as they could be by a knife, while the external coat still remains entire.

Beside these coats the arteries, in their proper situations, are connected by means of a fine cellular substance, with surrounding membranous sheaths; and if an artery be divided, the divided parts, owing to their elasticity, recede from each other, and the length of the cellular substance connecting the artery with the sheath, admits of its retracting a certain distance within the sheath.

Still another important point is that when an artery is divided, its truncated extremities contract in a greater or less degree, and the contraction is generally, if not always, permanent. The arteries, moreover, inflame in course of time after an injury, whether it be accidental, or one consisting of the surgeon's ligation; and subsequently the injury is repaired, or the tube permanently closed. At the time when Jones wrote, the process of inflammation was looked upon as a means by which nature repairs injuries.

The blood, then, besides filling the cellular substances about the artery, also fills that at the mouth, in a particular manner; for, the divided blood-vessel, by its retraction within its cellular sheath, leaves a space of a determinate form, which, when all the circumstances necessary for the suppression of hæmorrhage operate, is gradually filled up by a distinct clot.

Jones, in his brilliant researches, goes on to give faithful and accurate details of a series of experiments on animals, which demonstrates "that the blood, the action, and even the structures of the arteries, their sheath and the cellular substance connecting them with it" are concerned in stopping bleeding from a divided artery of moderate size, and in the following manner: "An impetuous flow of blood, a sudden and forcible retraction of the artery within its sheath, and a slight contraction of its extremity, are the immediate, and almost simultaneous, effects of its division. The natural impulse, however, with which the blood is driven on, in some measure counteracts the retraction, and resists the contraction, of the artery. The blood is effused into the cellular substance, between the artery and its sheath, and, passing through the open space in its sheath, formed by the retraction of the elastic artery, when severed, flows freely externally, or is extravasated into the surrounding cellular membrane, in proportion to the open or confined state of the wound. The artery has, however, left the internal surface of the sheath uneven, by lacerating or stretching the cellular fibres that connected them. These fibres entangle the blood as it flows, and the foundation is laid for the formation of a coagulum at the mouth of the artery, which is rendered more complete by the blood, as it passes through the canal of the sheath, gradually adhering and coagulating round its internal surface, till it completely fills it up from the circumference to the centre."

In a word, when severed, the elastic artery draws back a short interval into the sheath or cellular passage in which it had been lying within the tissues. The narrow open space, formerly occupied by the retracted vessels, at once fills with blood; but as the blood flows out, the rough surface of the sheath causes it to coagulate, which impedes the further flow of blood. This, Jones called the external coagulum. Within the end of the artery the blood is now at a standstill, and as far up as the first branch, into which the blood stream is now flowing.

As far back as the first branch the blood is at rest, and in this situation a second coagulum also forms, which is adherent to the walls of the artery at the broken end. This, Jones termed the internal coagulum.

In ligating, or tying an artery, the two inner coats, as has already been pointed out, are severed, and Jones discovered, furthermore, that when it was not desired to leave the ligature in the part, the same effect could be produced by ligating, and then untying the artery after a short time; when the flow of blood in the part would be found to be permanently stopped.

Another means of arresting hæmorrhage, though mentioned, indeed, by Galen, was about 1828 revived in France by Amussat, Velpeau and others. This practice consists simply in twisting the end of the severed vessel with a pair of forceps made for the purpose. By twisting even the larger vessels in this manner the bleeding may be arrested. The principle of flexion, or sharply bending the limb above the seat of the hæmorrhage, was pointed out by Formey in 1843. Cauterization and the use of escharotics, or styptics, was almost the only means employed by the older surgeons for the stopping of hæmorrhage; and the part which Jones took in introducing a more scientific study of the phenomenon, and getting at the best means for prevention, by a closer examination of the factors themselves which go to make up hæmorrhage, was an exceedingly important one. Others carried on the study where he left off, and at the close of the century the questions which perplexed the surgeons of a hundred years ago are happily solved.

To the same period also belongs Sir William Blizzard, who enjoyed the distinction of being the first surgeon to tie the subclavian artery. This is the large blood-vessel which supplies the upper extremity. By pressing with a suitable object, the rounded handle of a key, for example, behind the clavicle, or collar bone, this artery may be firmly held against the first rib, which lies beneath and behind the clavicle in this situation, and profuse bleeding from the arm be controlled by this means. Blizzard was also the first surgeon to tie the superior thyroid artery which supplies the gland of that name. The enlargement of this gland, commonly known as goitre, might, he hoped, be prevented by shutting off the blood supply, a theory which has not been encouraged by the results of practice.

Upon the Continent the advance of surgery was equally rapid; indeed, in some branches the French surgeons seemed to have outstripped the English in improved methods. M. Roux, in a work entitled *A Journey to London in* 1814, *or a Comparison of English with French Surgery,* devoted so much space to an explanation of the many improvements which French surgery, under Desault, had made, and the little or nothing which had been accomplished by the English in the treatment of fractures, that Samuel Cooper is forced reluctantly to admit that the "doctrine and practice recommended by Mr. Pott in regard to fractured thighs have done considerable harm, and the more so as coming from a man who was deservedly looked upon as one of the best and most experienced judges of surgical practice. Many a surgeon in this country," Cooper continues, "implicitly believed everything which was asserted by so able a master, and the very observations which some years ago were here considered to be the glory of their author, and the pride of English surgery, are now exposed by the surgeons of neighboring countries, as specimens of our wrong precepts and bad practice. M. Roux, in fact, has had but too much room for animadversion upon his subject."

Considering the state of feeling which existed between England and France in the year 1814, it is not hard to understand the complacence with which the French writer criticized the clumsy surgical usages of the English, or the chagrin with which the profession in England were forced to admit the truth of his aspersions.

"This," Cooper remarks severely in conclusion, "was a matchless opportunity for M. Roux to draw a parallel in favor of French surgery, and of course he has not neglected it. It is to be hoped, however, that the period has now arrived when we shall give to the study of fractures the time, the attention and the importance which it claims."

This incident is here referred to, not by reason of its importance, so much as to indicate the transient nature of all usages in a profession that is rapidly advancing. As surgeon gives place to surgeon; as one by one the masters of the craft drop out of the race; so one theory follows another; and the form of practice that receives the highest meed of praise by one generation is totally forgotten by another.

Though the biographical element must necessarily enter somewhat into any history, the history of medicine and surgery consists not so much of personalities as of practices, and bears not so much upon the lives of even the most eminent practitioners of the art, as upon the new and improved methods instituted by each. The oracle of to-day will receive the indulgent smile of compassion to-morrow. The continued pre-eminence of any one man, in science, as in military history, indicates not so much the individual strength of the man, as the weakness of his adversaries. This is equally true of Alexander, the soldier, and Aristotle, the pedagogue.

Though built of enduring brass, and destined to stand through the ages, to all appearance, Fate at last confronts the greatest with the sarcastic smile of Monsieur Roux. The adherents of the old doctrine at first start up in anger, half appalled; then comes calmly the inevitable after-thought, and at first with undisguised pain, afterwards with philosophical indifference, the world admits the truth of the trenchant critic; and as time sweeps evenly onward the fallen master and the smiling critic are alike forgotten in a new order of things, in which new masters rise for a short time to a brilliant supremacy, to be in turn, when their hour has come, cast down by the fatal criticism of a doctrine still more advanced.

The sincere lover of science, to whom fear and vanity and tradition are alike paltry or unknown, must learn to forget himself in his science, and to be himself forgotten in the advance of the science to which he had cheerfully devoted his life. The truly great man accepts this destiny. In the realm of thought, as in the realm of animated nature, periods of construction alternate eternally with periods of chaos—the chaos of the vernal season being followed by the eager constructive development of the summer, and this again by autumnal decay. The chaos, however, is only apparent, not real; and no more real is the apparent stage of construction; for all alike form, when more closely scrutinized, a cycle of gradual growth, as inevitable as the upward swell of the tide between advancing and receding waves. A cycle in which Percival Pott performs a part no more important than Joseph-Philibert Roux.

The effect of the French writer's aspersions evidently proved salutary in the extreme. The same year the plaster of paris bandage, and various other contrivances, by which the fractured bone might be retained in an immovable position, were introduced into England and Europe upon the recommendation of the English Consul at Bassorah. The practice, it would seem, had long been in use in the East, and much benefit was derived by its adoption in Europe.

When a bone is fractured, or broken, the first object is to place the broken ends in position, and to so fix the limb that they will remain in the same position until nature repairs the injury. "A fractured bone," to repeat the words of Erichsen, "is united by the formation of new bone around, within and between the fragments. The new bone that constitutes the bond of union is termed callus. In most cases a larger quantity of this is developed than is permanently left. This temporary formation of bone goes by the name of the provisional callus. It is formed partly externally to the fracture, encasing the broken ends, and partly in the medullary canal, so as to include the fragments between layers of new bone, and thus maintain them in contact. That which is permanently left, and which intervenes between the broken ends is called the definitive callus."

The callus is at first soft and almost gelatinous, but it afterwards increases in density, until at last the formation of new bone commences to appear in the soft callus, in the form of yellowish-white points, or streaks, which gradually increase until the callus becomes converted into soft, spongy bone, which eventually becomes of a stronger texture, when the union of the originally broken ends may be said to be complete. If, however, the limb is so carelessly bound that the broken ends can grate against each other, and change in position with every movement of the patient, it follows that this process by which nature repairs the broken bone will be of no avail, and that no union will occur. Again, if the broken ends are kept in apposition, or firmly braced end to end, yet in an unnatural position, it follows with equal certainty that, when the union of the broken bone has taken place, the limb will be deformed. The practice of forcibly breaking bones where the union had occurred in this way, and setting them a second time in the proper position, came into use about this time also; and though seldom a matter of life and death, was certainly one of convenience, utility and even personal comeliness.

During the early years of the century, and amid the multitudinous disputes and discoveries and revolutions of science, a great English surgeon was rising into prominence who, after the death of Abernethy in 1831, and of Sir Astley Cooper, ten years later, took the lead in British surgery and continued to exercise a profound influence upon the art almost until the time of his death, which took place well on in the latter half of the century.

This was Sir Benjamin Brodie, a man of more profound learning, nicer culture and truer science than Sir Astley Cooper, and as a medical teacher, more polished than Abernethy. More than any other surgeon of the time he endeavored to raise the standard of the profession, of which, in one of his lectures at St. George's Hospital, he speaks in these words:

"One business of education is to impart knowledge, but another, and still more important one, is to train the intellectual faculties. To acquire the habit of fixing your attention on the object before you; of observing for yourselves; of thinking and reasoning accurately; of distinguishing at once that which is important from that which is trivial; all this must be accomplished in the early part of life, or it will not be accomplished at all: and the same remark is not less applicable to qualities of another order. Integrity and generosity of character; the disposition to sympathize with others; the power of commanding your own temper; of resisting your selfish instincts; and that self-respect, so important in every profession, but especially so in our own profession, which would prevent you from doing in secret what you would not do before all the world; these things are rarely acquired, except by those who have been careful to scrutinize and regulate their own conduct in the very outset of their career.

"I know of no profession that is worthy of being pursued which does not require as much exertion, as much labor, as many sacrifices as that in which you are engaged; and I also know of none in which he who has the necessary qualifications is more sure of being rewarded for his labors. If it be your ambition to obtain political rank, or to have that sort of reputation which a political life affords, you will be disappointed; for, as I have already observed, our profession has nothing to do with politics. It belongs to private life, and the only other association which it has is that of science. There are few departments of either physical or moral science with which it is not, in a greater or less degree, connected; and there are some with which the connection is so intimate, that the study of them may be almost regarded identical. You are to look, not to political rank, but to the rank of science. No other rank belonged to Newton or Cavendish, to Hunter or Davy; yet their names will live in distant ages; and they will be remembered as benefactors of the human race when the greater number of their more noisy contemporaries, if remembered at all, are remembered without respect.

"All varieties of character will be thrown open to your view; but, nevertheless, you will see on the whole the better side of human nature; much, indeed, of its weakness, much of its failings, much of what is wrong; but more of what is good, in it. Communicating, as you will probably do, with persons of all conditions, you will be led to estimate others according to their intrinsic qualities, and not according to those circumstances which are external to themselves: you will learn that of the various classes of which society is composed, no one is pre-eminently good, or pre-eminently bad: and that the difference is merely this, that the vices and virtues of one class are not exactly the vices and virtues of another. You will have little sympathy with those prejudices which separate different classes from each other; which cause the poor to look with suspicion on the rich, and the rich to look down upon the poor.

"You must feel and act as a gentleman. I can find no word so expressive of what I mean as this. But let there be no misunderstanding as to who is to be regarded as a gentleman. It is not he who is fashionable in his dress, expensive in his habits, fond of fine equipages, pushing himself into the society of those who are above himself in their worldly station, that is entitled to that appellation. It is he who sympathizes with others, and is careful not to hurt their feelings even on trifling occasions; who, in little things as well as in great, assumes nothing which does not belong to him, and yet respects himself; this is the kind of gentleman which a medical practitioner should wish to be. Never pretend to know what cannot be known ; make no promises which it is not probable that you will be able to fulfil ; you will not satisfy every one at the moment, for many require of our art that which our art can not bestow."

CHAPTER VI.

SURGERY IN EUROPE.

OVER all Europe during the opening years of the century war was being constantly waged ; and this gave a new impetus to the study of military surgery in all countries, though more especially in France and England. The constant presence of war, moreover, afforded ample opportunity for study and observation, not only of gunshot wounds and other injuries usually inflicted in battle by land and sea, but also of the best methods of caring for the wounded and the sick upon the field or on shipboard.

With the brilliant rise of military surgery during these years, the name of Larrey, the surgeon of Napoleon Buonaparte, is closely associated. He had chances for studying his profession which never before perhaps came within any one man's experience ; for he participated in sixty great battles and four hundred engagements.

Upon military surgery Larrey was for many years the standard authority, and he has left several treatises upon the subject. But it is not so much by these learned and justly famous works, valuable though they be, that he will be remembered with affectionate admiration in future years ; nor even by the improved surgical usages which he inaugurated ; as by the heroic place which he occupies in one of the most dramatic epochs of human history : for his is a personality which reminds one less of the Nineteenth Century than of the days of Orlando or Arthur. Indeed, his life has the dignity of true epic ; and laying aside for a moment the thread of scientific development, no excuse will be required for interpolating here Mitchell Bank's brief sketch of the great surgeon's career.

In the latter part of the last century war was made on a scale which was never known before, and was made also with a rapidity and a precision quite unprecedented. Moreover, the science and art of surgery had been rescued from quackery, and surgeons in actual practice were able to be of great and real service to the wounded. As a result of the vast masses of men that were hurled against each other, the number of wounded after a big battle amounted to thousands, and civilization had so far advanced that it was imperative that immediate help should be given to them. Thus about this time the military surgeon really became an important officer in warfare, and began to have his rank and pay well defined, and his merits (up to a certain point) recognized.

In 1776, near the Pyrenees, was born Jean Dominique Larrey, the Surgeon-in-Chief of the Grand Army, the friend and body-surgeon of Napoleon, the greatest military surgeon that ever lived. He studied at the medical school at Toulouse, and in 1792 joined the headquarters of the Republican Army of the Rhine under Custine. Now the ambulances of those days were obliged to remain about a league from the army, and the wounded were only picked up after the fighting was done. General Custine was a man who moved his troops very rapidly, which made matters worse for the wounded. This greatly affected Larrey, who set to work and devised a new ambulance, hung on springs, and combining great strength with lightness. Such carriages were termed *ambulances volantes.* They could keep up with the advanced guard of the army with the speed of flying artillery and they carried off the wounded almost as they fell. Larrey had early perceived the enormous advantage a wounded man got by having his fracture set, or his bleeding stopped as rapidly as possible, and by then getting a roof over his head before night set in.

General Beauharnais, in a despatch to the Convention, made special mention of "Surgeon-Major Larrey and his comrades with flying ambulances, whose indefatigable care in the healing of the wounded had diminished those afflicting results to humanity which have generally been inseparable from days of victory, and has essentially served the cause of humanity itself in preserving the brave defenders of our country."

The staff of a flying ambulance was about 340 in number. For each divison there were four heavy carriages and twelve light ones. Some had two and others four wheels, and they were furnished with mattresses. In Napoleon's Italian campaigns they came greatly to the fore, and the great man displayed a lively interest in them, reviewing them and causing them to manœuvre before him just as if they were on a battlefield. After one of these inspections he said to Larrey: "Your work is one of the most happy conceptions of our age. It will suffice for your reputation."

When Napoleon undertook his Egyptian campaign Larrey proceeded to Toulon to organize the medical staff. So readily did professional men respond to the call made by him, that he soon was able to reckon on 800 well qualified surgeons, of whom many had served in the army of Italy, and these were in addition to the medical officers actually attached to the regiments. This, I think, shows the value that the king of commanders set upon the health of his troops, and the trouble and expense which he was prepared to face in order to maintain it—a great contrast to the miserable way of dealing with this subject, which has too long been the fashion with our military rulers.

Not long after the landing at Alexandria a certain General Figuières was severely wounded. By able treatment he recovered, and in gratitude for the preservation of his life, he asked Napoleon to accept a valuable Damascus sword. "Yes," said the latter, "I accept in order to make a present of it to the Surgeon-in-Chief, by whose exertions your life has been spared." Upon the sword were engraven the words *Aboukir* and *Larrey,* and the surgeon had it till the fatal day of Waterloo, when the Prussians robbed him of it. Some months after the occupation of Egypt, a terrible revolt took place in Cairo by fanatical Turks. Utterly regardless of anything except how to get at Frenchmen to murder them, they attacked the hospital which was crowded with sick and wounded soldiers, but the doctors valiantly defended their patients, and two staff surgeons, Roussel and Monjin, were killed, while Larrey nearly shared the same fate.

At one period there was a total dearth of meat, and Larrey had nothing wherewith to make even a drop of bouillon for his patients. He ordered camels' meat to be used for this purpose, and when that fell short, he used up the horses. Years afterwards, in the second campaign against Austria, the Imperial Guard and several corps were crowded together in the island of Lobau, in the midst of the Danube, which Napoleon was endeavoring to cross. The days were roasting and the nights icy cold, and provisions became so scarce that Larrey's patients were in danger of starvation. Without more ado he impounded certain officers' horses, and had them slaughtered and employed as food. As there was a lack of kettles he employed the cuirasses of those who had been killed, and made his horseflesh soups and stews in them. Certain generals made bitter complaint to the Emperor of Larrey's proceedings, who summoned the Surgeon-in-Chief, and in the presence of his staff demanded an explanation, with a severe expression of countenance. "What," he said, "have you on your own responsibility disposed of the horses of the officers, in order to give soup to your wounded?" "Yes," answered Larrey. He added no more, but soon afterwards he heard of his promotion to the rank of Baron of the Empire.

In those days means of transport were so inferior, and the necessity for removing hopelessly damaged limbs as soon as possible after the injury so imperative, that amputations were performed on the field of battle, while it was still raging, and amid showers of bullets. During the battle provoked by the landing of the English at Aboukir Bay, General Silly had his knee crushed by a bullet. Larrey saw that unless the leg was promptly amputated the case would prove fatal, and the general giving his consent, the operation was performed in the space of three minutes, under the enemy's fire. Just then the English cavalry came upon them. "I had scarcely time," said Larrey, "to place the wounded officer on my shoulder and carry him rapidly away toward our army, which was in full retreat. I spied a series of ditches, some of them hedged with caper bushes, across which I passed, while the enemy, owing to the ground being so cut up, had to go by a more circuitous route. Thus I had the happiness to reach the rear guard of our army before this corps of dragoons. At length I arrived at Alexandria with this honorable wounded officer, where I completed his cure." One must admit that these were a pair of heroes.

As may be imagined, the awful retreat from Moscow called into play all Larrey's resources, and many an interesting story could be told of his efforts. Think of the terrible battle of Borodino, where under Larrey's own direction two hundred amputations were performed, where there were neither couches nor blankets, nor covering of any kind, and where the food consisted of horseflesh, cabbage stalks and a few potatoes ; think of cold so intense that the instruments requisite for the operations too often tumbled from the powerless hands of the French surgeons. Think of the savage Cossacks, hovering about the while, and waiting their chance to kill the surgeon and the wounded man equally with the combatant. Then came the passage of the Beresina. Take an incident of it. Among the wounded was General Zayonchek, who was over sixty years of age. His knee was crushed, and without amputation the saving of his life was impossible. It was performed under the enemy's fire, and amid thick falling snow. There was no shelter except a cloak, which two officers held over him while the operation was being performed ; but the surgeons did their work with such coolness and dexterity that the old general survived and died fourteen years afterwards, Viceroy of Poland. Larrey succeeded in getting over the Beresina with the Imperial Guard, but discovered that the requisites for the sick and wounded had been left on the other side. At once he recrossed the river, only to find himself in the midst of a furious struggling crowd. He was on the point of being crushed to death, when providentially the soldiers recognized him. No sooner did they do so, than they carried him across the river in their arms, with the cry, "Let us save him who saved us!" and forgot their own safety in their desire to preserve the man whose tender kindness they had so often experienced.

Following his adored master through victory and defeat, Larrey at last stood at night on the field of Waterloo, alone, except for some medical officers and the wounded who lay groaning around them. Down upon them came a squadron of Prussian lancers. Expecting no quarter he fired his pistols at them and galloped away. They shot his horse and sabred him as he lay on the ground. Leaving him, apparently dead, they went off. But he recovered his senses and tried to crawl by cross roads into France. Again he was seized by another detachment of Prussian cavalry. They robbed him promptly of all he possessed, and took him before a superior officer, who ordered him to be shot. About a quarter of an hour before the sentence was to be carried out, a surgeon-major recognized Larrey. He had attended with deep interest a course of lectures which Larrey had delivered in Berlin six years previously. The prisoner was brought before Bulow, and finally presented to Blucher, whose son in the Austrian campaign had been badly wounded, and captured by the French, and who owed his life to Larrey's exertions.

Larrey's honorable and glorious life terminated in 1842. Napoleon, when he made his will at St. Helena, wrote in it: "I bequeath to the Surgeon-in-Chief of the French army, Larrey, one hundred thousand francs. He is the most virtuous man I have ever known." From Napoleon's lips words of free, spontaneous, ungrudging praise such as this rarely fell.

While dwelling upon the state of Continental surgery in the early years of the century, the name of Jean Civiale must not be forgotten. In 1822 he succeeded in crushing calculus. This disease is extremely painful, and the only possible means of alleviation up to this time had been the operation of lithotomy, which consisted in cutting down through the tissues and extracting the foreign body from the opened viscus. An operation so severe, in days before chloroform was known, was dreaded by all; while the weakened health of many would not permit of their undergoing it. The discovery of any means, therefore, by which the calculus could be extracted without a cutting operation, proved of unspeakable benefit to thousands, and the operation is now a surgical procedure in common use. In this discovery much less had in the first place been hoped than was eventually realized. In his original experiments the object was only to extract a small portion of the calculus for the purpose of chemical analysis; and this led ultimately to the invention of the lithotrite, by which the calculus was broken *in situ.* The operation was in after years, as shall be seen subsequently, greatly perfected.

Guillaume Dupuytren was not inaptly styled the "Napoleon of Surgery." Besides his lectures and his position as physician-in-chief to the Hôtel Dieu, he had an enormous private practice, and added greatly to the advance of surgery. In the early part of the century his name was a synonym for all that was brilliant and advanced in the art, and until his death he maintained the predominence of French surgery. To the knowledge of fractures (particularly complicated fractures) and to the treatment of dislocations he added much. He first performed resection of the facial bones, and cast light upon the entrance of air into the veins, the theory of cysts and enterotomy.

By Dupuytren also pathological anatomy was first utilized in surgery, and by him tumors were reclassified as homœoplastic, those corresponding to the normal tisues, and heteroplastic, those depending upon abnormal tissue formation. In 1835 he died of empyema. He had intended to be operated upon by Sanson, but finally refused the operation, saying that since death was inevitable he would rather die at the hands of God than man. His funeral obsequies were those of a prince.

Jacques Lisfranc, of Saint Martin, and physician to the Hôpital de la Pitié, was another eminent French surgeon. He was the first to apply physical investigation to surgery, and secure for this science complete precision. In 1815 he invented new methods, in conjunction with Champesne, for the disarticulation of the shoulder, but he is better known to-day by his partial amputation of the foot, an operation which bears his name, though it had been performed in 1803 by William Hey. A new method for resection of the lower jaw was also practised by Lisfranc. He was himself a skilful and a particularly rapid operator. Shortly before his death, in 1847, his voluminous works on Clinical Surgery and Operative Medicine were published.

Armand Trouseau, of Tours, was another surgeon who rendered special service to Medicine by his study of croup, and the operation of tracheotomy, which he practised as an expedient. In domestic circles croup, the word, quite as much as the disease, has always been regarded with profound dread.

The cause of death, in many cases, is due to the occlusion, or closing up, of the air passage in the vicinity of the larynx by the false membrane, and the swelling of the parts beneath; the patient dying simply by suffocation. In the larynx, where the vocal cords are situated, the air passage is very narrow indeed, aud the complete closure of the inlet is likely to occur should there be much swelling.

The plan adopted by Trousseau was to cut through the trachea, or windpipe, beneath the larynx, and, holding this orifice open, to allow the patient to thus fill his lungs with air from a point beneath the seat of constriction and disease. The results of the operation, as practised by Trousseau, were not altogether encouraging. However, it must be remembered that the best results have been obtained when the operation is performed early, while in the cases which came under Trousseau's notice he had been consulted, and the procedure at last allowed, only as a final resort.

To the same period belongs Auguste Nélaton, the body-surgeon of Napoleon III., who gained a world-wide reputation by the invention of a most ingenious probe for detecting the presence of bullets, by which on one occasion he was able to find the location of a musket-ball in the body of Garibaldi. His chief works consisted of a treatise on *Tumors, and the Elements of Surgical Pathology,* in three volumes.

Turning from France to the progress made by surgery in Germany and other countries, Carl Ferdinand Von Græfe of Warsaw was in 1811 a medical professor in Berlin, though at the time only twenty-four years old. During the war of Poland for her independence, however, he was appointed "General-artz," but after the close of the war he resumed his professional studies, and became very influential in the development of German surgery; being particularly popular as an operative surgeon. He made a specialty, as it would be called now, of what is known as plastic, or reparative surgery.

Sometimes as the result of an accident, or a burn, the eyelids or the nose will become greatly deformed. Oftener, perhaps, the deformity has been present from the time of birth, and not only causes the unfortunate patient great inconvenience, but may be so unsightly as to prove a perpetual source of humiliation to him. Von Græfe attempted to rectify certain forms of such deformity by surgical means.

It has long been known that portions of the body may retain sufficient vitality to become again adherent, when attached only by a very narrow portion of tissue to the part from which they had been all but separated. This had often been observed in injuries of the face and fingers. The most remarkable instances of this kind, indeed, are those which are related by Hoffacher, and attested by Chelius and Velpeau. Hoffacher had been appointed to attend as surgeon at the duels between the students of the University of Heidelberg; and as those encounters are generally with swords, he saw many incised wounds, and wounds in which portions of the nose, lips and chin were sliced off, and which upon being placed in position again contracted adhesions and eventually healed entirely. On one occasion a dog, which happened to be in the room at the time of the duel, snapped up a portion of a nose which had just been dissevered from the face of one of the duellists. It was recovered as promptly as possible from the mouth of the dog, and upon being put on again, became firmly fixed in its original position.

In order that union should take place between parts which have been nearly, or altogether separated from the body, it is necessary that they should be soft and vascular, or well supplied with blood vessels; and more especially still, that they should be homogeneous in character. For the healing of such wounds the face is very favorable. This tendency for complete union to occur between parts at one time completely severed, having been once established, the next step of surgery was naturally to supply deficiencies of the sort long afterwards, with a portion of tissue that might reasonably be supposed to act as a substitute. Von Græfe practised blepharoplasty, or repair of the eyelids, rhinoplasty, or repair of the nose, and staphyloplasty, an operation to supply deficiency of the uvula, a pendant process of mucous membrane at the back of the palate.

By his surgical works published in 1812 and 1814 he inaugurated the Plastic Surgery of the century, though the facts mentioned had of course been long known; and an operation somewhat similar to Von Græfe's, performed as early as the sixteenth century by the Italian surgeon, Tagliocotius. In India, also, the loss of the nose had been repaired at a much earlier date by analogous means.

John Friedrich Dieffenbach was a contemporary of Von Græfe's. This Berlin professor was a born surgeon, a particularly ingenious operator and a scientific writer, who won a reputation almost undisputed at home and abroad. In 1821 he went as a travelling physician with a blind lady to France, where Dupuytren and Larrey gave him special advantages. On returning to Germany in 1822 he took his doctor's degree at Würzburg. After a brilliant career in private and public practice, he was in 1832 nominated professor extraordinary, and in 1840 became Græfe's successor. Like the latter, his chief merit lies in having perfected plastic operations in the widest sense.

His principal work was one on operative surgery; and his own operations were many and varied. He practised transfusion of blood, an operation which consists in transferring from the veins of a strong and healthy person, a needed supply of blood to the veins of one in the act of dying through loss of it. He also made many experiments in transplantation in animals. According to Rohlfs, he was the first to transplant pieces of the cornea in man. He also made the experiment of dividing the sterno-cleidomastoid muscle, the edges of which can be felt upon either side of the neck anteriorly, and the shortening of which causes torticallis, or wry-neck. He even performed a surgical operation for stammering; and for strabismus, or squint of the eye, performed numerous successful operations.

The eye lies within a hollow space at the front and upper part of the skull. The orb is moved by six minute muscles. Of these there are four known as the recti muscles, by which the eye is turned in each direction at will, while, by the action of two additional muscles, known as the oblique, the orb is caused to rotate slightly in its socket. Weakness or paralysis, from any cause, of any one of these muscles gives full play to the muscle drawing in the opposite direction. Oftentimes the complications would prove somewhat confusing to one who had not given the matter particular attention. Dieffenbach's method was to cut the muscle whose tension caused the distorted position of the eye. When the muscle in question was severed the eye, he showed, would return to its normal position, and the divided muscle would in a short time heal again, though in a modified and satisfactory position.

"Of all the branches of medical science," he writes, "operative surgery is most adapted to carry away you young men with enthusiasm. The man of feeling shudders at the thought of plunging the knife into the flesh of a fellow man, of doing this in cold blood, of moving the knife here and there, of cutting still deeper, of being sprinkled with a shower of blood, in the midst of the cries of anguish of the poor mutilated patient, and yet of thinking and feeling! Operative surgery is a bloody struggle for life with disease, a struggle for life and death. Audacity and insensibility cannot here win the victory, but calmness and enthusiasm, knowledge and dexterity. Without a certain natural disposition for this branch, and without a fiery devotion to it, he who dedicates his life to operative surgery will always continue a beginner. This, however, makes the true surgeon—

to be able, and to know how to execute that which is not written in the books, to invent new methods, not a new bandage or a new knife—to be always an inventive Odysseus, and under the most difficult circumstances to be capable of winning the battle at once without any council of war. Any one can learn to make verses, but to write poetry cannot be learned; it is a faculty innate in the poet.

"One may also learn to use the knife, but often he is compelled to cut differently from what he has learned in the books. That is operative surgery. The best surgeons are recognized only by the clearness of their thought and the simplicity of their expression. The best surgeons have always been the best writers, they may be recognized by their style, and the writings of old Pott, of our Richter and of Astley Cooper might be read in our schools as models of style."

This is Dieffenbach's tribute to surgery. From his own imaginative style in writing he has been termed the Romancist of Surgery.

Among the pupils of Dieffenbach who rose to distinction was Nikolai Ivanovitch Pirogoff, who, in the study of anatomy, was the first to resort to the frozen sections of bodies; a method made easy, and very probably suggested, by the exceeding coldness of the climate of Russia, where he lived. He did much also to improve the military hygiene in Russia, and used his influence in the popularization of the plaster of paris splint when it was introduced. A well-known amputation of the foot bears his name.

George Friedrich Louis Stromeyer of Hanover made a great reform in operative orthopædia by the application of subcutaneous tenotomy; not in a few special cases only, as already practised by Delpach, but in all the deformities of the skeletal system.

Tenotomy consists simply of cutting through a tendon with a knife sharp at the end like a chisel. A tendon is the fibrous extremity by which a muscle is attached to the bone upon which it reacts. When the tendon is divided the bone is released, and if it has been maintained in an undesirable position by the action of the muscle in question, it returns to a position more natural, the tendon healing in the altered position and allowing the bone to retain its normal relation to the neighboring parts. A striking example of tenotomy may be seen in the operation for club-foot. Take for example the form known as *talipes equinus,* where the foot is extended to such a degree that the patient cannot walk with the heel upon the ground. By cutting the tendo Achillis, the tendon above and behind the heel; so named because when the mother of Achilles, the Achaian hero, immersed him in the Styx that he might become invulnerable, she held him by this very convenient part of the heel, which therefore came not in contact with the sacred waters, and was hence vulnerable to the arrow with which it was, in due time, pierced in battle—by severing this powerful tendon, the foot is able to at once resume its normal position, and when the tendon has formed a new union, and the wound is quite healed, there will be no return of the first deformity. This apparently insignificant operation, indeed, has produced the most brilliant results, and has relieved the most painful conditions, as well as removed the most unsightly deformities.

Sharers with Stromeyer in the foundation of this new branch of surgery were Dieffenbach, who has already been mentioned, Bernhard Von Langenbach and Friedrich Esmarch of Schleswig, whose elastic bandage for the prevention of hæmorrhage, in the operation for aneurism and other operations is still known by his name throughout the world.

Though in retrospect the progress of surgery during the first half of the century may be said to have been most satisfactory, in some cases even brilliant, one is ever conscious, as he carefully reviews the various advances made, of the limitations with which the art was narrowly circumscribed upon every hand.

To a somewhat more accurate anatomical knowledge than had formerly been thought necessary a few of the simpler principles of physiology had been added—thanks to the unremitting labors and almost intuitive genius of such men as John Hunter; and the result had been the improved methods of surgical practice described in outline in the preceding chapters. The advance in the art of surgery, as will be seen, was in exact proportion to the advance made in the study of anatomy and physiology, and when the latter came to a pause, surgery also, following closely afterwards, came likewise to a standstill. Surgery is after all but the manual application of known physical and physiological principles. Both surgery and medicine are at the rear of the train, and must ever wait, with what dignity they may, until the axe-bearing pioneers—anatomy, physiology or pathology, as the case may be—have cleared a trail into the regions of the unknown.

The next experiment in the pathologist's or the physiologist's laboratory may throw a flood of light upon some point in the nature of disease or function which may revolutionize the practice of medicine. To pathology and physiology all else must maintain always an ancillary attitude, for only with their advance can the practice of medicine itself make any advance. John Hunter was one of the first to see this, and by this one thought the greatness of his genius may be estimated.

At the period under consideration, the essential nature of inflammation was not understood at all, and no intelligent means were in use to limit or prevent it. The causes of infection were as little understood; but the dread of it—like the chimæras and other terrifying monsters that ramp about the margins of ancient maps—preserved for many years yet to come some of the most important regions of the body as a *terra incognita* to the surgeon's knife; during which years, probably many thousands died from cerebral, abdominal or pelvic forms of disease which would now be considered amenable to surgical treatment.

Again, owing to the intense pain of surgical operations, swiftness was esteemed the first requisite in operating, and while to overhaste fatal results were often probably due, the pain endured by the patient would in any event have operated unfavorably to his recovery.

In fine, from a study of how far mutilation may be perpetrated without causing immediate death, the professional butchery, of which the surgery of early times consisted, with its various forms of gratuitous torture to the patient, had so far advanced, that the amputation of limbs was now made with neatness and dispatch! The articles were understood a little better, as also the bones, and something was being done to even correct deformity — the restitution, perhaps, commanded by Fate from a profession which had been for centuries so largely instrumental in producing it. Ovariotomy, which was first performed in America, and kindred operations were still, however, regarded in the light of recklessness little short of murder. And at this point the art of surgery came to a period for the time being.

CHAPTER VII.

ENGLISH PHYSICIANS.

The practical bent of the English mind has always been evident in the progress of English medicine. The discovery of vaccination by an Englishman, and its subsequent adoption by all the countries of the world, depends upon no elaborate theory of the disease itself, or of the manner of its propagation, but is simply a practical method by which the spread of smallpox may be prevented.

"How has it happened," Latham asks, "that while, in other countries, the medical profession has been exhibited under every imaginable form of ridicule, here, in England, it has been so seldom chosen as a fit thing to laugh at? The truth is, that here no idea of ridicule was ever popularly associated with it; and to have exhibited it as if there were, would have been out of nature and unsuccessful. A vain, pompous, counterfeit form of knowledge without, and a downright solid ignorance and incapacity within, made up a precious combination, which not long ago was found everywhere abroad. The mockery and fun that it excited were irresistible and inexhaustible. Depend upon it, what all men indiscriminately are told they *ought* to know, all men indiscriminately will soon *pretend* to know, be it never so extravagant; and when every medical man in every town and village throughout England, be he physician, surgeon or apothecary, shall, in right of his profession, claim the homage due to vast learning and science, there will not be wanting some Molière or LeSage to hold us all up to the just ridicule of mankind."

"The fact is certain," the same author remarks elsewhere, "that to many eminent physicians, of foreign school especially, to whom speculatively we owe the most, practically we owe the least. Their lessons of pathology and diagnosis are copious, original and instructive; their lessons of treatment are brief, barren and unprofitable. Yet it concerns physicians, above all men, that theirs should not be a barren knowledge, but that it should claim honor of mankind from a sense of the benefit which they receive from it. Far be it from me to contend that every piece of pathological knowledge is to be disparaged or rejected, which cannot at once be made subservient to a practical purpose. The knowledge is to be obtained at all events, and kept ready for use, whether the use come soon or late or never. Use, however, is the end always to be regarded, as well philosophically as morally. An age of great increase of speculative knowledge in medicine ought surely to be an age distinguished by some great practical benefit."

"It is much to be lamented," Latham continues, "that any eminent master of pathology, who, while he is concerned with the nature of disease, has seemed at home, and in earnest, and satisfied with his work, pleased to instruct, and gaining favor for his instruction as he goes along, should come at last to the treatment of disease as to a humbler and less worthy portion of the physician's care. For this ought not to be. Medicine, as it begins to touch upon higher interests, even the interests of life and death, should feel itself in alliance with higher motives than any which can be thought to help and quicken its pursuit as mere science. For now it claims a sort of moral respect in the handling; it calls upon the conscience as well as the intellect, for more caution to avoid error, and more fearfulness of overstepping the truth."

This tendency to place the speculative above the practical began to manifest itself subsequently among the English physicians also, as shall be seen presently, and the brilliant discoveries of Addison and Bright during the first half of the century, while casting much new light upon the nature of disease, were valuable rather as contributions to the sum of scientific knowledge, than as effectual methods for the practical mitigation of disease.

Much is to be said, nevertheless, for the Vienna and French schools, and afterwards for the English school of medical teaching, in which this fault has been found. The diseases slowly brought to light were of an exceedingly complex nature, and in the state of physiological knowledge at that time it was still impossible to perfectly understand them; and in the tacit contempt for the treatment, the physicians in question doubtless referred ironically to their own helplessness, and felt not so much an indifference to the welfare of the race, as a desire to disclaim the empty pretensions of those impostors and charlatans who professed by multiform methods of medication to cure diseases which they could not cure, and for which no cure was as yet known, and for which, moreover, in some cases, no cure has even at the present time been discovered.

To detect the presence of a disease never before understood was certainly a great step—but after all only the first step. These investigators in the maze of nature gave to the world what they could—all they had; and if they had no specific form of treatment by which they could cure the diseases which they had brought to light, it is surely the magnanimous part to wait until that too is vouchsafed: not to cavil and complain because the first gift was not a greater one. In the array of great men who have added to the world's knowledge—and these are the greatest—it has been the destiny of few, if any, to bring forward anything complete in itself. So fragmentary is all knowledge!

Thomas Addison, and his colleague, Richard Bright, two of the physicians of Guy's Hospital, London, by their careful study of certain forms of renal disease, were able to cast a new light upon a region which had been, until that time, involved in obscurity. Kidney disease is hardly mentioned, if mentioned at all, in the works of the earlier writers.

Addison had been pursuing his investigations quietly for some years, when chance so ordered it that his important discovery was made known in a rather dramatic manner. He had been specially consulted in a case of disease which had baffled all the physicians who had attended upon it After a careful examination Addison stated positively that the patient was suffering from a disease of the supra-renal capsules which would before long prove fatal. This opinion was received with polite incredulity, but it was justified by the result, and after death an examination showed that the supra-renal capsules were indeed diseased, and moreover, that they were the only organs found to be in a diseased condition.

These capsules are two small bodies lying above, and adjacent to, the kidneys, each to each. They secrete or contain, Lauder Brunton states, a substance which exerts a depressing action upon the nervous apparatus of the heart, somewhat similar to that observed in the use of tobacco. Up to that time little attention had been paid to their existence even; much less was there any thought of there being any disease to which they might be subject.

The disease occurs rarely, and very few cases for study and comparison were available. The symptoms which characterize it are a gradually increasing and fatal debility, or asthenia, a peculiar discoloration of the skin and a liability to nausea and vomiting. The capsules themselves when examined are found to be materially changed in structure, at one stage of the disease being enlarged and in the last stage much reduced below the normal size, and with adhesions to the neighboring parts. For the general discoloration of the skin mentioned, the term "bronzed skin" is hardly apt. One can hardly give a better idea of the hue than by saying that it resembles that of one or other of the dark races of mankind.

Addison's extraordinary diagnosis was soon noised abroad, and on the continent brought Addison more honor than in England. Trousseau in France was cordially supported in naming it "*La Maladie d'Addison*" (Addison's Disease), a name which it will long retain.

The discovery of Richard Bright was announced in a less dramatic manner. In 1827 he made known the fact that in many cases of dropsy there are well known lesions, or signs of disease, in the kidney, and that the excretion from them is then albuminous or coagulable by heat. Dr. Wells, of St. Thomas Hospital, and Dr. Blackall had both pointed out, a short time before, that dropsy is often attended with serum in the blood, and that the kidneys, in the autopsies which they had made, had been found to be "remarkably hard;" but they both regarded the presence of disease in these organs as an accident: Blackall's idea being that the reason why serum was excreted must be that it was in a vitiated state for some cause or other, possibly from having already formed part of the dropsical effusion in one of the serous cavities or elsewhere, and having afterwards been reabsorbed into the blood.

To Bright, therefore, belongs the full credit of having been the first to show that such renal disease is frequent, and to indicate its relations, both to the phenomena of dropsy and of albuminuria; and his name is most justly associated with it throughout the world. Often when some new discovery, like the one under present consideration, has revolutionized the whole system of treatment, the patient public, almost reeling under its vast weight of maladies, will half humorously half grimly ask the physician why he should add a new disease to their already heavy burden. But it is a question of names after all. Richard Bright is not responsible for all the Bright's disease that has afflicted humanity after his time, any more than he is responsible for the innumerable cases that occurred before he made his discovery; cases which, being unrecognized, progressed to a fatal termination without receiving any scientific treatment whatever.

Flajani in 1798 and Parry in 1825 alluded to certain symptoms of an obscure nervous disease which is now known as Exophthalmic Goitre, and in Germany sometimes as Basedaw's, sometimes in England at Graves' disease. Dr. Graves of Dublin fully described it in his lectures, which were published in 1835, five years before Basedaw published his paper upon it, and there was therefore some warrant in calling it "Graves' disease," as was suggested by Trousseau, though as medical nomenclature developes the object in the future will not be so much to perpetuate historic facts, as to convey by the names applied a description of the nature of the disease itself. For a few years, however, one need not grudge to the patient, hardworking old practitioners who have left the world so much in their debt, the gruesome honor of having the diseases which for years they made their particular study, named after them; and though the diseases may eventually receive other names, in accordance with a general scientific method, the discoverers will be remembered in the great Parthenon of genius and intellect as long as science itself is respected among men. Graves' disease, which is accompanied by violent palpitation of the heart, staring of the eyeballs and an enlargement of the thyroid gland, is not of every day occurrence.

Of uncertain cause, and also of unfrequent occurrence, is Hodgkin's disease, which was first described by him in 1832, and which occupied the attention subsequently of Velpeau, Sir Samuel Wilks, Billroth and Cornil. Trousseau also devoted a chapter of his *Clinique Medicale* to a description of the characters and nature of the malady. The most important symptoms of Hodgkin's disease are enlargement of the lymphatic glands, anæmia, enlargement of the spleen, rise of temperature and progressive loss of strength, with emaciation. To this mysterious disease, which for the most part affects children or young adults, the closest attention has been since given by the most eminent exponents of medical thought, and at the close of the century it still occupies a prominent position in all works of medicine.

The influence of the French school of medical thought, with its insistence upon the manifold importance of pathological anatomy, has already been observed in the brilliant discoveries of the English scientists at the beginning of the century. In Ireland, a country more accessible to French influences than either England or Scotland, the so-called Dublin school arose, of which Graves, John Cheyne, Abraham Colles and William Stokes were the most eminent representatives.

Colles's name has been given to a fracture of the bones at the wrist, while the names of Cheyne and Stokes have been linked together to designate a form of respiration, or breathing, observed in some forms of disease. "Cheyne-Stokes" respiration was first described in 1808 in a work upon the diseases of children.

It consists in inspirations, or inbreathing, at first short, then deeper and more and more labored, until the paroxysm is at its height, then becoming shorter and more shallow until the breathing is suspended. The pause lasts from a quarter of a minute to a minute, when the respiration begins again in the same manner, at first faint, then a little stronger, then still stronger, then again subsiding in a descending scale, to end in the same standstill. This sort of breathing is not a good sign. It is apt to happen when from some cause the supply of arterial blood is cut off from the brain, or respiratory centre in the medulla oblongata, the part of the brain controlling the vital functions.

Begbie, by way of drawing attention to the unchangeableness of disease, quotes a passage from Hippocrates, in his address in medicine at the British Medical Association. As he points out, it is almost word for word what a physician of our own day might inscribe in his case-book. Indeed, Begbie contrasts the ancient memorandum with another of modern origin. The Greek "Case" will probably be of interest to the reader of the present day.

"Philiscus," Hippocrates states, "who dwelt near the wall [of the city] was laid up. On the first day fever acute; he perspired; night very disturbed. Second day, aggravation of symptoms; night quiet. On the morning of the third day, and up to noon, appeared full of pain; but in the evening acute fever, with perspiration, thirst, dry tongue; night disturbed; he did not sleep at all; his mind wandered on all subjects. On the fourth day, general paroxysms; night more endurable. On the fifth day about noon a little blood escaped from the nostrils; night distressing and little sleep; talkativeness; delirium; extremities very cold, and could not be warmed; he rested a little towards daybreak; lost speech; had a cold sweat; extremities livid. About the middle of the sixth day he died. The respiration was throughout *large and rare* like that of a person who required to be reminded to breathe."

Galen, commenting afterwards upon this passage, attached the meaning, "like a person who forgot for a time the need of breathing, and then suddenly remembered." With this, contrast the words of Dr. Cheyne in 1816. "For several days," he wrote, in his account of an elderly patient who had fatty degeneration of the heart, with irregular and intermittent pulse, and whose death was due to apoplexy, "his breathing was irregular; it would cease for a quarter of a minute, then it would become perceptible, though very low, then by degrees it became heavy and quick, and then it would gradually cease again. This revolution in the state of his breathing occupied about a minute, during which there were about thirty acts of respiration." Subsequently Dr. Stokes connected this peculiar respiration with a weakened state of the heart.

And so one is able to trace back through the centuries the phenomena of nature, as seen in the processes of disease. The symptom mentioned was particularly noted by the great master of medicine; but through imperfect physiological and pathological knowledge he was not able to give to it its true significance.

Sole attention was not being paid, however, to rare and unusual forms of disease; for coincident with the marked attention which was being now given to the kidney and the diseases to which it was subject, was to be noticed a renewed interest in all the organs of the body.

In 1835 William Stokes furnished an important monograph on *Peritonitis from Perforation of the Serous Membrane,* in which he credits Graves with having revolutionized the practice hitherto adopted in the treatment of this disease by the bold administration of opium in place of the routine treatment, then in use, of bleeding and purgatives. The system advocated by Stokes was to support the strength of the patient, so as to gain time, and to diminish as far as possible the peristaltic action of the intestine. Guided by these principles, Stokes and Graves discarded bleeding and purgatives, and boldly administered opium in such quantities, and with such striking benefit to the patient, as to change the whole aspect of the therapeutics of this disorder. Previous to the publication of these researches the treatment of peritonitis was little more than a "contemplation of death." Possibly no single improvement in the medical art, except the use of anæsthetics, can be placed on a level with this one. In the present day it is impossible to think of the treatment of peritonitis, from any cause, as apart from the use of opium; and had Graves and Stokes done nothing else but this, mankind would have good cause to hold them in remembrance.

A clearer knowledge of the diseases of the lungs had been made possible by Laënnec's invention of the stethoscope, and in 1837 Stokes's work on the diagnosis and treatment of diseases of the chest appeared. In this admirable performance it was furthest from the author's intention to attempt to supersede Laënnec's "imperishable volume." Indeed, "it would have seemed," to use his own words, "almost unpardonable heresy to have criticized or added to it; and accordingly until the appearance of the present work we have had little more than compilations in various shapes and forms of the original."

Stokes, however, brought to the subject some important material that had possibly escaped Laënnec; and, to repeat the words of Gerhard von dem Busch, who translated the work into German, "Since the publication of Laënnec's great work, which formed an epoch in medical history, many valuable treatises have appeared in France and England on the same subject, but none of them can bear comparison with that which has lately emanated from the pen of Dr. William Stokes."

In the personality of Stokes, as in that of Larrey, there is to be felt, even through the dry medium of medical literature, a certain warmth and sprightliness which endears him to the reader. It is perhaps, after all, the sparkling Celtic nature that can be chilled into dull stupidity by neither an exemplary scientific career, nor the acquirement of a great reputation. Stokes was not a snob. The dignity of philistines could not paralyze him. He wore his respectability lightly, and without that oppressive self-consciousness which is sometimes noticed in the successful Anglo-Saxon. His kind Irish heart bubbles over with mirth, his eyes detect at once the pathos of every situation, as will be repeatedly observed in the delightful little memoir of his life which has been lately written by his son.

At the time of the Irish famine in 1850, Stokes moved amid scenes of sorrow and disease. The "famine-fever" broke out, as a matter of course, among the poorer classes, and some amusing anecdotes are told by him which show with what warm human sympathy he observed the lives of those about him. During the famine Sir Robert Gore Booth chartered some vessels to send out the people free of charge to America, and when one was on the point of sailing, the names of the emigrants were called over. In one case a ticket had been given for a man and his mother; but when the couple appeared, the mother was found to be a young girl of eighteen. This was his sweetheart whom he had substituted. "Hallo," said Sir Robert, "who is this one? Is she your mother?" "No, your honor." "Who is she then?" "She is instead of her." The girl was ordered on shore, where she set up such a loud wailing that Sir Robert's heart relented, and he asked if they were married. "No, your honor, the priest would not marry us." "Why so?" said Sir Robert. "Because she wasn't my mother, sir." There was a priest on board, however, and the couple were shortly afterwards united.

In another characteristic anecdote Stokes told how a young cattle jobber had sold a diseased cow to the Protestant clergyman of the parish. The fraud being shortly detected, the unscrupulous youth was called for. He meekly acknowledged his fault, returned the money, and prepared to take away the cow, when the clergyman detained him, and dwelt for a time upon the impropriety of wantonly selling a diseased cow, when he replied: "Don't be angry with me, your riverence; sure I'm only a lame boy, and have no way of livin' but by strategims!"

A subject that always interested Stokes was learning some of the popular remedies on which the peasantry had chief reliance in the treatment of various maladies. Some of them are curious if not efficient. The following account of a method of treatment for epilepsy will be regarded as an interesting, though somewhat heroic addition to the therapeutic resources for that malady, and at one time was said to be of high repute in the southern part of County Kerry.

Mr. Bland, of Derriquin Castle, met one of his tenants. "Well, John," said he, "how is the boy?"

"He's well, sir!"

"How did you cure him?"

"I deluded him to your honor's bog."

"And what did you do with him there?"

"I drownded him, your honor."

"How was that?"

"I brought him to the edge of your honor's bog-hole and threw him in suddint, and lept down upon him, and held him under the water till the last bubble was out of him, and he niver since had a return of the complaint, glory be to God!"

Graves' death at a comparatively early age was keenly felt by Stokes; for in him he lost a steadfast and loyal colleague, and one whose learning and exceptional mental powers placed him among the first of the distinguished men of his profession in Ireland. Graves was a man who in a marked degree combined the scientific mind of the physiologist with the intensely practical quickness of the clinical observer. One of his sayings used to be, "When I am dead let my epitaph be, 'He fed fevers.'"

The knowledge of heart disease was also being rapidly extended, and considering the intimate relation, both in health and in disease, which this organ bears to the kidney, it is fortunate that the scientific study of both should have received so strong an impetus at the same time. Heberden and a number of the older writers had contributed to the subject of heart disease, but in his work on the *Diseases of the Heart and the Aorta,* Stokes made a distinct advance in the knowledge of the subject. Resisting the one-sided tendency which had been too much in vogue, of basing the diagnosis solely on physical signs, without sufficient regard to the all important vital phenomena, Stokes laid less weight on the differential diagnosis, or lesions of the several valves, and on the situation of the sound, than on the condition of the heart in general, and especially on the question as to whether a murmur was organic or inorganic, and whether the disease itself was organic or functional.

He could not form a judgment without viewing the subject all round, and it was felt that so large and liberal a spirit in the conception of disease must revolutionize the dogmatic routine of practice. In this work is to be found the description of the "Cheyne-Stokes respiration" already described, a condition observed by Cheyne, though not connected by him with any special cardiac lesion.

In this work Stokes also discussed fully the connection of heart disease with hepatic enlargement and pulmonary disease, and laid down at length rules of diet and of hygiene for those affected with cardiac disturbance. For them he advised early hours, regular habits, and above all, a certain amount of muscular exercise.

The treatise, which was at once accepted as one of the most acute, graphic and complete accounts of the clinical aspects of the organ under inspection, exemplifies in a very remarkable way the several characteristics of the writer's mind; at once so purely scientific and so eminently practical.

Another work upon the diseases of the heart which enjoyed a very wide influence at the time was the admirable series of lectures on *Clinical Medicine, Comprising Diseases of the Heart,* in which Peter

Mere Latham treated the subject with a fulness and a perspicacity attempted by few other writers. Latham understood the difficulties of his task —difficulties still to be found in every department of medicine. "One reason," he says, "why surgery is more popular than medicine is that it is easier. Moreover, the adaptation of curative means requires more vigilance in medicine than in surgery. There is no end of the circumstances to be taken into consideration day after day, in order to practise medicine with tolerable success. A man has an *external* inflammation; the surgeon sees it, and is at once sure of its existence; he prescribes for it, and sees its gradual decline as plainly as he first saw its rise and progress. A man has an *internal* inflammation; but the physician, not seeing it, is obliged to come to the knowledge of its existence by a great variety of considerations; he prescribes for it, and is again obliged to enter into a variety of considerations before he can know that it has begun to decline or has ceased. The uncertainty of physic I readily admit, but I do not admit the vulgar reproach which has followed from it. There is nothing absolutely sure but what rests upon the basis of numbers, or falls within the sphere of the senses. Where reasoning begins, there begins uncertainty, and on this account the highest and the best things in the world are all uncertain, and so is our profession. But from this very uncertainty those who practise it successfully claim their greatest honor, for where there is no possibility of error, no praise is due to the judgment of what is right."

Latham laid great stress upon actual clinical experience in the wards or sick room. As a physician he took the same ground that John Hunter, the surgeon, had taken years before when he contemptuously waved aside the mention of text-books, and said that the young student of surgery would find his best books in the dissecting room. To bear this out Latham in another place tells a quaint anecdote whose moral can scarcely be missed.

A country pastor made one of his flock a present of Bunyan's *Pilgrim's Progress,* and, anxious that he should both read it and profit by it, took care that the copy which he gave him should be well furnished with notes. Meeting the man some time afterwards, he asked him how he liked the book, and whether he was sure that he understood it; and received for answer, that he liked it and understood it all well enough, *except the explanations.*

So with students who have free access to the wards of a great hospital, the professor of medicine should not be too ready in describing and commenting upon the ordinary phenomena of diseases which are constantly before their eyes, lest, perchance, they should in a similar spirit make the retort "that they understood all well enough, except the explanations."

To Alfred Swayne Taylor is due the distinction of having opened up a new and separate branch of medical study in Toxicology, or the science of poisons, which forms so important a factor in Forensic Medicine. In his frequent visits to the medical schools on the Continent he had opportunities of hearing Orfila and Guy Lussac, and he was strongly influenced by them in his early interest in chemistry. The importance of Medical Jurisprudence was beginning to be recognized at this time. The part which the doctor and the surgeon play as witnesses in the hearing of criminal cases is often very prominent; and in all instances of death or wounding, to which there are suspicious circumstances attached, a previous training in the principles of forensic medicine enables the physician to be of great use in furthering the ends of justice. Beside his extensive work upon the subject, which was for many years a standard text-book, Taylor was a very prolific writer upon scientific subjects, and was long retained by the British Treasury department as their medical adviser upon such cases.

John Hughes Bennett, who was professor of medicine in Edinburgh, was in 1841 the first physician of England to recommend cod-liver oil in pulmonary tuberculosis, or consumption; the beneficent results of which use need not be described here, though the reliance upon the remedy, as shall be seen hereafter, was eventually superseded by a far more scientific system of treatment. Bennett also claimed to have been the discoverer of Leucocythæmia, though to Virchow has been generally accorded that distinction.

A medical teacher who exerted a very deep influence upon English medicine of this time was Sir Thomas Watson, whose extended work upon the Principles and Practice of Physic was read with applause by the medical profession in England. Though Watson never himself made any striking scientific discovery, the charm of his personal character caused him to be universally beloved and honored; while his literary style, which was of classical purity, made his work a most popular one, and incidentally of considerable authority. In successive editions he from time to time changed his views, in accordance with the changes which medicine itself underwent, and each change of front was made with such ingenuous and manly simplicity that criticism was disarmed at once. His personal character was as unique as his advice was valuable.

Like Sir Benjamin Brodie, his mind was turned into the channel of medicine by an accident. Having become a wrangler and a fellow at St. John's College, Cambridge, it chanced that at that time only two fellows could retain their fellowships without taking orders, and of these one was required to study medicine. After the usual course of medicine, during which he came under the influence of Abernethy, he married and settled on Henrietta Street, London, where he remained for fifty-seven years. After various connections with one institution and another he was appointed in 1836 to the chair of the Principles and Practice of Medicine at King's College, and during the ensuing winter delivered the first draught of those lectures upon which his fame rests.

They soon became known and were printed weekly, as popular novels are nowadays, in the *Medical Gazette*, a periodical of the time. They were subsequently published, and became acknowledged as medical classics.

That literary effort should count for so much is not at all to be wondered at. The makers are very rarely the writers of history. The work on Medicine commenced by Addison and Bright, in collaboration, was never completed beyond the first volume. Indeed, so noticeably is this the case that great discoverers in science have almost always been surrounded by faithful followers whose mission it has seemed to be to expound and explain the truths arrived at by their master, but which he had not sufficient skill to make clear himself. Bacon's *Novum Organon* is not a favorite work with the public; Newton's *Principia* is very rarely looked into outside the university, and the principles of evolution are not grasped by the popular mind, if grasped at all, through a faithful perusal of the eminently lucid and sprightly works of Darwin upon the Origin of Species and the Descent of Man. The foregoing are scarcely read at all by the mass of the people, in spite of the tremendous influence which they have exerted.

In former times the unseen Oracle spoke through his priest to the listening populace. It is unbecoming the dignity of an Oracle to speak in person; but it is a very great dignity indeed for an ordinary man to be allowed to speak for him.

To be able, then, to set down in lucid language, so clear that it is not an effort to understand the meaning, the truths and the doctrines of a great branch of scientific learning, even though one has had no hand in their development, is no small accomplishment. The academical spirit is, I know, opposed to such clearness that even the laity can comprehend. By the academical spirit I mean that bias of mind, very frequently seen in circles of learning, which strives to arrogate to itself all learning or knowledge as a particular heritage; as if all intellectual discoveries were not the possession of the race at large, and a largess from the beneficent hand of the discoverer to all who could grasp the significance of the discovery or be benefited by it.

It is this academical spirit which would with satisfaction retain the world in its mediæval gloom and ignorant superstitions. It was this academical spirit that conspired for centuries to lock up all the treasures of thought from the masses in a language unintelligible to them. Until nearly the beginning of the present century, as has been pointed out already, all works of learning, including medicine, were written in the Latin tongue. These pedants, like false stewards, have selfishly hidden the pillaged goods of the greatest and noblest minds of the ages from the common gaze; selling them second-hand, as it were, to the class who could pay for them, and fattening thus upon what they had plundered from their betters.

Nor have the shallow pedants of the academic class alone this fault. When at last men of learning began to write in a language which the people could understand, many affected a wilful obscurity, partly in affectation, and partly, also, that they might be incomprehensible to the general public. Emanuel Kant was guilty of this singular practice, and openly admits in one place that he wrote particularly for the academic class, and that it was his object to give this exalted circle something which would prove unintelligible to the vulgar reader, that their power to disentangle the sense might prove a test of their own intellectual magnificence, leaving a delicious glow of superiority and satisfied vanity. *Odi profanum vulgus et arceo.* That a great thinker should prostitute his genius in so puerile a manner seems hardly credible.

But during the present century times have very greatly changed. Those now who make a profession of their erudition, like those who make a profession of their sanctity, must at least display a certain degree of sincerity. And so many voices are now raised, so many of the most brilliant minds are now suing the public for their attention, and so great has been the decay of blind reverence on the part of this same public for the pompous pretensions of the class referred to, that even if a man has a great message to impart, he must say it succinctly and clearly and in a pleasing manner, or no one will listen to him. The day of the academic impostor seems to have passed. The black hood and gown and the jargon of a foreign tongue fail to convey the same terror and awe as of old. And, after all, the simplest thoughts are the greatest. It is a mistake to imagine that because one can make neither head nor tail of what a writer says that he is necessarily profound. The public of to-day, in which may be noted a growing egotism in matters of learning as well as in political matters, simply think that such a writer is maudlin, and promptly pass him and his book from their mind. This is not an altogether bad sign. It marks the spread of the democratic spirit to the world of intellect.

And so Sir Thomas Watson showed that medicine could be so expressed as to be both comprehensible and interesting. Plato did as much for philosophy, with whose clear and simple dialogues contrast the dull, heavy, and at first unintelligible oracles of Kant.

As medicine, however, must be to a great extent a written science, the work of Watson cannot be too highly estimated. He not only influenced the literary style of his time, but also set a standard for subsequent medical writers. Indeed, even at the present day, an English work on medicine displays a certain elusive quality, the polish of which can scarcely be described, but the lack of which is at once manifest, when, for example, one turns to many works upon the same subject by writers of other countries. The charm of Clifford Allbutt and of Lauder Brunton, writers of the present day, indicates how permanent has been the influence of Watson upon the literary form of English medicine.

"Do not think," Watson exclaims in his first lecture, "that I am wandering from my proper subject when I bid you to remember how profoundly interesting, how almost awful, is the study in itself and for its own sake, revealing, as it surely does, the inimitable workmanship of a hand that is Divine. Do not lose or disregard that grand and astonishing lesson. The profession of medicine has for its end the common good of mankind, knows nothing of national enmities, of political strife, of sectarian divisions. Disease and pain the sole conditions of its ministry, it is disquieted by no misgivings about the justice or the honesty of its client's cause, but dispenses its peculiar benefits, without stint or scruple, to men of every country or party, and rank and religion, and to men of no religion at all. And like the quality of mercy, of which it is the favorite handmaid, it 'blesses him that gives and him that takes,' reading continually to our own hearts and understandings the most impressive lessons, the most solemn warnings. It is ours to know in how many instances, forming indeed a vast majority of the whole, bodily suffering and sickness are the natural fruits of evil courses. Familiar with death in its manifold shapes, witnessing from day to day its sudden stroke, its slow but open siege, its secret and insidious approaches, we are not permitted to be unmindful that our own stay also is brief and uncertain, our opportunities fleeting, and our time, even when longest, very short, if measured by our moral wants and intellectual cravings."

CHAPTER VIII.

NEW FIELDS OF MEDICINE.

WE now come to the Practice of Physic, as it used to be called. The term Medicine was used then, as now, in a general sense to indicate the healing art as a whole. The surgeon practised surgery, or the treatment of those diseases which are more amenable to manipulation. The physician practised physic, or the so-called internal diseases, which are best reached by medication. The well-known work of Cullen was called by him a *Practice of Physic,* a title also applied by Sir Thomas Watson to his lectures upon the same subject.

Somewhat later, however, the term Medicine began to be used in this more restricted sense, and at present the term physic is scarcely used at all; and a work on the diseases of the internal viscera is usually called a Practice of Medicine in contradistinction to a work on the Art of Surgery. As the term medicine is still used also in its old generic sense, to imply the healing art as a whole, the double meaning of the word is sometimes a cause of confusion to the general reader.

Great advance was made in medicine, as well as in surgery, during the early years of the century. The discovery of vaccination for the prevention of small-pox, and the invention of the stethoscope for the diagnosis, or detection, of disease of the heart and lungs, have already been mentioned. As compared to the surgeon, however, the physician still labored under great disadvantages, and his field of action was much limited, by reason of the imperfect knowledge of physiology at his command, and the slight and often erroneous notions of pathology which were then held.

Especially was this true in the case of the "continued fevers." Owing to the exceedingly contagious nature of some of these fevers, notably typhus, it is probable that a post-mortem examination was rarely made in those instances where fever proved fatal. This cowardice was probably general in times of epidemic, when deaths were taking place by the hundred, and often by the thousand, and when the populace had as a consequence become panic-stricken. The physicians of the time, therefore, should not be held solely responsible for a negligence which did so much to retard the advance of scientific knowledge. Moreover, the fact must not be overlooked that the altruistic standard which is so often, and in such a dramatic manner, brought to the test in modern medical practice, did not exist to the same extent, if at all, in the preceding century. When Sydenham, one of the greatest of English physicians of his time, unaffectedly left London to avoid the Plague, no unfavorable comment was made; indeed one writer remarks candidly that "it was the custom."

Though medical literature abounds in passages which, in the light of modern discovery, are full of significance, it was not until the middle of the present century that the actual differentiation was at last made between typhus and typhoid fever, while up to a very few years before this the existence of diphtheria as a separate disease had never been suspected.

To an English physician belongs largely the honor of having finally made clear beyond any future gainsay the separate nature of typhoid as a distinct fever, though the steps by which this conclusion was at last reached involve the labors of a number of scientific investigators in France; so that in the differentiation of fevers, as in every other great achievement of science, the guerdon is not wholly due to any one man, though one, truly enough, by bringing together and applying the data supplied by his forerunners, may at first appear in the light of an independent discoverer. In his classical work upon the continued fevers Charles Murchison has traced the fevers under consideration down through ancient and modern history, and it will be found convenient to draw freely from his pages in the following account.

The appellation Typhus, originating with Sauvages, adopted by Cullen, and now in general use, is not very appropriate. The word literally means smoke, but was employed by Hippocrates to define a confused state of the intellect with a tendency to stupor. In the latter sense it expresses a prominent symptom in the disease. Previous to the time of Sauvages, it was known as Pestilential, or Putrid Fever, or by some name expressive of the locality in which it appeared, as Camp, Jail, Hospital or Ship Fever. It is a disease of great antiquity, and was possibly one of the diseases to which frequent allusion is made in the sacred writings under the term Pestilence, which appeared under the same circumstances as are now known to give rise to typhus, especially famine and overcrowding. Numerous epidemics of contagious fever occurred during the first fifteen centuries of the Christian era in different parts of Europe, but the descriptions of the Greek, Latin and Arabian writers are not sufficiently precise to warrant the assertion that they were always typhus, for in many instances, indeed, the disease was oriental plague, and the two affections long continued to be confounded. The Plague of Athens, which broke out during a siege, was possibly typhus. Frequent pestilences also devastated Rome, from which, on one occasion, Galen fled on account of the extremely contagious character. During the middle ages similar epidemics repeatedly occurred, and in 1566 the notorious "Morbus Hungaricus" appeared in the army of Maximilian II., and thence spread from Hungary over the whole of Europe, which in 1641 was still devastated by the disease thus celebrated in a poem by Zylingius:

Insolita exarsit febris, quæ corpora rubris
Inficiens maculis (triste et mirabile dictu !)
Quartâ luce frequens fato pendebat acerbo.
Pulsus erat minimus, tremulusque soporque
Mens vaga, visque labens ; lotium crassumque rubensque
Interdum tenuæ instar aquæ.

The disease which in England was formerly so prevalent in prisons, and was described as "Gaol Fever" and "Jayl Distemper," was typhus. Many observations show that it originated in prisons, and it was the general belief that the cause was overcrowding, with deficient ventilation. The prisons, indeed, constituted the principle foci, whence the disease spread with dire results among the population. Such was the story of the various "Black Assizes" of which history furnishes an account of six.

The first occurred during the reign of Henry VIII., at Cambridge, when the justices, gentlemen and bailiffs, and most of the persons present in the court, were seized with a fever, which proved mortal to a considerable number. The next "black assize" was held at Oxford Castle in the reign of Queen Elizabeth for the trial of Rowland Jencks, a Roman Catholic bookbinder, for treason and profaning of the Protestant religion. There were a number of other prisoners, but the accounts state that after judgment was pronounced against him, "an infectious damp or breath" arose among those present. Many seem to have taken ill on the spot, including Sir Robert Bell, chief Baron of the Exchequer, Sir

Nicholas Barham, Sergeant at Law, two sheriffs, one knight, five justices of the peace and most of the jury, of whom several died within a few days. "Above six hundred sickened in one night, and the day after, the infectious air being carried into the next village, sickened there an hundred more."

Loss of appetite with great headache are mentioned as the symptoms, sleeplessness, loss of memory, deafness and delirium, so that the patients would get up and walk about like madmen. The general impression at the time was that the "infection arose from the nasty and pestilential smell of the prisoners when they came out of the jail, two or three of whom had died a few days before the assize began." The other explanations offered were that it resulted from the "diabolical machinations of the papists," or, according to the Catholics, that it was a miraculous judgment on the cruelty of the judge, for sentencing the bookbinder to lose his ears.

Nine years later, in 1586, another black assize occurred at Exeter. Thirty-eight Portuguese seamen had some time before been cast into "a deep pit and stinking dungeon" in Exeter Castle, and there left, without any change of raiment, to lie upon the bare ground. Many of them were sick during the trial of a contagious fever which had broken out among them, and from them the disease was communicated to those present in the court. The judge, three knights and many others died, and the disease spread over the whole county. The fever was believed to have proceeded from "contagion by reason of the close aire and filthe smell of the goale."

The sixth and last "black assize" was that of the Old Bailey, in 1750. Nearly a hundred prisoners were tried, who were all, during the sitting of the court, either placed at the bar or confined in two small rooms which opened into the court. The court was crowded to excess and many present were sensibly "affected with a very noisome smell." Within a week or ten days many of those present were seized with a "malignant fever" of a fortnight's duration, from which more than forty persons died, including the Lord Mayor, two of the judges, an alderman and several of the jury.

The conditions which produced Ship Fever were identical. In the spring of 1810 typhus broke out among the French prisoners confined in the prison-ships in Plymouth harbor. Typhus was not prevalent in Plymouth, and, even if it had been, the seclusion of the prisoners could not have been more complete. But on board, in addition to spare diet and the mental depression consequent on their situation, the prisoners were packed together in a most shameful manner. For thirteen hours out of the twenty-four upwards of 400 of them were crowded into a space measuring sixty by forty-two feet and only four and a half feet high. With little or no ventilation, the air was so dense that a lighted candle appeared in it as through a thick mist. Such was the condition of the prisoners for some time before the commencement of the epidemic, in which more than a thousand were stricken with the fever.

Typhus fever, again, is as old as the disputes of nations, and has been in the past a constant accompaniment of warfare. Its characters are recognized in the descriptions handed down to us of the majority of those epidemics which have decimated the ranks of armies in the field, and the garrisons of besieged cities. The terms Camp and Army Fever number, from this circumstance, among its many appellations. Its appearance has been due almost invariably to overcrowding, with bodily and mental depression, and it is to be especially noted that in many parts of Europe where typhus never occurs in times of peace, it becomes epidemic in time of war. Ample illustrations of this are found in the campaigns of Louis XIV., Frederick the Great, Napoleon and in the Crimean war. It has also from time to time originated in overcrowded and badly ventilated hospitals when the term Hospital Fever has been applied to it. In Ireland it was, furthermore, known at one time as Irish ague. With all its names, however, and occurring, as it does, in all times and places, it is always due to the same conditions.

The advent of the disease is in most cases somewhat sudden. The patient is seized with a sense of chilliness, followed by lassitude, headache, pain in the back and loss of appetite. The face becomes flushed and dusky and the edges of the eyelids tumefied. About the fourth or fifth day an eruption makes its appearance, and about the end of the first week the patient becomes delirious, sometimes violent, after which follows a period of great collapse, with sleeplessness and low muttering. The teeth and lips becomes covered with sordes; the tongue is hard and dry, dark brown or black and contracted into a ball. At last the stupor passes into profound and fatal coma, and death ensues usually without any return to consciousness.

Parotid buboes and other inflammatory swellings have been noticed in many epidemics of typhus, and have been usually regarded as a serious complication. Riverius, in his account of an epidemic at Montpellier, stated that a number had such swellings and that the majority of those cases proved fatal. This feature in typhus apparently constitutes a connecting link between this disease and Oriental Plague, but recent investigations have shown that the two diseases are quite distinct. The plague, or "Black Death," by which twenty-five millions were said to have died during an epidemic in the Middle Ages, has been found to occupy an intermediate position between the miasmatic or malarial diseases proper, such as ague, and the true contagious fevers. There is evidence that its virus may be acquired both direct from the soil, and also from infected persons and objects above the soil. A micro-organism which seems to fulfil all the conditions required for the propagation of the disease, and which is probably the specific cause of the disease, has recently been discovered by Kitasato in Hong Kong. Up to the present time no such organism has been detected in typhus fever.

This tendency, or perhaps one might rather say inclination, on the part of the early observers, to find points of similarity between diseases quite different in origin, and upon the slightest premises to form a false conclusion of their identity, was not confined to typhus and the black plague. For centuries a fever had been present from time to time in various parts of Europe which had been invariably regarded as typhus, or as a form of typhus. For many years its totally distinct nature was never seriously suspected. This was the fever known at the present time as typhoid or enteric fever.

Galen described a form of fever which was thought to be produced by grafting a tertian on a quotidian intermittent to which he applied the term Hemitritœus, and this, with the Febris Semitertiana of later writers, was probably enteric fever. Subsequently there is frequent mention of the Slow Fever, the Nervous Fever, and the Slow Nervous Fever. By Strother it is even referred to as the "Lent Fever," probably on account of its duration, which seldom, if ever, exceeds forty days. In 1757 Eramus Darwin proposed as a question for discussion at the Medical Society, "Whether the nervous fever of Huxham be the same as the petechial or jail fever."

With the commencement of the present century, the pathological anatomy of fever began to be carefully investigated in France. M. Prost in 1804 described correctly the intestinal ulcerations peculiar to typhoid fever, though he regarded them merely as the ultimate stage of ordinary inflammation, and was unacquainted with the peculiar seat and nature of the disease. Broussais extended the views advocated by Prost, and believing that the symptoms were the result of inflammation, advised copious depletion, in his writings, an unfortunate doctrine which it took many years to overcome. Petit and Serres were the first to regard typhoid fever as a specified disease.

It was reserved for Bretonneau, of Tours, to prove that the disease was always localized in the solitary and agminated glands of the ileum. He also was the first to maintain that it depended on the action of a poison which was communicable from the sick to the healthy. These views were made known in Paris about 1820, and nine years later the elaborate and philosophic work of M. Louis appeared, which constituted an important epoch in the history of continued fevers by furnishing a standard of comparison with other fevers. In this work Louis showed that the glandular changes mentioned were always present in the fever as it occurred in Paris.

All the French observers, however, regarded the contagious typhus of camps and armies, and of the English writers, as identical with the disease under their own observation. "*En effet,*" Broussais remarked, "*puis que le mot typhus est synonyme du mot gastro-entérite, chaque fois que l'on dira typhus* *des prisons, typhus des hôpitaux, typhus d'Amérique, typhus de Levant, ce sera, comme si l'on disait gastro-entérite des prisons, des hôpitaux."* Bretonneau and Chomel regarded the two affections as identical, though deploring the absence of careful post-mortem records of typhus cases, which, they thought, could alone decide the question.

While French pathologists were thus maintaining that continued fever was always associated with disease of the intestinal glands, observers of fevers in England were making the discovery that in most fatal cases of fever these parts were unaffected and apparently healthy. These statements were, however, confused with still other statements by other observers of the same period to the effect that the intestinal lesions had been found — the general belief in England being that the primary seat of fever was the brain, these lesions of the intestine continued to be regarded merely as an accidental complication.

In 1836 H. C. Lombard, of Geneva, visited the hospitals of Great Britain and was astonished at first to find none of the intestinal lesions with which he had been familiar on the Continent. Subsequently, after further investigations, he was the first to state that "there were two distinct and separate fevers in Great Britain; one of them identical with the contagious typhus, the other a sporadic disease, identical with the Fièvre typhoïde, or dothinenteritis of the French." Meanwhile, Gerhard and Pennock, two American physicians, who had observed the epidemic of typhus which had prevailed in Philadelphia in the same year, and who had previously studied enteric fever in Paris, and were familiar with it in their own country, noticed, not only that the first was contagious and the second rarely communicated, but insisted upon the "marked difference between the petechial eruption of typhus and the rose-colored spots of typhoid." To Gerhard and Pennock certainly belong the credit of first clearly establishing the most important points of distinction between the two diseases.

The Académie de Médecine of Paris awarded prizes in the following year to the authors of two essays on the "Analogies and Differences of Typhus and Typhoid Fever," and in 1839 Dr. Shattuck, of Boston, came over from Paris, where he had studied enteric fever, and after having watched a number of cases in the London Fever Hospital, strongly insisted on the existence of two separate fevers in England, and pointed out with considerable minuteness the distinctions between them. Valleix, upon this, published a memoir in Paris in which he arrived at the conclusion that both typhus and typhoid fever were to be met with in England, that the latter was identical with the fièvre typhoïde of France, and that the English physicians were confounding them.

There was still much opposition to the doctrine of non-identity; indeed, notwithstanding the decided opinions expressed, there was a general impression, both in England and in France, that the evidence adduced was insufficient to establish the specific non-identity of the two fevers, and the opposite doctrine continued to be taught in all the schools of medicine. Much of the remaining doubt was removed, however, by the admirable researches of William Jenner, which were published between 1841 and 1851. He confirmed and amplified the distinctions between the symptoms of the disease, previously drawn by Gerhard and others, and did much to facilitate their diagnosis. His statements were supported by carefully recorded cases, and by an elaborate analysis of symptoms and post-mortem appearances of numerous cases of both fevers observed by him. The most important part of his investigations was that which demonstrated the dependence of the two fevers on distinct causes. He showed, moreover, that the two fevers did not prevail together, and that the one did not communicate the other. He also adduced cases to prove that an attack of the one fever protected from subsequent attacks of itself, but not of the other. The specific distinctness of the two diseases is now recognized in every part of the world.

Dr. William Aitken, the eminent medical writer, who was himself attacked with typhus after having served for three months, during an epidemic, in the fever wards of the Dundee Infirmary, remarks long after the vexed question had been finally settled: "In common with many I had as a student been taught to recognize the striking similarity between the two fevers in outward aspect, in many respects;

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and therefore I was unduly biased by the *resemblances* rather than led to give sufficient importance to the numerous and remarkable differences between them."

"Diphtheria," Oertel asserted, "is one of the oldest epidemic diseases of the human race." A disease similar to diphtheria prevailed sporadically from time to time in England, and assumed an epidemic form when, early in the century, the "Boulogne Sore Throat" occurred on the French coast. The writings of the older physicians indicate that from time to time the disease had been very common in many parts of Europe; and the accounts of it show that it has preserved its essential character and nature from age to age. Ever since the end of the sixteenth century diphtheria has been observed in every region of the old world. At first it continued for a time in Spain, and during nearly forty years it was noticed in different parts of the peninsula. Rather later all Italy was successively afflicted with it. Toward the middle of the last century, especially, epidemics of the disease had occurred, as has been pointed out, in England and France; and also in Sweden and America, particularly in New York and Philadelphia. It terminated the life of Washington and of the Empress Josephine.

The disease, however, has only been known by its present name since Pierre Bretonneau investigated the epidemic which occurred at Tours in 1818, and after long and careful clinical study came at last to the conclusion that he was dealing with a distinct and separate disease, and gave to it the name diphtheritis, or diphtheria, which it now bears. In 1855 a severe epidemic prevailed in the south of France, and it was fatally prevalent also in England during the same year. Nevertheless it still continued to be described in medical certificates as "putrid sore throat" or "cyananche maligna."

One source of constant confusion is to be traced to the different uses of the term croup, which the French writers have used in the sense of diphtheria. Indeed there were many accomplished physicians, including Addison, who, when the disease broke out in England, declared that they had never seen it before. An important step had been gained, therefore, when it was clearly recognized as a distinct disease. The local inflammation in the throat is followed by general constitutional disturbance; but as the phenomena of fever had been so completely neglected, the constitutional derangement which formed the essential factor of the disease was for many years passed over, and the sore throat alone noticed. It was observed that there were some sore throats worse than other sore throats. That was all. Boerhaave in the preceding century had used the thermometer for taking the temperature of the body during disease but the practice had unfortunately been allowed to fall into disuse.

The poet Milton, in one of his early poems, describes the death of a fair infant, "dying of a cough."

The little child, "no sooner blown but blasted," quite possibly succumbed to diphtheria. Alexander Pope also tells, in one of his Moral Essays, how at church "My good old lady catched a cold and died." Though a cold is often a rather serious matter with old ladies, a simple cough or cold, as the terms are now used, does not usually end so fatally. Many instances could be brought forward to show how a disease may be present for centuries and escape recognition through some trivial incident. The history of science is full of such apparent puerilities.

As soon as diphtheria had become distinguished, through the labors of Bretonneau, as a distinct disease of which the presence of the sore throat was merely an adventitious circumstance, the closest attention was paid to it, and an eminently scientific system of treatment was inaugurated in later years.

The disease appears to be more frequent in low-lying regions where there is a moist climate and cold damp winds. The micro-organism causes first a local throat affection, which subsequently becomes constitutional, like the fevers which have been under consideration. This bacillus was at one time supposed to be present always in sewer gas, but subsequent investigation has not substantiated this view. The disease is present among some of the lower animals, the cat for example; and another common source of infection is milk, which readily propagates the germs of the disease when they come in contact with it. It must be remembered, moreover, that the cow herself may suffer from diphtheria, and her milk be charged from the first with the fatal taint.

The prevalent, but most disgusting habit of promiscuous kissing is also a very common cause of infection; and not only as a prophylactic against the spread of diphtheritic infection, but for numerous other medical reasons, it would be well if individuals could be either educated or intimidated into a certain degree of self-restraint in this particular. Among the perfectly healthy this custom may be regarded as a matter of taste or judgment; but the act in a person whose breath is laden with the deadly germs of disease is nothing less than criminal, and whatever the emotional import may be, is to all practical intents and purposes an act as fatal often in its results as any other form of poisoning or assassination. The popular association of the practice with the gentler sentiments is most unfortunate; and though any expression of repugnance or opposition to the practice may arouse the easy merriment of the shallow and the uninformed, the fact nevertheless remains that thousands of little children have gone innocently to their early graves through the venom of a kiss.

A quarter of a century after the introduction of vaccination for the prevention of smallpox, a new disease never seen in Europe before, and one of the most terrible that has ever appeared among the human race, was about to sweep over all Europe and America. This was the Asiatic Cholera. It has been described by Garcia del Huerto, a physician of Goa, in 1560, and had appeared in India in 1774. It became endemic in Lower Bengal in 1817, whence it spread gradually till it reached Russia in 1830 and Germany in 1831, carrying off nearly a million persons in the year 1830 alone. In England fifty thousand died of cholera in 1845 and twenty thousand in 1854. In Palermo twenty thousand died in four months in the year 1837. In Constantinople, during the month of August in 1865, fifty thousand died of cholera; and in Spain, between May and September in 1885, nearly a hundred thousand died. In July and August in 1890 more than thirty thousand died of cholera in the epidemic which took place in Mecca.

Upon its first appearance in the winter of 1817, in the camp of the Marquis of Hastings, then engaged in the Mahratta war on the banks of the Sind, it proved a very fatal malady and was accompanied by vomiting and purging. It was then taken for a new disease, and created the utmost terror.

The disease begins with restlessness and depression of spirits, headache and noises in the ears. Patients complain, not only of the noise in the head, but of being pained by the sound of their own voices. The countenance of the patient during the premonitory stage is often pallid, anxious and sorrowful. Very often there is no premonitory stage, however, and then the disease develops itself with the most startling suddenness. The patient may die within twelve hours after the commencement of the attack.

In the morning one may be in perfect health and by nightfall be dead. The violent purging and vomiting which characterize the onset of the disease are followed, more or less rapidly, by the development of a very remarkable condition which is known as cholera collapse, or the algid stage of the disease. It commonly appears within six or seven hours after the commencement of the purging, or even earlier. Indeed, in some exceptional cases the patient actually dies of collapse before the appearance of the purging.

The essential sign of this state is a failure of the circulation, beginning at the extremities, and afterwards creeping slowly to parts nearer the heart. The pulse at the wrist becomes more and more thread-like, until at last it is quite imperceptible. Upon listening to the heart with the stethoscope the second sound may be quite inaudible, while the first sound is still heard. The surface of the body becomes cold, livid and shrunken; the hands are like ice and look shrivelled. The features have a dark leaden hue, the eyeballs are deeply buried in their sockets, the nose is pointed, the tongue is cold and the breath has lost all its warmth. The breathing meanwhile is increased, for there is a sense of suffocation. There is great weakness and the voice becomes so feeble that no sound is heard upon the movement of the lips. Towards the last, if at all, the patient becomes unconscious. Before death the eyes become dry and the corneæ slightly opaque. Shortly after life has become extinct there will be found to be in the body a rise in temperature. Spasmodic quiverings or twitchings are sometimes observed in the body during the first half-hour after death. The limbs may actually move, and in one case the elbow became raised above the level of the chest across which it was lying.

One of the most remarkable circumstances with regard to cholera is that, although it has spread to almost every part of the world, and has sometimes prevailed under widely different thermometric and other conditions, it seems to be capable of establishing itself permanently in no country except India, and there only in a particular region.

"Cholera literature," remarks Kenneth MacLeod, of Calcutta, "is immensely voluminous, and from time to time many theories have been advanced to explain the nature, origin and diffusion of the disease. These speculations, putting aside the purely mythical, have concerned themselves with every possible influence—cosmic, sidereal, telluric, climatic, septic, ochlotic, etc.—to account for cholera visitations. A study of statistical aggregates and too exclusive an attention to 'broad' views have begotten vague and fatalistic generalizations, as of mysterious forces and pandemic waves, which have of late years become discredited. General causes do not produce exceptional, limited, erratic and contingent results, and a closer study of cholera on a more rational basis has made it clear that so specific a malady must have a specific cause. The microbic agents investigated by Koch and others have now for eleven years been subject to criticism, experiment and research, and year by year his theory has gained support from clinical, pathological, bacteriological and epidemiological studies. The theory which offers a key to the bewildering mass of cholera literature which the present century has produced, is that which finds the causation of cholera in a disregard of the laws of health, and in the presence of organic (microbic) poison, capable of conveyance under favoring circumstances by man himself."

CHAPTER IX.

THE PARIS AND VIENNA SCHOOLS OF RESEARCH.

During the closing years of the last and the early part of the present century the separate schools of medical thought, founded often upon a single physiological idea, and that not necessarily a correct one, became very numerous. Amid much that is perhaps confusing there is, nevertheless, in the rapid succession of these schools of thought, an indication, in the first place, of the great activity which medical science experienced at that time; and, upon closer observation, of an actual progress; though sometimes, perhaps, not very apparent. But however remote from the truth, the general tendency of each revolution or departure was nearer to it.

Boerhaave, who was the most eminent physician of the eighteenth century, does not speak in very glowing terms of the profession to which he was himself so distinguished an ornament; and in one place even goes so far as to say that when the good accomplished by a very few of the great physicians of the past was excepted, the influence of medicine as a whole had been rather for evil than for good.

That most of the evil referred to may be traced back to the practice of blindly following the theories of this or that school, can hardly be doubted; and yet it is almost safe to say that the evil would have been even greater if there had not been these different schools, for such would have indicated utter stagnation. Repeated retrogression and divergence mark the progress of all learning. The slow advance of human thought toward the truth is not dignified or impressive. In medicine especially is this the case. The divergence marks the stage of search; as when a group of children scatter far and wide in seeking for the path which is lost. The ultimate coalescence of all the schools ought to mark the discovery of the truth.

A slight acquaintance with the theories and the tenets of the more important schools of the eighteenth century, already mentioned cursorily in an earlier chapter, will cast considerable light upon the state of medicine at the beginning of the present century, and will give also a clue to many of the prejudices of the time which at present must appear inexplicable.

Georg Ernst Stahl, in his "System," makes the soul (anima) the supreme principle. Though the life-giving and life-preserving principle, it is not, however, to be confounded with the spirit. It imparts life to dead matter, is active in generation, and, having provided for itself the body, counteracts the constant tendency of the latter to decay and corruption. When in any way obstructed in the performance of this function (a matter of not infrequent occurrence) the condition of bodily health changes to one of bodily disease. This doctrine of Stahl's has been called "Animism," and in it one sees the reaction against the exclusively mechanical and chemical theories of the seventeenth century. Stahl discarded Peruvian bark because it suppressed fever, a condition which he regarded as salutary. Opium also he discarded because it restrained the "movements," and iron, because it had been recommended by his enemy, Hoffmann.

Friedrich Hoffmann, this enemy, was also the founder of a system known as the Mechanico-Dynamic. In this system he claimed that force was inherent in matter, and that in the body these forces express themselves in movement. Life was therefore movement, especially of the heart; and death the cessation of all movement in that organ. Death and life were, according to Hoffmann, simply mechanical phenomena, and health consisted of the regular occurrence of the movements; disease, a disturbance of the same.

Haller's doctrine of the irritability of animal tissue, more particularly of the heart, was, immediately after its demonstration, applied to theoretical medicine; and, combining this theory with Hoffmann's teachings already mentioned, a new system of Pathology was founded by William Cullen, which, in contradistinction to the Animism of Stahl, was known as "Solidism." The living solid portions of the body, of which the nerves were the chief agent, formed the foundation of Cullen's System.

Vitalism, on the other hand, had its origin in the school of Montpellier, and Théophile de Bordeu, by whom the theory was inaugurated, maintained the existence of a general life of the body which resulted from the harmonious working of the individual lives and individual powers of all its organs. The various separate organs of the body, while associated with each other, had each a definite function apart, and was, as it were, an organism within an organism. The heart, the stomach and the brain were the most important of these, and were designated as the "Tripod of Life." To this doctrine, which was subsequently elaborated by Barthez, the term "Vitalism" was applied; while in Germany the same theory was developed into a system known as the Doctrine of Vital Force by Christian Reil. According to the latter, each organ has its own special force, but is united by sympathy with the rest of the body. The phenomena of vital force are not produced in matter until a union has taken place between the force and certain imponderables, such as heat, light, electricity and others which are unknown.

Of all these schools of the eighteenth century the one which exercises the most prolonged influence in the nineteenth was the Brunonian System, founded by John Brown, which in many ways recalls by its various points of similarity, the teachings of Asclepiades and the early Methodists of Rome. Brown held that life was not a natural condition, but an artificial and necessary result of irritations constantly in action. Tending ever towards death, the characteristic of all living beings is that irritation can compel life in them. Health is an intermediate grade of excitement, while disease consists of either too much or too little excitement. Diseases were therefore divided by him into the sthenic and the asthenic.

In the founding of general and pathological anatomy by Marie Francis Xavier Bichat, originated the tendency in medicine which manifests itself today. "Take away some fevers," Bichat said, "and nervous troubles, and all else belongs in the kingdom of pathological anatomy." The tendency of similar tissues to similar forms of disease was also established by Bichat. "You may observe diseases of the heart and lungs for twenty years," he remarks in another place, "and the whole furnishes merely a jumble of phenomena which unite into nothing complete; but if you open only a few bodies you will see the obscurity speedily give way; a result never accomplished by simple observation, if we do not know the seat of the disease."

Here one recognizes a new tendency, which, more than any other of the doctrines just enumerated, suggests the methods of modern scientific enquiry. The earlier medical doctrines resembled somewhat the earlier metaphysics; and their theories as well as their disputations had the pomposity, the ingenuity and the inanity of the schoolmen. Still another corrective, not less salutary than the teachings of Bichat, was the promulgation of the Positive Philosophy of Auguste Comte.

At the dawn of the new century medicine, instead of being a field for idle speculation and transcendental dreams, became an arena for the practical and intelligent worker in science. The acute Cabanis gave voice to this growing feeling in his work, *Du Degré de Certitude de la Médicine,* in which he considers at length the objections then expressed as to the scientific certainty of medical conclusions.

"Here in a few words," he says, "are the reasons alleged by the detractors of medicine. The hidden seat of life eludes our scrutiny, and we have no exact notion of the principle by which we are animated, or of the means by which it exercises this function. The nature and the primary causes of disease are absolutely unknown to us. Again, the nature of the substances which are employed as remedies is a mystery to us, as well as the way in which they act upon the body; nor, indeed, have we any means by which we may arrive at this knowledge. Furthermore, if medical practice were fixed upon a sound basis, its theories would remain unchanged for all time; but when one turns to the History of Medicine what a diversity of views one finds at once, what opposition in the methods of treatment! Herodicus reverses the system raised by his predecessors; Hippocrates reverses in great part that of Herodicus. Then the two Hippocratic schools of Cnidus and Cos, in their turn, are constantly in dispute. The Dogmatists strove to arrive at the truth by other hypotheses and deductions drawn from the same. The Empirics on the other hand banished reasoning altogether from their practice and reduced it to the observation of facts pure and simple." The influence of the Baconian philosophy upon experimental science, and particularly medicine, was also becoming more marked at the beginning of the nineteenth century; while the teachings of Schelling, Hegel and Lotze, himself a physician, were largely influential in setting medical research upon a sound and practical basis.

From the history of every century, as a German historian of medicine aptly points out, and especially from the history of medicine, we may draw the experience that the representatives of any epoch always regard it as certain that they have trodden the very best paths to attain the knowledge of the truth; they even incline to the assumption that they alone are in possession of the highest attainable science and of the best methods of investigation; indeed, often of the truth itself. In this they doubtless affirm nothing more than the principle of evolution; in virtue of which the living and the present, in contrast with the past, place themselves in the forefront of the right.

But even the present, the same writer continues, is of course only a phase of the general development of culture, upon which is imposed always those limitations and errors which have ever existed in the development of the sciences, as in that of humanity. That this is quite true for the present century also, and especially for its medical culture, its history has already demonstrated. It is no more free from error than the earlier centuries, and, indeed, even surpasses them in the monstrosity of some of its medical doctrines. In this connection we may merely mention Rademacherism, Ideal Pathology, Homœopathy, Isopathy and Christian Science, all of them phenomena of our century, so boastful of its superiority.

The changes of systems, theories, methods of thought and hypotheses constantly recur, so long as medicine exists, and are the expression of every tendency of culture and of the bent of every age. But these are not the truth. Hence they are for the most part only maintained during the period of florescence. The systems of an earlier day were longer lived; as for example those of the Dogmatists and of Galen. In modern times they are becoming more ephemeral. While the systems of Theophrastus of the Iatro-Chemists and the Iatro-Physicists lasted on an average a century, the most highly prized systems of the eighteenth century endured scarcely more than a quarter of this period; while in our own day, many scarcely last a decade, and are outstripped in this respect only by the revolutions in therapeutic methods, so that Gutzkow could say: "Medical men devise new systems every day."

The phases of development of humanity in history are various. Humanity itself and its essence alone remain unchanged. The latter is uninterrupted development to an object and end for us inscrutable, but which, at all events, excludes the possession of complete truth.

Johann Andreas Roeschlaub was an advocate of the theory of excitement; and according to him life depended upon irritability inherent in the organism as an independent capacity. This theory partook somewhat of Brunonianism. Roeschlaub claimed that bodily health consisted in moderate irritation and moderate excitibility. Disease, on the contrary, he insisted, was either a deviation from that medium condition upwards (hypersthenia), or downwards (asthenia).

Another offshoot of the Brunonian theory was that of Stimolo and Contrastimolo, which had for its author Giovanni Rasori of Milan. According to him there are external and internal irritants. Blood is the most general internal irritant. Venesection, or bleeding, therefore, was to be regarded as the most reliable means of *diagnosis!* If it was found to be beneficial, one set of remedies were to be selected, but if venesection was found to be injurious to the patient another form of treatment was indicated. Though carried out with the best of intentions, these practices had the most baleful influence, and a patient was often reduced to the verge of death by repeated venesections and the administration of large doses of powerful drugs; when with no treatment at all a recovery would have been made in good time.

These modifications of Brunonianism, like the theory already described of Brown himself, may be traced back either directly or indirectly to the suggestion of the Methodists. The *diathesis di stimolo* of Rasori is the *diathesis sthenica* of Brown, which in turn corresponds to the *Status strictus* of the Methodists; similarly the *diathesis contrastimolo* of Rasori is but another term for the *diathesis asthenica* of Brown and the *Status laxus* of the Methodists. The main principle of the Methodists was that it was useless to consider the causes of disease, or even the organ affected by the disease; but that it was quite sufficient to know what was common to all diseases. These common qualities, or *Communitates*, were of three possible forms, the state of relaxation (*Status Laxus*), the state of contraction (*Status Strictus*) and a mixed state (*Status Mixtus*), partly lax and partly constricted.

François Broussais with his theory of Physiological Medicine rendered a signal service to science; though in some of his doctrines he favored the one-sidedness of the anatomical school. By Bouillaud, however, he was regarded as the Messiah of medicine: a science overstocked, one sincere observer remarks, with Messiahs. To Bouillaud, nevertheless, medicine owes not a little; for by his labors the knowledge of diseases of the heart and their connection with rheumatism was rendered clearer.

It was however the French, or more properly speaking, perhaps, the Parisian, school of pathological Anatomy and Diagnosis which has given tone to the medicine of the nineteenth century. "France was the country," Rokitansky remarks, "in which the attempt to reconstruct medical science upon a practical anatomical basis was made in the most effectual manner; not that it was exactly the cradle of pathological anatomy, but that it was the land of all others in which men sought and found in it a solid foundation for medical knowledge. Such men were, amongst others, Bayle, Corvisart, Laënnec, Dupuytren, Broussais, Cruveilhier, Andral, Louis and Rayer. It is true that one of these, namely Broussais, disseminated in his system of physiological medicine an error from which his pupils cannot yet disentangle themselves: the erroneous theory of vitalism in which Brunonianism seemed once more to be trying its strength upon novel ground."

This school laid perhaps too great stress upon the morbid changes found in the organs or tissues during disease; and made the great mistake of trying to remove the local products of disease instead of striking at the causative morbid processes. The latter were utterly neglected; and many diseases, therefore, came to be regarded as incurable, since the processes of disease and the morbid products of disease which had run their fatal course were observed and studied more than the process of healing. The ability, almost desire, indeed, to cure disease was thus weakened.

In France, Kratzmann at the time remarked, every one experimented with the sick, less to attain the best method of cure, than to enrich science with an interesting discovery, and to advance a step the accuracy of diagnosis by some new physical sign. Foreigners were not wrong, therefore, when they said that in France the physician treated rather the disease than the patient.

Though a most natural error for one wrapped up in the advance of scientific knowledge, this was a most grave breach of the sacred responsibility which the physician takes upon himself when he becomes a healer of the sick. Scientific zeal, or to use a simpler term, the curiosity of the scientist, should never cloud for a moment the physician's first duty to the patient. Of Bright also it was sometimes complained that as soon as he had studied a case far enough to be able to make a diagnosis he became satisfied and quite lost any further interest in the case, leaving off just where the unfortunate patient wished him to begin—at the treatment. Any tendency to specialism which leads to a one-sidedness of this sort cannot be too greatly deplored.

Gaspard Laurent Bayle made extensive investigations in the morbid changes of tissue which take place in consumption, a disease from which, like Laënnec, he died himself. A condition in this disease known still as "gray miliary tubercle" was first carefully described by him, and thus named.

Jean Cruveilhier of Limoges was a pupil of the surgeon Dupuytren, who repeatedly recommended to him the study of pathological anatomy. His subsequent teachings regarding pyæmia, a frequently fatal fever caused by the introduction of purulent matter into the blood, excited much attention at the time. His conclusions were not correct; as, indeed, no investigations ever are entirely: nor is this a matter of humiliation in a stage of rapid transition. The vitality of any branch of research is indicated best, perhaps, by the changes of opinion. The doctrine of Cruveilhier was amended afterwards by Virchow, and, as thus amended, awaits, who shall say, some other mind to revise it yet again.

To repeat the words of Gabriel Andral, an indefatigable investigator and eminently critical mind. "I have begun several times," he says, "from the very beginning. The first time in my studies concerning pathological anatomy; the second time on the occasion of my investigations in the sphere of auscultation and percussion; and the third time in my physical and chemical investigations of the different fluids of the body. I scarcely think this will be the last."

Discouraged by no opposition or ridicule, unwearied after the hundredth failure; so the true philosopher, who by years of intellectual drudgery has earned the right to one short flight into the empyrean, picks, in the hope of this, an uncertain path along the scarcely discernible track of Truth; tireless, fearless, ever ready to return to the very beginning; from there to make a fresh start; and, when too weak to continue the search further, solicitous chiefly that the progress thus laboriously made may prove an advantageous starting point for some one else whose happier destiny it may be to approach perhaps a little nearer to the face of mystery.

In this spirit Charles Alexandre Louis, who was the first to apply the "numerical method" to pathology, approached the study of medicine. "As often," he says, "as I have formed an *à priori* idea and have afterwards had an opportunity to prove the facts, I have invariably found that my idea was false." The numerical method, or the study of the statistics of medicine, as well as of other matters, is now a very important and a very familiar branch of scientific literature. It occurred to Louis that by numbers only would it be possible to ascertain the frequency of certain symptoms; and, by a definite enumeration, he attempted to utilize the special relations of age, sex and the constitutions of the patients, so that it might be said with reasonable certainty that this or that symptom or termination might probably occur a certain number of times in a thousand cases.

Mathematical accuracy in cases of this kind was, however, impossible; for no consideration could be taken of the innumerable idiosyncrasies which characterize any given group of patients. Indeed, Bacon had himself remarked, "All induction from simple enumeration is child's play; its conclusions are assailed; its decisions insufficiently grounded, and thus it is exposed to an easy overthrow." Tables of medical statistics, or the principles of numerical prognosis, therapeutics and ætiology were afterwards elaborated by Jules Gavarret in accordance with the principles of probabilities and the higher mathematics. At present absolute accuracy is not claimed for data of this kind; but the statistics are usually given for just what they are worth—and they have been found to be worth a good deal to the practical physician.

François Magendie was, next to Andral and Louis, the most important representative of the new French medicine. As an experimenter he marks an epoch in the history of medicine; and though often unsystematic and sometimes accused of being unnecessarily cruel, he largely developed the knowledge of pathology and of the action of drugs upon the human system, by his introduction of the experimental method into those departments of study. Some of the alkaloids, the chemical principle obtained from many vegetable drugs, were introduced into practice by Magendie.

Armand Trousseau, already mentioned among the surgeons of the time, was also one of the most eminent writers on medicine of the earlier century. As a teacher of clinical medicine he was perhaps most famous, and his clinical lectures are still regarded as models of concise description and accurate observation.

Claude Bernard, the successor of Magendie, was a famous experimenter in physiology and pathology. While an apothecary's assistant at Lyons he had felt the literary aspirations which seized so many of the French youth at the time of the Romantic movement, and having spent all his free evenings at the *Théâtre des Celestins,* he was eventually drawn to write a vaudeville comedy himself, entitled *"La Rose du Rhône,"* which, though not printed, was acted with a certain amount of success. Encouraged by this, he set himself seriously to a five-act tragedy in metre; but subsequently curbed his ambition to a prose drama, not, however, giving up the idea of Paris, "la scéne du monde," as it was called by himself and two student friends who made that their rendezvous.

Thither, with his little comedy, *"Arthur de Bretagne,"* he came, and with also a letter of introduction to the great critic Saint Marc Girardin. There are few sadder moments than those experienced by a youthful genius upon his entrance into a vast city. Simply clad and poor, perhaps, his provincialism is then for the first time brought home to him by the splendid and lavish ostentation of wealth which greets him upon every side; by the brilliant equipages of the rich, the magnificence of their lacqueys, the grandeur of their dwellings and all the other affectations of pomp and display with which the vulgar and the shallow insolently attempt to attract attention to themselves. He is swept to one side unnoticed by the hurrying multitude. Unfamiliar languages, strange cries and unusual noises upon every side serve to oppress him, and the talents with which he had modestly hoped to rise in this glittering turmoil sink swiftly into insignificance;

for genuine worth ever doubts itself. Happier then by far is the lot of the commonplace, "pushing" individual who takes not himself but only the world, and *such* a world, seriously.

Girardin, the professor at the Sorbonne, Foster relates, received the young student kindly, and conscientiously read his transcript. He saw that the drama showed that the author possessed literary powers of no mean kind, but he shrank from giving to the aspirant the hopes which might have been his due. Instead of encouraging him to devote himself to literature he bade him turn to something else by which to earn his bread, and court the muses in his leisure moments only. "You have studied pharmacy," said he; "study medicine, you will thereby much more surely gain a livelihood."

So in the *Quartier Latin,* and in a little garret, Bernard worked on at his medical studies. The skilful manner in which he prepared the dissections entrusted to him while an interne at one of the hospitals where he had for a time served as externe, made a good impression upon Magendie, then one of the physicians at the Hôtel Dieu, to whom Bernard had been allotted as an assistant. Magendie, as the story goes, one day soon afterwards, on a sudden called out roughly to Bernard, busy at a dissection, "I say, you there, I take you as my preparateur at the College de France." The latter's career as a physiologist may be said to date from that moment.

In Germany, meanwhile, the development of medical theories was very active. Here, as in France, a physiological system of medicine was also elaborated by Wunderlich, Roser and Griesinger, which differed in many ways from the French physiological system of Broussais. Wilhelm Roser was the representative of the new school in the department of surgery. Griesinger still enjoys much fame as an alienist, and his work on Mental Diseases was in its time no less an authority upon that subject than was Wunderlich's volume on Pathology and Therapeutics.

"The doctrine of life," Wunderlich explained, "is physiology. Physiology therefore, in its strict sense, must include all vital phenomena. From a certain portion of these phenomena, to wit, those called morbid, a special science has been formed which, though artificial, is yet a practical division."

While Wunderlich declared that pathology was the physiology of the sick men, Henle, the anatomist, who, with Pfeufer, was instrumental in founding the German school of Rational Medicine, claimed, on the contrary, that no distinction can be made between the physiology of the healthy or the sick. "We may call the expression of life produced by an injury, a disease; nevertheless it remains physiological. From the action of such abnormal influences, out of which disease arises, we may learn to recognize the faculties of the healthy organism."

Parallel with that of Broussais ran also in Germany the school of Natural Philosophy. "It led speculation into extremes, and nothing better could have prepared the way in Germany for the opposite philosophy than precisely the excesses of which this school was guilty. Indeed, throughout all the history of medical culture it is a manifest law that the one-sidedness and exaggeration of any existing school prepare the way for the opposition of the future. This historical task, though a negative one, the school of Natural Philosophy performed so thoroughly that the Realistic school, as has been seen, stepped ultimately, without serious struggle, into its place."

In connection with this school may be mentioned Lorenz Okenfuss (Oken), the discoverer of the Wolffian bodies in Mammalia, who explained putrefaction as "nothing but a separation of organic matter into simple little cellules or points, the infusoria. If these adhere again, they give rise to higher plants or animals, so that we may regard flesh as a crowd of numerous infusoria grown together, and thus forming, as it were, the seed for the entire animal kingdom."

The School of Natural History was the immediate successor of the foregoing, and made already important concessions to modern realism. The doctrine of disease advanced by Schönlein, its founder, is based in many respects upon earlier ideas, and is on the whole decidedly ontological. Pathological changes of tissue, for example, he regarded, not as the results of previous disease, but as the concrete expression of the abstract and independent entity, "disease," whose relation to the organism he looked upon as that of a parasite sojourning temporarily within it.

Karl, Baron von Rokitansky, a Bohemian, was one of the founders of a new school of medical thought which extended its ideas over all Germany and, indeed, exercised an influence upon the medicine of foreign countries. After a college course of not unusual brilliancy ("good enough" was the comment made by the examiner upon his second examination) and an early professional career marked by unsuccessful attempts to obtain academic positions which he desired, he was at last advanced to the position of extraordinary professor in 1834, confining himself

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in his lectures to special nosology, "for upon this," he remarked, "depends the fruitfulness of pathological anatomy."

In 1866 he celebrated his thirty thousandth post mortem; to have accomplished which he must have attended an average of more than two every day from the year when he entered on the study of medicine. Such amazing industry is unparalleled. By the tireless efforts of Rokitansky the actual succession of morbid changes which takes place in a diseased organ, especially the changes of inflammation, were established upon a more scientific foundation. The microscope had not yet come into general use in pathological research, and was therefore never used by him. His works are distinguished by the simplicity and clearness of their statements, and his record of pathological observation may be regarded as a monument of scientific labor.

His contemporary, Joseph Skoda, introduced a genuine reform in the conception of the phenomena of physical diagnosis by adapting them to the laws of acoustics. He also, and to a much greater degree than Rokitansky, was influential in replacing with the realistic tendency the earlier idealistic philosophy of German medicine. By his views on physical diagnosis Skoda showed himself an independent spirit; and, having received his impulse from France, he carried on the science of diagnosis to a completeness which had not been reached by the French. With Skoda, moreover, the "specialty" familiar in France, made its appearance for the first time in Vienna; and in this new departure he was followed by Hebra, who made a specialty of cutaneous diseases, and by others also who embraced other specialties. This very accentuation, however, of one particular branch of research so operated eventually that practical medicine in the hands of Skoda deteriorated into simple diagnosis. At a consultation where he was asked about the remedy to be prescribed he replied, "Oh, that is immaterial."

Though the influence of these two great founders of the New Vienna School was so far reaching, they each wrote but a single important work, and this upon a special branch. Contrasted with the artistic style of Rokitansky in his Pathology, Skoda's manner, though succinct, seems harsh and ungainly.

Johannes von Oppolzer, though he wrote no independent works, adapted to direct the tendency of the school to which he belonged, yet possessed in an eminent degree the characteristics of the born physician; by means of which gift he rendered physical and anatomical diagnosis popular. To therapeutics, or the use of remedies, he also restored in great degree its rights usurped. Ferdinand Ritter von Hebra, a colleague of Oppolzer, was an important agent in inaugurating new and permanent therapeutical methods in the treatment of cutaneous diseases, and in this branch of science the result of his labor is still apparent.

It is a striking and curious, though not altogether inexplicable phenomenon, that contemporaneous with the Vienna system the pseudo-Paracelsian theory of Rademacher and the homœopathic doctrine of Hahnemann were able, not only to make their appearance, but even to find followers. Gottfried Rademacher studied Paracelsus kindly, with honest sincerity and with a simple heart; while Hahnemann falsified him. The teachings of Rademacher were based upon the precept of Paracelus, "A natural, genuine physician says this is a *morbus helleborinus* or *terpinthinus,* not that this is *phlegma chorryzza* or *catarrhus.*"

Rademacher, therefore, classified diseases in accordance with the remedies by which experience had shown they might be cured. It was impossible, he alleged, to distinguish the ultimate essence of disease, but it was possible by experiments of various sorts to ascertain a remedy which would prove beneficial, and the disease should be named after the remedy. Of these remedies there were three, according to Rademacher: cubic-nitre, copper and iron; and for this reason, accordingly, three general diseases of the body whose essence and secret were unknown, but which should be called Copper-disease, Iron-disease and Cubic-nitre-disease. Investigations should be continually made until the proper remedy was found; but in the event of the patient dying in the meantime, the physician had probably not had time enough to discover the correct remedy.

The principle of Homœopathy brought forward by Hahnemann was less dangerous in practice than that of Rasori's modification of Brunonianism; and, indeed, might be called entirely innocent were there not in the treatment of the sick sins of omission as well as of commission. In homœopathy the action of drugs upon the healthy becomes the guide for the selection of remedies for those who are suffering from disease. "In this system there is no *vis medicatrix naturæ;* and likewise there is no disease which can withstand homœopathy. All diseases are curable by its means, and occasional failures are due, not to the practice of homœopathy itself, but to human shortsightedness, which overlooked the proper homœopathic remedy. As a result of these principles this system, more than any other, produces the impression of reckoning upon the ingenious arrangement of deception and the credulity of the weak-minded."

According to Hahnemann there are only general diseases, none local; and the products of disease found upon post-mortem examination are the result of blundering; and particularly of the blunders of regular, or "allopathic" physicians, as this magnificent theorist called all those who did not practise homœopathy: a term which was not accepted by the latter, any more than the term "gentile" has been accepted by those who are not of Semitic origin. No such morbid changes, Hahnemann claimed, were observed in homœopathic treatment—and truly, because Hahnemann never made autopsies. Subsequently there arose a new and "scientific" system of homœopathy; and the more modern school recognized the necessity of an anatomical and physiological basis, and admitted the necessity of diagnosis, and the investigation of the character of the disease, in addition to the superficial array of symptoms. Of the original homœopathy not much more than the name survives at the present day, which, though defined as something substantial, is really but an empty name. Charlatanry, however, as an observer has remarked, is so much better paid in medicine than rational treatment that the name is found to be very remunerative. "In the idea of the majority of the laity medicine appears to be a mystical knowledge, or a blind matter of experiment, no less at the present time than in the middle ages; for the famed sound and simple common sense of the masses, so frequently and boastfully referred to, yielded here, as it had ever done, to the mysterious doctrines of the empiric."

An offshoot of homœopathy, and one, moreover, which brought much harsh criticism upon its parent system, was the doctrine of Isopathy which has been not intemperately designated as the filthiest theory ever invented. According to this system, like was to be cured by like. For smallpox, the purulent matter from another smallpox patient was taken internally by the mouth. For diarrhœa, excrementitious matter was administered in a similar manner. For tape-worm, the joints of another tape-worm were swallowed. It would thus seem, remarks a medical writer, that no pure or impure possibility, and no conceivable absurdity can be adduced, from which it is impossible to form a medical theory. And so it is certainly not the most gratifying advantage of the study of the history of medicine that one observes how every absurdity, if it is only preached up with the necessary confidence and perseverance, finds its dupes and followers, and that the history of medicine is often in the most unexpected ways metamorphosed into a record of human follies.

To enumerate all the frauds perpetrated upon a credulous populace would be impossible. Yet another outgrowth of homœopathy was the Electro-Homœopathic system of Count Cesare Mattei. This imaginative genius expatiates in a most edifying manner upon "red," "blue" and "green" electricity. When imposture reaches this height there is a certain sublimity about it which forces the admiration. The Count's manner was evidently very earnest and proportionately convincing, as may be gathered from the following quotation from his writings.

"But what," exclaims this philosopher, "do we know of vegetable electricity? So say the doctors, and rightly, for even I, who discovered it, know nothing of this agent. I know that I investigated it and found only a little magnesia. I noticed that this vegetable fluid manifested a quick and often momentary activity, and I said: 'This activity is electrical, it is electricity!' I have seen this electricity cure troubles regarded as incurable, and I said to myself again, 'This is a remedial agent!' That is all I know of vegetable electricity, and far be it from me to make a secret of it. On the contrary I tell it to all, even to those who do not wish to know of it!"

Audacious knavery, however flagrant, seems always to arouse only a certain lenient amusement among those who have not suffered by it. The tendency would seem to be as deep as human nature itself. How invariably does the rogue in the story or the play become a prime favorite; as witness, the vogue of the Beggar's Opera. And so even in the solemn page of medicine one smiles when he catches the faint wink of a Count Mattei as leniently and as kindly as he does when Falstaff enters.

That class of fool to whom the term mattoid has been applied by Lombroso is never amusing or interesting, however. A knave has a fiery and brilliant touch of the criminal sparkling upon the surface. The mattoid is heavy, barren and utterly stupid. To the latter class belong the votaries of the senseless vagary known as phrenology, which in the early part of the century wrought considerably upon the credulity of the public both in Europe and America, and which arrogated to itself some of the pretensions of a science. According to the promoters of this humbug the domestic and social and intellectual qualities are arranged in large nodules, embossed upon the surface of the brain, which cause the skull so distinctly to bulge out that the manipulating phrenologist claimed by feeling the head of an individual to be able to tell whether he had studied Greek, or whether he would make a model husband. They also, it seems, could by the same means detect nascent or potential abilities. These impostors, therefore, gave advice as to the choice of a vocation in life, and, like the Gypsy practitioners of Palmistry, with whom they stood upon an equality, gained in popularity by feeding the easy vanity of their credulous victims.

With the practice of phrenology may be also mentioned that of Mesmer, another notorious mountebank, who enjoyed a distinction almost as great as that of Spurzheim and Gall of phrenological fame, and from whom the term Mesmerism originated. This extravagant doctrine is the source from which hypnotism, mind-reading and various allied forms of quackery of the present time are derived. The immense popularity of such rubbish, then as now, serves to indicate what class of mind preponderates in the general public; which is another way of saying that the proportion between wise men and fools mentioned in Shakespeare remains at the present time undisturbed.

CHAPTER X.

THE STUDY OF ANATOMY.

"STRANGE things," Latham observes, "have been said in jest, or in earnest, concerning the studies necessary to form a physician. Sydenham advised Sir Richard Blackmore to read *Don Quixote.* He probably spoke in jest. But it is impossible to read Sydenham and not perceive that his mind did in truth hardly admit any auxiliary to the exercise of its own observation. What he says of anatomy must startle the painstaking pathologist of modern times who bestows all his industry in tracing diseases home to the primitive structure in which they are engendered. Anatomy, he has told us, is only fit for a painter."

In this somewhat inaccurate statement Latham seems to refer to a quotation from Hippocrates employed by Sydenham (*Tractatus de Podagra et Hydrope*), in his dissertation on Dropsy, in which place the author states that there must of a surety exist *caeci meatus,* secret passages, by which fluids are conveyed, *ex abdominis cavitate ad intestina.* "But because we cannot solve how it should be," Sydenham continues, "I cannot but mention that famous saying of the wisest and best physician, according to the opinion of all ages, viz.: Hippocrates in his book *De Prisca Medicina:* 'Some physicians and sophisters, says he, say, that it is impossible to know the art of physic, unless you know what man is, and how he was first made, and compacted; but I, says he, think, that those things that are said and written by some sophisters and physicians of nature, more properly belong to the art of painting than to physic.' "

"But," comments Sydenham, "lest this divine author should be counted erroneous, or empirics should seek a cloak for their ignorance from this place, I declare that I, according to my best thoughts about practice, suppose that it is absolutely necessary that a physician should well understand the structure of the human body, that he may be the better able to conceive and form true ideas of the nature and causes of some diseases. Chirurgeons also ought to understand the structure of the human body, that in their operations they may be the better able to abstain from those vessels and parts which, if they should be violated, would destroy the patient, nor can they well reduce dislocated bones to their natural places, unless they curiously inspect and well understand the frame of the bones called a skeleton. Therefore such knowledge of the human body is absolutely necessary, and he that has it not will, as they say, fence winking with some diseases, or go to sea without his compass. Moreover this knowledge is easily and soon acquired, for it may be shortened more than others that are more difficult; and may be learned by sight in human bodies or in some animals, and that very easily by such as are not sharp-witted.

"But though by a diligent search in dissecting bodies, the greater organs which nature uses in performing her business appear, and also some vessels, yet what is the original and primary cause of this motion the eyes cannot see, nor can the best microscope discover by what passages the blood passes through the arteries into the mouths of the veins, so rude and unlearned (pardon the expression) is our knowledge, and in a manner only conversant about the outside of things, and only rises to understand things are so, but can by no means reach the cause of things."

Even at this time, however, the first steps were being made towards a clearer understanding of the class of phenomena to which Sydenham referred in this very passage; for Antonius von Leeuwenhoek had already been able, by the use of the simple microscope, to detect the corpuscles in the blood, and the presence of infusoria in water. The primary importance of a thorough knowledge of anatomy seems then, as now, to have been generally felt, and, indeed, the subject made in the seventeenth century unprecedented advances. In examining the extensive work of Thomas Bartholin, *Archiatri Danici,* published very soon after the volume of Sydenham just referred to, one cannot but be struck with the comprehensiveness and lucidity of his treatment.

A certain incidental knowledge of anatomy was general from probably a very early age, to which many early religious customs tended to contribute. The custom of embalming the dead among the ancient Egyptians, and of human sacrifice among many other races, would tend eventually to familarize the priesthood, who were also the physicians of the early civilizations, with a general notion of the arrangement of the parts, and the principal viscera of the human frame. The primitive mode of warfare also, which was accompanied by very extensive mutilations in actual combat, not to mention the custom of tearing to pieces the bodies of fallen foes, would give frequent opportunity for the study of the anatomical structure. Again, in the early Christian era, the tortures inflicted upon the martyrs, both by way of public spectacle, as well as with more leisurely secrecy in the cell or the dungeon, might have afforded excellent opportunities for extending the knowledge of human anatomy; though there is no record of these various persecutions having been made to serve even this legitimate purpose of scientific utility.

It was not until a comparatively recent date that the human body was subjected to a systematic, intelligent and thorough scrutiny, and every gland and membrane accurately and minutely described, as far as it was possible to do so with the unaided eye. Anatomy at the time of Bartholin was confused somewhat with the subject which is now known as physiology. At the present time the anatomist describes an organ with the utmost care. Of its function or use anatomy is silent. The part played by the various organs in the animal autonomy lies within the domain of physiology. But at that time, though many very important physiological discoveries had been made, this branch of research had not been set apart as a separate study, and hence the anatomists of two centuries ago frequently vouchsafed what information they could as to the probable functions of the parts which they had described.

The anatomy of the nineteenth century, beginning where John Hunter had left it, may be said to have almost reached its utmost limitations in every direction, just as a time came in the same century when little remained to be added to the geographical knowledge of the planet upon which we find ourselves. The vast field which was yet to be revealed by means of the improved compound microscope, is not now included in the study of anatomy proper, but has been, like physiology, set apart as a separate branch of research, to which the term Histology, or microscopical anatomy, has been applied.

Anatomy is simply a description of the textures which go to make up the human body in its entirety, and of their relative position to each other in the body. There is no scope, indeed no chance for theorizing, as in physiology. All human bodies are constructed, with singularly few exceptions, upon one design. A muscle, therefore, or a gland either does or does not exist; and if it exist, it either is or is not to be found in a certain particular region, and in a certain fixed and definite relationship to the adjacent parts. In case of dispute the only argument is to make an examination of the tissue or part in question.

The foundation of the whole body, upon which everything else is constructed, is "the frame of bones called a skeleton." Though to an inexperienced eye there may seem little worthy, or indeed capable, of study in a heap of dry, white bones, yet the one branch of osteology, as it is called, would constitute of itself a considerable library. Close observation, however, a habit indispensable to the successful study of medicine, and one which becomes second nature to those who have followed medical pursuits for any length of time, soon detects striking points of difference, as well as of resemblance in the various bones of the skeleton.

Upon the surface of each bone faint markings are found which indicate the position occupied during life by the muscles and even of the arteries. The surgeon also studies the points of contact where bones form a joint; as well as the physical peculiarities of certain bones, where the tendency to break is great, or to dislocate, and the manner in which these mishaps usually take place. The ethnologist also sees in the bones, especially of the cranium, the story of racial development and history, while the zoologist traces the growth of species by the same means. Indeed, Cuvier, the eminent French anatomist, having obtained on one occasion a single bone from the skeleton of an animal which was extinct, and of which nothing was at that time known, was able by means of the single bone in his possession to reconstruct the whole skeleton of the unknown animal upon deductions of his own, which was found afterwards to be similar to a skeleton of the same animal when it was subsequently unearthed.

Having classified the two hundred bones of the body, the anatomist next goes on to examine the fastenings by which the bones are bound together. These fastenings are found to accomplish their design so securely that they will not allow the bones readily to start from their places, while with such exquisite nicety, nevertheless, that when necessary a certain amount of yielding is allowed to take place, when occasion requires it; or even motion to and fro, as in the case of the joints. The fastenings which bind these bones together are called ligaments, and they are very tough and fibrous, though possessed at the same time of a certain amount of elasticity. When removed from their position and boiled in hot water, or subjected to heat, the ligamentous tissue becomes greatly changed in color, as well as consistence, and in culinary parlance animal ligament and cartilage is sometimes known as gelatin.

Every appreciable motion of the body is the result of certain motions of the bones, and these motions are accomplished by the muscles which are intimately attached to the bones like very tense elastic bands, capable of more or less power of traction. The muscles are of all sizes, from the minute stapedius, a fraction of an inch in length, which is found in the auditory apparatus of the middle ear, to the sartorius, or tailor's muscle, a couple of feet in length. The muscles lie so closely together that it is only by the dissector's skill that they can be separated into distinct bands. Muscular tissue has a definite grain like wood, and in color varies from a deep red to a pale pink. Beside the more extensive changes of position which are constantly taking place in the body by means of the leverage produced by the action of the muscles upon the bones, there are many muscles, and much muscular tissue which is attached to no bone, but acts by the same principle as the skeletal muscles. The heart is simply a hollow muscle. The calibre of the arteries is regulated by the muscular layer in their walls.

When at last the position and action of each muscle have been described, it comes to follow the course of the arteries as they wind in and out among the muscles and circle about the bones. An accurate knowledge of their exact positions is for obvious reasons necessary; even more than a knowledge of the position and divisions of the nerves, which, from main trunks thrown out from the vertebral column, divide in much the same way as the arteries, and are distributed to the same regions in company with them. The arteries are reddish tubes, not unlike translucent rubber, and after death are found to be empty. The nerves, on the other hand, are simply white cords which are capable of separation into many filaments or strands. After the arrangement of the bones, ligaments, muscles, arteries and nerves has been made clear it still remains to explore the contents of the cranium, the thorax, the abdomen and the pelvis.

In the nineteenth century, while it cannot be said that the discoveries in anatomy have been remarkable, the subject having been already exhausted by the investigators of the two preceding centuries, great advancement has been made in the methods of instruction. Facilities, as shall be shown presently, for the practical study of anatomy by dissection are now enjoyed which the prejudices of earlier times would not permit. The literature of anatomy, moreover, has been more extensive than ever before, and has reached a point of excellence which hardly seems capable of further improvement. More and more simplicity in description has been reached by each succeeding author. One form of classification has repeatedly given place to another, which set forth the matter in a more lucid manner. Writers have emulated each other in ingenuity of diagram or correctness of engraving. Here, as in many other branches of medical literature, much is due to the modern art of photography. A text-book on anatomy of the present day, instead of being a vast storehouse of confused facts, carelessly, or even clumsily arranged, presents the fabric of the body in a manner so clear and so concise that the study loses many of the difficulties with which it was formerly surrounded.

In 1800 Sömmering published an excellent anatomical work in the German language. In France about the same time the *General Anatomy* of Bichat had appeared, and was attracting the admiration of anatomists both in that country and abroad. In this work Bichat raised "a monument of philosophical genius which will last as long as the structure and functions of the human body are objects of interest." In 1815 Meckel published a descriptive anatomy which combined the philosophical generalisations of Bichat with precise description and pathological knowledge. Henle's treatise on anatomy is probably the most complete work upon the subject which has emanated from Germany, being remarkable not only for the clearness of the descriptions, but the beauty and correctness of the engravings. Recent works on anatomy are for the most part compilations and are too numerous to mention.

But no merely verbal description, however exact, and accompanied by engravings and diagrams, however true to life, can commence to convey a satisfactory knowledge of anatomy, such as is absolutely required of the practising surgeon, and for that matter, of the physician also. The clearest and the most comprehensive treatise upon anatomy can only be to the learner a useful guide, to the practitioner a reference.

So intimate is the arrangement of the various tissues of the body that only immediate contact with them as they are can begin to convey an idea of the real structure of the human frame. This knowledge is gained by the dissection of the dead body. To dissect a dead body does not consist, as many might think, in hurriedly cutting to pieces the corpse of a person recently deceased. Indeed dissection, as practised in the educational institutions of the day, is by no means as repulsive a practice as might be imagined. It is an unfortunate custom to invest dissection, as well as vivisection, with the most sensational ideas which have no existence in reality. The object in view in both cases is so important, and withal so humane, that men of the finest feelings, recognizing the great necessity, have overcome their repugnance in a matter of sentiment, that they might be enabled afterwards to render not a sentimental but a tangible service to the race.

It was not, however, until the second third of the present century that the government of England came to recognize this fact. Before that time the subjects for dissection were of necessity obtained in a clandestine manner, and at last the abuses became so outrageous that provision was made by the authorities for the legal apportionment of the bodies of certain classes for this purpose.

Many anecdotes are told of Sir Astley Cooper, who when anatomy formed a great part of the work of the medical college, was of a necessity concerned with the "resurrectionists" and was, it must be admitted, one of the main supporters of their practices, with the details of which he was often, no doubt, made acquainted. But as has been mentioned already, the state of the law, which almost made it impossible to legitimately gain possession of subjects for dissection, must be accepted as an apology for much that would now be regarded as unpardonable. "Probably no one knew more of the habits, the crimes and the few good qualities of the body-snatchers than Sir Astley. They exacted at that time almost any price they chose, and if any demur was made promptly stopped the supplies; by which the course of instruction in the medical college was embarrassed. When a resurrectionist got into the toils the surgeons were forced to make great exertions in his behalf, often advancing large sums of money to defend him or to support his family while he was serving his time in prison. The high price paid for subjects led many people of not over delicate sensibilities to offer their bodies for use in this way as soon as they died, provided a consideration were paid to them which they could enjoy while still alive."

The late Dr. Gibney, in his *Recollections of an Old Army Doctor,* thus describes some of the experiences and difficulties of a Student of Medicine at the beginning of the century:

"The room for practical anatomy upstairs was very well attended, and as it was the place where my first attempts at dissections were performed, I own that I did not much like it. The horror of the surroundings, the ghastly look of the dead bodies, mangled and corrupt, legs and arms on one table, trunks and heads on another, bones, often half divided, lying on the floor mixed with various instruments for injecting blood vessels, and old rusty surgical instruments which had served the purpose of operating on dead subjects for many years past, in fact, everything around looked like a charnel house, so that I, quite a young man and a novice, was disconcerted, not to say horrified, at the scene before me. However, I suppose custom like poverty makes one acquainted with strange associates and stranger scenes in the bargain. The older hands exhibited none of this squeamishness. On the contrary, I doubt if there was another place in Dublin where more jokes were cracked, more wit perpetrated, or more fun carried on than in this very dissecting room. In the midst of death, scenes of everyday life constantly passed before us, and to such an indifference had our feelings been subdued, that many of the students living at a distance thought nothing of taking sandwiches or light meals in this dissecting room, and washing all down with good porter clandestinely fetched by Paddy O'Rourke, the attendant on duty.

"This Mr. Paddy O'Rourke was quite a character in his way, and a constant butt for the students, who played all manner of tricks on him, and worried his life out. He was a short and sturdy man, with a broad Irish face almost hidden with red whiskers; his face never being particularly clean, nor were his auburn locks often disturbed by brush or comb. He was decidedly ugly, full of droll sayings, being not only witty himself but often the cause of it being displayed by others.

"In nowhere was he more amusing than when accompanying us on resurrection excursions to some of the neighboring churchyards, his odd ideas and expressions often making a *grave* subject pass off in a scene of merriment. To hasten or frighten some of the younger students he kept perpetually repeating on these occasions, 'Bedad, sir, they're coming,' meaning the watch, or 'Faith, gintlemen, they are upon us now.' We were not always successful in our search, and on one occasion when we were empty-handed, Mr. O'Rourke proposed that we should play a trick on the watch themselves, so as to make them less observant in future. We could not imagine what he was at, but when he spread out the two sacks which we usually carried with us, and suggested that two of us should for a time become occupants of these sacks, and, feigning to be dead, submit to being drawn on our car through some of the principal streets of the city, we were convulsed with laughter, and, entering into the joke, two of our number, first bargaining for some holes being cut in the top of the sacks for the admission of air, were duly packed up, and then drawn over Essex Bridge, of course lying stretched out as stiff as buckram.

"The police, or watchman, saw something suspicious approaching, not in silence, however, but rather boisterously, and at once stayed our further progress. 'Och! bedad, gintlemen, we are cotched, and sure hadn't we better give in dacently?' exclaimed Paddy, loud enough for the constables to hear, who then had taken possession of the car, at the same time directing us to go with them to the station, as engaged in body-snatching.

"After a moment's dispute, and a show of indignation on our part, two of the force got on the car, and smoothly and in silence all went well enough until one of the occupants of the sacks sneezed. However, this appeared to pass unnoticed, but shortly afterwards one of the constables muttered something about a corpse moving, and whilst he was watching for a repetition of this unusual proceeding in a dead body, the other corpse was heard to groan distinctly, the occupant of the sack being nearly stifled through want of air. The constables becoming alarmed, and, like most of the peasantry, very superstitious, could not conceal their terror, and after whispering together, one exclaimed, trembling meanwhile like an aspen leaf, 'Faith! they are coming to life again, and by the holy Virgin it isn't for the loikes of us to be here. We'd best be off and lave these body-snatchers to take care of the craturs, dead or alive.'"

In America at this time the bodies of executed criminals were occasionally furnished by the authorities to the medical colleges; but the chief supply of anatomical material was undoubtedly obtained surreptitiously by robbing cemeteries. Popular prejudice against the dissection of the human body ran very high, and in 1788 the "Doctors' Mob" defied for two days the control of both the municipal and military authorities of New York; while in the same year an enraged populace in Baltimore forcibly wrested from the doctors the body of an executed criminal which they had obtained in a regular manner from the proper authorities.

Until the year 1830 the practice of human dissection was a legal felony in the State of Massachusetts, and as late as 1883 this feeling still lingered in the public to such an extent that when certain idle members of the police force, accompanied by irresponsible newspaper reporters, one night forcibly raided the dissecting room of the Winnipeg medical college, their senseless performance, illuminated by the glowing imaginations of the journalists mentioned, met with much solemn approbation, which would readily have kindled into something much stronger had the busybodies in question succeeded in identifying any of the subjects found.

An amusing story was told a few years ago of a practical joke perpetrated by some of the students of the old Toronto School of Medicine upon one of those public characters who appear in the police court at very frequent intervals upon repeated charges of drunkenness. Having been found on one occasion lying profoundly intoxicated in a public place, it occurred to the wayward youths in question to reverse the proceeding practised once by a certain whimsical nobleman upon Christopher Sly, the tinker, and study the moral effect of a less pleasing awakening from the stupor into which, like

Christopher, he had drunk himself. They accordingly carried him, without being observed in the dusk of the evening, to their dissecting room, which was a gloomy apartment on the second story of the building. Here, entirely stripping him, he was laid upon one of the tables, along with fifteen or twenty other subjects. It would seem that at a very early hour in the morning, upon arousing himself, he was most unpleasantly affected by his surroundings, and took the most immediate possible manner of withdrawing from them. This was by way of the window, through which he leaped violently, carrying glass and all with him. Fortunately the sloping roof of a small veranda broke his fall and deflected him into an alley, whence he retreated with remarkable alacrity. The moral effect of the experience may have very possibly "quite changed his life," for the police court knew him no more; and indeed, beyond a vague legend, current for a time, of a large, fat, naked man draped very imperfectly in an old newspaper, having been seen at an early hour strenuously begging for some of the simpler articles of raiment, no further word was ever heard of this convivial reprobate.

The terrible disclosures relating to the practice of "Burking" in Edinburgh led in 1829 to the passing of the Anatomy Act, legalizing the dissection of human subjects under proper regulations. In other words the *unclaimed* bodies of criminals and paupers, dying in prisons and hospitals and poorhouses, were placed at the disposal of the medical colleges.

The crime of burking which was so influential in bringing this about was a new species of murder, thus named from Burke, the first criminal brought to trial for the practice. His victims were attacked suddenly by night in unfrequented places and killed by pressure, or other modes of suffocation, and their bodies, which exhibited afterwards no actual signs of violence, were sold to the surgeons for what they would bring. Burke was executed at Edinburgh in 1829; as was also in London, a couple of years later, an unscrupulous person named Bishop, together with one of his accomplices, for the murder of Carlo Ferrari, a poor, friendless, Italian boy. The custom had not been confined to these miscreants alone, but had probably been practised extensively by others; nor were the isolated crimes for which these had been brought to justice the only ones of which they had been guilty, for they confessed to many similar murders.

Upon receiving a subject for dissection the colleges place the body with others in a vat of methylated spirits, where it may remain for months before it is disturbed. The alcohol has a peculiar action upon the tissues, so that when the subject is at last placed in the hands of the student it does not decompose, and in fact differs in so many ways from a cadaver recently dead, that even a sensitive person finds it not hard to overcome his repugnance to the practical study of anatomy by this means. Into the arteries a red fluid is injected which, showing plainly though the semi-transparent coats, renders them more readily distinguishable. The parts beneath are then carefully laid open, steel forceps and a scalpel, which is a small knife, with a blade not unlike that of an ordinary pocket knife, being the only instruments used.

As the air fills up every open space in nature, so in the human body all the interstices between muscles, bones and vessels are occupied by these so-called connective tissues. Clearing this away the muscles with their fasciæ, or sheaths, are laid bare. At first their arrangement appears almost inextricable, but week after week of close observation at last serves to indicate the order in apparent disorder, and once carefully learned in this way their arrangement is remembered for years. Months may thus be occupied in dissecting a single part.

Besides learning the mechanism of the human frame, the learner also gathers skill in dividing and manipulating the tissues—skill which in the future he may suddenly be called upon at any moment to employ in saving human life—skill by which in a professional career of only a few years he may be able to save the lives of hundreds—prolonging happiness, averting disaster, and restoring to the home its support or its attraction—skill, which, though giving so much in return, is gained by no sacrifice of life or of happiness to any one—giving all, yet asking nothing.

CHAPTER XI.

THE NEW PHYSIOLOGY.

PHYSIOLOGY embraced originally "a study of the whole course of nature, and included physics and chemistry. It is now restricted to a knowledge of the functions of the animal body in health, while 'Pathology' deals with a knowledge of the functions of the body in disease." The knowledge of the anatomical structure of the human body was originally obtained by dissections of the dead subject. The knowledge of physiology which we now possess has been obtained, for the most part, through experiments upon living animals. This method of experimental physiology is known popularly as "vivisection"; and, though not very clearly understood by the general public, has from the first, and is still, meeting with their vehement opposition; much as did the practice of dissection in the earlier years of the century. So inevitable is the tendency of idle people to interfere in matters of which they have but little knowledge and which are none of their business. Vivisection is by no means as cruel a practice as has been represented by irresponsible writers; though, even if it were, the advantages to be gained by it are sufficiently great to excuse the cruelty; more especially as the constant repetition of each experiment is not necessary; for vivisection, unlike dissection, is not a means of imparting knowledge, so much as a means of discovering scientific principles. The principle once clearly grasped, the further demonstration of the same by experiment is unnecessary. This being the fact it is unfortunate that the public, possessed only of a half knowledge of the matter, should attempt to place any obstacles in the way of legitimate scientific enquiry.

Yet some recent writers seem to have deliberately adopted the "horrors" of vivisection as a part of their literary repertoire; not because they care anything about it, or indeed know anything about it, but because it ministers to a prevalent taste for the morbid, and gives the writer an opportunity for exercising his descriptive powers. For an example of this one may turn to the "moving lay" of an English minor poet, who sings of the physician and his favorite dog. The latter cannot be induced to leave the side of its master, and exhibits all the admirable traits which are usually observed in a good dog. Without any very exact suspicion of what is before it, the dog continues through sundry stanzas to bound about its master, wagging its tail. The master, however, is interested in a scientific question, and suddenly (to the great surprise of the dog) catches up his former pet and straps him closely to the table. The poet and the reader of the poem are both naturally very much shocked at this. Then the unfeeling physician proceeds to try a number of painful experiments upon the dog, at which the dog howls. The nature of the experiments is, in true pre-Raphaelite style, left entirely to the imagination of the reader; though, as a suitable closing, the physician is pictured as gloating, ghoul-like, over the pangs of the faithful animal.

As a matter of fact, when it is thought that vivisection will alone throw light upon a vexed question, as much kindness is shown by the responsible investigator to the comfort of the animal as to the comfort of a patient about to be operated upon. Often it is not necessary that the animal should die at all; but when it is, it may be looked upon as a survival of a human custom, as old as man, as old as fear and as old as religion—the custom of sacrifice. But the sacrifices of science to human suffering are not cruel but kindly. Contrast with a modern scientific experiment the immolation of Polyxena or Iphigenia.

Now if this physician in the poem had wished to make an experiment on a dog, he would very probably have chosen some person else's dog for the purpose, or some unattractive little dog that belonged to no one. The very fact that the dog mentioned was so faithful and affectionate indicates the kindness of the treatment formerly experienced by it, and renders it very improbable that the same master would gloat over its sufferings. But writers who make a "specialty" of pathos are not always consistent. In a much similar strain there recently appeared a very "touching" story of a little sick girl's dog. The dog was called Loveliness, and seems, like commoner dogs, to have strayed or been stolen. It was eventually purchased by a medical college for the purpose of making an experiment upon it. The hearts of the readers, having been for a suitable time racked by an able description of the child's sorrow at the loss of her pet, are, at the proper moment, soothed by the gratifying intelligence that the dog had been found at the last moment in the hands of the wicked, conscienceless, abandoned old professor, and by him, with sullen reluctance, had been restored to the little girl. If this improving narrative had any foundation in fact it is altogether probable that the college authorities were quite as pleased to return the dog to the original owners as the latter were to receive it. And as far as the dog was concerned it is certainly fortunate that it fell into the hands it did, instead of the net of the public dog-catchers appointed by most civic authorities, who every year, as is well known, destroy large numbers of ownerless and unclaimed dogs for fear they might be in the way or become a nuisance. To adhere strictly to plain prosaic facts would, however, have spoiled the story, and not being by their trade confined to facts, it has suited the literary ends of the writers mentioned to introduce sinister motives and Mephistophelian antics. As actually practised by learned societies and institutions of learning, vivisection too closely approaches the commonplace to be amenable to literary treatment; and hence it was necessary that the stage accessories mentioned should be furnished gratuitously from the febrile imagination of the author. In a word, the popular literature against vivisection has been as stupid as the popular crusade against it.

Claude Bernard, one of the most kindly and lovable men who ever lived, and a man, furthermore, who has done infinite service to the human race by his discoveries, lived at a time when physiology, far from receiving any assistance, was persecuted and reviled, though chemistry, provided with adequate laboratories, was rapidly advancing.

"In those days," Bernard remarked, "the physiologist had need of a real passion for his science, and, in order to ward off fatal discouragement, had to possess his soul of high courage and general patience. So soon as a physiologist was discovered he was denounced, and was given over to the reproaches of his neighbors and subjected to annoyances by the police.

"About 1844," he continues, "I was studying the digestive powers of gastric juice by the help of the method introduced by Blondlot, namely, that of collecting gastric juice by means of a cannula, or sort of silver tap, fitted into the stomach of a live dog in such a way that the health of the animal does not in the least suffer thereby. Just then the celebrated surgeon of Berlin, Dieffenbach, was on a visit to Paris, and hearing of my experiments through my friend Pelouze, he was anxious to witness the operation of the introduction of the gastric cannula. Informed of this wish I hastened to gratify it, and performed the experiment on a dog in the chemical laboratory which Pelouze then had in the Rue Dauphine. After the operation the animal was shut up in the yard of the laboratory in order that we might examine it again later on. But on the morrow it was found that the dog had, in spite of precautions, escaped, carrying still the accusing cannula of a physiologist. Some days afterwards, quite early in the morning before I had got up, I was visited by a person who came to tell me that the police commissioner of the quarter of L'Ecole-de-Médicine wanted to speak with me, and requested me to call on him. In the course of the day I presented myself at the police office in the Rue du Jardinet. I found there a little old man of a very respectable appearance, who received me very coldly, and at first said nothing. Then, taking me into an adjoining room, he showed me, to my great astonishment, the dog on which I had operated in Pelouze's laboratory, and asked me if I admitted having placed in the dog the instrument which he still bore. I replied in the affirmative, adding that I was delighted to find my cannula again, for I had given it up as lost. My answer, however, instead of satisfying the commissioner, appeared to anger him, for he addressed to me an admonition couched in the severest terms, accompanied by threats at my audacity in having taken his dog to experiment on. I explained that it was not I who had taken his dog, but that I had bought it of the men who were in the habit of selling dogs to the physiologists, and who stated that they were employed by the police to collect stray dogs. I added that I regretted having been the involuntary cause of the pain which the misfortune of his dog had caused him, that the animal would not die of it, and that there was only one thing to do, namely to let me take back my silver cannula and for him to keep the dog. These last words at once made the commissioner change his manner of speaking, and completely appeased his wife and daughter. I removed my instrument, and on leaving promised to call again. In a few days the dog was completely cured, I became the friend of the commissioner, and could henceforward count on his protection."

Johannes Müller was one of the most distinguished of the German physiologists. After nine years spent at Bonn, he was removed to the University of Berlin in 1833, where he filled the chair of Anatomy and Physiology until his death in 1858. He made numerous researches in various departments of physiology, giving particular attention to the mechanism of the voice and speech, and also of the phenomenon of hearing. He also extended his enquiries into the chemical and physical properties of the blood, chyle and lymph. He is to be remembered, however, not so much as an original investigator as a profound and independent thinker in physiological science. The contributions to physiology had since the time of Haller been numerous, but in 1830, when Müller may be said to have begun his labors, he proceeded to reduce the mass of miscellaneous facts to order, and to draw from them general principles. He also directed physiology into the new lines of research which were indicated by the brilliant discoveries which had been already made in chemistry and physics since the beginning of the century. Müller, therefore, may be regarded as the founder of modern physiology, and the appearance of his great work on the elements of physiology, which was published in 1837, was the beginning of a new period. In this work he showed great ability in marshalling facts and reasoning philosophically upon them. The most important part of his work was in dealing with the nervous action and the mechanism of the senses. Here he laid down the principle, never before recognized, that the kind of sensation following irritation of a sensory nerve does not depend on the mode of irritation but upon the nature of the sense organ. Thus different forms of irritation, whether pressure, light or mechanical irritation, acting upon the retina of the eye, all alike produce luminous impressions. On the other hand, when the same stimulus is applied to different sense organs, entirely different sensations are called forth, according to the nature of the organ upon which it is exhibited. This has sometimes been termed the law of specific nervous energy.

Like the other investigators of his time, Müller was a vitalist; but to him vital force was something different from the forces of lifeless nature; its administration following physico-chemical laws, so that his whole endeavor was to explain vital phenomena mechanically. In doing this he uniformly went over the entire field of vital activity, and by his own investigations laid the foundations upon which physiologists work to-day. Keeping the grand end of science constantly in view, he regarded special methods critically, and only as a means to an end for arriving at a harmonious comprehension of nature. Throughout his whole life he remained steadfast to this philosophical conception of science. Instead of avoiding psychology he regarded physiology as an essential to its advance, and in his examination for the doctorate defended the thesis "*Psychologus nemo nisi physiologus.*" Soon after his death physiology became divided and directed along purely chemical and purely physical paths.

"Physiological chemistry is simply an explanation of certain phenomena which are constantly occurring in the human body by the laws of chemistry. For example the change which takes place in the dark blood from the veins upon being forced into the lung from which it presently emerges, changed in color to a bright red and changed also in many other ways. The oxygen of the air with which the blood has come in contact while in the lung has caused this change. It is a chemical change. It is dependent upon definite chemical laws. Venous blood, as a definite substance, independent of its existence in the animal body altogether, would inevitably undergo the same change wherever it might be brought into contact with oxygen. It is simply, then, a chemical law acting in the body as it would act any other place. The same applies to the phenomena of digestion, which is also a series of chemical changes.

"Physical Physiology, on the other hand, explains certain physiological phenomena by the laws of

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physics. The entrance of air into the lung for example. This happens in definite accordance with the known laws of aerodynamics. This phenomenon does not happen because it is necessary to life that it should happen, and, as it were, out of compliment to life. It happens because the breathing apparatus supplies, with the atmosphere, all the conditions necessary for the action of this law. The same may apply to the motion of the blood through the vessels. This also is accomplished by a fixed physical law of hydrodynamics. So also the movements of the arms and legs follow mechanical and mathematical laws, especially the laws of the action of levers."

In the year 1828 Wohler gave to the old theory of Vitalism its deathblow. Up to this time it had been claimed that substances which were produced in the body were produced only through the activity of vital force. Wohler, however, succeeded, in the face of this notion, in manufacturing artificially in his laboratory, and from inorganic or mineral materials, a substance known as urea, a very characteristic material product of the animal body which had never before been produced artificially outside of the body. This synthesis, or bringing together of the constituent parts to form a definite compound, was soon followed by others.

Justus Von Liebig established other new views regarding metabolism, or the chemical changes which take place in the body, and within each separate cell of the tissues. This eminent chemist had studied chemistry in Paris under Gay-Lussac, and having induced the Darmstadt government to build a chemical laboratory at Giessen, he carried on there, for many years, while engaged as ordinary professor of chemistry, many very valuable experiments, of which those which have a bearing upon physiology are of particular interest in the present connection. His investigations into the relations of organic chemistry to physiology led him to the conviction that the only source of animal heat is the heat produced by the oxidation of the tissues. This view he had to defend against the strenuous opposition of his medical critics. He also succeeded in abolishing the belief in the possibility of the spontaneous combustion of the human body.

In the physical direction the movement was led by Ludwig, Weber, Helmholtz, du Bois-Raymond, Maray and others. Ludwig invented a mechanical contrivance by which the pressure rhythm of the pulse, manifest to a certain degree to the unaided touch, could be accurately indicated upon the smooth surface of paper moving at a fixed rate. The introduction of this graphic method subsequently proved of the greatest use in the representation of muscle contraction, or respiratory movements and of the heart beat. Maray in France developed the principle to completeness, so that at the present time it serves as the most important method of investigation in all the researches that deal with the phenomena of appreciable movement in the living organism.

In his researches upon the general physics of muscle and nerve E. du Bois-Raymond established also a method which became of the utmost importance in physical physiology. This consisted in the stimulation of living animal tissues by the galvanic current. The ingenious investigations of Helmholtz along other lines led to discoveries regarding the physiology of the sense organs which cast a new light upon the problems of psychology.

The physiology of the central nervous system was perfected by the labors of Hitzzig, Horsley, Flourens and others; and subsequently chemical investigations led to a recognition of the law of the conservatism of matter. This was applied by Robert Mayer to the energy of organisms, and the calorimetric, or heat-measuring researches of Helmholtz, Rosenthal and others have afforded experimental proof that this law is as true in living nature as in lifeless.

Physiological thought was also advancing in England during the first half of the century, for it was in England that Sir Charles Bell divined what Magendie in France afterwards definitely proved: that there are two entirely different systems of nerves in the body, just as there are two entirely different systems of blood vessels. There were the nerves bearing impressions outwards from the brain, and causing motion in remote parts of the body, and hence called *motor* nerves, and the nerves carrying impressions from remote parts of the body to the brain, and hence called *sensory* nerves. The nerve, by the agency of which one causes his finger to move, is an altogether different nerve from that which bears to the brain a sensation of cold or of pain in the same finger. The first carries force or electricity from the brain, the other carries force to it.

The first record of Sir Charles Bell's experiments in regard to the nervous system occurs in a letter writen in 1807 where he remarks, "I have done a more interesting *nova anatomia cerebri humani* than it is possible to conceive." This he developed gradually into an introduction to the nervous system; but does not appear to have been struck by the importance of the discovery upon the track of which he found himself, for he seemed to be more deeply interested in obtaining the professorship of anatomy then vacant at the Royal Academy. It was not, therefore, until four years later that he privately circulated his pamphlet under the title, *An Idea of a New Anatomy of the Brain.* From the friends among whom this was circulated the author received very meagre appreciation; some seeing nothing of moment in the ideas put forth, others carelessly regarding them as incredible, and all promptly dismissing the matter from mind, after a careless perusal.

He subsequently carried his experiments to the nervous apparatus itself. A study of anatomy reveals the fact that from the brain a large bunch of nerve fibres descends within the vertebral column. This is called the spinal cord. Upon its course branches are given off in pairs upon each side, which supply the human frame. Of these pairs on each side one lies in front of the other. In his experiments Bell directed his attention to these nerves. The first hasty outline of the result is as follows: Experiment 1. "I opened the spine and pricked and injured the posterior filaments of the nerves—no motion of the muscles followed. I then touched the anterior division—immediately the parts were convulsed." Experiment 2. "I now destroyed the posterior part of the spinal marrow by the point of a needle—no convulsive movement followed. I injured the anterior part and the animal was convulsed."

It was at once inferred that the anterior root of the spinal nerves was motor in its functions, the posterior root, sensory, and this simple fact modified the physiology of the whole subject. In 1821 Bell's first paper on the nervous system was read before the Royal Society, and was received with great approbation, after which it gradually became known throughout Great Britain and on the Continent; being by almost every one acknowledged as strikingly original. Bell furthermore demonstrated what is known as the "muscular sense" by which the qualities of closely surrounding objects are perceived, and the muscular apparatus of the eye also received his attention.

Close in the footsteps of Sir Charles Bell came Marshall Hall, who possessed the true scientific instinct. A successful practitioner, a profuse writer upon a number of subjects, he was above all an original investigator in the physiology of the nervous system. Sir Charles Bell possessed in a large degree that quality which has sometimes been designated as scientific imagination, and of which some of the greatest scientific discoverers have been found to be possessed. Together with this scientific imagination, however, Hall had what Bell had not, the unabating fervor and zeal of the worker, the mechanical ingenuity, and the ready invention of the great scientific investigator.

His career was not a peaceful one. Even at this day to open a book of his is to presently catch the tumult of dispute in which he lived, somewhat softened and indistinct in the distance, it is true, but no less unmistakable. Soon one feels that he is in the presence of a man inspired by a new and great truth and fighting desperately against an organized mob for its recognition.

After a brilliant college career and a few years of successful practice at Nottingham, he removed to London, having already published an admirable treatise on Diagnosis. Researches commenced some time previously were tirelessly continued; but from the first he met in London with an antagonism, churlish, outspoken and unanimous. The hospitals and colleges of medicine were closed to him, and even the Royal Society repeatedly rejected his scientific communications, though their great importance was almost immediately recognized by the leading scientists of the time upon the Continent; by Flourens in France and by Johannes Müller in Germany, in whose *Archiv* a translation of one of Hall's monographs appeared.

This was the same prejudice which was extended, during their lifetime, to many other of the greatest minds which adorned England. To drag sectarian rancor into politics has been sufficiently deplored, but to dwell unremittingly upon personal considerations, when a scientific question is involved, seems almost incredible. The fact that Hall was a nonconformist in religion had surely no connection with the nervous system to which his researches had been extended; yet the literature of the time suggests an ecclesiastical controversy, with an excess of the *odium theologicum,* rather than the statement and criticism of a scientific discovery. The truth of Hall's teaching, however, is now admitted in England itself, though for years accepted by the world at large.

It was while he was examining the circulation of the blood in the newt's lung that he noted the fact from which his great discoveries arose. The newt's head had been cut off; thus its life in the ordinary acceptation was destroyed. The tail was afterwards separated: "I touched the external integument," Hall explains, "with the point of a needle; it moved with energy, assuming various curvilinear forms. What was the value of this phenomenon? I had not touched a muscular nerve. I had not touched the spinal marrow. I had touched a cutaneous nerve. That the influence of this touch was exerted through the spinal marrow was demonstrated by the fact that the phenomenon ceased when the spinal marrow was destroyed. It was obvious that the same influence was reflected along the muscular nerve to the muscles, for the phenomenon again ceased when these nerves were divided." And thus he had the most perfect evidence of a reflex or diastaltic, or diacentric action.

The principle here indicated is very far reaching, and is to be found in many of the physiological operations of the body. For example, upon touching a hot stove one withdraws his hand before he has had time to reason out in his mind the advisability of doing so. Upon the same principle the eyelids are swiftly shut upon the approach of an object from without. By a long course of careful experimentation Hall was eventually enabled to explain the phenomenon of reflex action, in itself, when examined, most remarkable, yet of so common occurrence in everyday life as to have escaped notice up to that time.

To show how bitter was the hatred felt for the brilliant scientist by his contemporaries in England, his works, when presented to the medical reviewers of the time, were contemptuously placed in the hands of mere students to criticize and malign. Among others, Carpenter, who afterwards became known as the compiler of a convenient text-book upon physiology, distinguished himself during his pupillage by certain puerile attacks upon Marshall Hall.

It would seem that these youthful writers laid great stress upon the fact that something similar had been observed by Whytt and Prochaska. "But," Hall points out, in the Preface to his *Diseases of the Nervous System,* "I observed that in their hands (Whytt and Prochaska) they had remained useless and sterile; having led to no conclusion;—having neither been traced backwards to any *physiological principle of action,* nor forwards to any *function in the animal economy.* I conceived it impossible that any such phenomenon should exist in nature without such connection, and I resolved to pursue the subject.

"Such," he goes on, after a résumé of his system, —"such is the system which my researches have unfolded and established, in the midst (I am sorry to say) of every kind of opposition, which malevolence and jealousy have been able to invent. My second Memoir on the Nervous System was refused publication by the Royal Society. My various publications were allowed to be criticized by a set of youths."

In 1841, however, assured by the authority of the great physiologists of Germany and France, that the discovery of Marshall Hall was indeed one of great moment, and knowing that it would be safe, therefore, to acknowledge him, and a course not without a certain distinction to be the first to acknowledge him among his own countrymen, Thomas Watson, who had never made a discovery of any kind whatever himself, but enjoyed a great fame by reason of his eloquence and general respectability, as soon as he saw it was *entirely safe* to do so, and no sooner, set the seal of his benignant sanction upon the work of Hall in the following words:

"It is no part of my purpose to enter into any history of the steps by which this curious problem has been worked out. Its solution is an achievement of our own time, and I may add, of our own country. I profess no more than to sketch in mere outline the leading facts that have been ascertained, yet I must in passing pay the tribute due to one indefatigable laborer in this department of science, whose sagacity has enabled him to seize the clue, and in a great measure to unfold the mazes of the labyrinth in which this part of the physiology of the nervous system was so long entangled. Dim and uncertain glimmerings of the truth appear in the writings of bygone authors, but it was never clearly discerned and clearly stated, until the publication in 1832 of Dr. Marshall Hall's ingenious and most interesting researches."

Eighteen years afterwards justice was also done him in the *Cyclopædia of Anatomy and Physiology,* where the editor, Dr. Todd, speaks thus of Hall's death: "Though a veteran in science he had finished his career before he had reached the ordinary limits of human life. His name must always occupy a prominent position in the annals of physiology."

In the same place the editor admits that in the publication of this gigantic Cyclopædia he has been "often dilatory, sometimes vacillating, occasionally *appalled* by the magnitude of the undertaking," which had been commenced twenty years before. That he should have been appalled is certainly quite reasonable. The work in question is a characteristically English performance. In a country where the respect for books is so profound that there is a general tradition that all knowledge is to be found in them, the birth of a new science, about which there were no books, at once suggested the need of a book which would treat of it, and, in proportion to the need, so should the book be in size. The need was great, and the book was therefore an encyclopædia of six vast volumes. Commenced, as we have seen, at a time when the subject was in its infancy, the only place from which many of the writers were able to draw material was from their inner consciousness, and after many painful attempts a number discreetly deserted, with all the dignity that was possible, so that, as the editor sorrowfully complains, "the immediate sale of the book was injured and the editor himself exposed to charges of violation of promises."

Many of the writers must have felt as they helplessly meditated upon the gloomy task which they had too willingly undertaken, much as Romulus would have felt had the first citizens of Alba Longa demanded of him that he should write *at once* (in six volumes) the *History of the Decline and Fall of the Roman Empire.* To me this large Cyclopædia of Physiology, with all its dull pretentiousness and all its sombre respectability, always seemed like one of the sublime jokes of history—and one of the very few that will ever call a smile to the face of Science. How so many thousand closely printed pages ever came to be written is perhaps a question that can only be answered when the graves give up their dead. But the evasive methods by which a few pages came *not* to be written are an easy discovery. One of Dr. Todd's sages had promised to write an account of the physiology and anatomy of the kidney, and for some time, no doubt, enjoyed complacently the distinction which the Prospectus gave him. But Prospectuses are not always what they seem, for they sometimes indicate what is to be done as if it were already accomplished. The article on the kidney was still to be done. However, the letter *K* is pretty well on in the alphabet, and the Cyclopædia was alphabetically arranged. In due time, however, the editor was upon him, and the sage, grown desperate, saw his way to a short reprieve. In a *learned* work, he insisted, the Latin name should be adopted, and the Latin for kidney is "Ren." By this means the punctilious scholar enjoyed well-earned repose while the monster Cyclopædia slowly dragged on from *K* to *R*. Then again came the long-enduring Todd to claim from the sage his article on the kidneys. But he didn't know anything about the physiology of the kidneys, for it was not clearly understood till some years later, and he didn't know anybody who did, and he didn't know where to apply for aid, and the evil day was no longer to be put off. So, like our first parents, he was driven by the avenger from the garden of the Prospectus, and another happier mortal put in his place. The confidence of the second in himself was short-lived, for he also discovered shortly that he didn't know anything about the physiology of the kidney. The confidence of Dr. Todd in others had also come to an end, for the first dismissal was promptly followed by a second and third, until at last he discovered a man of genius who could produce something which looked just as good as what was really wanted. When it is remembered that the average person does not very clearly comprehend the literature of science the method will be understood by which it is possible to produce something which, without being scientific in the remotest degree, has, as far as the general public is concerned, a striking resemblance to, and quality with, the authentic literature of science.

From this spectacle, ridiculous in its helpless pomposity, one turns, not without a sense of relief, to the French school of Physiology. To Reil and his Vitalistic doctrines, with which physiological notion the century began, we have already traced the activity of the French in a branch in which they were for a time pre-eminent, and of which, indeed, a large part even at the present day remains of their contribution.

To a certain extent the influence of two very great Frenchmen operated for a time in a way unfavorable to the advance of physiology, and in a manner kept it back. Cuvier, the great anatomist, was, as an anatomist, so impressed with the importance of the mechanical explanations offered as solutions of anatomical problems, that he was led to depreciate any chemical explanation offered as a solution of a physiological problem, and so, by his influence, supported the vitalistic views. Bichat also, though he helped in a great degree to make physiology an exact science by expounding the idea that the life of the body as a whole is but the combined and adjusted lives of the constituent tissues, so far missed the purport of Haller's teachings as to base his whole exposition upon the idea that vital manifestations are the result of a conflict between vital forces on the one hand and physico-chemical forces on the other; that these are essentially antagonistic to each other, the chemical forces having untrammelled play only where the vital forces have been obscured by death.

Experimental inquiry into the phenomena of life was naturally discouraged by a practice of vaguely attributing to an indefinite vital force all that could not be readily understood, and though subsequent thinkers went so far as to declare that some of these phenomena of life are the outcome of chemico-physical causes which might be explained by experimental methods, all that remained still continued to be regarded as a part of the vital principle whose causes "mock alike," to use the words of Magendie, "our conceptions and our curiosity."

Yet Magendie during the first half of the century was justly acknowledged as the physiologist of France. From the very commencement of his career in 1807 he was engaged in constant experiments, and did in France with his own hands more than was being done by all the physiologists of other lands. His contributions to physiological science were numerous and important. Driven by the transcendental discussions of the vitalists and theorists of the day almost to the other extreme, he arrived, to use the words of Sir Michael Foster, "almost at the position of substituting experiment for thinking," and often carried these on at hazard without any very intelligent idea of the object in view, but with a fervent hope that something might come of it. "Every one is fond of comparing himself," he says, "to something great and grandiose, as Louis XIV. likened himself to the sun, and others have had like similes. I am more humble. I am a mere street scavenger of science with my hook in my hand and my basket on my back, I go about the streets of science, collecting what I find."

By a series of most ingenious experiments Bernard somewhat later threw an entirely new light upon the glycogenic functions of the liver. Interested in diabetes, a disease where sugar is excreted, and observing that sugar when acted upon by the gastric juice was changed into glucose as a necessary preparation for its utilization by the tissues; and knowing also, as Gmelin had shown, that in the alimentary canal starch also is converted into glucose before being absorbed, Bernard asked himself what became of this glucose (diastase) into which all the carbohydrates were transformed.

Feeding a dog with a substance rich in sugar, he examined the blood in the veins coming from the liver when digestion was at its height. An abundance of sugar was found. It was not in the liver therefore that the sugar disappeared. Another dog he fed on meat only, making sure in the first place that no glucose was present. To his utter astonishment he discovered, upon examining the veins, that the blood was loaded with sugar.

"Why," said he, "if I have made no mistakes, I have in this experiment come upon the production of sugar—the liver produces sugar." After further experiments he felt justified in making known to the world that the liver was capable of producing sugar not brought to it as sugar in the food; that sugar made its appearance in the liver itself by an act which seemed very analogous to the act of secretion by a secreting gland, and which therefore might be spoken of as an internal secretion.

In Italy also, as well as in Germany, England and France, already mentioned at length, physiology was cultivated and with results far beyond what the political difficulties of the time would lead one to expect. Here, where in later years more than one branch of science was illuminated by Italian thought, Spallanzani and Fortuna achieved much under influences the most adverse; and Matteuci also, though in the ordinary lines, was carrying on researches of a substantial value.

CHAPTER XII.

ADVANCES IN CHEMISTRY.

BETWEEN the healing art and the science of chemistry the relationship has always been very intimate; indeed one of the two great schools of medical doctrine, the iatro-chemical, which flourished in the seventeenth century, was based almost entirely upon the principles of chemistry; while, coming down to our own day, chemistry has not only accomplished much already in explaining the mysteries of physiological transition; but it is to chemistry that medicine must still look for the ultimate explanation of much that is at present confused or unknown.

The history of chemistry is as old as that of medicine; and, like the latter, was associated in its incipiency with various forms of imposture and superstition. During the middle ages it formed a part of the art of magic, and a certain knowledge of chemistry was also possessed by the alchemists. That the way of the magician was hard, moreover, may be gathered from the fact that Roger Bacon, a worthy cordelier of the thirteenth century, who was surnamed the Admirable Doctor, was imprisoned upon an accusation of magic having been preferred against him. The common people, then as now, dreaded and feared everything that they could not understand. Bacon was said to have invented the camera obscura and gunpowder, and in many ways seems to have possessed accomplishments which it was hardly wise at that time to possess, when there was on all sides a firm belief in witchcraft and demonology.

In the early part of the sixteenth century Paracelsus, a Swiss physician, brought chemistry into the service of medicine, and, while greatly benefiting medical practice by his labors, gave to chemistry at the same time a prominence which it had not before enjoyed, except in a bad sense. This impetuous man, Fourcroy remarks, pretended that there existed a "universal remedy." He substituted chemical medicants in the stead of those of the Galenical pharmacy then in use, and cured many disorders by mercurial preparations which were then deemed scarcely curable. His miraculous cures seemed prodigious; but, transported by success far beyond the bounds within which he ought to have confined himself, he publicly burned the books of the Greek physicians. He died in the midst of his triumphs in an inn at Salzburg, at the age of forty-eight years, after having promised himself immortality by the use of his medical secrets. This folly, highly extravagant as it was, revived the ardor of the alchemists. Some among them, who vainly imagined they had succeeded in the discovery of the universal medicine, dignified themselves by assuming the new title of "adepts." Some of the promoters of chemical science subsequent to Paracelsus were not entirely cleared of the ideas his ungoverned imagination gave birth to. Such were Cassius, known by his precipitate of gold; Sir Kenelm Digby, who believed in the sympathetic action of medicaments; Libavius, whose name is prefixed to a preparation of tin; Van Helmont, famous for his opinions in medicine, and the chemical notions he propagated; and lastly, Borrichius, who first discovered the method of inflaming oils by nitrous acid.

Chemistry had not as yet been treated philosophically. The chemical arts had been described, medical formulæ had been given, and the nature of metals had been laboriously inquired into with a view to the making of gold, or of the universal medicine; but nothing more had been done. To Joachim Beecher, of Spires, and to Stahl, however, chemistry owes the introduction of the first consistent theory of the constitution of compounds and of chemical action. The former, struck with the wonderful property certain bodies possess of producing fire, concluded that combustion depended upon a particular principle which he called Inflammable Earth. J. Ernst Stahl, whose attention was strongly fixed on this doctrine, imagined that this principle was pure fire, or the matter of fire fixed in combustible bodies, and gave the name of Phlogiston, or the inflammable principle, to this element when in a nascent state, or a state of combination, in order to distinguish it from fire in action, or in a state of liberty. All substances from which fire could be produced, that is, everything which would burn, was supposed to contain Phlogiston, which remained inactive until the substance was kindled; when the Phlogiston concealed within it was supposed to be set at liberty, and to make its appearance in the form of fire. Though essentially incorrect, this theory was far in advance of the ancient doctrine which divided all material matter into four elements, air, fire, water and earth; upon which Boerhaave composed a scientific work which enjoyed great celebrity in his time.

Stahl, however, overlooked the influence of air in the phenomenon of combustion, a fact to which Boyle and Hales called attention. From a large number of substances the latter had obtained a "fluid" (the term gas was of later introduction) which he supposed to be air, and which led him to the conclusion that air was the cementing principle, or cause of solidity in bodies. The experiments of Priestly and Bayen, and especially of Lavoisier, proved, furthermore, that a portion of the air becomes combined with such bodies as are calcined or burned; and in consequence of all these discoveries a new sect or class of chemists arose who began to doubt the presence of Phlogiston; and attributed to the fixation of air, or its disengagement, all the phenomena which Stahl had supposed to depend on the separation or combination of Phlogiston. From this hypothesis was developed the Pneumatic Chemistry of the early part of the century. For many years the dispute continued between those who upheld the phlogistic theory of Stahl, and the adherents of the pneumatic or anti-phlogistic theory. In the establishment of this system, Lavoisier was assisted by Fourcroy, who, in his chemical writings, states in full the facts advanced by both sides.

The *caloric* of the French chemists of the time is synonymous with the *igneous fluid* of Lavoisier and the *matter of heat* of La Place. These terms are used to indicate a particular quality of matter which was supposed to exist under a variety of modifications that were mutually convertible. One of these modifications was free caloric, in which state animals are affected with the sensation of heat. Dr. Black proved that the causticity acquired on ignition by magnesia and lime was attributable, not to the entrance into them of ponderable caloric, but to the expulsion of a peculiar kind of air which occurred fixed, or in a state of combination, in unburnt, or mild, earths, and caused them to be heavier before than after exposure to heat.

Priestly's discovery of oxygen at the close of the eighteenth century has already been mentioned. Priestly was a supporter of Stahl's phologistic theory, and, failing to grasp the real significance of his own discovery, remained to the last a firm adherent to that doctrine. It is thus reasonable to say that though by a blundering accident which took place in his hands oxygen was generated, he was not the real discoverer of that element. To the gas evolved he applied the term *Dephlogisticated Air,* believing that the phlogiston evolved in the burning of combustibles united with the dephlogisticated air contained in the atmosphere. It is hardly possible, therefore, that he ever properly estimated the profound importance of the discovery which he had made; though from the discovery of oxygen the whole fabric of chemical knowledge may be said to have had its beginning. Another firm believer in the phlogistic theory was Henry Cavendish, an English chemist, who was the first to call attention to the importance of ascertaining the specific gravity of the various gases. The radical difference also between hydrogen and nitrogen was established by him.

The Atomic Theory of Democritus, assailed subsequently by Anaxagoras and defended still later by Lucretius, in his poem, was in 1808 revived by Dalton in his *New System of Chemical Philosophy,* as affording an hypothesis by which the composition of compounds could be conveniently explained and represented, and one which, it may be added, has subsequently proved of the utmost utility in the formal logic of chemistry. The same year Gay Lussac announced his discovery of the laws of the combination of gases by volume. He pointed out that there is a simple relation existing between the volumes of two gases, which unite together, and also between their collective volume in the uncombined and in the combined condition. For example, one volume of chlorine with one of hydrogen always forms two volumes of hydrochloric acid gas. The law of definite proportions was found to hold good also with respect to the weight, as well as the volumes, of the combining bodies.

In 1811 Avogadro enunciated the hypothesis that equal volumes of any gas or vapor contains the same number of atoms; and Berzelius, from considerations based upon the law of combination by volume, accounted the atoms of elements distinct from their equivalents. Thus two volumes of hydrogen were recognized as the equivalent of one volume of oxygen. In 1834 Faraday discovered that the decomposition effected by the voltaic current indicated the quantity by weight in which the elements combine. These fundamental laws, having been once clearly demonstrated, the chemist found himself upon the outer bounds of an altogether new world. The traditions of the past were laid aside; and, with the key already placed in his hand, the chemist had only to open the door to a wonderland of scientific truth which until the nineteenth century had been unseen, undreamed of.

The changes which take place in matter were again examined; and it was observed, for example, that when a piece of iron underwent the change known as rusting, its weight was increased. This indicated that something had been added to it. The iron had combined with the oxygen in the air to form a compound of iron and oxygen; and the iron was increased by the weight of the oxygen which had combined with it. When a piece of marble was heated, however, it lost weight; for during the heating a certain amount of carbon di-oxide gas had been given off which left the calcium decreased in weight by the weight of the gas. It was seen that the changes were essentially different in character; the first being one of composition, the second of decomposition. It was furthermore observed that iron could only undergo the first class of change, that of combination with some other substance; and that it was incapable of being decomposed by any known means. Further investigation showed that there were a number of other substances which also possessed this remarkable property. This discovery led to the eventual division of all matter into two great classes: the *Elements,* which, like iron, could not be further decomposed into two or more still simpler substances; and the *Compounds,* which were composed of elements in combination, into which simpler forms they were capable, by one means or another, of being decomposed.

During the remainder of the century chemical experiments were carried on with great activity; the science being greatly encouraged and facilitated by the laboratories which were established by various governments and institutions of learning. Many of the most brilliant scientists of the time were led to devote their lives to this branch of research. One element after another was discovered by the chemists already mentioned, and by others. No astronomer could more diligently sweep the heavens by night for some wandering asteroid or new planet than did the chemist in his laboratory ransack the world of matter for a new element. The list, which at present numbers sixty-nine, is subject to constant revision, owing to the new light which is being by each new experiment thrown upon the subject. Subsequently, by means of the improved spectroscope, the science of chemistry was boldly carried from the earth to the very stars which circle in the skies, and to the sun itself. These remote bodies were composed, it was discovered, of the same elementary substances which constitute the earth.

More closely touching medicine, however, than either stellar or solar chemistry, is the chemistry of vegetable and animal life, or Organic Chemistry, which has already been referred to in the chapter on physiology; upon the chemical aspect of which science so much light was thrown by Justus Liebig and Wohler.

Parallel with this may also be mentioned the service which chemistry has rendered to the useful arts. The preparation of the aniline dyes alone may be said to have marked an epoch in pathological and bacteriological research; for by the use of these coloring agents a process of staining was instituted by which it was possible to observe through the microscope the cellular arrangement of tissues as well as the presence of micro-organisms. The old pharmacopœia also underwent sweeping changes. Chemistry cast a new light upon the composition and manufacture of drugs, and afforded improved processes for their preparation, besides discovering many entirely new remedies.

In the early part of the century iron, opium and "bark" were the most important remedies in the pharmacopœia. The preparations of these drugs then in use were extremely crude and not always of a definite strength. The pharmaceutical chemist, however, has succeeded in extracting from the crude gum opium the various substances from which its action is derived, and in a chemically pure state. The quinine, cinchonine, cinchonidine and other alkaloids obtained from Peruvian bark have similarly superseded the use of the crude bark itself. The preparations of iron are now innumerable. Some are claimed to possess peculiar virtue from the fact that they are obtained from the animal kingdom; others still greater virtue because obtained directly from the vegetable kingdom.

Indeed, in the preparation of pharmaceutical novelties, many of which are only ephemeral, there may be said to have been of late years an excess of chemical ingenuity expended, which has somewhat weakened the effectiveness of medicine by adding too lavishly to its armamentarium. The scientific physician uses but a small number of drugs, and those only in moderate quantities. On the other hand the very great variety of drugs recently introduced into the pharmacopœia somewhat confuses the inexperienced practitioner, in whom, during his scientific studies, a sense of credulity is sometimes found to have been developed which eagerly accepts the most preposterous statements if presented and recommended in the technical verbiage of conventional medical literature.

The difficulty of obtaining some drugs which were growing scarce, such as quinine, led chemists to experiment with a view to preparing those drugs synthetically; and with the result that a number of compounds, notably those based upon the tar products, have been brought into existence which have been found useful. Trianol, sulphonal, phenacetine and acetanelid belong to this class. Other remedies have been prepared from the products of disease, and have been used for the treatment of the same disease. The *tuberculin,* to be mentioned hereafter, and the antitoxin, which has been extensively used in the treatment of diphtheria, are of this class, and have been suggested by the new theory of serum therapy which is as yet too young to be finally pronounced upon. It has been discovered also that many drugs are affected chemically by the secretions of the stomach, and their operation interfered with. Moreover all drugs are slower in producing the desired effect when taken by the mouth, and with a view to overcoming this difficulty the hypodermic syringe was devised not many years ago by which powerful drugs, dissolved in water, are injected beneath the skin, where they are absorbed at once and produce almost instantly the effect desired. The skin is pinched up in the place desired and the hollow needle of the syringe inserted—a proceeding which causes no more pain than the momentary prick of a pin.

Compare with the present elaborate system of medication the methods of therapeutics indicated by the following "Charge" to the old-time "Apoticarye," who (so runs the "Charge")—"Must fyrst serve God, foresee the end, be clenly, pity the poore. Must not be suborned for money to hurt mankynde. His place of dwelling and shop to be clenly, to please the sences withal. His garden must be at hand with plenty of herbes, seeds and rootes. To sow, set, plant, gather, preserve and kepe them in due tyme. To read Dioscorides, to know ye natures of plants and herbes. To invent medicines, to chose by coloure, taste, odoure, figure, etc. To have his morters, stilles, pottes, filters, glasses, boxes clean and sweete. To have charcoles at hand, to make decoctions, syropes, etc. To keepe his clene ware closse, and cast away the baggage. To have two places in his shop. One most clene for the physik, and a baser place for the chirurgie stuff. That he peruse often his wares that they corrupt not. That he delyte to reede Nicolaus Myrepsus, Valerius Cordus, Johannes Placaton, the Lubik, etc. That he do remember his office is only to be ye Physician's Cooke. That he use true measure and weight."

CHAPTER XIII.

THE CELLULAR THEORY.

When Marshall Hall described reflex action he added another detail to the study of physiology. The chemical and physical laws by the operation of which the various vital processes are accomplished in the body during health constitute the entire legend of physiology, and embrace a series of phenomena which in health take place with the regularity and the accuracy of a machine. Like other material mechanisms, however, the human frame is subject to wear of the parts and to incidental injury; and when such occurs a certain degree of irregularity is observed in the combined motions of the whole. Pathology, which presupposes a distinct knowledge of the adjustment and action of the mechanical parts, and of the general laws by which they are governed, is more particularly engaged with the wear and injuries which constantly take place in them, and with a consideration of the retarded action or actual suspension of energy which frequently follow. As in any other finely adjusted instrument, weakness or breakage of any one part leads to a series of irregularities which at last affect the working order of the entire mechanism.

Harvey, in his attempt to describe the circulation of the blood, was met at the outset with a very serious difficulty, and one with which all his successors in physiological research were confronted in turn as soon as they had advanced to a certain point in their investigations. In Harvey's case this difficulty was in explaining the exact means by which the arterial blood was transferred to the venous system—the fine capillary vessels being invisible to the unaided eye. Physiologists soon discovered, in a similar manner, that some of the most important vital processes took place in structures of a form so minute and intricate that it was impossible to intimately observe them by any means then known. The mystery, therefore, by which many functions of the economy were accomplished remained unsolved until at length an expedient was discovered by which the minute structure of all the organs and tissues could be examined. Meanwhile morbid anatomy continued, even by the imperfect means then at the disposal of students of science, to be studied with undiminished ardor.

Cruveilhier, Andral and Louis have already been mentioned in other connections, and in the department of pathology they were equally active; while Abernethy and Cooper in England; in Italy, Scarpa and Malacarne; and in Vienna, Rokitansky, carried on similar investigations. The new light thrown upon disease by their combined researches in this subject gradually worked a revolution in the entire system of medical treatment; and eventually a faint light began to be cast upon the nature of disease itself. This, too, was before the field of pathology was transferred from the deadhouse to the laboratory, and when little could be done beyond a careful examination of the viscera as they appeared to the naked eye upon being removed from the bodies of the recently dead.

The development of what had long been considered a toy for the amusement of savants into one of the most powerful auxiliaries of scientific research worked, in the study of both physiology and pathology, a complete metamorphosis during the years that immediately followed the labors of Rokitansky, and, indeed, changed still again the entire face of scientific doctrine.

I refer to the microscope. It had already been used extensively in Histology, a study which embraces the minute anatomy, or ultimate elements of animal texture. Marcello Malpighi of Crevalcuore, and subsequently physician-in-ordinary to the Pope, discovered in 1661, by the use of a microscope, the capillary circulation. As may be imagined, his instrument was a rude and imperfect one. Four years later he discovered the corpuscles in the blood. Anton van Leeuwenhoek in 1688 began a course of observations on the larvæ and feet of frogs, whereby he was enabled to study both the red and white blood corpuscles more carefully than Malpighi had done. By means of colored injections Machetti of Padua at last succeeded in positively proving the continuity of the arteries and veins through the network of the capillaries, whose microscopical size had so long defied demonstration. In Machetti's experiment is seen, in the rudiment, the two principles of modern pathology—the staining and the magnifying of animal tissues.

Since the days of Leeuwenhoek the microscope has grown from a simple magnifying glass to an instrument which magnifies an object in the same proportion as would an instrument, placed upon a mountain top, which would cause a man at a great distance to appear three miles long. By means of the modern microscope one may readily detect living cells, or microbes, so minute that a special unit of measurement has been adopted for their estimation—the micro-millimeter, which is about equivalent to the one-twenty-five-thousandth of an inch. Some micro-organisms are only one-seventh as long as a micro-millimeter, and one-ten-billionth of a milligram in weight.

Any transparent medium, whether liquid or solid, of lenticular form may act as a magnifier. A drop of water placed above some very minute object will magnify it; or if a small hole be made in a thin plate of metal, and a drop of water placed within it, it will magnify; while, upon a larger scale, I have sometimes accidentally placed an oval-shaped glass bottle, filled with colorless liquid, in such a position that objects immediately behind it were much magnified. The frequency with which this phenomenon is met every day, together with the skill shown by the ancients in cutting and polishing gems, gives rise to some surprise that the principles of the microscope were not utilized at a much earlier date.

Microscopes are distinguished as simple and compound. In the simple microscope the rays which enter the eye of the observer come from an object brought nearer to it after refraction by a single lens. The compound microscope, on the other hand, consists of at least two lenses, so placed relatively to the object, to the eye and to one another, that an enlarged image of the object, formed by the lens which is placed nearest to it, is looked at through the lens which is placed nearest to the eye, and which magnifies for a second time the already magnified picture.

Leeuwenhoek succeeded in grinding and polishing lenses of such short focus and perfect figure that the simple microscope was more valuable for many purposes than any compound microscope which had then been constructed, and it was with this simple instrument that he and his contemporaries made their valuable discoveries.

The perfection of the compound microscope was much more slow, and it was not until the lapse of more than two centuries that a satisfactory instrument of the sort was constructed. The idea of placing two convex lenses in such a position that the picture magnified by the first would be again magnified by the second seems to have at first occurred to Hans Zansz about 1590. The spherical aberration and the chromatic aberration were so great, however, that it was found impossible to apply this device, and the compound microscope remained unimproved until early in the present century.

One device suggested was the so-called doublet, consisting of a lens which was itself composed of two other distinct lenses, made of different kinds of glass, and cemented together so accurately that it seemed as one lens. That of Dr. Wallaston consisted of two plano-convex lenses, the smaller being placed beneath, and the upper at a distance of one and a half times its focal length above it. A further improvement was in introducing a perforated diaphragm between the lenses. In 1821 Sir John Herschell showed mathematically that by the combination of a meniscus with a double convex lens spherical aberration could be entirely extinguished for rays parallel to the axis.

The first attempts directed to the achromatization of microscopic objects appears to have been made by Professor Amici of Modena in 1812. An achromatic lens is one which transmits light without decomposing it into its constituent colors—one which is sensibly free, that is to say, from chromatic aberration. It is usually made of two lenses constructed of glass having different refractive and dispersive powers, the forms of which are so adjusted that one lens very nearly corrects the dispersion of the other, without destroying its refraction. For a familiar example take the double convex lens of crown glass with the concavo-convex lens of flint glass. These two varieties of glass were used by Chevalier of Paris in 1820. Five years later Tully in London succeeded in producing a triplet which was so well corrected as to perform very satisfactorily with an eye-piece.

It proved more advantageous in practice, however, to make the several components of an achromatic objective (the lens nearest the object under examination) correct each other's aberration, than to attempt to render each absolutely perfect in itself. Instead of combining three achromatic doublets, therefore, many preferred to place in front a plano-convex doublet of crown glass, and add a third lens of crown to the doublet at the back; still using a doublet in the middle, and the whole combination consisting of six lenses, four of crown and two of flint glass. In front of these, in their higher powers, a single plano-convex lens of crown was frequently placed, by which addition a greater working distance could be obtained. Every such addition, however, necessarily increases the liability to error from imperfections in the centring and grinding of the lenses; and where angular aperture is regarded as the quality of primary importance it will be usually found preferable to have recourse to objectives constructed on either the water or the oil emersion system. This expedient had already been pointed out by Professor Amici.

A microscope is an object too familiar to every one to require special description; still, to understand the principle of oil emersion, an accurate knowledge of the instrument is necessary. The metallic barrel of brass in which the lenses are placed is so adjusted in the stand that it may be raised and lowered above a stage upon which the object to be examined is placed. In the microscopes of higher power this stage is partially of glass, or perforated so that a powerful stream of light may be directed upwards from a point immediately beneath the object to be examined. In scientific laboratories this object generally consists of some particular fluid, or a very thin section of solid substance. For example, a preparation of the sputa expectorated by a person who is suspected of having pulmonary tuberculosis, after having been stained with the necessary mordant, is placed upon a small piece of glass, nearly an inch wide by three or four inches long. Only a very small quantity is, of course, placed upon the glass, and over this again is laid a small square of very thin glass to protect the preparation about to be examined from the action of the air and to prevent it from drying. The strip of glass containing the fluid thus covered is then laid upon the stage of the microscope, and so placed that the substance to be examined is immediately beneath the objective. The stream of light is then directed upwards from beneath it, and thus illuminated, the microscope is adjusted and the observer places his eye to the uppermost glass, from which point he can see the preparation, very highly magnified.

When a solid substance—such, for example, as a section from a cancer—is to be examined, an instrument called a microtome is used, by which a very thin filmy section is shaved from the larger mass. Before this can be satisfactorily accomplished, however, the substance must have been elaborately prepared, hardened and afterwards stained. The almost transparent section is then placed upon a similar strip of glass and covered. Generally the smaller square of thin glass which protects the preparation is cemented permanently in its place, after which the specimen may be labelled and kept for an indefinite time for future reference, curiosity or comparison.

But when a microscope of very high power is adjusted for examination, the objective is lowered to a point so near to the specimen under examination that it often almost touches the cover-glass. There always intervenes, however, a small stratum of air. With regard to this space it was found that there was a certain loss of light resulting from the passage of the rays from the glass covering the specimen into this air space, and from this again into the superadjacent glass of the objective immediately above.

It was obvious to Amici, moreover, that when a drop of water was placed so that it occupied the space between the specimen and the objective of the microscope, that the refractive and dispersive action would be so greatly changed as to necessitate important modifications in the construction of the instrument itself to meet the new condition. This modification was never successfully effected by him; though when the idea was afterward taken up by Hartnack and Nachet, it was found that this simple expedient, which has since become so familiar as the "oil-emersion" system, was not only attended by the advantages pointed out by Amici, but by others which he had not foreseen.

The chief difficulty with the water emersion was that water was of a different refractive power; and in the course of time a new method was introduced by which, instead of water, a liquid was placed between the cover-glass and the objective of the microscope which was of the same refractive and dispersive power as crown glass. After a long course of experiments Professor Abbé discovered that oil of cedar wood so nearly corresponded with crown glass, alike in refractive and in dispersive power, as to serve this purpose extremely well; except upon such occasions as it was desired to take special advantage of the most divergent, or marginal, rays, when oil of fennel was found to be preferable.

The practice of oil emersion inaugurated by Abbé was the commencement of a new era in microscopy, coinciding closely with the appearance of the germ hypothesis which about this time began to engross the attention of medical science. Indeed, the importance of the microscope as an instrument of research can hardly be estimated. It has opened up entirely new avenues of study and enabled the scientist to replace the fantastic speculations of the past with the uncontrovertible facts of the present. Like the magic lamp of Aladdin, it has called into sudden existence an entirely new world where the unseen friends and foes of the human race, mystically foreshadowed in the myths and fables of antiquity, are seen in the living and moving substance. The modern study of bacteriology, by which the general trend of medicine has been turned into an altogether new channel, is the outcome of the microscope. By the use of this instrument, also, a new light has been thrown upon physiology and pathology, necessitating frequent reconstruction of these departments of research.

The microscope itself, meanwhile, has undergone many developments since 1850; and the instrument of the present day would be a source of amazement to the student of even twenty-five years ago. To enumerate in detail each step of improvement would scarcely be possible in any brief account. For many years the instrument in its highest form of completeness has been identified with the name of one man, an optician of singular genius who has devoted his life to the perfection of this instrument. I mean Ernst Leitz, of Wetzlar, Germany, who, fifty years ago, began the construction of microscopes under the superintendence of C. Kellner. Upon the death of the latter he continued to construct instruments of such accuracy and reliability that his name eventually became a synonym in the world of science for all that was best in microscopy; and such it has continued to the present day. Hardly a year but has witnessed some slight change of detail, or the addition of some new accessory to the instrument. This celebrated optician has kept pace with every advance in medical research, and has anticipated and supplied the needs of the investigator in manifold ways, at a time, too, when the most brilliant discoveries of science have been made in microscopical work, and when the diligent use of this instrument has given promise to the ambitious physician of the surest and quickest path to honor and distinction in the world of medicine.

In a little book upon the use of the microscope Ernst Leitz describes the principle upon which the lenses of the modern microscope are constructed. "The objectives," he explains, "constitute the most important and valuable part of a microscope. There are two classes of objectives, the achromatic and the apochromatic lenses, with the following distinctive properties. The achromatic lenses are constructed upon well-tried and comparatively simple formulæ, and fully satisfy all the principal requirements of a good objective. They are achromatically corrected for the brightest part of the spectrum comprised within the orange and the blue, are free from spherical aberration in all zones, and their numerical aperture, upon which the resolving power of the objective mainly depends, has the greatest possible value obtainable without complicated or hazardous means. In the Fraunhofer curve of the bright rays of the spectrum, it will be seen that the color correction of the achromatic lenses within the lines indicated embraces the brightest part of the spectrum.

"In the apochromatic objectives chromatic correction is carried still further with the aid of complicated means. Their characteristic property, the elimination of the secondary spectrum, is not, however, apparent to all eyes and in all objects alike. This objective represents in its present form the most perfect product of microscopical optics. The apochromatic lenses assert their superiority also in the photography of unstained objects with sunlight. The lenses are exclusively made of glass capable of resisting the influences of the atmosphere and changes of temperature. Their permanence has been sufficiently established by the results of many years."

For two generations past the majority of physicians have had their first introduction to biology, histology, pathology and bacteriology by means of a Leitz microscope; and in late years a certain sentiment has become attached to the very name which carries one back to memories of bygone years, faces passed away and the old college laboratory where one received his first ideas of science. The Leitz microscopes we used then, though the best made at the time, were by no means as elaborate as the instruments which are prepared by him now. To-day rapid change of magnification is facilitated by revolving eye-pieces and revolving objectives. Focusing is also made much easier, and the native clumsiness of many of us is provided for by the coarse and the fine adjustments which are regarded now as indispensable parts of a microscope; the micrometer screw of the fine adjustment enabling one to focus with the utmost delicacy.

The illuminating apparatus has also become a very elaborate accessory in the Leitz microscope. The condenser is controlled by an iris diaphragm so that the intensity of the light may be graduated to suit the requirements of the moment. The mechanical stage is another device which is of great use when making observations with the higher powers. As the astronomer would be greatly confused to find the location of a particular planet in the immensity of the starry heavens without an accurate knowledge of its exact position; so in the examination of a specimen, the field of vision under the higher magnifications is so extensive that the observer sometimes finds it impossible to return to a certain point of observation after the slide has been moved. By the use of the mechanical stage a record may be kept of the situation of any minute object in the specimen which enables the student to return to it at any time. A micrometer eye-piece is also used in the Leitz microscopes by which larger objects may be measured. A millimeter scale etched on glass is placed between the eye-lens and the collecting-lens beneath a movable indicator controlled by a micrometer screw. The dimensions of objects under examination may be correctly reckoned by this means.

Still another device, which is especially valuable to the active investigator, is the drawing eye-piece. This apparatus consists of a prism so adjusted as to accomplish a total reflection of the image. For example, a piece of paper is laid upon the table behind the microscope, and the latter inclined at an angle of forty-five degrees. Upon this paper a clear and sharp reflection, devoid of all disturbing and secondary images, is caught; and by tracing with a pencil, a representation of the magnified specimen, just as it appears to the eye, may be made with almost photographic accuracy upon the paper. A photo-micrographic apparatus is also used for actual photography of the image, which consists of a combination of the microscope and the photographic camera. A polarizing apparatus has likewise been introduced for use in the analysis of foods; and a hæmocytometer for the counting of the blood corpuscles. These instruments, together with the microtomes for the preparation of microscopical sections, and the staining methods now in use, will be referred to in another chapter.

But it was with the microscope that the discoveries which have so profoundly influenced medicine, and established science upon a new basis, have been made; and when the history of modern medical investigation is written in full the name of Ernst Leitz must not be omitted, for without the microscope the greatest savants would have found themselves helpless, and their labors in vain. It seems a strange contrast, too, that Germany should have given at once to the age two men each with a world-wide reputation: one, Ernst Leitz, the optician, whose instruments by thousands are to be found in every civilized country where science is cultivated and prized; the other, Herr Krupp, whose great guns roar over the battle-fields of the world.

The importance of such an instrument as this can scarcely be estimated. By means of the improved microscope one discovery swiftly followed another, by which a wholly new light was cast upon the science of medicine. Of these discoveries one of the most important was that of the Cellular Theory, or the doctrine that the tissues of the bodies of all animals and plants consist of a number of cells, as expressed in the phrase *omnis cellula e cellula.* This doctrine was, it is true, anticipated by Kaspar Friedrich Wolff, who died in 1794, and by Karl Ernst von Baer; but it was in 1838 established permanently, in regard to plants, by Matthew Jakob Schleiden, who was professor of botany in the university of Jena; and in regard to animals by Thomas Schwann in the year following.

"Words have no value in themselves," Schleiden remarks, in his classic contribution to Phytogenesis, "but are like coin, merely tokens of a value not exhibited in specie, in order to facilitate commerce. And to carry the simile further, insecurity in this intellectual property results, and frequently bankruptcy, if this coinage has not its unchangeable accurately determined standard; in a word, the utility of a scientific expression depends upon the accurate definition of the idea on which it is based. Unfortunately the perplexity of our social relations has caused us to forget entirely the original meaning of money; the sign has become to us the thing itself; may some good genius protect us from similar mistakes in our intellectual life."

"What then," he continues, "is the meaning of 'to grow'? In hackneyed phrase we are told, 'To grow signifies increase in the mass of an individual, and takes place in the inorganic world by juxtaposition, in the organic, by intussusception.' Have we gained anything for vegetable physiology by this reply? I think not. If the plant is to grow by intussusception, then I say it consists of an aggregation of single, independent, organic molecules, the cells; it increases its mass by new cells being deposited upon those already existing; consequently by juxtaposition. But the single cell in the progress of its expansion, which frequently reaches an enormous bulk in comparison with its original size, also increases in substance in the interior of its membrane, and by this means also the mass of the entire plant is increased; it consequently grows by intussusception also. Finally, after a certain period, the cell deposits new organic material in layers upon its primitive membrane; thus another form of juxtaposition, which still, however, belongs to the cycle of vegetable vitality."

Schwann, in his *Microscopical Researches into the Accordance in the Structure and Growth of Animals and Plants,* published a year after the foregoing, endeavored to show by a series of observations that though "animals present a much greater variety of external form than is found in the vegetable kingdom" and "exhibit also a much more complex structure in their individual tissues," yet "all their manifold forms originate likewise only from cells, indeed, from cells which are entirely analogous to those of vegetables, and which exhibit the most remarkable accordance with them in some of the vital phenomena which they manifest."

"If a crystal," he remarks at the close of his work, "be laid in a pretty strong solution, of a substance similar even to itself, nothing ensues without our interference." If, however, "a *cell* be laid in a solution of a substance even different from itself, it grows and converts this substance without our aid. And this it is for which the process going on in the cells obtains that magical character, to which attaches the idea of Life."

A very powerful impetus was given to microscopical research during the years immediately following; when, to use the words of Lewellys Barker, "incited by the publications of Schleiden and Schwann, anatomists busied themselves in ransacking all regions of the body, hunting for 'cells.'" Out of these researches the science of histology and pathology in their present sense may be said to have been developed.

By the aid of the microscope the actual formation of each tissue was observed for the first time, and it was found that the life of the mass was in reality the life of each individual cell. These cells are exceedingly minute, and while some can be readily detected when highly magnified, others cannot be clearly defined until the tissue has been prepared and stained. The methods of preparing tissues for microscopical observation are often very elaborate, and require a considerable degree of practice and skill; while, with every method which ingenuity can devise, and after more than half a century of constant investigation in many lands, science finds itself eluded still, in some branches, and at the present day only upon the threshold. Especially is this the case in the histology and physiology of the nerve system, upon which so many books have been written in the last twenty years. Yet in the whole domain of medicine there is perhaps no more fascinating subject, none more involved, when all is said, in complete mystery. The human frame like a vast realm is connected together by these delicate wires of intercommunication, with innumerable points of concentration where the nerve cells assume myriad fantastic shapes. Each tender nerve thread, so slight as to almost escape detection, has been shown by the microscope to be in reality a huge bundle of transmitting wires, bound closely together in a common envelope, and each separate in itself, and isolated, indeed, as securely as the Atlantic cable. The recently defined principle of the neurones will be described in another place.

Even bone is found to consist of irregular cells, though built with a beautiful regularity, and with intercellular spaces which allow of the passage of the blood to each individual cell. In the skin the flat cells lie edge to edge like the plates in a coat of mail; and the blood also, which consists of an amber fluid, capable of rapid chemical transitions, is found to contain innumerable cells of a reddish color afloat within it.

Having observed the bewildering phenomena which take place in normal living tissue, as far as the present means will admit, the next step is to observe the changes which take place in the same tissue when it is seen to be affected by disease. These changes, *en passant,* are very numerous, and are produced by intrinsic or extrinsic causes. The intrinsic causes of disease may be congenital, or embryonic in their origin, or due to senility, exhaustion or malnutrition. The extrinsic causes of disease may be due to actual traumatism, to chemical or physical irritants, to the action of poisons, corrosive or narcotic, and to the presence of micro-organisms within the tissues, and to their products, chemical and physical.

Upon examining a particular tissue it may be found to be hypertrophied or atrophied; it may have undergone degenerative changes, fatty or otherwise; neoplasms may be present, as in the case of carcinoma, or the normal structure of the tissue may have undergone many striking alterations due to the presence of micro-organisms already referred to, as in the case of pulmonary tuberculosis. One of the commonest consequences which follows degeneration, malnutrition, irritation of any origin, actual injury, and which may sometimes even make its appearance spontaneously, as the careless observer might think, is Inflammation. This is a pathological change which may take place in any organ or tissue, not excepting bone even; and as all the very numerous forms of pathological change cannot be described in detail in this place, the general changes which take place during Inflammation may be recorded here as a casual illustration of a common pathological phenomenon.

When a part has become inflamed one sees with the naked eye what Hippocrates saw, and no more. It is found to be swollen, red in color, hot to the touch and painful. But this is, as it were, a view from the distance, and, as knowledge, is about as perfect and full as the knowledge one would gain of what was actually occurring, who stood some miles away and watched the fire and the smoke, and listened to the distant roar of a burning city. It would be impossible, of course, for any one to be a near spectator of such a conflagration; impossible to see each dwelling as the fire engulfed it, and to note the way in which the flames invaded in turn chamber after chamber, and consumed in turn one article after another of the furniture. Yet by the use of the microscope the minute processes of inflammation can be watched in every detail—the stoppage of the blood current in the capillary blood-vessels; the huddling together of the red blood cells in a state of panic; the suspense and demoralization in the presence of a dangerous foe. Yet why this unwonted disturbance? There is evidently something wrong in the tissues right at hand. A group of travellers passing along a narrow road in a deep and sombre forest could not show more alarm when the word has been passed from mouth to mouth that a band of murderous bandits lay waiting in ambush within speaking distance. Then a few of the more venturesome travellers with drawn knives press into the forest, leaving their more timid brethren still standing in the roadway. Beating about among the trees they perhaps surprise the robbers, and in a determined attack cut them down. In the inflamed region even so, from the artery issue then the leucocytes, the warrior cells of the blood. They press headlong into the surrounding tissues from whence came the cause of the alarm, passing without apparent difficulty through the cellular walls of the vessel, very much as a bloodhound pushes through a hedge. Then ensues a battle, the Phagocytosis of the white corpuscles, upon which the life of the person in whom the inflammation has taken place may depend. There is a period of suspense. Then the cause of the dread seems at last to have been removed. The current in the vessel is resumed, the wayfaring blood cells go upon their journey, and the tissues adjacent regain their former tranquillity; haunted perhaps, like the robbers' wood, with the tradition of some ancient tragedy, yet as fresh and wholesome as ever under the summer's sun. Should the leucocytes be examined now, it will be found that these remarkable cells have actually eaten up the micro-organisms which had unwisely found their way into the human tissues. As they move complacently onwards it is possible to see the remnants of their feast in a partially digested condition in their substance. Unhappy indeed is the lot of the unlucky bacillus who meets upon his journey these unpitying Bluebeards of the blood, who, unless overpowered by numbers, give no quarter to invaders, and, when outnumbered, die, like the old guard, sooner than surrender.

"*Rubor, tumor, calore et dolore!*" That was all that the Greek and Roman surgeons could see in inflammation—redness, swelling, heat and pain. That, however, was the distant view. The cellular pathology of the present day brings one face to face with all the minutiæ of the phenomenon, and traces each step in its progress. The termination is not always favorable to the phagocytes. In spite of their opposition the micro-organisms may gain and multiply, producing, meanwhile, poisonous substances known as ptomaïnes, which paralyze the resisting forces of the animal invaded. These ptomaïnes may be carried to distant parts of the body, and then follows the long train of symptoms which indicate constitutional disease. Even when at the very point of conquest, the micro-organisms may at last succumb, the victims of a counter-venom, produced in the body itself; or failing that, the balance may again drop, and the life of the patient be terminated as a result of bacterial invasion.

The cellular form of plants was noticed by Sir Robert Hooke as early as 1677, though the significance of the cell was not considered until the time of Schleiden and Schwann. Robert Brown first observed cell nuclei; and in 1858 Rudolph Virchow announced the theory of Cellular Pathology, or Modern Vitalism; borrowed from natural scientific medicine, and distinguished from the Vitalism of the previous century in this, that it breaks up the old vital force (which was supposed to be either distributed throughout the entire body, or located in a few organs) into an indefinite number of associate vital forces, working harmoniously, and assigns to them all the final elementary principle without microscopic seat.

"Every animal principle," Virchow explains, "has a sum of vital unities, each of which bears all the characteristics of life. The characteristics and unity of life cannot be found in any determinate point of a higher organism, *e.g.*, in the brain, but only in the definite, ever recurring arrangements of each element present. Hence it results that the composition of a large body amounts to a kind of social arrangement, in which each one of the movements of individual existence is dependent upon the others, but in such a way that each element has a special activity of its own, and that each, although it receives the impulse to its own activity from other parts, still itself performs its own functions."

This is only another way of expressing the Cell Doctrine, which has since been accepted by all students of medicine; and which, when summed up, simply claims that the human frame is built up of various cells, and that each cell has a unity and a purpose of its own. The *Cell* now assumes the place which was occupied during the two preceding centuries by the *Fibre*. As a result of this a great step has been made toward making of Medicine an exact science.

CHAPTER XIV.

SANITARY SCIENCE.

In Greek mythology Hygeia was the goddess of health, and the word Hygiene, as employed in the present day, implies in a general way the laws of health. The term Preventive Medicine is sometimes used in much the same sense. The study is probably as old as its name; and in former times its precepts were supposed to have a divine origin, and were embodied in the teachings of religion. This was notably so in the case of the Hebrew race, among whom many sanitary precautions were practised as religious rites. The comparative immunity enjoyed by this race from many of the diseases which afflicted the neighboring races upon all sides was no doubt due to their strenuous observance, as a people, of some of the simpler rules of health. Among the early Greeks Ulysses is described as disinfecting with sulphur the hall in which the bodies of the suitors whom he had slain were lying. The presence of an epidemic was usually attributed by them to the wrath of a god; as, for example, when an infectious disease broke out in the camp of the Greek warriors assembled about the city of Troy, attacking first the horses and afterwards the men of the Greek army, and was attributed to the resentment of Apollo because the daughter of his priest was still detained in the camp of the besiegers.

When one reflects that it was not until late in the present era that the actual causes of such epidemics came at last to be clearly apprehended, there seems nothing unreasonable in the claim which has been put forward that sanitary science, in its fullest sense, is almost entirely a development of the nineteenth century. Never before was it placed upon a strictly scientific basis; and indeed the superstitions, ecclesiastical and otherwise, with which it was formerly associated were suggestive rather of witchcraft and charlatanism than of medical science.

The discovery of Jenner suggested the fact that no disease was a necessary condition of life, and that a disease could be prevented if the proper means were taken. Subsequently the study which was given to typhus fever and diphtheria stimulated further thought along the same line; and as typhus was always found to have followed overcrowding and insufficient food, it was at last thought worth the while, purely as an experiment, to see what improved hospital arrangements would lead to, as well as a more humane care of the convicts in the prisons. The improvements made met with much opposition from that class of people who regard any amelioration of a prisoner's condition as a direct incentive to crime, or kindness to the poor in hospitals as a step towards their pauperization; forgetting that the maintaining of such centres of disease infection is a constant menace to the health of the community at large. The results, however, which followed even the half-hearted measures at first permitted were so encouraging that one reform was allowed to follow another until typhus fever and a number of other diseases became far less prevalent.

Still later the complaint of Sir James Simpson against a system of abuses which he claimed existed in the hospitals of the time, and to which he applied the term "Hospitalism," while meeting with vehement opposition from those who were responsible, did much, no doubt, to remedy those errors of prejudice, ignorance and neglect by which the public were made to suffer so severely. About the same time also the nation awoke to the fact that the poor in the large cities, living as they often did, entire families in a single room, and that perhaps in a cellar, were supporting, no less than the convicts overcrowded in their reeking cells, the conditions which favored the development of disease. In the rural districts the state of things was found to be quite as bad. The landholders, while felicitating themselves upon the quarterings of their arms and the splendor of their ancestry, allowed their tenants to live huddled together in filthy lairs where everything favored the generation and transmission of zymotic disease. Though these reforms in the housing of the criminal and the destitute classes were suggested by purely selfish motives, and were carried out often by the more wealthy classes as a means merely of self-preservation, the results were no less advantageous to the classes immediately concerned.

Subsequently the establishment of the germ theory made clear the law which the terrible lessons of the black assizes had failed to teach, and showed that the true criterion of the health of a locality must be based upon the conditions of the poorest and most ignorant members of the community, and not upon the health enjoyed by the privileged classes. The taint of a single dwelling might, it was discovered, spread its contamination at any moment to the whole neighborhood. The reforms, already commenced in the larger public institutions, were therefore imitated in private life. About the same time compulsory vaccination was made a law, and a system of quarantine established by which the passengers from infected vessels were prevented from landing, houses and individuals suffering from infectious diseases isolated, the chamber occupied by the patient fumigated, and the fomites and belongings burned. Isolation hospitals were eventually built in many cities for the care of such cases; and to the thoroughness of the quarantine service at any time may be traced the immunity from infectious disease enjoyed by the inhabitants of the city at the same time.

The principles of sanitary science are in themselves exceedingly simple, and could be very readily apprehended and carried out by the poorest and the most ignorant if the artificial conditions of modern civilization were not in many ways unfavorable, and even detrimental, to the primary laws of health. To ensure good health in an individual not already handicapped by hereditary disease, pure air, pure water and plenty of light are necessary. To obtain these there should be sufficient space. Furthermore the individual must obtain the necessary amount of proper food for the maintenance of his system, and be protected from climatic changes by suitable clothing and a clean dwelling place. A certain amount of daily exercise in the open air is also absolutely essential. By these means his physical well-being will be assured. The mental and nervous system is, however, of equal importance, and though the matter has not as yet received much consideration, the fact still remains that conditions of life which exhaust the nervous system will produce nervous diseases; and that a routine of labor, never broken by any form of mental relaxation, will leave the intellectual faculties undeveloped, and thus be one step towards the production of insanity and crime. In view of these facts it at once becomes manifest that the life in almost any city which has a population of over a hundred thousand, and in many cities of even smaller population, it is next to impossible for the great majority of the population to ever obtain these requirements to the extent necessary to ensure health of body and of mind.

The breathing and living space allotted to each individual is so limited that it is impossible for him to obtain a sufficient amount of light or air; what air there is, furthermore, being contaminated in innumerable ways, both by the products of manufacture, and through the defectiveness of the sanitary arrangements. Every form of food, also, will be found to be adulterated in various ways; the water, as often as not, is unwholesome, and the poor man's dwelling, beside being a nidus for the germs of disease, is usually built upon a principle so faulty that life in one of them for any length of time tends to undermine the health of the most robust. Little light, moreover, could be expected to permeate the smoke-laden atmosphere, and gain admittance through the narrow street or alley to such a dwelling, even if the walls were made of glass; while the facilities for ventilation, were they carried into effect, would only exchange the fœtid air of the overcrowded chamber for the sewer-polluted air of the street.

While, therefore, the laws of sanitary science are few and simple, it is next to impossible to carry them into effect in many modern cities where the conditions for their operation are entirely lacking. The same statement applies with equal force to the mental needs of the individual. To barely earn his bread the laboring man is often compelled to expend his total supply of energy in grinding toil, often in itself unwholesome, and tending to disease and premature death. From his day, which should be triply divided by toil, recreation and repose, the element of recreation is wholly eliminated; or if he be able to seize an hour for diversion, it is too often to spend it in a manner antagonistic alike to physical repair or mental development. When one without prejudice examines the daily life of many of the poorer classes of a large city he is not surprised so much that there should be vice, that there should be disease, that there should be insanity and that the death rate of children under five should average up into the thousands annually, as that there should still remain so many of the class not sunk in vice and still unbroken by disease.

The advance in sanitary practice during this century has been very great, however, in many particulars. Modern engineering has done much to facilitate good water supplies to the majority of the large cities. The enormous expense and labor expended by Rome and Carthage and the cities of ancient times upon their aqueducts, which were often of great length, and generally insufficient in their supply, forms a striking contrast with the comparative simplicity of the water systems of the present day. Not knowing that water confined within a tube, however deeply it may be inclined, will rise again to its former level, the ancients conducted their water in open and inclined channels, often being forced to bridge extensive valleys that the same undeviating incline might be maintained from the source to the outlet. When hydraulic engineering consisted of little more, therefore, than the stone-mason's art, there was much excuse for a defective water supply, but at the present time no such reason exists for an impure or insufficient water supply.

The source of supply is usually from lakes, rivers or wells. All that is necessary is that the water be brought from a point at such a distance from the city that there will be no probability of its having been contaminated. Many of the cities in the American lake region draw their water supply from the adjacent lake only a short distance removed from the vent where the sewerage of the city is emptied into it. It can hardly be said that this is a wise proceeding. The expense of extending the distance of the intake is not so great that it should be postponed until the frequency of disease originating from this source makes the change imperative. The water from no surface well should be used when situated in the vicinity of a populous community. Even in the rural districts the greatest care should be shown in the site chosen for the digging of a well. The same does not apply so much to artesian wells. These wells, so called from the first one of the sort which was constructed not many years ago at Artois, are made at very great depth by boring into the earth, and inserting joint after joint of iron pipe as the depth increases. Having bored through various strata a subterranean reservoir of water is often struck; and, cold and sparkling from the dark and hidden chambers of the earth, the water gushes forth by its own impulse, and often with such great force that the power may be utilized for some industrial purpose.

The poorest water-supply imaginable, because the most inadequate, is the device forced upon the inhabitants of some regions of Peru. This consists of evaporating and condensing sea water. In that region even the rain, which is the source of the water-supply of the coral-formed Bermudas, is absent. Water should be as far as possible free from organic matter, such as sewage, refuse, microorganisms and decayed vegetable matter. Stagnant water and surface water should not be used for consumption. The presence of mineral salts, also, frequently disqualifies water for use, and in some countries goitre has been attributed to the use of such water.

The air-supply is quite as important as the water-supply. The air should be pure, and there should be plenty of it. In sleeping and living rooms there should, at the very least, be four hundred cubic feet to a person. In schools the average allotment is between one hundred and a hundred and fifty cubic feet to each pupil, though it would be as well if the proportion were larger. In prisons about eight hundred cubic feet is allowed to each convict, and in British army barracks about six hundred. For comfort a person should have a thousand cubic feet at the least. These figures refer to space. From two to nine thousand cubic feet of air an hour are needed for breathing. Whatever the space allowed, therefore, a constant current of pure air must be kept pouring through the space occupied by the individual. In attempting to arrive at the right degree of ventilation, it may be taken as a rule that a stream of air travelling at the rate of three miles an hour is sufficient. When passing more rapidly some inconvenience may possibly be experienced. Ventilation is in reality of more importance than heating, though when the proper arrangements have been established the first may be carried on without any sacrifice of the second. The economical consideration that when one has gone to the expense of heating some air, he should not be guilty of the prodigality of wasting it, but should keep it indefinitely for breathing purposes, is exceedingly unfortunate, and forms one explanation of much of the feeble health, lack of resistance, and tendency to disease which is to be observed everywhere. Especially does this seem to be the case in the rural districts, where the rooms are invariably too small, and where the attempt is frequently made to keep them hermetically sealed. The cooked air of such a living apartment soon vitiates the strongest constitution.

In country air ozone, an allotropic form of oxygen, and possessed of a certain stimulating quality, is always present, while in cities it is invariably absent. Sulphuretted hydrogen and marsh gas are generally present in closely populated districts. The air of the country may be generally regarded as the purer; though, even in the wilderness, the atmosphere may contain irritating qualities. The more common of these are the fine particles of vegetable matter, pollen and the like, which in the case of some sensitive persons produce hay fever and other respiratory difficulties. In the neighborhood of low swampy land the miasm rising from the stagnant water and decaying vegetable matter is probably as deleterious as the atmospheric impurities found in cities. The sea provides its own disinfectants; and in the mountain districts, or a high desert tract, such disinfectants are unnecessary; hence the air of the seashore and of the mountains are preferred by many. In desert localities the air is dry and pure, although filled with fine particles of sand, sometimes, which may prove very distressing. Lastly, air may contain too much water. In low, damp countries, where there are rapid and extreme changes of temperature, as in the American lake region, the moisture of the air is found to be very productive of pulmonary disease.

In cities one of the commonest forms of pollution of the air is from defective sewers. Good sewerage is one of the sanitary advances of the present century; but occasionally the system is faulty through ignorance or neglect of the officials. Some of the manufactories also poison the air, not only by the smoke, in the production of which they generally enjoy unrestrained liberty, but in other ways. Still another serious source of contamination to the air is the pavements of the streets. City pavements should be constructed of some mineral substance, granite setts, macadam, asphalt and brick being the best. Wood in any form as a material for street paving is extremely unsanitary. There are many varieties of block pavement commonly in use, but the further use of wood in this way was very sensibly prohibited by the authorities of London. "The General Board of Health," the official report ran, "set aside wood as an ineligible material for this, amongst other reasons, that street surfaces ought to be impermeable; and for roads of light traffic and cheap construction they look to modifications of macadam. Wood has been reproduced for the purpose, and strongly pressed in improved forms for trial. But hygienists object to its use on grounds which, in the absence of sanitary science, are overlooked, but which it is important to particularize, as showing the dangerous state of ignorance and incompetency of the authorities by whom they are not entertained or are disregarded." The wooden blocks decay very rapidly and afford a secure and congenial matrix for the development of micro-organisms. In the wet months of spring and autumn the odor from the streets thus paved is as offensive as it is unhealthy. The mercenary motives which lead first to the choice and then to the retention of such a form of pavement cannot be too strongly condemned.

Sanitary science can do little to purify the crowded slums of a large city, but that little has been done. The entire theory of a city is contrary to nature. It was from the first an artificial expedient. People gathered together in walled places for a refuge and mutual protection against common danger. Subsequently the modern city was suggested as a means of commercial convenience. The cities simply grew as the needs of the moment suggested. The difficulty, the slowness and the expense of transportation was a further cause for the existence of the city. For these reasons, large numbers of people crowded together in the vicinity of their common interest. If commerce requires the concentration of products in a very small area, there is still no reason why each merchant should eat and sleep beside his goods, as if he had to keep guard over them.

The modern city represents the principle of frugality run mad. The teachings of such persons as Benjamin Franklin are accountable for much of the neurasthenia and actual break-down of the present day. That a little time might be saved the crowded and cramped humanity in these cities has swelled to the hundreds of thousands, till the ground beneath has reached a fabulous value, and the strain of numbers in painful attrition become so great that the necessities of health are unattainable, a wholesome, natural life impossible, happiness and simplicity unheard of, and vice inevitable and this because the members of the artificial population acknowledge themselves as passive integral parts of a vast commercial machine. Were transportation reduced to the actual cost of producing it, and could the hour of toil commence an hour later than at present, there would be no appreciable change in the prosperity of the land; and the people who are now crowded together in a few stifling acres could be dispersed over a county, where the humblest laborer might enjoy the sunlight and the fresh air, and the open space of which he is by the present conditions deprived.

Even commerce itself is becoming more scientific; and though the immense profits from labor-saving devices in the past have not been to the advantage of the laborer, there will come a time, it is certainly to be hoped, when every expedient for saving labor will tend to abbreviate or lighten the toil of the laborer. It has already been discovered, for example, that under one roof the trade of five hundred separate shops can be transacted. If this serves to do away with the multitude of small shops it is certainly a matter for gratification. The small shop is not divine in its origin. Man is really of a little more importance than his shops. Human life and happiness ought to be the first consideration, and commerce afterwards. An intensely artificial and mercenary life has reversed the proper order.

The sociological aspect of sanitary science is one of the last to be recognized, but it is the most important. When the masses are so housed that it is possible for them to live in a wholesome manner, it will be necessary to turn to their mental needs; and labor-saving methods, if put to a proper use, ought to shorten the daily period of a man's work to at most five or six hours, without in any way reducing the proportion of remuneration. This will give him the leisure that every man should have, and of which the poor man has been deprived too long; the leisure to feel, to think, to know that he is a man and the equal of other men. The privileged classes point to "the man with the hoe," or the man in the slum, as the case may be—jaded, overworked, soul-benumbed beasts of burden; silent with fatigue, with all the higher feelings in a nascent state because no opportunity has been given for their development—plodding slowly on automatically, with faces dulled by the dreary lethargy of unremitting toil. The privileged classes point with contempt at these, overlooking the fact in their contented ignorance that a year of the same sort of existence, if they were physically strong enough to survive it, would render them equally besotted. But the members of the privileged class are often prone to force themselves into personal comparisons which reflect favorably upon their own superiority.

To the hygiene of the dwelling, whether in the country or the city, must also be added the hygiene of climate which by the recent development of science is found to be a most important consideration. In 1796 William Heberden published his work *Of the Influence of Cold on the Health of the Inhabitants of London.* Many medical works upon Meteorology and Hygrometry have since appeared with a view to explaining some features of susceptibility to disease which have hitherto appeared inexplicable.

By the conditions of the atmosphere all are influenced, but some to a greater degree than others. In the course of several generations the members of a particular community will be seen to thrive in a low damp locality, where the newcomer rapidly succumbs. In the same way another community thrive in a hot climate after it has been occupied by them for several generations. The salubriousness of a climate is not an intrinsic quality, it would appear, but refers rather to its connection with the life history of the individual. The fact is simply an illustration of the law of evolution. At the present time, however, the old racial barriers seem to have fallen, and the emigration from one country to another is more extensive than it ever was before. The individual always suffers somewhat by transplantation; but in some instances the transplantation can only mean disease and extermination. The connection of climate, therefore, with racial characteristics should not be lost sight of in the scientific investigation of race strength and race decay, as exemplified by the susceptibility of the individual to climatic conditions.

CHAPTER XV.

THE TREATMENT OF THE INSANE.

THE treatment of the insane since the year 600 of the present era, or thereabouts, may be divided into three epochs—the barbaric, the humane and the remedial. In ancient times, however, the treatment of the demented seems to have been almost identical in principle with that which is employed at the present day. The teachings of the classical medical writers upon this subject, especially Hippocrates, Soranus, Paulus Ægineta and Aretæus, were of the soundest character.

"It appears to me," Hippocrates remarks in his section on the Sacred Disease, "to be in no wise more divine nor more sacred than other diseases, but has a natural cause from which it originates like other affections. Men regard its nature and cause as divine from ignorance and wonder, because it is not at all like to other diseases. And I see men become mad and demented from no manifest cause, and at the same time doing many things out of place; and I have known many persons in sleep groaning and crying out; some in a state of suffocation, some jumping up and flying out of doors, and deprived of their reason until they awaken; and afterwards becoming well and rational as before, and there are many and various things of the like kind *which it would be tedious to state particularly.*"

Hippocrates here refers to epilepsy, but other forms of mental alienation may be included in a general way; for, as he naïvely remarks in this reference to the great variety of the symptoms, it would be "tedious to state them particularly." Medical writers for many centuries afterwards appear to have been of the same opinion, and found the enumeration of mental symptoms so tedious, indeed, that it was not until the present century that anything like a complete description of the various clinical forms of insanity was even attempted.

Those afflicted with the Sacred Disease, Hippocrates continues, "ought to be taken to the temples and presented to the god, if a god be the cause of the disease. Neither, truly, do I count it a worthy opinion to hold that the body of man is polluted by god, the most impure by the most holy; for were it defiled, or did it suffer from any other thing, it would be like to be purified and sanctified rather than defiled by god. For it is the divinity which purifies and sanctifies the greatest offences, and the most wicked, and which proves our protection from them. And whoever is acquainted with such a change in men could also cure this disease, if he recognized the proper season for administering his remedies, without minding purifications, spells and other illiberal practices of like kind."

From words such as these it would seem evident that insanity was viewed from an intelligent standpoint by the greatest exponent of medicine of that time, and that no one affected with mental disease would have been harshly or brutally treated at his suggestion. Even the methods used by the charlatans of the time in the treatment of the insane, though they may not have led always to favorable results, had at least no deleterious effect upon the health of the patient.

The treatise of Soranus, who lived about the year 95, has been preserved in the Latin translation of Cœlius Aurelianus, who made no acknowledgment of the source from which his volume was derived, and thus enjoyed for a considerable time the distinction of being himself the author. The instructions laid down in this work for the treatment of the mentally unbalanced plainly indicate that in his day also the kindest methods were employed for the care and cure of this class of patients—at least for the most part.

"Maniacs," Soranus observes, "ought to be placed in a moderately light room with moderate temperature, the quiet of which no noise can disturb. The beds ought to be placed so that the patients may not see people coming in, or be irritated by a number of faces. Means of restraint, employed without management, increase and even originate fury instead of calming it." Soranus goes on farther to deplore the severe methods sometimes resorted to. "They seem mad themselves when they compare them to wild beasts to be tamed by deprivation of food and the tortures of thirst. Doubtless led away by the same error they want to chain them up cruelly, without thinking that their limbs may be bruised or broken, and that it is more convenient and easier to restrain them by the hand of man than by the often useless weight of irons. They go so far as to advocate personal violence, the lash, as if to compel the return of reason, but which only aggravates their condition, and covers their limbs with blood. They also order their being sent to sleep by the use of drugs, and produce a morbid torpor instead of a healthy sleep. Moreover, they use without discretion the stimulant of

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music, which may have good results when properly applied, and on the contrary may do much harm in a large number of cases. It has been said that the Phrygian rhythm, full of softness, and at the same time of vivacity, was well suited to those who were alternately overwhelmed with grief and transported with fury; and the Dorian warlike strain was adapted to those who gave themselves up to trifles and bursts of childish laughter."

With the growing popular belief, four or five centuries later, in a personal devil, from which was subsequently evolved the system of demonology of the middle ages, the mental peculiarities of the insane began to be viewed in a new light, and the mentally deranged were popularly supposed to be possessed of devils. This was, moreover, regarded not as the misfortune of the patient, but as a just retribution; for the patient was supposed to have committed some heinous offence, and had been subsequently possessed of a devil as a just punishment.

Vast numbers of the insane were probably murdered outright during this period; or executed in good faith, upon charges of witchcraft. As late as the eighteenth century the insane were burned in England upon the grounds of demoniacal possession; and the judicial murders of this sort in England alone during the previous century and a half number more than thirty thousand persons. It has been left for science to correct this theological misapprehension of more than a thousand years. Various rites of ecclesiastical exorcism were also resorted to; though more frequently, perhaps, an *auto da fé* terminated the unfortunate patient's existence.

Bertrand Le Blas was sentenced about the beginning of the seventeenth century " to be dragged on a hurdle with his mouth closed with an iron gag to the market place. Here his right hand and foot were burned and twisted off between two red-hot irons, his tongue was then torn out by the root, and with his arms and legs fastened together behind his back he was hooked by the middle of the body to an iron chain, and made to swing to and fro over a slow fire till he was entirely roasted."

When *auto da fé* was not practised, the patient was sometimes shut up in a noisome dungeon where he was privately maltreated by the clergy in various ways. Numerous hospitals were established during the middle ages under the charge of the clerical orders; and in these some of the insane were incarcerated; but these institutions were so miserably managed and attended with such gross abuses that they were little more than houses of death.

The first asylum for the insane was established at Feltre in Italy. In 1409 a second was established in Seville; and by 1500 four additional institutions of the same kind had been founded in Padua, Saragossa, Toledo and Fez. The treatment employed in these places was barbaric in the extreme. The patients were heavily chained, half-starved and cruelly beaten, so that the ecclesiastical superstitions which had so long delayed the initiative of separate care for the insane, still operated, even when these institutions were at last opened, in making the treatment ineffective. For the same reason insanity with a religious coloring was warmly cherished; and many of the saints of the middle ages are seen in the light of modern science to have been nothing more than insane patients, suffering from some form of religious mania. Of medical treatment there was not the least thought. The insane wallowed about in chains and without clothing in horrible dens and covered with filth as long as they were able to endure it without dying.

In the sixteenth century psychiatry was still in the same lamentable condition. The superstition regarding demoniacal possession of the insane continued on to the present century, and even to-day one sometimes comes across the same barbaric notion; though, fortunately for civilization, there is now a growing tendency to look upon all forms of mental disorder simply as manifestations of disease. This, however, is a development of our own time. Shakespeare, anticipating modern medical teaching upon the subject, has described a typical case of insanity in King Lear, and even suggested a rational form of treatment; yet the insane of his time were still left in their rusting shackles to wallow in the gloom and filth of their granite dens, naked, starving and brutally beaten by their inhuman jailers. There many died of cold and starvation in their very prisons.

Dr. Andrew Borde, in his *Breviarie of Healthe,* published in 1547, in "An Order and a Dyett for them the whiche be Madde and out of their Wytte," gives the following advice. "I do advertise every man whiche is madde or lunatycke or frantycke or demonyacke, to be kept in safe garde in some close house or chamber where there is lytell light; and that he have a keeper the whiche the madde man do feare." Towards the close of the sixteenth century the Hospital of St. Mary of Bethlehem, popularly known as "Bedlam," is described as "So loathsome as to be unfit for any man to enter."

In the seventeenth century insanity still failed to be treated in its entirety or separately, though some advance had been made in the understanding of certain forms of mental disease. In the treatment there had been no improvement whatever. Sydenham incidentally mentions madness in his *Practice of Physick,* where he devoted two or three paragraphs to the subject. "The common madness," he says, "which is wont to befall brisk people, without any fever going before, is of another kind, and therefore to be treated with a quite contrary method; though in this sort also those things that strengthen the brain and the animal spirits are not to be omitted."

To Willis, who belonged to this period, may be accorded the distinction of having first described paralytic dementia. He referred mental disorders to diseases of the brain tissue. Robert Burton also wrote about this time a ponderous work entitled *The Anatomy of Melancholy,* which, while ostensibly treating of the subject, is so loaded with quaint anecdotes and innumerable quotations from ancient literature, that the volume has acquired a fame as a literary classic which it would not have obtained as a scientific work.

All diseases are more or less influenced by the environment of the patient; to a great extent before the onset of the disease, to a still greater extent after its invasion. Most of all does this observation apply to mental disease. The organ in which the process of disease is going on is so extremely delicate in its nature that the patient is sensitive in the highest degree to external influences. Harsh treatment, therefore, or anything which has a tendency to irritate or shock the sensibilities only renders the symptoms more violent; or, after their temporary cessation, may again suddenly precipitate them.

Hence for centuries it may be said without any exaggeration that the insane of both England and the

Continent died prematurely and by direct violence. To say that thousands were deliberately murdered would be a euphemism. They were ingeniously tortured and died lingering deaths. They were starved to death. They were allowed to freeze to death. They did not even receive the consideration which a dog or one of the lower animals usually receives at the hand of man. By their friends they were regarded as dead as soon as they had lost their reason; and an effort was no doubt made by their family and relations to blot out their very memory. Such cruelty could be perpetrated by the connivance and actual encouragement of a clergy steeped in the most baleful superstitions. But not only were the incurable cases doomed from the first to meet a death by violence, but the class of cases which are now known to be curable did not have any opportunity to recover. Indeed, to be immured in such surroundings and daily subjected to such villainous torture would soon be found quite sufficient to deprive even a sane man of his reason.

In the case of those who did not break down at once beneath such a regimen, their mental symptoms assumed forms more horrible and more forbidding than are ever to be witnessed at the present time in well regulated hospitals for the insane. So repulsive and dreadful, indeed, was the spectacle of their desperate condition, that it was customary at one time for the English ladies of quality and the exquisites and beaux of the period to resort to the Bedlam asylum, where two pence a head was exacted by the keepers. Thither the *ton* of the hour flocked in much the same spirit as people go now to a wild beast show: an index to a condition of hideous selfishness, which, if it still exists among this superficial class (and it does) is carefully concealed beneath a veneer of studied conventionality.

In the closing years of the eighteenth century, however, a great man, as good as he was great, and as bold as he was both, became incensed by this world-wide system of abuse, for which he saw there was no adequate excuse, and which he saw could be rectified by a few of the simplest reforms, and yet which had been allowed to go on for centuries without protest—without comment even. This man was Philippe Pinel, one of the greatest of French physicians, who after the lapse of so many centuries seems to have caught again the spirit which actuated Soranus and Paulus Ægineta. Pinel was born at the Chateau de Rascas, Saint Andre, in the department of Tarne, France, in 1745. He studied medicine at Lavour, and afterwards at the University of Toulouse, where he took his doctor's degree in 1773, further carrying on his medical studies at Montpellier, and removing five years later to Paris. Here his attention was turned by an accidental circumstance to the study of mental disease. One of his friends who had become insane escaped into the forest and was there devoured by wolves.

In 1791, after having already made a translation of Cullen's Nosology, he published his medico-philosophical treatise on mental alienation, and the following year became the chief physician at the Bicêtre, an insane hospital for male patients in Paris. Two years later he received the corresponding appointment at the Salpêtrière, an asylum for the female insane, where he began to deliver a course of clinical lectures upon a subject which had received up to that time but too little attention. In the meantime, however, he had successfully introduced one of the most philanthropic reforms of modern times. Having himself known what it was to suffer privation and distress—for he had been reared in great poverty, the son of a village physician—he was able to sympathize with the sorrows of others more keenly than the *jeunesse dorée,* already referred to, and was hence moved to the most profound compassion by the misery which he saw upon all sides.

Upon being appointed chief physician to the Bicêtre he straightway began to strive to alleviate the lot of the patients who were under his care, turning first to the public authorities. Unterrified by the menacing reception which he received at their hands, —for they hailed him as " conservative " and " aristocrat," general terms of extreme offensiveness in the ears of the populace at that time, and which in so troublous an epoch would in many cases have been equivalent to a death sentence,—he appeared at last before the Common Council of Paris, and with renewed warmth requested authorization for his reforms.

" Citizen," said the famous Couthon to him, " I will visit thee in the Bicêtre to-morrow morning, and woe to thee if thou hast deceived us and concealest enemies of the people among thy madmen." Couthon came as he said, but the cries and howls of the insane, concerning whom he wished to make inquiries, soon disgusted him and he said to Pinel, " Ah, Citizen, art thou thyself a madman, that thou desirest to turn such cattle loose? I greatly fear thou wilt become thyself a victim of thy preconceived opinions." Still Pinel began his undertaking the same day, and with his own hands, heedless of the terror of the attendants about him, struck off the iron shackles from a number of the patients who had been chained to the wall for many years.

The other engines of restraint were subsequently abolished by him as he saw his way clear in the face of the most bitter popular prejudice, to do so, and the patients were given all the freedom that was possible within the limits of reason. The almost incredible improvement in their condition was instantaneous. One of the most violent patients, from whose limbs the irons had been taken, became afterwards one of Pinel's most faithful attendants.

Indeed, were it necessary to prove the truth of Pinel's theory, it would be very easy to do so at the present day. It is customary in the Canadian jails to bind the feet and hands of those whom the court has described as insane with either steel or leather bands. Though the patients are only subjected to this restraint, which is mild compared with what was formerly endured, and only for a short time, they are often in a state of violent fury when received at the asylum whither they are transferred from the jail. Upon being here set entirely at his liberty, I have often seen such patients take advantage of their new found freedom by running excitedly about the ward from place to place. No attention being paid to them, however, and no attempt being made to in any way hinder their movements, they would in a short space of time become comparatively calm, and would be seen with amazement by their friends upon the following day, in whom there had been no expectation of so gratifying a change.

A case in point recurs to mind in this connection, and one frequently met with by the practitioner. A certain amount of mental derangement having manifested itself in a lady who was undergoing treatment for general disorder in a hospital, she showed marked signs of restlessness, and tried repeatedly to rise from her cot. The nurse, afterwards, as she became more insistent, aided by the other nurses, succeeded with great difficulty in holding her by main force in her cot. The patient, who now occupied the attention of half the nursing staff, had become so great an embarrassment that the physician asked for a camisole, fancying that they were of course in daily use in all institutions for the insane. Making further inquiries, I suggested that instead of adding to the restraint by binding the patient with a camisole, her entire liberty be tentatively allowed her, and her movements watched. She was accordingly left to her own devices, and appeared somewhat surprised at the withdrawal of the cordon of nurses. Then, as if trying an experiment, she rose from her cot, and being still unrestrained, walked across the ward, screamed a couple of times, and making no impression upon any one, and lacking the imagination for any further exploit, quietly returned to her cot, which she showed no further inclination to leave.

Having removed all unnecessary restraint, and put a stop to corporeal punishment, and like abuses, Pinel also limited the use of narcotic and sedative drugs and the indiscriminate practice of venesection among the insane patients. The convicts he subsequently separated from the insane, and taught, as Hippocrates and Soranus had done more than twenty centuries before, that mental disease was the result of morbid tissue changes in the body. In spite of Pinel's humane teachings, however, lunatics were found in cages in some of the French provincial cities as late as 1834; while, on in the seventies, camisoles, or strait-jackets, were still in use in the remoter regions of Europe and the new world. Muffs of leather or iron, for binding the hands together, as well as the so-called covered beds, which consisted of coffin-shaped boxes, about the size of the body, in which restless patients were fixed, and jammed down with a perforated cover, were until a few years ago used in the Canadian asylums. In Toronto Asylum there is still a Restraint Book somewhere, in which some years ago a record was kept of the patients who were subjected to these brutal and degrading measures.

In 1810 Esquirol, afterwards a writer of much distinction upon the subject of insanity, succeeded Pinel, and strongly recommended instruction in the intelligent management of mental disease, establishing in 1817 a Clinic. To Pinel's simple classification of the forms of mental disease, into mania, melancholia, dementia and idiocy, Esquirol added a fifth, monomania. Cullen in his *Practice of Physic* some years before had in Edinburgh adopted a still simpler classification, melancholia, mania and the vesaniæ, including hallucinations, or false perceptions, and morositates or erroneous appetites.

The reforms effected by Pinel in the treatment of the insane in France made subsequently so profound an impression, that in Britain the abuses in common practice in the madhouses there began at last to be inquired into, and the state of things was found to be so outrageous that an attempt was made to correct them. The management of the Bedlam asylum was entirely altered, and many of the old abuses abolished. About the same time the Quakers built a special retreat for members of the sect who were mentally deranged, and under the care of Tuke the humane methods of treatment taught by Pinel were scrupulously imitated in this institution. Among the Italians Vincenzio Chiarugi, of Florence, was chiefly active in exciting fresh efforts in the same direction. He regarded the mind itself as something immaterial, and consequently incapable of disease in the ordinary sense of that term. In Germany John Gottfried Langermann became the reformer in Psychiatry, and was the first there to place the curable and the incurable patients in separate institutions. The St. George Asylum, near Beyreuth, to which he had been appointed physician, he succeeded in raising eventually to the position of a modern asylum. Reil and Hoffhauer were about the same time making special efforts to bring psychology into accord with physiology, in the department of alienistic science.

Following the more humane form of treatment of the insane the latter part of the century has also witnessed a very rapid advance in the scientific study of the disease. Recent pathology has cast considerable light upon the actual processes of cerebral lesion, and the original causes of many forms of insanity have been more clearly apprehended.

Much still remains to be accomplished in remedial measures; and as most insanity is the culmination of two or three generations of defect, it is hardly possible that any radical cure for the more chronic cases will be ever discovered. With a better understanding of the general causes of insanity, however, it may be possible to obviate much of the disease in the future by the inauguration of preventive measures. Indeed, it is no new idea that it is easier to prevent than to cure mental disease; and if the measures adopted are effective no heritage of insanity need be left to the future such as has come down to the present from the half barbaric past.

CHAPTER XVI.

THE ART OF NURSING.

THE history of hospitals in the present sense of the word does not go beyond a comparatively recent period. In the earliest times the care of the soul and the care of the body were very closely associated together. The art of medicine was a branch of religion, and the early physicians were usually members of a priesthood. Hence the temples of the gods were probably the first hospitals. The patient would make propitiatory offerings at the temple of Æsculapius or of Apollo, and the women in travail would call upon Juno for aid. To many of the celebrated shrines of antiquity the rich, when in physical distress, would make pilgrimages, and were perhaps benefited by the religious and medical treatment which they received there. Much of the cure was due probably to the change of air and of surroundings, and to the physical exercise and stimulation entailed by the journey thither. The priests and the priestesses of these early temples may be looked upon as the first nurses.

In Rome at the time of Galen, "*Tabernæ Iatria*" and "*Tabernæ Medicinæ*" were erected in many towns at the expense of the community, where probably the poorer classes found such succor as was then obtainable, and were cared for, no doubt, by slaves skilful in such matters. In the early Christian era Nosocomia were established in various localities. These were probably refuges for the indigent sick.

The remedial measures were those of the period and the attendants, or nurses, had some degree of training. In the time of Justinian a large number of Nosocomia were in existence.

With the spread of the Christian religion, however, and the multiplication of monasteries and nunneries, the care of the sick was almost entirely relegated to the religious orders, and during the middle ages continued so without change. At a comparatively recent time Hospices were established in France, and somewhat later similar public institutions for the care of the sick were erected in England. St. Bartholomew's Hospital was the first of these, and was opened in London in 1123. The condition of the early hospitals may be gathered from Max Nordau's account of one of the great Continental institutions in the time of Louis IX.

"In the lower halls," Nordau says, "which lacked light and air there were no beds. On the tiled floor lay heaps of straw, and on these pallets the sick crowded each other, packed together like herrings in a cade. On one occasion when Louis the Saint visited the hospital, the straw upon which the miserable creatures were rolling was so frightfully filthy, stinking and rotten, that the king ordered fresh straw to be brought. About the middle of last century beds were furnished, but the situation of the sick was in no way improved thereby. In one bed of moderate width often lay six persons beside each other, the feet of one to the head of another, children beside gray-haired old men, indeed, incredible but true, men and women intermingled together. In the same bed lay individuals affected with infectious diseases beside others only slightly unwell; on the same couch, body against body, a woman groaned in the pangs of labor, a nursing infant writhed in convulsions, a typhus patient burned in the delirium of fever, a consumptive coughed his hollow cough, and a victim of some disease of the skin tore with furious nails his infernally itching integument. Medical service was deficient, the medical directions scarcely followed, and the choice of remedies very limited. The most miserable food was doled out to them in insufficient quantities. The whole building fairly swarmed with the most horrible vermin, and the air of a morning was so pestiferous in the sick wards that nurses and inspectors did not venture to enter them without a sponge saturated with vinegar before their mouths. The bodies of the dead ordinarily lay twenty-four hours and often longer before they were removed, and the other sick were compelled during this time to share the bed with the rigid corpse which, giving out an infernal stench, was surrounded by humming green carrion flies."

The development of nursing into an art belongs particularly to the nineteenth century, and to the latter part of that. There have always been "born" nurses, of course; and the faculty for tormenting the sick with suggestions and medications seems to be inborn in womankind; even when any special aptitude for caring for the helpless is lacking. Probably this propensity has in a general way led to the overestimation of women's actual gifts for nursing. At present more attention is paid to the acquired experience of the nurse than to her inherent faculties; and the "trained nurse" is therefore a modern product.

Previous to the year 1840 nurses were of the very worst classes of the community. In selecting a nurse the main object was to find one who was not a confirmed drunkard. "No respectable person," a physician of the early part of the century remarks, "would undertake so disagreeable an office." Almost every vice was rampant among them. Lazy, incapable, unscrupulous, the patient often suffered severely at their hands. In severe cases these creatures would often remove the pillows from the patient or the coverlets, in order to hasten death if possible, and thus curtail somewhat their tedious vigil. A typical nurse of the period, but by no means a lost type, as any physician of the present day well knows, was described by the author of *Martin Chuzzlewit* under the name of Sarah Gamp. Her quaint good humor and open mendacity proved redeeming qualities in her case, but her addiction to drink and pilfering and lying may probably be taken as an index of the class; in striking contrast to the Sisters of Charity, who about the same time in France carefully attended the sick, both in the hospitals and on the battlefield.

In 1840 Mrs. Fry and Lady Inglis founded the first nursing institution in London under the patronage of Queen Adelaide. The members were called Nursing Sisters, and the idea had probably been conceived through comparing the paid English nurses of the time with the Sisters of Charity who performed a similar office upon the Continent. The idea did not meet at once with the sympathy of the public, however, for in 1847 when Sir Edward Parry published a request for nurses for the Hasler Naval Hospital his appeal met with no volunteer.

In the same year two orders of nurses were formed: the Anglican Sisters and the Society of the Holy Trinity at Devonport. Two years later Miss Lockhart founded the Sisters of Saint Mary, the Virgin, at Wantage. In 1848 the Middlesex Hospital was enlarged and rooms were provided for the superior nurses; though the inferior nurses, like charwomen, which in reality they were, continued to come in, with the milk, in the early morning.

In 1851 Florence Nightingale entered the institute at Kaiserswerth, and Miss Byron, who had received her training at King's College Hospital, established a home for incurables, from which originated another order of nurses, the Sisters of All Saints. At this time also monthly nurses were admitted for training at Queen Charlotte's Hospital. The following year Miss Nightingale published in a small volume her *Notes on Hospitals,* which gave evidence of a mental grasp of the subject at once practical and thorough, and brought her name so prominently before the public that she was called upon to organize a nursing staff for the care of those wounded in the Crimean war which broke out at that time.

In November, 1854, Miss Nightingale with her nurses disembarked at Constantinople and at once proceeded to Scutari where they undertook the care of the wounded soldiers. Though no doubt an exceedingly improper proceeding for a young lady nurtured in wealth and luxury, and deplored at the time by the more respectable members of British society, there was nevertheless something in her course which appealed to the hearts of the poorer classes, who are born with a certain hereditary awe of the aristocrat, and Miss Nightingale presently found herself the heroine of the populace, who promptly subscribed £40,000 for her, and whose loud applause evidently drowned for the time the voice of dissent in more select quarters.

Emboldened by her example the nursing world now began to receive reinforcements from the more intelligent classes; and though expressions of decided disapproval are to this day heard in very respectable society, and the profession of nursing is still regarded by old-fashioned people as degrading and plebeian, and, indeed, scandalous, it may still be affirmed that by her dramatic example upon this occasion Miss Nightingale did more to establish the status of the nurse and to popularize the movement, than any other event of the time; more even than the training school for nurses which she afterwards established with the subscription already mentioned.

In 1854 Mrs. Monsall founded the Society of St. John the Baptist, and Dr. Neale the next year founded the nursing sisters of St. Margaret. In 1859 district nursing in the houses of the poor was inaugurated; while in 1861 a diaconal order was set on foot to accomplish a similar end, known as the Diocesan Deaconess Association. In addition to her training school for nurses which was connected with St. Thomas Hospital, London, and in which more than a thousand "gentlewomen" have since been trained as nurses, Miss Nightingale in 1861 established a training school for midwives. On that occasion she wrote these words: "Sickness is everywhere; death is everywhere. But hardly anywhere is the training necessary to teach women how to relieve sickness, to delay death. We consider a long education and discipline absolutely necessary to train our medical men: we consider hardly any training at all necessary for our nurses, although how often does our medical man himself tell us 'I can do nothing for you unless your nurse will carry out what I say.'"

In 1865 Miss Agnes Jones began nursing in the Liverpool workhouse, and died in 1868 of typhus fever contracted while at her work.

In 1869 "Her Majesty's Nursing Sisters" were appointed at Netley Hospital, whose duty it was to nurse the soldier in peace or war; and with the events of war by sea and land this order of nurses has been identified ever since. The same year Miss Ayckbourn founded the Sisters of the Church which, like the diaconal order already referred to, combined with nursing many other offices of practical charity.

In 1870 Guy's Hospital at last followed the lead of the other London hospitals, and introduced regular nurses in the place of the "scrubbers" and general charwomen who had formerly officiated in that capacity. For every twenty-four beds a Sister, a day nurse, a night nurse and a probationer were appointed. About the same time the Edinburgh Royal Infirmary turned to the Nightingale system for assistance in generally re-ordering its nursing department. The following year the Staffordshire Institution for nurses was founded at Stoke-on-Trent; and in 1874 a code was drawn up by which probationers were to receive a certificate of efficiency at the end of two years.

During the Franco-Prussian war Miss Byron and a number of the All Saints Sisters went to the scene of battle. Miss Florence Lees and Lady Pigot were also volunteers at the front, and the latter received the ribbon of the Legion of Honor, while the former was also decorated with an order from the Empress Augusta. In 1875 two nurses went out to the Zanzibar Mission; and it has since become usual for a nursing staff to accompany the mission stations established in foreign fields; their presence aiding greatly in the labors of the missionaries who usually find much to do in a medical way.

In 1876 five English nurses went to Bucharest to assist in caring for the wounded Servian soldiers; and the same year the Guild of Saint Barnabas was founded, and the Order of Saint John of Jerusalem, which proved the nucleus from which sprang the Metropolitan National Association of Nurses. In 1878 the Saint Denys Community of Nurses was founded at Warminster, and from this order India and some of the other British colonies have been supplied.

In the same year four nurses went out to Bulgaria to nurse the Russian wounded, at which time also the Baroness Burdett-Coutts and the Stafford House Committee, the first Transvaal war being then in progress, sent a staff of trained nurses to Ladysmith to nurse the British soldiers wounded in the war. In 1880 a quarrel in the nursing world arose at Guy's Hospital as to whom the nurse should be ultimately responsible. Among some of the nurses an opinion seemed to have developed that they were responsible to no one, and one of the nurses at Guy's (the story goes) having upon her own responsibility ordered a bath to a very feeble patient who died in consequence, the physicians protested; upon which one of the nurses, by way of recrimination, wrote to one of the magazines of the day that many physicians were guilty of practices (probably referring to vivisection) which could not be repeated in public. It was ultimately conceded, however, that the nurse should be responsible to the physician, that she should not criticize or countermand his orders in regard to the treatment of patients nor herself give orders independently of him; and this understanding still exists between physician and nurse, between whom there ought always to be, and generally is, mutual confidence and harmony of action.

In 1882 the war in Egypt broke out, and employment for Her Majesty's Nursing Sisters was found in the Egyptian ports, and also on board the hospital ship Carthage which conveyed the wounded back to Netley. The following year Queen Victoria founded the Order of the Royal Red Cross for the purpose of rewarding women who had given special service to those wounded in war. The decoration consisted of a Maltese cross bearing the words "Faith, Hope and Charity," and was worn on the left breast. This decoration was the same year presented by the Queen to the Princess of Wales, the Princess Beatrice and to several other ladies of the royal family who had given special service to the wounded in war. Owing to a quarrel of Miss Lloyd with the hospital authorities, the new nursing Order of Saint John the Divine was founded to distinguish the nursing faction which held her views from the Order of Saint John the Evangelist, which held the contrary view.

In 1886 Sister Dora died of cancer, and the story of her life was written by Miss Lonsdale; in answer to whose appeal a statue was erected to Sister Dora's memory. Nurses in 1887 were sent to Poona; and homes in the Hills for Indian nurses were erected at the instigation of Lady Roberts. To Rawalpindi and to Bangalore, India, nurses were sent in the following year, and nursing homes were established at Cairo and at Alexandria in Egypt. Scotch and Welsh branches of the Queen Victoria order of Jubilee nurses were founded in 1890; and trained nurses went to Barbadoes in the West Indies, to the Fiji Islands, to Hong Kong and to Bechuanaland, while Sister Rose Gertrude went to Molakai to nurse the lepers there.

The system of nursing also underwent much improvement in the British colonies. In Canada the patients in the public hospitals had formerly been nursed entirely by Les Sœurs de Charité, as in France; and for the most part by the Order of St. Vincent de Paul. Here these sisters still have charge of some of the chief hospitals, including the Hotel Dieu and Notre Dame in Montreal, the Sacre Cœur and St. Jean de Dieu in Quebec, the hospital at Ottawa and the settlement of lepers at Tracadie.

At the Royal Victoria Hospital, Montreal, and at the General Hospital, Toronto, training schools for nurses, based upon the English system, have been formed where certificates of efficiency are granted upon examination after a residence of two years—a period of training extended more recently to three years. Subsequently schools for nurses have been also established in connection with various other hospitals in the colony. Here too an order of nurses has been founded known as the Victorian Order of Nurses for the purpose of nursing the indigent, free of charge; especially the residents of remote and sparsely settled districts such as the Yukon Territory. The scheme, as originally proposed, has since been found to be impracticable, and the members of the order are at present devoting themselves to general work in the larger cities and towns. In Australia the training of nurses is only now about to be attempted.

In the United States attention seems to have been given to the teaching of nurses much earlier than in England, and in the rapid improvements which have been mentioned during recent years, America has kept pace with Britain and the Continent. As early as 1790 Dr. Seaman lectured to a class of nurses at the New York Hospital. The first attempt at organization was made in America in the year 1830, and was the result of sectarian prejudice. In this year the Society of Friends established a nurses' society which was speedily followed by other similar societies. The narrow spirit of a sectarian community regarded with ill-concealed suspicion and concern the simple and unselfish work which had for so long been performed by the Sisters of Mercy. The Protestant orders of nurses have since become very numerous in all parts of the Atlantic States. For private nurses who have received a thorough training in regular institutions the demand is still somewhat in excess of the supply; and the trained nurses in the city of Chicago have banded themselves together to form, not a red, but a "Blue Cross Association" to help, not the poor, nor even the public, but each other in times of sickness. A uniform consisting of a gray cloak, bonnet and veil has been adopted, and is the first uniform worn by any American woman, there being a very strong prejudice in the country against the wearing of any form of uniform by women.

A Red Cross Society has also been formed in America by Miss Clara Barton, and both during war and in the presence of epidemics, the assistance rendered by this society is of the greatest importance. At the time of the epidemic of yellow fever in Florida, and the great distress and destitution caused by the floods at Jacksonville, as well as during the Spanish-American war, the Red Cross Society provided promptly for the need of the sick; though the inexperience of a large number of its members, who had received no adequate training, and brought nothing but their sympathy and their enthusiasm, was much felt.

On the continent of Europe the religious sisterhoods, as well as the diaconal orders of the Roman Catholic Church, which have existed from the time of the early centuries, still perform the greater part of the nursing in the hospitals and in private houses. Besides the nuns of the Order of St. Vincent de Paul, the Order of Les Demoiselles de Charité was more recently founded in France. In Belgium there are "Les Sœurs Hôpitalièrs," and in Italy the "Fatebene" sisters and brothers. In Spain sectarian hatred still seems to envelop the national character, even at the bedside of death, and a spirit which reminds one of the times of *auto da fé* is still observed. Indeed, it has been complained that foreigners who are admitted to the hospitals of Spain are isolated in the chamber reserved for heretics, in which anticipatory Hades the dying patient is piously left to himself, the victim of neglect and indifference. The nursing system is excellent in Germany, where until a comparatively recent date the nursing was performed by the Orders of Chivalry, the Knights of Malta and St. John. In Austria, on the contrary, the system of nursing is exceedingly bad; the nurses being engaged without a "character"—and leaving without one.

In the mention of so many orders and societies of nurses one must not for a moment be led to conclude that there is anything characteristic in any of them beyond the name. The art of nursing taught to all and practised by all is essentially the same. In a word the ideal nurse should be the physician's assistant, when present, and his representative during his absence. Her training is of such a nature as to enable her to assist the physician or surgeon in the sickroom, the ward and the theatre during operation.

Her theoretical knowledge should be such as to enable her intelligently to act as his representative when in charge of the patient alone. Her practical training has become more thorough and more exact during the last few years and her theoretical knowledge has been added to constantly as the scope of her responsible office gradually increased from that of a mere servant to that of a professional assistant.

At the head of a nursing staff there is a matron or a lady superintendent. Associated with her is an assistant matron and a home sister who has charge of the nurses' residence. Over each ward there is also placed a head nurse or a nursing sister; the term having no religious significance, but being merely used as one of respect. Under her direction there is usually a certified staff nurse having charge of from fifteen to twenty beds; and she is in turn assisted by a "probationer." Together with the steward of the institution, the matron has charge of the domestic arrangements, the stores, the wines and spirits, the linen and clothing and the utensils. It is for her to issue all supplies required daily by the dietary sheets for meals, to see that everything is clean and properly cooked, to supervise the laundry, to make the necessary inventories and to discharge or suspend nurses and servants. Besides these executive duties, which are in great part performed by her assistants, the lady superintendent also gives instruction to the nurses in the art of nursing. The head nurse of the ward accompanies the physician upon his round of inspection, administers the medicine, is present when the meals are taken by the patients and also instructs the probationers, who, with the staff nurse, to whom also they are forced to give precedence, do the actual nursing.

What is expected of a nurse may be gathered from the charge which in some such words as the following is usually addressed to all nurses when entering upon their duties at a hospital. "You are required to be sober, honest, truthful, trustworthy, punctual, quiet and orderly, cleanly and neat, patient, cheerful and kindly." If possessed in a high degree of these virtues, the nurse is next expected to become skilful in dressing blisters, burns, sores and wounds; in applying fomentations, poultices and minor dressings and in the administration of hypodermic injections. She must also be able to apply leeches internally as well as externally; to give enemas to men and women, and to use the catheter for women. She must furthermore understand the management of trusses and appliances for uterine complaints, beside the best methods of friction and massage to be applied to the body and the extremities. She must be able to undertake the care of helpless patients, such as moving and changing; attending to the personal cleanliness, feeding them, keeping them warm or cool as the case may be; preventing, or, when present, dressing bed sores; managing their position and the like. She must beside this be an expert in bandaging and making bandages, rollers and lining of splints. She must understand the making of beds and removing the sheets while the patient is in bed. It is her duty, moreover, to attend at all operations in the operating theatre when required. She must be able to cook gruel, arrowroot, egg flips, puddings, punches, and mix drinks for the sick. She must understand ventilation and be able to keep the air of the ward fresh, and the utensils and vessels of any kind absolutely clean. It is her further duty to keep a record of the pulse and temperature, the secretions and expectorations, skin, appetite, mental condition (delirium or stupor), breathing, sleep, state of wounds, eruptions, formation of matter, effect of diet or of stimulants and medicines, as well as the management of convalescents. Besides these duties the nurse of the insane must possess tact and patience in dealing with this particular kind of patients. These nurses are often obliged to resort to a certain amount of physical restraint in preventing one patient from injuring another, or the nurse herself, and in anticipating attempts at suicide. This is probably the most difficult form of nursing there is; and for various reasons it is hardly wise for any nurse to attempt the nursing of the insane for any considerable length of time. In this branch the nurse very rarely finds herself in charge of any but her own sex.

Though so great an advance has been made in the training and also in the social status of nurses there is still much to be desired which does not seem to have been realized by the multiplication of new orders of nursing sisters. At present, for example, the nurse is forced to work too hard. Always on her feet, it is admitted that her work is exceedingly trying; and the present hours are certainly excessive. A nurse should not be on duty for more than seven or eight hours at the most, while in many hospitals the nurse is kept at her post in the ward for twelve or even fourteen hours in the day. This must in time tell upon the strongest constitution. It is again not desirable that the nurse should reside in the hospital building proper. The nurses' home should be quite distinct. The improvements in her condition have up to the present time been so rapid that it is quite probable that there will eventually be other changes in the direction referred to. Indeed, the titled and wealthy women who amuse themselves by founding new "orders" of nurses might find a field of great usefulness in studying the nurse's actual needs, and assisting in the inauguration of such reforms as will conduce to her comfort or assist her in perfecting her efficiency and knowledge.

Furthermore, though in no way endangered thereby as a profession, there is still a possibility that the calling of the nurse may be weakened for a time and rendered ludicrous by the unwarrantable accession to its membership of a class of flippant and shallow women who have in large numbers assumed recently the responsibilities of the nurse, because the calling satisfied the caprice of the moment and appeared at the time to be very much in the fashion; but who have never seriously addressed themselves to acquiring any of the accomplishments expected of a good nurse. Frederick Treves, the surgeon, in referring to the second war in the Transvaal, where a large number of "smart women," suffering from khaki fever, had gone to the front as alleged nurses, remarks, "So far as the sick are concerned there are only two plagues in South Africa—the plague of flies and the plague of women. The flies we get rid of by horsehair whisps and other appliances, and the flies at least depart at night. But the women are absolutely and really a terror. They come out in the guise of amateur nurses after having exhausted every other form of excitement. Considering that we are engaged in a war, the number of well-dressed ladies at Capetown and elsewhere giving picnics is a blot on the campaign."

Florence Nightingale also, who at the age of eighty still takes an active interest in the war nurse, is equally strong in her condemnation of the society women who, under the shallow pretence of nursing, have recently gone to South Africa in search of novelty. The nurse's profession is degraded and rendered contemptible by the presence of this class of persons within its ranks. "They cannot know, these fine women," Florence Nightingale exclaims, "what a terrible thing war is, or they would approach it in a sober, earnest spirit, instead of going as if on a pleasure tour. It would be a calamity if any social influence enable any but the best qualified to deal with the sick and wounded."

CHAPTER XVII.

THE GERM HYPOTHESIS.

The presence of animalculæ in stagnant water and other substances was known from an early period; some of the larger species having been discovered by Leeuwenhoek as early as 1675. It was not, however, until the close of the last century that the attention of scientific observers began to be directed to them; Spallanzani in 1776 showing by experiment that the spontaneous generation of these animalculæ, or micro-organisms, in fluids was impossible. This he accomplished by boiling putrescible fluids in a sealed flask.

In 1838, the microscope having meanwhile undergone great improvement, as has already been shown, Ehrenberg described under the general name of vibrioniens four separate genera, viz.: bacterium, vibrio, spirillum and spirochœte. Ehrenberg may thus be said to have made the first attempt at their classification; scientific writers having before his time been satisfied with the general fact that in various substances, especially stagnant water and putrefying material, there were present very minute living animals invisible to the naked eye. Three years later Dujardin also described these animalculæ as "filiform *animals,* extremely slender, without appreciable organization and without visible locomotive organs."

In the lowest forms of life the line of demarcation between animal and vegetable is not as clearly drawn as in the higher forms; but in 1853 Charles Robin, who for various reasons was led to regard these micro-organisms as vegetable forms of life, suggested the relationship of the vibrioniens of Ehrenberg with certain genera of the algæ. Davaine also insisted subsequently that they were vegetable organisms in every sense of the word, and very closely allied to the algæ. Another step was thus made in the understanding of these organisms; and the term animalculæ fell gradually into desuetude.

As early as 1839 Schwann had clearly demonstrated the relation of the yeast plant, which belongs to this class of organisms, to the process of fermentation in saccharine fluids. This discovery served to correct the early notion that, owing to their microscopical size, these organisms could not possibly exert any activity which would be at all appreciable in the gross mass.

Pasteur in 1860 demonstrated by various experiments that the organisms were not killed by being subjected to the temperature of boiling water, and explained this fact five years later by indicating the presence of the spores, which are minute germinal centres from which the micro-organisms are developed, and to which Pasteur applied the term *"corpuscles brillants."* Though the micro-organisms were themselves destroyed by heat, their spores, Pasteur discovered, were capable of resisting even the temperature of boiling water for a certain time.

Another discovery, not itself of great scientific significance as regards the life history or functions of the micro-organisms, but one which subsequently proved of great practical value in all scientific investigations which related to bacteriology, was the discovery of Schröder in 1854 that a cotton plug proved an impervious barrier to the escape or entrance of the organisms, while freely allowing the entrance of air. This simple measure overcame the difficulty with which Spallanzani had been met in his earlier experiments. As the growth of many of the organisms had been found to depend upon the presence of air, no experiments, such as those of Spallanzani, where a sealed phial had been used, could be regarded as conclusive; the air being excluded from the substance in which the micro-organisms were present. Indeed, in the whole history of scientific discovery it will be noticed that an entirely new epoch has been repeatedly inaugurated, not by the profound deductions of the savant or the combined speculations of a school, so much as by some simple mechanical device by which scientific investigations could be rendered more accurate in one direction or more far reaching in another.

In 1876 the nature of the spores was further studied by Cohn and Koch, and the conditions under which these reproductive bodies are formed was at length determined by a number of elaborate experiments directed to the spores formed by the bacillus of anthrax. Meanwhile still another step was taken in a direction which ultimately proved of incalculable value to medicine. This was the experimentation as to the resisting power of both the micro-organisms and their spores to various physical and chemical agents—experiments which indicated by what means the micro-organisms might be entirely destroyed.

Much of the advance made in the knowledge of the subject up to this time may be said to have been due to the constant controversy which had been aroused by the experiments of the earlier investigators. There had first been much controversy as to the spontaneous production of the micro-organisms, which had led to the experiments of Spallanzani. Afterwards the marked difference of opinion regarding the part played by the organisms in the production of fermentation had led to experiments of equal value to science. A fact which, as far as science is concerned, clearly refutes the general opinion formerly held, and expressed by Milton, that all disputations have a tendency to be in a circle, and to end exactly where they began. In ethics the latter may be the case (in some quarters), but in science the controversial element has always been found a necessary stimulant to more accurate and fuller investigation.

Schröder's introduction of the cotton air-filter was afterwards followed by the use of sterile culture fluids, by which the micro-organisms could be artificially propagated for further observation and experiment. A sterile culture fluid is merely a substance which contains the pabulum necessary for the life of the organism, but in which at the time no living organisms are present. As the organisms are present everywhere in the atmosphere, a perfectly sterile fluid for their subsequent culture can only be obtained by destroying all the organisms present in the substances of which the fluid is composed.

From the first much difficulty had arisen from the fact that many of the organisms and their products are of very uncertain color, or are almost colorless, which rendered the detection of many of them next to impossible when subjected to examination by the microscope, with which instrument all investigations of the sort are necessarily conducted. Conscious of this difficulty more and more as the study advanced, Wiegert succeeded eventually in overcoming it with a system of artificial staining which he introduced

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in 1877; and which was at once adopted by the scientific investigators of the time, and afterwards underwent numerous modifications and improvements. By means of this staining process it has become possible to define with great clearness and delicacy the outline of the cells, and even to determine differences existing between many apparently similar when unstained, owing to the fact that some cells by reason of certain chemical characteristics inherent in them receive the stain in a manner different from others. This device was also adopted by investigators in sister branches of science, and in histology, which is devoted to the study of the ultimate structure of the normal tissues of the body, proved of the greatest value, by bringing out many characteristics of structure which by the usual means of examination had escaped detection. In pathology also, which, in an analogous manner, makes a study of the minute structures of diseased tissues, the practice of staining tissues before subjecting them to microscopical examination proved of equal value.

Artificial cultures of bacteria had formerly been grown in liquid preparations, copiously supplied with the substances found to be necessary for the life and development of the organism. In 1881 Koch introduced solid cultures, which were sterilized like the former and which added greatly to the convenience and to the scope of bacteriological experimentation. Bacteriology was thus placed upon a scientific basis, and by the facilities now at hand the investigator was able to study the life history of these organisms, and arrive at definite conclusions regarding the habitat, the mode of propagation and the means by which the organisms might be destroyed, beside the various new products evolved during their existence.

The next step may be said to have been made by Davaine, who now claimed that infectious diseases were due to the presence of micro-organisms in the blood and tissue of the patient. The experiments of Davaine were not thought at the time to be altogether conclusive, as the organisms from dead bodies used by him in his experiments contained also the material of the dead body. Pasteur and Koch, however, subsequently succeeded in removing these objections. A number of experiments were also carried on by Pasteur relative to *pébrine,* a disease which was confined to the silkworms, and which threatened to destroy those which were cultivated in France at the time.

Obermeier in his studies of relapsing fever discovered in 1873 a germ which he proved to be always present in that disease, and not to be present in any other disease, and the presence of which he therefore claimed to be cause of that disease. It was now that the individuality of the micro-organisms began to be recognized, and from that time onward the closest attention was paid to the distinguishing characteristics of the germs. Five years afterwards Koch succeeded in isolating the micro-organism present in traumatic injuries, or wounds, and which gives rise to the suppuration which takes place in the affected part, as well as to the constitutional symptoms observed in traumatic fever.

The discoveries of the separate germs which cause, and are present, in various forms of disease soon became numerous. In 1879 the germ of leprosy was defined by Hansen, and was found to be always present in leprous tubercles. The next year the germ of typhoid fever was discovered in the blood and tissues of typhoid fever patients by both Koch and Eberth. The same year also marked an epoch in bacteriology by Pasteur's introduction of the etenuated virus of anthrax and fowl cholera. By subjecting the germs of these diseases, as found in the lower animals, to heat, or exposing freely to air, Pasteur discovered that the germs lost much of their original virulence, and when injected into animals failed to produce the fatal effects originally observed, acting, in fact, much in the same way as the vaccine produced from the cow acts in preventing smallpox. He therefore proposed the etenuated virus of anthrax and fowl cholera as a remedial means for anthrax and cholera.

The virus of rabies conveyed to human beings by the bite of a rabid dog, wolf, fox, jackal, hyæna or other animal of the same genus, and which in the human being subsequently produces a similar disease, generally fatal, and known as hydrophobia, was also carefully investigated by Pasteur, and in 1882 he proposed the etenuated virus of this disease as a cure for the disease when it occurred in persons. The results obtained by him were eminently satisfactory, and upon that occasion a deputation of English doctors visited France and inquired into the nature of his experiments; afterwards returning a report "confirming the results" described by the French savant. The humorous aspect of such a performance does not seem to have struck the English tourists, nor its insulting aspect to have been apparent to Pasteur. The same year Pasteur published the results of his experiments on the disease known as *rouget*.

In the year 1882 Koch announced his discovery of the germ of tuberculosis, which proved conclusively that consumption or phthisis pulmonalis or pulmonary tuberculosis, by all of which names the disease is known, is due directly to the presence of a specific germ in the tissues of the lung which tends eventually to entirely destroy the lung tissue, and thus terminate the life of the patient. Probably no discovery of the last quarter of the century has been more far-reaching in its results than this discovery of Koch. Two years later Koch also discovered the "comma bacillus" of cholera.

In 1884 Löffler isolated the micro-organism which causes diphtheria, thus inaugurating a series of investigations as to the ultimate cause cr causes of this disease which are being continued by various investigators at the present time. The same year the specific germ of tetanus (lockjaw) was discovered by Nicolaier, a student in a German laboratory. Upon similar forms of technical procedure the research in all varieties of disease has continued with the utmost activity, and at the present time more than five hundred separate varieties of micro-organisms have been described by bacteriological investigators. Of these a large number produce no untoward pathological symptoms when present.

Many diseases, however, still elude the present methods of bacteriology, and succeed in hiding from the eye of science the unseen foe to life. Carcinoma (cancer) may be taken as an example of the latter, and while many facts seem to point to the presence of a specific microbe, other facts apparently contradict such a theory. In the almost universal search of modern medicine for germs, possibly much is lost to view that deserves consideration as well as the actual presence of a germ, as a cause of diseased conditions. For example many of the disease germs, it may be asserted with some confidence, are everywhere present in the atmosphere, or in water or other substances all the time, and with them the average person comes daily in contact without any appreciable result following. A certain number of the community, however, when they receive them, presently develop symptoms of disease. Therefore, as the germs may be supposed to be always the same, there must be a difference in the physical condition of the individuals. The same fact is also illustrated by the course of an epidemic, when the majority of the population usually escape infection, though the immense number who may perish may so appal the survivors as to blind them for a time to the fact that after all only a small percentage of the community as a whole have been affected.

These considerations remind one therefore that there are intrinsic as well as extrinsic causes of disease; not very clearly defined, perhaps, by actual observation, but, in principle, utterly separate. It would seem that an almost intangible process of intrinsic degeneration, either of a special tissue, or of the entire organism, must have advanced to a certain stage before the extrinsic causes of disease, with which this section deals, can become operative at all. The action of the bacillus may be said therefore to represent in a general way the final stage in a career of disease which is imperceptible in its obscure beginnings. The bacillus, like the Roman Lictor, comes only at the last moment, after a trial of long duration, to terminate the existence of the already condemned man.

The intrinsic causes, or rather, conditions of disease, are not a mystery at all. They are readily understood. The development of them may be in reality the work of two or more generations, just as it may take three or four generations of careless spendthrifts to entirely ruin a magnificent estate. Such persons are like separate numbers of a monthly literary periodical. Each contains chapters of romances common to the other numbers, and in each succeeding number a new story may have its beginning, of which there was nothing present in the preceding numbers. At last, and in the last number of the year, all the romances together come abruptly to a finis, and then there is silence. So one person, with the accumulated weakness of all his predecessors, and with what he has added himself to the common fund, pays the forfeit, not only for his own, but for the ignorance, the follies and the vices of his predecessors, and by this glittering germ of disease that lies so still beneath the microscope is brought to a final pause.

Thus the micro-organism of our day may serve to recall many of the mediæval rites, practised for the purpose of detecting crime, and with scientific accuracy repeats the miracle of the various ordeals superstitiously resorted to by the people of the middle ages. By the ordeal of fire, and of swords and of water, indeed, many innocent persons then suffered. It is not so now. Blindfolded like Justitia, and as just, yet calm and terrible, stands clothed in darkness and in utter silence the unseen horror, this ordeal of our own time, as one after one approaches, the pure walking with the impure, the untainted with the tainted, and all equally in fear. White faced and weak the pure may return from this test, but the tainted never. For this is the ordeal of Nature which has never swerved for ten hundred thousand years; of Nature who has smiled sometimes as the centuries slowly rolled away to hear the busy babble of fools making and unmaking their little worthless laws, in-consistent and invalid; talking wisdom and looking wise, but never suspecting her wisdom and her law which softly encircles all things like a wreath of flowers; till violated, when it becomes as gyves of steel dragging downwards to the grave—of Nature, who, like the fabled daughter of Ypocras, seemed not lovely to the eye, but even as a dragon, terrible and strange; until after many days her sombre hiding place was entered, and in humble and worshipful guise, as had been prophesied, one kissed gently her brow, upon which she was transformed and became beautiful.

It remains to describe more fully the micro-organisms themselves. They are vegetable organisms, or life entities, consisting of only one cell which is enclosed by a cell membrane, and consist apparently of structureless protoplasm. There exist, as has been indicated, however, various widely distinguishing differences which have not yet been made apparent by the optical appliances now at the disposal of investigators. In 1892 Sjöbring, by fixing the organism with nitric acid and then, without previously drying, staining with carbol-methylene-blue, and examining in glycerine, was able to demonstrate two kinds of corpuscles; one immediately within the cell wall, and the other in that portion which in the higher scale of vegetable cells is usually occupied by the nucleus.

Micro-organisms have been classified in many ways. Pasteur divided them into aërobic and anaërobic: those which developed in the presence of oxygen, and those which did not require it. Those which were capable of movement and those which appeared incapable of movement were called motile and non-motile germs. Again, micro-organisms were divided according to the mode of reproduction. There were

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thus endospores, those developed within the cell body to be subsequently liberated, and arthrospores which are found to extend from the parent cell in long straight or spiral filaments. The most common classification is based upon the shape of the organism. The spherical are usually known as micrococci and the rod-shaped are called bacteria; though this term, as well as bacillus, has been much used in a generic sense to indicate micro-organisms as a whole.

When under examination by the microscope bacteria sometimes appear to move. Often this movement is purely a molecular one, common to all particles suspended in a fluid where there is always a vibratory movement *in situ*. This has been called the Brownian movement. There exists, however, an actual movement of some of the bacteria. This is sometimes slow and deliberate; though often it may be vigorous and active. Löffler, by improved straining methods, has succeeded in defining minute flagella extruding from the sides of the cells, by which they are probably propelled. This would account for the to and fro motion often seen in some, and for the darting and extremely rapid movements of other bacteria.

The methods by which the organisms are artificially cultivated and afterwards stained for observation have already been referred to. It is necessary to obtain a "pure culture," or one containing one species of bacteria only, before a satisfactory knowledge of the biological characters of the different species can be obtained. Hence much attention has been paid to the culture media used. A "natural culture medium" is one which is obtained in nature. Blood serum is one of the most important of these. On the other hand Pasteur's solution, which contains sugar and tartrate of ammonia, may be called an artificial culture medium. Others are the infusions of meat, and the solid culture medium, introduced by Koch in 1881, which consisted of gelatin and agar-agar. Some of the organisms produced a peptonizing ferment, by which the gelatin was dissolved, which led to the further classification of bacteria by Koch as liquefying and non-liquefying. The flesh-peptone-gelatin culture has also been extensively used, together with the glycerin-agar preparation, and the preparation of agar, gelatin and potato. These culture media are all sterilized before using, either by heating or by passing through some substance which destroys the life of the bacteria probably present upon the surface of the substance at the time.

For staining Wiegert employed the basic aniline colors, of which the most useful for this purpose were found to be fuchsin, methylene-blue, gentian violet, Bismarck brown and vesuvin. The spores for some reason do not take these stains and appear, therefore, as highly refractive bodies in the interior of the rods or filaments of the organism where they were formed, or scattered about, if they have been set free. To aid in the preservation of the solution certain mordants are also used by experienced bacteriologists. In this branch of science, also, as in many others, the art of photography has been of signal service. To photograph a bacteriological preparation the microscope is placed in the usual position with the preparation to be photographed beneath. The lens which usually receives the eye of the observer is then connected with the camera, and powerful rays of sunlight or artificial light directed through the prepared section, and the magnified image collected and cast upon the sensitive plate of the camera, just as in ordinary observation it is cast upon the retina of the observer's eye.

The experiments of bacteriology do not stop with staining, cultivating and photographing the bacteria. When the presence and characteristics of these organisms have once been carefully defined, their effect upon animals (and presumably upon human beings) must also be studied. For this purpose the mouse, the guinea pig and the rabbit have been found of most service. It is now very rare to employ condemned criminals for purposes of scientific investigation which tend to surely terminate the life of the being upon whom the experiments are made. The dog and rat are of little use in this connection on account of their very slight susceptibility to the action of germs.

This fact has led to much speculation as to the causes and the nature of immunity, roughly hinted at in a preceding page. The septicæmia of the house mouse, for example, does not affect the field mouse; while the bacteria of glanders, though affecting the field mouse, does not produce any effect upon the house mouse. Much care is necessary, therefore, and the greatest ingenuity has been shown by investigators in the methods of inoculating animals with the germ cultures obtained.

Agata and Jasuhara found that by cultivating the germ of anthrax for some time in the blood of dogs or white rats, both of which are immune, it could without injury be injected into the blood of susceptible animals where it acted somewhat as a vaccine. By repeated inoculation its virulence was restored, however, as shown by Pasteur in his experiments with the rouget virus.

All living cells, whether animal or vegetable, appropriate during their active growth certain elements for their nutrition from the pabulum in which they exist; while at the same time excreting certain other substances. In the higher forms of plant life poisons are secreted, by which the plant protects itself from enemies; or aromatic oils and volatile odors for the purpose of attracting insects and thus ensuring the necessary cross fertilization. In a similar manner, perhaps, some of these minute vegetable organisms, standing lowest, as they do, in the scale of vegetation, produce the deadly ptomaïnes, by which the vital resisting power of the animal invaded by them becomes so paralyzed as to enable the vegetable parasite to live on at the expense of its host.

The processes of disease, therefore, are not due to the mere presence of the bacteria in the blood and the tissues, but to the effects of the poisons produced by them. In the disease already mentioned, death, when it takes place, is simply a death by poisoning; quite as much as if a poisonous drug had been administered, or the patient poisoned by the venom of a serpent.

When chemically examined the ptomaïnes have been found to consist of various basic substances containing nitrogen, and in chemical constitution resembling the vegetable alkaloids such as strychnine or atropine. To these chemical compounds the term ptomaïnes was first applied by Selmi. Of these a few are non-toxic, and have no poisonous effect, including neuridin, cadaverin, putrescin and saprin. The action of the majority of the ptomaïnes upon the living animal organism is intensely poisonous, however, and among these may be enumerated neurin, which was discovered by Liebreich in 1865, and upon the administration of which the respiration, growing slow and labored, is finally quite arrested, and the heart

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stopped in systole, death ensuing at once. Others of somewhat similar physiological action are cholin, muscarin, tyrotoxin, mytilotoxin (which acts in a manner almost identical with curare), typhotoxin and tetanin.

The significance of bacteriological study as far as medical science is concerned is obvious. The object of medicine will plainly be to prevent the admission of the bacteria into the system, to destroy them if they are there already, and if that be impossible, to prepare for the action of the poisons which will shortly be secreted by them with such measures as may possibly counteract their action.

In medicine their exclusion can only be accomplished by sanitary means and by quarantine. An understanding of the principles of bacteriology has wrought an entire revolution in surgical praxis, and a system which is known as antiseptic surgery was introduced from France into England, largely by Lister's influence, and inaugurated a new epoch in operative surgery.

As the observation of bacteriological life became more general it was found convenient to make still another classification of these organisms based upon the relationship which the germ bears to man and the higher forms of animal life, and the term Saprophytes was accordingly applied to those which have an existence independent of the living animal, subsisting upon dead vegetable and animal material and the like. The majority of micro-organisms belong to this class. Opposed to these may be mentioned, on the other hand, the "strict parasites," which cannot live but in the tissues and fluids of a living animal. A middle position is occupied by the "facultative parasites," which can adapt themselves to either form of life. The bacteria of leprosy and tuberculosis may be mentioned as cases of strict parasites, for it is impossible for them to have an existence independent of the living animal. As examples of the facultative bacilli may be mentioned the bacilli of typhoid fever and cholera, which exist under other circumstances than life, but when introduced by accident into the living animal continue to multiply there with equal readiness, and produce the phenomena seen in those diseases.

There can be but little doubt that the bacteria of tuberculosis and the other strict parasites were at one time saprophytes, and that in the process of time, by the laws of natural selection, which operate with greater rapidity in all probability among the lower than among the higher forms of life, they gradually become adapted to a parasitic life. Contrariwise, strict bacilli may be gradually returned by artificial means to a saprophytic condition of existence. The blood usually offers an active resistance to the invasion of bacilli, but when the victim is constitutionally weakened by malnutrition, crowd-poisoning, disgust of life and numerous other primary causes of physical degeneration, the tissues may be affected in a pathogenic manner by saprophytes which would not succeed under ordinary circumstances in obtaining a foothold within the system. The most frequent points of entrance are by the lungs in respiration, by the mouth and stomach and through the skin by way of abrasions or wounds.

The immunity of certain species to some forms of bacteria and the immunity of certain races is probably nothing more than an acquired tolerance due to natural selection and inheritance. Repeated and continuous exposure to the same pathogenic agent establishes in all probability a race tolerance at last. The comparative immunity, for example, which is enjoyed by southern races, and by the negro especially, from yellow fever, may be taken as an example of this; while variola, on the other hand, is fatal among them to a remarkable degree, and even rubeola to which such trifling attention is paid by the races of the north. Carnivora, again, are not susceptible to many of the diseases which prove fatal to herbivora. The same principle is illustrated also in the immunity which the individual enjoys from further attack of a disease with which he has once been afflicted. This immunity is more permanent in some diseases than in others. In scarlatina the immunity is permanent, while in influenza the immunity may only extend to the epidemic then in progress, or for a couple of years.

More than one theory has been advanced in explanation of these facts. Pasteur for a time explained immunity by the *theory of exhaustion.* Present in the tissues there was, he thought, some substance necessary to the development of the micro-organism. This substance became exhausted eventually by the continued presence of the organism, and when the exhaustion was complete the further development of the germ in the body was impossible. This theory was afterwards abandoned by Pasteur and by his school. By Chauveau the *theory of retention* was suggested in 1880. Chauveau thought it possible that certain products were formed in the tissues during the development of the pathogenic micro-organism which were prejudicial to its further growth. An acquired tolerance of the toxic products of the pathogenic bacteria was also suggested upon the theory of vital resistance. Metschnikoff subsequently, after actual observation of the phenomenon, suggested *phagocytosis* as a probable explanation, in which, by the process known as chemiotaxis, the leucocytes of the blood current approach and destroy the germ.

None of these theories, however, are altogether satisfactory; and one which is at present rapidly gaining ground is that during the development of the bacteria, some substance is formed within the body of the immune animal which completely neutralizes the toxic products of the pathogenic micro-organism. Exactly what this neutralizing substance is, or in what manner it is formed, is not known at present; but that such a substance is actually formed which acts in this manner seems to have been proved by the recent experiments of Ogata, Behring, Kitasato, Tizzoni, Catani, Klemperer and others.

CHAPTER XVIII.

THE DISCOVERY OF ANÆSTHESIA.

FROM the earliest times attempts have been made by various means to allay the pain caused by surgical operations; not only for the sake of the patient, but also that the surgeon himself might feel more free to perform the operation with the deliberation and thoroughness which was difficult, or impossible, when he felt that every moment occupied in the operation was causing the patient the most intense agony.

In the East a form of hypnotism seems to have been resorted to by which means the patient was rendered apparently unconscious to the pain inflicted. This method was never, however, employed satisfactorily upon Europeans, and it is to be questioned if it always proved efficacious even in Oriental surgery. A practice somewhat analogous to the above was in the eighteenth century introduced into Europe by Mesmer, and the mental condition produced by his method has been named after him, though in the hands of so notorious a charlatan, it is possible that much that was reported to have been accomplished by him must be taken *cum grano salis*.

Narcotic drugs appear also to have been used at a very early period, both to allay pain, which already existed in the presence of disease, and to annul as far as possible the pain which the primitive surgeon found himself forced to inflict. The Nepenthe mentioned in the poems of Homer probably belongs to this class, and may have been an opiate obtained from the poppy, or possibly the hemlock, which was long afterwards given to Socrates when condemned to die. Mandragora was also used during the middle ages, as well as Hasheesh, Cannabis Indica and other narcotic drugs. The application of cold was moreover found to mitigate the pain to a certain extent, while there probably existed many other crude devices by which the pain caused by the surgeon's knife was thought to be somewhat reduced.

As early as 1653 Edward Elton, a divine of the period, when expounding the text, "If ye mortifie the deeds of the body by the spirit ye shall live," makes the following remark: "The word *mortifie* is metaphorical drawn, and taken from Chyrurgions, who when they are of necessity to cut off a legg or an arm, use means to benumme that part of the body, and to make it without sense of feeling, that it may be cut off with as little pain to the party as is possible." What these chirurgical means were seem to have had no bearing upon the text, for the eloquent speaker does not mention them.

It was not until the middle of the present century that the practice of actual anæsthesia came into general use, though the chemical preparations by which at last the insensibility to pain was induced were discovered long before that particular use of them was thought of. Indeed, there is some probability that sulphuric ether was referred to by Raymond Lulli, an alchemist of the thirteenth century.

Priestley's discovery towards the close of the last century had given a new interest to the study of gases. It will be remembered that it was then that the keen controversy between the Pneumatic school of chemistry and the Phlogistians was at its height, and Dr. Beddoes had established a Pneumatic Institution at Clifton for the purpose of experimenting upon the medicinal effect of gases. In 1798 he invited Humphrey Davy, who was then an apprentice to Mr. Barlase, a surgeon at Badmin, to become its superintendent, and after two years of diligent experimentation, Davy published in 1800 his *Researches, Chemical and Philosophical, Chiefly Concerning Nitrous Oxide.*

"As nitrous oxide," he remarked in this volume, possibly remembering his surgical apprenticeship, "in its extensive operation, appears capable of destroying physical pain, it may probably be used with advantage during surgical operations in which no great effusion of blood takes place."

When one considers that from time immemorial an artificial means of alleviating pain had been regarded by surgeons as a great desideratum, it certainly appears strange that there was no one who caught at this suggestion of Davy's. And even though his remark in the work mentioned may have passed without observation, the drug itself presently became exceedingly well known through the popular lectures on chemistry, in which the laity of that period seem to have taken pleasure, and where it was customary at the close of each lecture to allow any daring spirit who desired to do so to inhale a certain amount of the nitrous oxide, which was commonly known as "laughing gas," on account of the ludicrous intoxication which it momentarily produced, and during which inhalation persons sometimes suffered certain slight physical injuries without being in the least conscious of any pain. For forty years, however, no one paid any attention to this most important property possessed by nitrous oxide.

In 1844 a certain Mr. Colton, an itinerant lecturer on chemistry, delivered a discourse on laughing gas at Hartford, Connecticut. Horace Wells, "an enterprising dentist of the town," with a certain amount of inventive skill, happened to be present, and at the close of the lecture, when the usual amusement of inhaling the gas took place, Wells noticed that one man was not conscious of any pain, though when excited by the gas he had fallen heavily across the benches and cut and bruised his knees. Asked afterwards, when perfectly calm, as to the truth of this, the man was confident that he had not been conscious of any pain at the time.

Convinced far more readily than a man of scientific mind would have been, and eager to believe what he so earnestly desired to be true, Wells immediately saw in nitrous oxide gas a means to painless dentistry, and proceeded to begin upon himself. Colton willingly administered the gas to Wells, and a friend of the latter, named Riggs, promptly pulled the largest tooth he could find. Wells remained unconscious for a few moments, and then started up exclaiming, "A new era in tooth-pulling. It did not hurt me any more than the prick of a pin. *It is the greatest discovery ever made!*" This remark has been made before.

In the next three weeks Wells administered the gas to a dozen or more persons during the extraction of their teeth with the most satisfactory results, and tradition says that Riggs also at this time pulled a few teeth on his own account and in the same manner, though he did not accompany the more sanguine Wells in his brilliant flight to Boston, where he hoped to enlarge his fame, and the reputation of his stupendous "discovery," not without certain visions also of its early introduction into general surgery.

Dr. J. C. Warren, the senior surgeon at the Massachusetts General Hospital, was quite willing to allow Wells to administer nitrous oxide for surgical operation, merely asking provisionally that its potency be demonstrated first in the extraction of a tooth. This Wells offered to do in the Hospital Theatre, where he had already been volubly explaining his plan to the students. Upon this occasion (as Wells afterwards explained) the bag of gas was unluckily taken away from the patient too soon, and before a sufficient quantity had been administered, with the result that the patient, as his tooth was drawn, broke forth into violent ululations of pain, at which the students in a body hissed and hooted, and the crestfallen discoverer was forced to withdraw, his discovery being harshly denounced as a transparent imposture. Very readily disheartened by this characteristic incident, Wells promptly left Boston, and presently falling into ill health was unable to practise dentistry any more, and after a short time gave up that calling and neglected the further use and study of nitrous oxide.

Possibly Dr. Warren's readiness to test the use of nitrous oxide in surgical operation was partly due to his knowledge of sulphuric ether, to the use of which, as a possible anæsthetic, Faraday had called attention as early as 1818. Indeed, he was himself in the habit of administering ether to patients in the last stage of phthisis, to soothe the violent paroxysms of coughing, a course also adopted by Dr. Pearson, an English physician of Birmingham. For this purpose ether was much more readily obtained than the nitrous oxide, and produced a similar effect. Like laughing gas, also, many seemed to have found a certain amount of mild amusement in inhaling it when desirous of a new sensation, and in South Carolina this innocent pastime served to while away the somewhat unexciting leisure of certain members of the community. On one occasion a valuable negro very narrowly escaped death, it was thought, by this means, for upon inhaling an unusual quantity of the ether he became perfectly unconscious, and though, to the surprise of the observers, he recovered consciousness after a time, the practice was subsequently suspended. One of those present was a Dr. Wilhite, who in association with Dr. Long afterwards practised medicine in Georgia, where the diverting practice of inhaling ether seems to have been renewed. Both Dr. Long and himself were struck with the insensibility to pain produced by the inhalations of the drug, and Wilhite again recalled the case of the negro, and it occurred to both physicians that ether might very probably be of use in surgery.

In the March of 1842, therefore, these physicians, it was claimed by them some years afterwards, when the use of ether had been introduced into general practice, induced a certain Mr. Venable (who was very fond of ether) to take an unusual amount, and when sufficiently under the influence of the drug to be quite insensible to pain, they proceeded to carefully dissect a tumor from Mr. Venable's neck. No pain whatever was felt and no harm followed the operation. So three months later Mr. Venable allowed them to remove another tumor. Having now exhausted Mr. Venable's surgical possibilities, Dr. Long began boldly to operate upon other individuals, and according to his account there was no occasion when the use of ether was followed by any untoward result. The claims of these physicians make, however, but a digression, and belong to the apocryphal portion of medical history.

Ether was adopted in Boston as an anæsthetic in the year 1846. Among others to whom Wells had talked in his unhappy visit to Boston were Dr. Morton and Dr. Jackson. Morton was a sordid, energetic, rough man, mainly determined to get practice and make his fortune. Jackson, while animated apparently by the same motives, was dilatory and unpractical, but admired and respected as an accomplished chemist and mineralogist.

In 1842 Morton had been a pupil of Wells, and was the next year his partner. At the time mentioned, however, he was studying medicine at the Massachusetts Medical College, and was living in Jackson's house. Neither Jackson nor Morton put very much faith in Wells' discovery; Morton, indeed, having witnessed his humiliation and failure in the college theatre. Still he felt that the extraction of teeth might possibly be rendered painless.

Of the habit of inhaling sulphuric ether for amusement Jackson had long known, and had himself used it as a remedy for the irritation caused by inhaling chlorine, upon which occasion he had taken sufficient ether to become for a short time insensible. It had occurred to him that it might be used as an anæsthetic, and he had frequently spoken of the matter to other professional men, and had advised its use, but had taken himself no active steps towards its adoption.

One evening Morton, who was full of some scheme which had reference to the Utopia of his calling, painless tooth-pulling, inquired of Jackson what drug would produce insensibility, and the latter again suggested the use of ether. Having procured from him a small quantity, Morton the same evening produced in himself by its means a period of unconsciousness of eight minutes' duration, and very soon afterwards induced a stout healthy man, who came to him to have a tooth extracted, to allow the administration of the ether, upon which he extracted the tooth without pain.

The next step entailed a more serious responsibility. At that time it was thought that life was in imminent danger when insensibility was prolonged by such means. Even Morton, therefore, hesitated somewhat before he decided to risk producing by ether an insensibility sufficiently prolonged to allow during its presence of the performance of a surgical operation, because in the event of an unfavorable termination he would find himself open to legal proceedings. After a prolonged discussion of the matter he asked Warren to let him try, and Warren went so far as to let him. It was felt at the time to be a very bold enterprise.

On the 16th of October, 1846, Morton administered the ether to a patient at the hospital, from whose neck a tumor was removed. The result was not altogether successful from the standpoint of complete anæsthesia, for though the patient did not feel the cutting, he was still conscious all the time that the operation was being performed. The next day a more severe operation was performed, and the result was perfect, for the patient felt nothing. Subsequent trials of ether as an anæsthetic met with the same success.

The adoption of ether in surgery was almost instantaneous, though somewhat more rapid in Europe than in America; where for some time longer it was regarded with a certain disfavor. Nevertheless it may be said, in the words of Sir James Paget, that in the history of surgery, a certain month may be named before which all operations in surgery were agonizing and after which all were painless.

In a mercenary spirit utterly the reverse of that shown formerly by Jenner and Laënnec when they presented their own discoveries to the world, Morton promptly attempted to make the discovery of advantage to himself, even attempting to conceal the identity of the drug by mixing it with volatile oils, applying to it the mysterious title of "Letheon," and afterwards, in conjunction with Jackson, who appears to have been quite alive to his own interests in the matter, attempting to retain the sole right to its use for the purpose of anæsthesia in surgical operations, as if it were a commercial patent which he could claim personally for himself. The remainder of Morton's life was largely spent in futile litigation concerning his legal rights in this discovery. Jackson showed an unexpected shrewdness at this time by secretly reporting the discovery, as his own, to the French Academy, and getting his thirty pieces of silver before the exact facts of the matter had become known to the world. And yet—and yet—

> "The evil that men do lives after them ;
> The good is oft interred with their bones."

In England ether was used extensively by Liston, a surgeon of the time, and in Edinburgh Sir James Simpson employed it in 1847 in obstetrical practice, in which connection he published a number of valuable papers advocating its general use, a matter which, as stated in a previous chapter, met with considerable opposition.

Chloroform had been discovered, or rather, prepared in 1831 by Soubeiren, and about the same time by Liebig and Guthrie, and the use of chloroform as a substitute for ether was suggested to Simpson by Mr. Waldie, a chemist of Liverpool. Simpson afterwards adopted chloroform altogether in place of ether, claiming for it certain advantages over ether, in spite of the nausea and vomiting which often follows its use, and the weakening effect often produced by it upon the heart, from which many patients have died upon the operating table. In spite of these most decided disadvantages chloroform still continues to be used as an anæsthetic in Europe, though in America ether is the anæsthetic generally employed.

In administering nitrous oxide a certain degree of intoxication is at first produced, but when a greater quantity is taken the insensibility becomes more marked. The same phenomena is also observed when ether is taken, while in giving chloroform the patient is always excited before being brought under, and speaks in a confused and incoherent manner, calling out to persons whom he imagines may be present, and struggling. Afterwards he may imagine also that much has taken place which has had no occurrence, and it is hence unwise for the surgeon ever to attempt to administer either anæsthetic without the presence of a third person. Some minutes generally elapse before the patient becomes unconscious. His return to consciousness is also gradual, but in the absence of complications, shortly follows the withdrawal of the anæsthetic, which, in prolonged operations, is administered during the entire operation.

Numerous other chemical preparations have since been found to possess anæsthetic properties, though none have taken the place of these two. Freezing the parts by the use of the ether spray has been resorted to in some of the minor operations, and an agent has also been discovered which will produce a local anæsthesia in one particular region. Cocaine is mostly used in special surgery.

The importance of the discovery, or rather, of the device of anæsthesia, bears chiefly upon the advances made in operative surgery, which it at once made possible. As a triumph of scientific acumen and inspiration it can hardly be said to hold a very high place. Indeed, when one examines the history of the introduction of anæsthesia, it is found to have consisted entirely of a long series of blundering accidents which reflect very little credit upon any one concerned.

The chemicals themselves were discovered by accident, and in the case of snlphuric ether, remained probably for centuries before the anæsthetic properties of the substance was noticed or any use made of it. The preparation of the latter is exceedingly simple and consists of distilling two parts of alcohol with one of sulphuric acid. Nitrous oxide is prepared by heating ammonium nitrate, when the gas is given off, and may be collected over water. Chloroform, like ether, is prepared by the distillation of alcohol, one part of the latter being distilled with ten parts of chloride of lime, and the impurities removed if desired by sulphuric acid.

The study of chemistry seems to have been a very amusing relaxation in the early stages of the science. The investigator got together all the miscellaneous substances he possibly could, and liked very much to mix bits of things together in a little phial, or to heat them and see if anything would happen. Sometimes an explosion would happen. This rendered his operations not without a piquant element of excitement. Priestley was profoundly engaged in heating a little red oxide of mercury when he made the most important chemical discovery of modern times. He did not know, however, what it was that he had discovered, and died firmly believing in the phlogistic theory. Oxygen had, in all probability, been "discovered" in a similar manner many times previously without attracting the attention of the discoverer at all.

Then when the existence of the compounds and of their properties was well known, no step was taken by either Davy or Faraday to thoroughly test their anæsthetic properties; and the general public, having apparently a prejudice against expedients of this sort, which to them may have appeared somewhat uncanny, just as hypnotism does now, the knowledge was allowed to remain idle year after year.

The fact, however, long well known to scientific students, having by accident come to the knowledge of an "enterprising dentist," who eagerly hoped to make a fortune "beyond the dreams of avarice" by its means, it was used for a time by him as an advertisement for "painless tooth extraction"; when, swollen by the success of the device, he succeeded, after much insistence, in having it used in operative surgery, though possessed of no scientific knowledge whatever of its actual physiological action. Thus fools rush in where angels fear to tread. Having taken the risk, however, which wiser men had feared to take, the further discovery was at last made that no evil results would follow the prolonged insensibility produced by the drug. And this fact it was, which might have been made at any time for half a century previous, by any scientific investigator, without any difficulty, that led at last to the general adoption of ether as an anæsthetic. The introduction of chloroform by Simpson can hardly be said to have any bearing upon the matter whatever.

In the previous section the combined investigations of the most brilliant savants of Europe, carried on patiently for half a century, have been traced; in the course of which, profound learning, the patience of inspiration, and methods such as genius alone could devise at last slowly brought to light one of the fundamental causes of disease, and explained, by the presence of the bacteria, the majority of the maladies to which the race are subject. And yet this noble discovery which will for centuries add to the intellectual glory of the nineteenth century can hardly be said to have exerted a more extraordinary influence upon operative surgery than the introduction of anæsthesia, which, when analyzed, serves only to remind one of the stupidity, at least of the carelessness, of the men of science of the time, to conclude which spectacle, as in other fables, Reynard, irresponsible, self-seeking, rash and ever cunning, farcically pronounces the Envoy.

From this time forward operative surgery ceased to be a mere feat of dexterity, the criterion by which a surgeon was judged being the rapidity with which he could get over his hateful task, and rival surgeons boasting, like artisans, that they could cut off a leg or an arm, or accomplish some given piece of surgical handicraft in two or three or five minutes less time than the other could. All surgeons being placed henceforth upon an equality by this innovation, as far as speed went, the art of surgery now tended rapidly to more scientific methods; and while mechanical skill and expedition were still acknowledged to be of value, other and far more important considerations began to be recognized. Fewer cases proved fatal through the unreasonable haste of the operator. It was now possible to proceed with far more deliberation, and the methods of performing operations underwent many changes. The first result of anæsthesia was an increase in the amount of surgery done; many previously having preferred to die in peace, as did the great Dupuytren, than endure the agony of an operation. The next result was found to be a benefit to the patients upon whom operations were performed. They were found to stand the operation better. Then, as already stated, the methods of surgery, placed at last upon a wider basis, underwent improvement, and eventually entirely new fields for surgical operation were opened to surgery.

In the wards of all hospitals and in the operating theatres anæsthetics were soon firmly established; and the contrast between an operation of to-day and one before the use of ether is very striking. Then the patient was brought in with blanched face as to his execution. The part was bared and the surgeon promptly applied his knife. The patient, writhing and screaming in agony, struggled violently and was held down by main force while the operation continued. Covered with blood the work proceeded, when, grown desperate, perhaps, the patient offered such determined resistance, possibly, that even the seasoned surgeon in compassion hastened his dreadful work, distracted by the pitiful importunities of the patient; or ended the scene, more likely, with some act of carelessness, due to overhaste, which afterwards cost the patient his life. Only the simple forms of operation were under such circumstances ever attempted, and the vast anatomical territory which the surgeon dared not invade was still left to the physician to treat as he best could; to a certain extent by deduction but mostly empirically and by guesswork.

Contrast with such a picture, revolting in its helplessness and its unwilling cruelty, a hospital theatre of to-day: a temple to Hygeia, spotlessly clean; the well-filled galleries of expectant students, respectfully attentive; the nurses in their white linen; then the silence, as the insensible patient is brought in; the continued silence as the operation slowly and deliberately proceeds. Here the brain is perhaps uncovered and is seen in its lining envelopes. The tongue is neatly cut out. The thorax is opened and the heart observed beating in its serous sac or the abdominal viscera are examined. At the head of the operating table sits the trained anæsthetist with the agent in one hand and his other upon the pulse of the patient. The life of the insensible being at whose head he sits is as much in his hands as is the safety of a vessel winding among the rocks at the touch of the pilot's hand upon the wheel. An hour, two hours may thus elapse. There is still breathless silence. To stand thus face to face with life and death generates a sense of awe that all must feel. At last every severed artery is closed. The hæmorrhage has ceased. The parts into which entrance has been made are closed at last and the patient, whose final remembrance was the face of the nurse in the private room as the anæsthetic was administered, wakes gradually to find himself again lying quietly in his cot; a diseased arm that was dragging him to his death gone, a tumor that was sapping his life substance absent; with vague sensations of pain perhaps, very weak, no doubt—and yet with a new hold upon life.

CHAPTER XIX.

EVOLUTION AND DEGENERATION.

SOME discoveries may be said to have been made in a personal way by one man, while others seem rather to have been made in a general way by the people of an age. The *Novum Organon,* for example, is the work of a single man whose genius stands apart and towers far above all the other thinkers of his time. Inductive logic cannot be said, therefore, to have been merely a habit of thought which had become common at a certain time, and which happened to be described by Lord Verulam. It is a distinct system of reasoning formulated by him, and, when brought to completion, offered munificently to the world. In a somewhat similar manner also were made known the discoveries of Newton and Kepler.

With the extension of general education, the enlightenment of the masses, and the very great accession to the number of the scientific and the literary men, such cases of isolated discovery as the foregoing will become less and less frequent. For every individual who a hundred years ago devoted himself to some one line of philosophical inquiry, there are now one or more schools of thinkers, comprising dozens and sometimes hundreds of members, with societies in various quarters, frequent meetings or conventions, departments in the universities with large professorial staffs and a copious—too copious a literature, in the form of periodicals, separate publications and the inevitable volumes of "Transactions." Compare with such a pretentious array of diversified energy as this Lord Verulam, old, weak in body, in disfavor at Court, standing in the open air before his house the winter before his death and carrying on with such crude expedients as he had at his disposal an experiment in natural philosophy which had been perplexing his mind.

Philosophy has now become a profession, and the professional philosophers of to-day, or a good many of them at least, make scientific discoveries for a salary. Failing to arrive at independent discoveries, they make a shift to keep up an impressive appearance of activity along the side lines of discoveries already made, or eke out a tottering existence by disagreeing with scientific doctrines which they have not sufficient intellectual illumination to understand.

The thought of the present age is not confined, however, to a class, but is distributed with varying degrees of intensity throughout the entire community, where it runs a common course, the mechanic with his newspaper following, in a most critical spirit, not very far behind the scientist in his laboratory. Hence many of the theories put forward of late years may be regarded as the thought of the age rather than the thought of the individual or the individuals who first gave expression to them; their utterances being merely a close anticipation of an opinion rapidly developing in the minds of all. The eager acceptance often given to some new theory, however far-fetched, which contrasts so strongly with the stubborn opposition with which any new idea, however reasonable, was met a century ago, may be explained to a great extent perhaps by this fact.

Speculations regarding the ancestry of man have largely occupied the attention of scientific thinkers during the latter part of the present century, and though numerous structural variations have been noted between the anthropoid ape and the human race there hardly seems, in the light of recent discoveries, any escape from the conclusion that both species have been very remotely derived from a common ancestor. Remains of the Early Quaternary Man, few and far between, have been unearthed during the last fifty years, and the Meuse has become famous by reason of the discovery of the "Naulette" and "The Spy" remains, which belong, there is very strong evidence for believing, to the Palæolithic Age.

The study of human anatomy has thus acquired a new interest, and the presence of certain rudimentary organs which for centuries had been casually passed over by antomists are now found to possess a profound significance. The problem of the Neanderthal skull may here, possibly, find a solution. There is absolutely nothing which is accidental or non-essential in nature, and this fact men at last are learning, when they have awakened suddenly to find in the very tissues of their bodies the written archives of phylogenetic development no less plainly or authoritatively set down than is the corresponding story of planetary genesis which has been found inscribed in everlasting characters and upon scrolls of stone within the deep crypts of the far looming mountain ranges.

Vestigial anatomy is only now at its beginning, and from this study, as from embryology, medicine may reasonably expect much. The sum of the individual's mental and physical characteristics may be regarded as the combined reflection of his heredity and his subsequent environment. Galton states that from each parent the individual inherits one-quarter, and from each grandparent one-sixteenth of his nature, leaving one-quarter which is inherited from more remote sources. Many characteristics remain latent for generations, when, by some jog in the inscrutable arcana of nature, the forgotten characteristic or quality springs into being anew. Thus polymasty and numerous other instances of reversion or atavism are found frequently to occur. They are not, however, constant in the race.

Present in every individual, on the other hand, there are found certain vestigial remains, which have fallen apparently into desuetude, and have come down from an earlier stage in the developmental career of the race, and others, too, which have a more dubious significance, and furnishing perhaps the rudiment of some organ which shall in the misty future minister to new needs or confer new capabilities. Take for example the supra-renal capsules, referred to in a former section as the seat of a fatal disease which was first described by Addison. While these mysterious bodies may probably be traced to a double origin, partly from the mesonephros and partly from the sympathetic nervous system, no conclusive proof has yet been brought forward which can decide whether they are phylogenetically in a progressive or a retrogressive condition, and their physiological significance is still as little understood as their primitive history.

In 1864 Herbert Spencer put forward in his *Principles of Biology* a theory of Inheritance which has since been very generally followed by speculations from all quarters upon the same subject. The germ plasm, or idioplasm of Nägeli, has been the subject of the closest study, and the ultimate step reached is that the chromosomes contained in the two combining cells are fundamentally concerned in the initial physiological process. To a very complicated architecture, which these cells are claimed by some observers to possess, is attributed the possibility of the transmission of hereditary traits. Others assign to external influences the ultimate presence in the offspring of traits which existed in the progenitor.

These opposite theories which, subsequent to the discovery of the cells by Leeuwenhoek, have divided scientific opinion, were in the last century known as Performation (the inherent action of the cell) and Epigenesis, wherein external influences played the most important part. In the present century His and Weisman claim that in the cell is contained in some way the miniature of the undeveloped individual, and the elaborate details described by Weisman of the parts played by the *ids* and the *idants* in this process is very ingenious if not conclusive. Hertwig, Pflüger and Boveri, on the other hand, insist upon the isotropous qualities of the germ plasm. The latter theory, which may yet be demonstrated by some means not at present known to science, seems the more practicable. Meanwhile the facts of hereditary transmission, though a mystery perhaps as to the means, are universally accepted as to the result. The principle of evolution is one which was very recently recognized; but as soon as the great part which it played in nature was discovered men began to reconstruct the fabric of biological science upon this theory.

About the middle of the century the *Origin of Species* was published by Charles Darwin, and was followed some time afterwards by the *Descent of*

Man. The general idea laid down by the author in these justly celebrated works was not altogether new, though it was new at the time to the general public, and was known to them, favorably and unfavorably, for some years afterwards as the Darwinian Theory. Faintly hinted at in the pages of Lucretius, suggested by the mythical story of Kadroma, bluntly expressed by the "eccentric" Lord Monboddo, in whom the opinion was regarded merely as an interesting vagary, the distinction of having grasped the underlying principle implied by Darwin in these works was also claimed, among others, by Wallace and by Herbert Spencer, the latter of whom refers at some length to the matter in the first volume of his *Synthetic Philosophy.* Subsequently the theory was elaborated, modified and expanded with various degrees of lucidity by Haeckal, Huxley and a multitude of other scientific writers.

In view of these facts, therefore, which in no wise cloud for a moment the brilliant achievements of Darwin, one feels almost inclined to look upon the theory of Evolution as not the distinct discovery of one man so much as of the epoch to which he belonged. This law of Evolution is based upon a series of associated phenomena which are observed, as has already been indicated, in every branch of animal and vegetable life, and which might even be followed by analogy into the region of chemistry, though the term evolution applies particularly to animal and vegetable life alone.

The tendency of the stronger to survive at the expense of the weaker has been known as the survival of the fittest. The transmission of distinguishing characteristics from one generation to another has already been referred to. Hence the characteristics by which the stronger members of the species survived at a given time would be transmitted, when existing in a most pronounced manner, the survival of the animal only being possible when these characteristics were pronounced. Add to this the principle of Natural Selection, which is a tendency noticed in the individuals to select from the opposite sex for purposes of procreation individuals also possessed of the same characteristics; and it follows that in the course of transmission from one generation to another these characteristics would gradually undergo a slow and almost imperceptible accentuation.

Subsequent observation has shown that this principle extends throughout the entire world of life, and that the different species of animals have originated in this way. That the process is exceedingly slow among the higher forms of life and amid stable circumstances goes without the saying. Tracing the human species for example from the earliest dawn of history, or even from pre-historic times down to the present day, very little physical modification will be discerned; though in the intellectual development the principle of evolution becomes more palpable. This is explained by the fact that the conditions of man's physical life remained more stable than the conditions of his intellectual life. In the domestic animals, where the conditions of life have also suffered little change, the process of evolution has been imperceptible, while in animals in the wild state the changes have been more rapid.

The law of evolution has so close a bearing upon the phenomena of life, and therefore of disease, that it is impossible to overlook it when considering the ultimate causes of disease, and the place of disease in the life career of the individual. The problem of Immunity referred to in a former chapter seems to find its explanation in the principle of evolution. In this connection, moreover, the fact must not be overlooked that while the external appearance of the type may apparently remain unchanged for centuries, it is hardly possible for one generation to replace another without some slight, though perhaps imperceptible, change having taken place. Indeed, the tolerance acquired by the same person for a drug or a new condition of life or a different climate is brought about by a certain adaptability of the organism, in which lies the principle of evolution.

In the evolution of the human species disease has undoubtedly played a very important part. Furthermore it is highly probable that in the footsteps of man as he walks the world to-day there follow unseen agencies which in the dim past would have stricken him down in death—the ancient enemy of the race, which, after a hard-fought battle, extending over thousands of years, was at length overcome, though still present and ready to attack man again at any moment, should he in some way lose the mysterious spell, by which he is protected from attack, comparable only to that spell which rendered Balder in the streets of Asgard invulnerable to the missiles of all but the one prepared by Lok.

The immunity of the dark races from the diseases to which they are continually exposed has already been mentioned. The singular freedom from all forms of disease, except those resulting from accident or preceding the decay of old age, which has been enjoyed by many uncivilized races, while they remained uncivilized, may also be noted. Contrast with this their extreme susceptibility to many forms of disease as soon as they change the place of their abode, or, more important still, their original habits and modes of life. The aboriginal races of America may be cited in this connection. To exposure to the most intense cold they appear to have been quite inured, as also to many other conditions which could not have been borne by men of another race. The least break in their habits or mode of life, however, rendered them susceptible in a remarkable degree to diseases which were resisted with ease by individuals of far less hardy habits.

In the early history of the race the survival of the fittest was an actual fact. To a certain extent this law has more recently been artificially counteracted by the advance in the methods of modern civilization; and the physical qualities or defects, which in a ruder age led inevitably to speedy extinction, are now preserved by the fostering care of scientific medicine, and the defects therefore propagated from generation to generation. It is thus seen that the principle of evolution works both in an upward and a downward direction, though with perhaps a somewhat more rapid progress in the downward. This accentuation of defect or weakness, both physical and mental, has at the close of the nineteenth century become so marked that the term Degeneration has been applied to it by observers.

It is a term applied to an accumulation of decadent qualities. The first indications are usually observed in the nervous system. The degenerate is neurasthenic. The mind is usually affected, or, to speak more correctly, the broad and wholesome development of the mind is retarded and suppressed. The result may be an absurd egotism, which sometimes takes the form of mawkish religiosity and emotional excitement; or it may extend into other avenues; an inability for any form of mental concentration, a puerile series of shallow enthusiasms, momentarily attached to this fad and the other fancy, or a tendency to posture, either as a heroine or a philanthropist. It may even extend to the borderland of insanity, or cross it. The natural instincts may have suffered such disadjustment as to be almost unrecognizable. The forms of perversion which have been discovered among this class are countless—and are not, I think, worth trying to count. At last the wholesome and normal co-ordination between the mental and the physical system which in its proper harmony may be said in a general way to constitute morality is possibly broken. The inhibitory power is diminished. All self-control is lost, and the degenerate may become in the scientific sense, or in both the scientific and technical (legal) sense, a criminal.

Lastly, the physical frame itself begins to show external signs of degeneration. These *stigmata* of the decadent are as numerous as his perversions, and as repulsive. Passing through a number of gradations the line terminates in cretinism and idiocy, which last, even scientific medicine cannot further prolong. Vice, overwork and various forms of intemperance are usually accountable for the first indications of degeneration. Frequently the first steps of decadence are accompanied by mental phenomena that dazzle the casual observer. A certain pseudo-genius may frequently be manifested which may even deceive the contemporary critics, especially when the critics are themselves, as they often are, members of the same pathological class. Or there may be present a criminal tendency that deceives to a similar extent the unscientific and unimaginative legal opinion of the period. Cesare Lombroso may almost be said to have founded a school of research upon this single phase of degeneration, and the principles clearly laid down by him have since been amplified by his imitators without adding to the subject in any way or to the reputation of the imitators referred to.

Among this pitiable class of degenerates it would almost seem that the law of natural selection worked also, but in the direction in which the class is tending, for the morbid finds its affinity in the morbid, and the sexual partnerships of the degenerate are generally such as to somewhat hasten the progress of racial decay and disintegration. Analogous to the atavism of virility and grace there is manifested at this stage a corresponding atavism of disease.

But the law of the survival of the fittest, to the operation of which man's "upward curve" in the chart of the ages may be traced, is not violated by the interference of curative medicine alone. The same tendency of the species upwards is also embarrassed and defeated by some of the conventions of modern civilization. The law of natural selection is suppressed. The unions thus implied become more and more a commercial arrangement, with vanity on one side and cupidity on the other. Among the class where it ought to mean most, where there is most at stake and most to preserve by it, marriage has lost its natural meaning, and has acquired an artificial meaning, exceedingly complex, diagrammatic in its sameness, and less a usage based upon the deepest feelings of the race, than a formality which has something to do with a drawing-room or a church, and more a matter of etiquette than of physiology. In the world of science the drawing-room is unknown, and the laws of etiquette are not natural laws, though a vast number of people, to observe the former, unhesitatingly break the latter. Thus it happens that among the class who represent cumulatively the highest intellectual development, the neglect and often the wilful repudiation of the principles which were active in producing the mental supremacy at which they have arrived, leads to the abrupt termination of racial advance and ascendency in the class; nature being forced then to begin *de novo* with other material.

The fact is not without significance that the average weight of male persons in Britain who contribute an equivalent in labor for the living vouchsafed to them is one hundred and forty pounds, while that of male persons who belong to the leisure classes is sixteen pounds more. Statistics do not however determine whether the additional weight consists of nerve and bone and muscle, which would signify a physical superiority. The fact nevertheless remains that where the body and mind are in constant use the hereditary tendency is usually upwards, while in classes where the chief vital activity is in the gratification of the appetites, as in the leisure class referred to, the tendency is downwards. Where ignorance and vice are, there also the tendency to degeneration is to be observed, and hence the decadence of a nation is usually observed in the two extremes of society.

Furthermore the protective laws of nature seem even to intrude themselves into the most artificial social conditions, and as it has been observed that the parasitic classes of society chiefly undergo this racial retrogression, so it may be that this too is one of the beneficial laws of nature by which the race-rids itself, before it is quite overwhelmed, of the parasites, both magnificent and squalid, which prey upon it; a law analogous in many respects to the law of immunity, not yet distinctly understood, by which the individual easily casts off from his system the pathogenic organisms which for a certain length of time have existed at his expense. The gratuities of nature, when the final reckoning is made, are as rare as the gratuities of commerce.

These opposite phenomena, therefore, of racial advancement and retrogression, of evolution and degeneration, the external manifestations of which are so confused in the multiform incidents of life, and the myriad forms of vital activity everywhere abounding, that their principle was never grasped in its entirety until the present century, may be regarded in a biological sense as no less far reaching than the law of attraction by the operation of which, in a physical sense, the harmony of the universe is maintained.

Race history in the true sense of the word is a record of the counteraction of one tendency by another; the action and the reaction of definite sociological forces, which at the last ends in decay, when the tendency to racial degeneration becomes so marked as to suppress and paralyze, as by a poison, the tendency to development. The first symptoms of racial decay are probably observed by the physician in the madhouse, the prison, the hospital and the darkened sick-room. The last stages of racial decay are seen upon the battle-field, and a silent record of it is found in the altered maps of the world.

CHAPTER XX.

DISEASES OF THE EYE AND EAR.

THOUGH the diagnosis and cure of even the simplest forms of disease often presented difficulties to the most skilful physician, there were some special varieties of disease, affecting organs little understood at the time, in the treatment of which the physician found himself absolutely helpless. These diseases were for centuries the despair of the profession, and were usually treated empirically. That is to say, some drug or nostrum which had been tried in one case and was said, generally upon very uncertain authority, to have been of benefit, was given after a blind fashion for cases apparently similar, without the least understanding of its action, but in the devout hope that it might again do good. That no treatment at all would have been preferable to such treatment as this goes without saying, but the anxious importunities of the patient and his friends often influenced the really conscientious physician against his better judgment. While it is hard for the physician to admit defeat, it is still harder for the patient when he does so. Many diseases of the eye and of the ear were regarded as hopeless. The affections of the throat and of the nose presented similar difficulties, and some of the diseases of women and children were quite as discouraging.

Patients of this class were never received by the honorable physician with confidence, and lacking confidence he soon lost enthusiasm or interest in the case. Speaking of such cases, I once heard an eminent professor of medicine, since deceased, remark that the practitioner could only expect to keep such patients for a short time, as they soon grew restless under a treatment which conferred no signal benefit, and deserted to go to some other physician. "It is for you to choose, therefore," this professor continued, "whether it will be best to keep the patient as long as you can from a mercenary motive, or to admit to him at once that nothing can be done for him. You are bound to lose your patient in any case."

In the early part of the century these cases were the peculiar domain of the charlatan, who stood ready to receive all cases pronounced incurable by the regular physician. His readiness to receive all classes of maladies, his specious lies, his positive assurance that he could readily cure all such cases, his cunning and his plausibility ensured to him a very large, though a very credulous *clientèle*. This, too, explains the eagerness with which the public submitted themselves to every new and fantastic theory of treatment.

Queen Anne, whose simple mind easily lent itself to every gew-gaw which superstition or imposture could devise, distinguished herself by her introduction of medical quackery into the church service, as well as by proving a frequent dupe to charlatans herself. Her weak eyes, of which she complained constantly, caused her to pass rapidly from one empiric to another in search of the relief which they all in turn promised to give, and in some cases even persuaded her that she had received. Her ruling passion was for quack oculists, and she was simpleton enough on one occasion to knight a certain William Reade, who had originally been a botching tailor, and was to the end of his career a thoroughly ignorant man. Upon receiving his knighthood, the latter hired a Grub Street scribbler to invoke the Muse upon his behalf, the result being "The Oculist: a Poem," in which effusion lines like the following are to be found:

> "That sacred hand does your fair chaplet twist,
> Great Reade, her own entitled Oculist;
> Her favours by desert are only shared—
> Her smiles are not her gift, but her reward.
> When the great Anne's warm smile this favourite raise,
> 'Tis not a royal grace she gives, but pays."

Out of this condition of incapacity on the part of the regular physician and rascality on the part of the quack grew the medical "Specialties" which are an outcome peculiarly of the present century. The difficulty of the treatment of these special branches lay generally in the imperfect understanding of the organs themselves. These organs, by their extreme delicacy, as in the case of the eye; or by their inaccessibility, as in the case of the ear, the inner portion of which is deeply situated within the petrous portion of the temporal bone; or the larynx, which is situated out of sight and out of reach at the lower extremity of the pharynx, defied for a long time any attempt at their study in the living subject. Furthermore, the means afterward afforded by the microscope for the examination of their minute structure had not yet been employed.

With the rise of the specialist in the present century came a new order of things. These men, by devoting their whole time and their entire energies to one circumscribed branch of medicine, were enabled to make amazing progress within a few years in the treatment of the diseases of the special organs. By their efforts the anatomical structure and the physiology of the organs was for the first time made clear; and with an intelligent understanding of these, the ingenuity of the earnest investigator soon suggested devices for examination and diagnosis, as well as instruments for operation. To the pharmacopœia, at the same time, a number of new drugs were fortunately added, which were found to be of the greatest value in the treatment of the diseases to which these organs were susceptible. It has been complained from time to time that specialism renders the practitioner somewhat one-sided, and in this statement there is probably a certain amount of truth. On the other hand, however, it must be admitted that the progress made in this class of diseases, which were formerly almost entirely abandoned to the mountebank and the impostor, would have been impossible had it not been for the concentration, sometimes falling little short of monomania, with which the specialists have devoted themselves to each branch.

The eye was the first *camera obscura*. The photographic camera, whether suggested by a study of the eye or not, is merely a repetition on a larger scale of the organ of vision. The eye consists of an outer aperture, curtained by the lid and regulated by the iris. For the first of these devices the photographer employs an outer cap and for the second the various diaphragms by which he controls the amount of light to be admitted. Next in the eye there is the lens, just as there is in the camera. Then there is a space, occupied in the eye by a transparent substance, in the camera by air. At the back of the eye is stretched the retinal screen of nerve fibres, in the camera the photographic sensitive plate upon which the picture is taken. Here the parallel ceases. From the retina which has been found to be of the most intricate construction, the optic nerves pass backward, cross each other and follow still further back into the substance of the brain; in the obscure recesses of which the multitudinous pictures, more swift, more comprehensive, more beautiful in color and in form, and more perfect both in temporal and formal proportion than those produced by any kinetoscope, are reproduced to the consciousness of the living being.

Both the external apparatus and the nerve of communication are susceptible to disease. The action of the eye is governed by physical laws. The knowledge of refraction and accommodation of the eye was worked out by Helmholtz, Purkinje, Sanson, Donders, Airy and Young about the middle of the century. The major operations, some of which have been already described in one of the sections on surgery, were perfected by Von Graefe and his followers, and the important relations of ophthalmology to general disease have been explained by Jonathan Hutchinson in his work on syphilis, Hughlings Jackson and Gowers in their studies of nervous diseases, and by Clifford Allbutt.

The various parts of the orbit are susceptible to inflammatory and degenerative changes, including not only the outer membranes, but the inner substance. Wounds also are of constant occurrence, by which every part of the eye is injured; and these are occasioned not only by missiles and physical violence, but also by fire and explosives. The treatment both of inflammatory disease and of wounds is the same in principle as in general medicine, though the means are more delicate. For example, instead of administering chloroform for an operation upon the eye, cocaine is often applied as an anæsthetic. The pupil is dilated by atropine and eserine is used to close it. Instead of corrosive sublimate or carbolic acid being used as an antiseptic, a solution of boracic acid or something of similar mildness is used. The instruments employed are of more delicate construction than those employed in general surgery.

Cataract is an opacity of the crystalline lens, which affects the sight and is due to senile change or to some defect of development, or local interference with the nutrition, as is also seen in glaucoma. It is sometimes due to the presence of general disease, as in diabetes. When the patient is under thirty-five years of age, or when caused by diabetes, the cataract is usually soft. It may, under other circumstances, be hard. Still another division is when the cataract is complete or when it is partial. There are three variations of partial cataract. The lamellar is applied to the variety where only one or more of the concentric layers of the membrane is affected. In the pyramidal variety a white spot is noticed upon the lens capsule and in the centre of the pupil. This is the result of corneal perforation. The posterior polar form of cataract begins at the posterior pole, and always indicates deep-seated disease. Traumatic cataract may also occur when the lens is injured. In the treatment of soft cataract the pupil is well dilated with atropine, and a fine needle is then passed through the cornea at the outer margin, care being taken to freely lacerate the lens capsule. The lens then swells up and gradually dissolves. The operation may have to be repeated, and three or four months may be occupied in the treatment. In the treatment of hard cataract the lens must be extracted entire, with a narrow knife incising the upper part of the cornea at its juncture with the sclerotic.

Glaucoma is a serious disease, sometimes in a few hours resulting in complete blindness, though more frequently taking a more gradual course. This disease is accompanied by increased tension of the eyeball. Retinitis, or inflammation of the retina, is also an occasional occurrence, though generally a sequel to constitutional disease, particularly albuminurea and syphilis. There is also a pigmentary variety of the affection. Besides these diseases there are also certain disorders of the optical apparatus acquired congenitally or due to age. The refractive powers of the lens being imperfect, a blurred image appears upon the retina, such as one sees in an opera-glass, before it is brought to the proper focus. The refraction is sometimes too great, sometimes too slight, and sometimes irregular. These errors of refraction are remedied by the wearing of glasses. In cases of hypermetropia near objects are indistinctly seen, due to the diminished thickness of the lens; and slightly convex lenses in the eyeglasses are worn. In myopia near objects, however minute soever, are distinctly seen, but distant objects are not clearly perceived. This is due to an overthickness in the crystalline lens in the eye, and is corrected by wearing pince-nez or spectacles fitted with slightly concave lenses. The above are not, strictly speaking, diseases of the eye, but personal peculiarities rather, which give little or no inconvenience. The first form mentioned is more frequent among those of middle age or advanced years, and the glasses are required for reading and sewing only. Myopia, on the other hand, is more frequently found among the youthful, and has a tendency to rectify itself in the course of time. Astigmatism, however, is a more serious complaint, more difficult of treatment, and indicating more serious derangement. The various forms of apparatus for testing the strength of the eyes, as well as for detecting their infirmities of vision, are now very elaborate and accurately based upon scientific principles.

Amaurosis is a term applied to blindness without known cause, and refers, of course, to changes which have taken place in the optic nerve beyond the region of the eye, or even deeper still, in the brain substance. For this calamity no remedial means have as yet been discovered.

In the study of the diseases of the eye the discovery of the ophthalmoscope by Hermann Ludwig Ferdinand von Helmholtz has proved of incalculable benefit. Indeed, without its use the progress already made in this specialty would have been impossible. The theory upon which the ophthalmoscope is employed is nevertheless exceedingly simple. The rays of light which enter the eye in any given direction are reflected by the choroid along the same direction. The fundus accordingly cannot under ordinary circumstances be seen; because an eye so placed as to see the emerging rays of light would necessarily intercept those entering.

But the ophthalmoscope, by placing the *source* of light immediately in front of the *observer's* eye, enables it to see and examine the interior of the other eye. There are two methods of such examination in use, the direct and the indirect. One will understand the principle of the practice by placing a convex lens of two-inch focus in front of a printed page, which for the moment will represent the retina of the eye to be observed, and the lens so held the crystalline lens of the eye. Then place a second similar lens in front of the first and the print will be seen inverted and somewhat magnified. This represents the indirect method. To illustrate the direct method let the observer now places a two-inch lens that distance from a printed page and his own eye close to it, and the letters will be seen this time in their usual position and enlarged.

The ophthalmoscope consists of a concave reflecting mirror, which is firmly fastened by a band to the head of the observer in the desired position, with an aperture in the centre of sufficient size for the observer to look through it, and a revolving disc bearing twelve lenses of varied size behind, and still another disc behind that again bearing four lenses, both of which discs may be readily revolved so that any two lenses may be glanced through at the same time. To use this instrument for examination the patient is placed in an otherwise dark room, with a strong light at one side and a little behind his head. If the indirect method is to be used the observer sits in front of the patient, and the light is reflected a distance of two feet into the eye to be examined, and when a red reflection is seen, a lens which the observer holds in his hand is placed in front of it and an inverted image of the fundus in the interior of the eye will be seen. If the patient then turns the eye a little inward the optic disc will be seen. The color of the disc is normally a yellowish pink, but varies considerably owing to the tint of the surrounding choroid. A paler spot in its centre which may be due to the fumnel-shaped expansion of the fibres of the optic nerve is called the "physiological cup." If the lens is removed from the eye this spot becomes smaller when the eye is hypermetropic, larger if myopic and altered somewhat in shape if astigmatism is present. The retinal vessels appear as red lines; the arteries paler, arising in the centre and running in pairs which branch as they cross the retina. The direct method of examination with the ophthalmoscope is practised without the lens mentioned, and in a position nearer to the patient. The first indication of some forms of disease are to be detected by the use of the ophthalmoscope, and with the practice which continual use gives, the physician is able to diagnose various forms of ophthalmic disease by this means.

If the eye was the first *camera obscura,* the ear, to make a forced parallel, was the first phonograph. What the eye does with the rays of light, the ear does with the vibrations of air known as sound. It collects them from the objective world without, and by some complex means accurately reproduces them for the subjective world within. The ear as a whole consists of the outer pinnaform appendage of cartilage, which was at one time capable of motion as are the ears of other animals, and still is possessed of the rudimentary muscles by which it was moved in relation to the head, as well as of the muscles in its own substance by which it was once folded upon itself for the purpose of better collecting sound coming from a given direction. The canal encircled by this appendage is known anatomically as the outer ear. Its passage is bounded by the chorda tympani, or drum of the ear. A hammer resting upon this vibrant membrane answers to every impression and conveys them again to the inner apparatus of the labyrinth which constitutes the inner ear, the middle portion being the intermediate space. Were this space not occupied by air the atmospheric pressure from without would at once break the drum which is impermeable to air, and to provide against this, two minute passages from the back of the mouth, known as the Eustachian tubes, bear air from the mouth to the middle of the ear.

Forcible expiration when the nose is closed forces air into the middle ear by this passage, and forcible inspiration when the nose is closed draws air from the middle ear. This is known as Valsalva's experiment. The examination of the outer ear is rendered easy by using a simple speculum made for the purpose through which the drum of the ear may be seen. It is of a grayish slate color. Much of the earache with which children suffer is rheumatic in origin, though unpleasant symptoms are often caused by the presence of a foreign body within the passage. A bead or a lentil or a pebble may cause much pain, or by pressure upon the tympanum may cause injury to that membrane. The ceral secretion of the part may also accumulate to such an extent as to entirely occlude the passage, and, hardening in that situation, may both impair the hearing and cause pain. The middle ear, on the other hand, may be the seat of inflammation and become entirely filled with a purulent discharge which will necessitate the opening of the drum to allow of its escape. The Eustachian tubes also may become occluded, and the hearing will be impaired in that way also; or the auditory nerve itself may be the seat of disease, or the terminal apparatus connecting it with the mechanical labyrinth. From diseases affecting the ultimate structures otology can offer at present but little aid; but for disorders of the middle ear much can be accomplished from without, and in occlusions of the Eustachian tubes a small catheter designed for that use may be passed through the passage as far as the middle ear, thus reopening the connection with the outer air.

Total deafness sometimes occurs in spite of every remedial measure however. In partial deafness the use of ear trumpets is sometimes of value, though, owing to their cumbrous size, the difficulty of holding them in position and the unsightly appearance which they make, they are not used to the same extent as eyeglasses for visual defect, and many persons, indeed, would sooner endure the inconvenience of partial deafness than resort to an expedient which is at once so inconvenient and attracts so much attention. Deafness is sometimes traumatic in origin, or results from deep-seated disease. Many cases of deafness have followed a case of scarlet fever or some other affection, just as blindness was in earlier days a very common result of variola. Absolute deafness, furthermore, is occasionally congenital and exists from the time of birth. Intermarriages between deaf-mutes are so common also as to be almost regarded as a usage, and in the extensive statistics recently published by the Volta Bureau regarding such marriages the fact is brought out that among the offspring of such unions the same infirmity is very likely to occur.

The number of those totally deaf at birth is much in excess of those born totally blind; indeed, the majority of those who become blind are over fifty years of age. Of the blind there are about thirty thousand in the British Isles, and in similar climates, where the practice of vaccination is observed, a number in proportion. Blindness is more common in tropical and warm countries than in the temperate zone. Among the blind, the balance between the outer and the inner world being disturbed, there is often developed a marked egotism and a strong desire to attract attention.

The first institution for the care and education of this unfortunate and utterly helpless class was established in Memmingen by Weef VI. in 1178, the second in Paris by St. Louis in 1220. In 1870 there were a hundred and fifty such institutions, and the additions since that time have been very numerous. In the institutions those who have been blind from birth receive suitable educations, and those of maturer years are taught many useful occupations. The men become very skilful in making baskets, brushes, rugs, while the women often show remarkable proficiency in knitting and hair-plaiting. Some too who possess artistic ability have become accomplished musicians; and, in a humbler rôle, a large number have competed with those in possession of their sight in tuning pianos. Some distinguished poets have been numbered among the blind, while many of less pronounced genius have occupied their extensive leisure with literary work whose chief interest to the casual reader generally depends upon the incident of the authorship.

An invention which has been a very important factor in the education of the blind, as well as a solace to them, is the Blind Alphabet. In 1784 Valentine Houy printed a portion of the Bible in large raised type similar to that in general use. The work was not altogether a success, because the characters which were adapted well enough for sight were not so readily appreciable to the touch. In 1827, therefore, Mr. James Gall arranged a new system of type consisting of triangular modifications of the common type which was warmly recommended by the Abbé

Carton in Paris and Dr. Howe of Boston. Subsequently Mr. John Alston of Glasgow experimented with a modification of the lowercase alphabet, and almost simultaneously Mr. Lucas of Bristol invented a stenographic form of printing with arbitrary characters and numerous contractions. This was followed by the "Scientific Representation of Speech" containing one character for each simple sound, by Mr. Frere of London. Dr. Moon of Brighton invented still another alphabet for the blind, and a fifth system was formulated by M. Braille of Paris, which consisted of sixty-two characters based upon six dots as seen in a die, from which the omissions made the variations. The advantage of this system was that it could be employed by the blind themselves when provided with a simple stamping device. A sixth system was suggested by Mr. Wait of New York, and is an improved modification of M. Braille's. A string alphabet also, designed for use among the blind themselves, was devised by Messrs. Milne and M'Baine of the Edinburgh Asylum, which was superseded by Gall's writing stamps.

So many competing alphabets have no doubt led to great confusion among the very class for whose benefit they were intended, but it is possible that ere long the best of these, or one of future invention, will become an accepted standard in all lands. Uniformity is certainly desirable for the reason of cheapness if for no other. Two methods of writing for the blind which can be read by the seeing have also been invented, one of these by Mr. St. Clair, a music teacher in Edinburgh, and the other the Zyphlograph of Gall. By these means reading, writing and arithmetic are being taught. The night-blind, or those who are only blind at night, and the day-blind, of which Larrey mentions a case in the person of a man long imprisoned in a dark cell who could not see by day, are of infrequent occurrence and need not be mentioned further in this place.

In the teaching of the deaf the problem is more complicated than in the education of the blind. A child born deaf, or rendered so by disease during his infancy, grows to years of intelligence without having the remotest idea of what sound is. He therefore, when he uses his voice, is not conscious of the sound made, and cannot possibly articulate words. He is consequently dumb as well as deaf. His sense of touch and sight is unusually acute, however, and by taking advantage of this fact almost marvellous results have been accomplished. It is enough only to mention the case of Laura Bridgeman who was born both blind and deaf, but who was taught to speak and to understand by Dr. Howe. A skill which could cast light from the world without into the utter gloom in which this unfortunate lady was so thickly enshrouded; stirring the stagnating brain and linking the heart, so cruelly isolated, with the unseen, unheard world in which she was born, is an achievement which indicates the importance of this branch of philanthropy. It was a long series of experiments also, carried on by Melville Bell, with a view to instructing the deaf by means of the electric current, that led accidentally to the invention of the telephone, a reward, one will say, not too great, when it crowned an endeavor so unselfish.

In ancient times deaf-mutes were looked upon, as were the insane, as smitten by the gods for crimes committed by their parents. The Spartan law condemned them to the great pit of Taygetus, into which the deformed were cast as useless to the state. By the Athenians also "they were without pity put to death without a single voice being raised against the monstrous deed." Into the Tiber it was decreed in Rome that they should be thrown. Their presence in a family was regarded as a deep disgrace. When not immolated in the ways mentioned they were in later times hidden out of sight, and destitute of education, nor understood, they lived in a deplorable isolation, looked upon as a useless burden, and no better than an imbecile. The dumb son of Crœsus, who, when Sardis fell, saved his father's life, as Herodotus relates, by crying out to a soldier, "Man, kill not Crœsus," was not deaf as sometimes supposed, but had suffered from an aphasia of cerebral origin which needed but a powerful shock to start into speech.

For the barbaric treatment and the utter neglect of the deaf through ensuing centuries Aristotle was largely responsible, who dogmatically asserted that "those who are born deaf are become [remain] speechless; they have a voice but are destitute of speech." Four centuries afterward Pliny refers to a Quintus Pedius, who had learned to paint; but in the pandects and decrees of the Roman Emperors guardians were appointed for the deaf and they were treated like children. Most adverse also to the interests of deaf-mutes was the preposterous anathema of Saint Augustine that deafness "itself hinders faith, for one who is deaf from birth cannot learn the letters by whose knowledge he would attain to faith." The limitations of the ecclesiastical mind proved unequal, it would thus seem, to any sympathy with the misfortunes of the deaf, as it already had with the misfortunes of the insane; and, as shall presently be shown, no attempt whatever was made to ameliorate the hard conditions which nature had laid upon them until a comparatively recent time. Jerome Cardan, born in Pavia in 1501, became a physician, and had his attention drawn by his anatomical studies to the organs of speech. We ought to be able to "make the dumb hear by reading," he says, "and speak by writing. For the dumb reads by reason as it were in a picture, though nothing is referred to sound." Cardan elsewhere, in his work, *De Subtilitate de Sensibus,* speaks of the sounds of the lyre being heard through a lance when one end of it was held to the teeth and the other touches the lyre. This phenomenon would largely depend for its success upon the nature of the deafness. Cardan had, however, pointed in the right direction, if nothing more, and the humane study was perfected and elaborated by another.

Pedro Ponce de Leon in the sixteenth century is said to have met with great success in teaching deaf-mutes. His pupils were among the sons of the nobility, and his theories were afterwards followed out upon similar lines by Juan Pablo Bonet, who, like the former, was also a Spaniard. Sir Kenelm Digby, who had been to Spain in the retinue of Charles, Prince of Wales, during his suit for the hand of the Infanta, thus describes Ponce de Leon's accomplishment: "I mentioned one that could heare by his eyes. But the Spanish lord was born deafe, that if a gun was shot off close by his ear he could not heare it, and consequently he was dumbe, for, not being able to heare the sounds of words, he could neither imitate nor understand them. At last there was a priest, who undertooke the teaching him to understand others when they spoke, and to speak himself that others might understand him; and, after strange patience, constancie and paines, he brought the young lad to speak as distinctly as anybody."

Much discussion has arisen as to the use of signs among the deaf. It certainly tends to defeat the object of the more scientific form of education which, as seen above, was making such headway. As many systems of sign language were invented, however, for the use of the deaf as there were alphabets for the blind. Bonifacio's *L'Arte de Cenni* was much used, and also John Bulwer's system of signs which appeared in 1644. In 1670 George Sibscota published his *Deaf and Dumb Man's Discourse,* and George Dalgarno, of Aberdeen, the *Deaf Man's Teacher.* Though well meant, no doubt, the ingenuity of these writers was unfortunately expended, being founded upon a principle of indolence, and retarding rather than advancing the theory of education for the deaf at that time in process of development. And this may be indicated briefly in the words of Van Helmont, who remarked that "they are dumb because deaf, and learn to speak by observing the appearance of the tongue and mouth of others in speaking."

In France something was done towards instructing the deaf by Pareira, and afterwards by Jacob Rodriguez, a Spanish Jew; but the real founder of the system which was afterwards introduced into England, and still later into America, was L'Abbé de L'Epée, who was born at Versailles in 1712 and died in 1789. Others had shown as acute reasoning, as great ingenuity and endless patience also, but it was not so much for these qualities that the Abbé commands, as does Pinel, the respect and love to-day of all humane men, as from his warm sympathy and tender compassion and intense devotion towards the emancipation of the whole class. Formerly the treatment had been taken in hand in behalf of the sons of princes and nobles, and the remuneration was no doubt in proportion to the gratification felt. L'Abbé de L'Epée, however, educated without reward the poorest as well as the richest who could pay. No mercenary consideration seems to have ruled him, but only his love for his work. Furthermore he did not regard his methods as a trade secret, but willingly instructed others in the mode of conveying instruction. In his book *The True Manner of Educating the Deaf and Dumb,* he thus indicates his plan of procedure: "When I am about to teach a deaf and dumb person to pronounce I begin by making him wash his hands thoroughly clean. This done I trace an A upon the black-board, and then taking his hand I introduce his fourth or little finger as far as the second joint into my mouth, after which I pronounce strongly an A, making him observe that my tongue lies still."

In Germany Samuel Heinike put to a somewhat more logical practice the principles of Bonet, Wallis and Ammon, and in the purely oral form of instruction accomplished as much as L'Abbé de L'Epée had in the educational. Froebel and Pestalozzi by their theories of education no doubt offered many hints to the teachers of the blind and deaf, to whom the use of objects as means of conveying ideas was of particular advantage. The Abbé Frederick Stork in Germany and St. Sernin at Bordeaux subsequently instructed very large numbers of the deaf; and about this time the first school at Rome for deaf-mutes was founded by the Abáte Silvestri. The institution on the Old Kent Road was founded in Britain in 1812. An institution was also established in Birmingham under the superintendence of Dr. de Lys. In 1814 Tiburgio Hernandez gave similar instructions at Madrid.

The systems employed in England and Scotland were borrowed of course from that of L'Abbé de L'Epée, and other teachers of the time, who freely published their methods. Braidwood of Edinburgh, however, finding that the Continental system was comparatively unknown in Britain, kept the method a profound secret, enjoining secrecy upon all who were instructed in it. With the instincts of a small tradesman he felt that his calling would be gone if his method were once known. Dr. Thomas H. Gallaudet had heard of the Braidwood family, and when in 1815 it was decided to establish a school for the instruction of the deaf in America he visited the Braidwoods in Scotland with the idea of studying the system of instruction; coming too, as one might say, much as a representative of one nation to another, in search of knowledge of the utmost value to humanity. He found, however, that in Great Britain he had to deal with the spirit of vested interests and exclusive claims; even though based upon discoveries made by others, and many years before at that. All information upon the subject was churlishly refused, and he was dismissed with insolent suspicion by the Braidwoods. Much discouraged, Gallaudet decided to leave England; but unwilling to return to America after a fruitless journey, he happened to go to Paris in 1816, where he was courteously received by the Abbé Sicard, one of L'Abbé de L'Epée's successors, who at once, and gladly, offered the American humanitarian every possible facility for the achievement of the object he had been vainly pursuing in Great Britain. Here he spent two months, and at the end of this time, by the consent of the Abbé Sicard, one of the instructors of the institution, M. Laurence Le Clerc, accompanied Gallaudet back to America to assist him in founding an institution for the instruction of the deaf. In 1819 was founded the American Asylum at Hartford, Connecticut, for the education and instruction of the deaf and dumb.

The writings of the Baron de Gerondo in 1827 have since given such publicity to the methods of instruction that it is hardly likely or possible that any individual will ever again repeat the contemptible practices of the mendacious Braidwoods. The work of Antonio Prevolo at Verona in 1829 and of O. F. Kruse, himself a deaf-mute from the age of six, may also be mentioned, as well as the Visible Speech, described in 1864 by Dr. Melville Bell, the founder of the Volta Bureau.

The method by which the deaf are at present taught, not only to speak themselves, but to understand the natural speech of others, has already been suggested. Though the actual nature of the different sounds of the letters can never be explained to them, the exact mechanical means by which the sounds are produced can be shown; and as their organs of speech are perfect, they learn in time to articulate the sounds of all the letters, and to combine them afterwards into words, the arbitrary meaning of which they have been taught. The lesson is often found to be a difficult one, and the teaching of it is generally very tedious; but the passionate desire of the pupil himself to accomplish a task upon which so much depends helps to overcome many obstacles. Some letters he learns by examining with his fingers the position of the lips, the teeth and the tongue of his teacher, and imitating the same position. The different vibrations faintly produced by the enunciation of certain letters in various parts of the face and neck and even the back form another key to the patient learner.

In listening to, or *reading,* as it were, the speech of others he is forced to rely upon the quickness of his sight, which is often remarkable. The sounding of each letter produces a distinct facial expression in the speaker, which, though escaping the indifferent observer, can be caught by the eyes of the deaf. To him each word, therefore, represents a rapid succession of slight movements affecting the lips, the face, the eye, the forehead and the general expression of the countenance; and by this means alone he is enabled eventually to understand much or all that is said.

At the present time every civilized state and country has one or more public institutions for the instruction of the deaf, where the children of poor and rich alike are given an equal chance to fit themselves for a useful and happy life.

CHAPTER XXI.

THE NOSE AND THROAT.

THE present method of treating diseases of the nose and throat may also be claimed as a development of this century. Indeed, until the latter part of the present century there existed no scientific means by which these regions could be studied when in health or examined during disease; and lacking a preliminary so necessary, both the early surgical and medical means of treatment were imperfect and unsatisfactory, and consisted chiefly in the administration of abominable gargles and vile snuffs. This too was all the more to be regretted when it is remembered that both the throat and the nasal passages, by reason of the delicate tissues of which they consist, and their important anatomical position, are susceptible to all the processes of disease which affect the other tissues. Inflammation due to irritation and to septic infection is of almost constant occurrence. Beside the simpler colds in the head and the sore throat which nearly everybody has experienced there are a large number of more serious maladies which are fortunately of less frequent occurrence, including deformities and neoplasms, such as carcinoma, which usually has a fatal termination in the course of a few months. Trousseau's operation of tracheotomy, by which he hoped to obviate the inevitable result of œdema glottidis, when severe, and the closure caused by diphtheritic croup, has already been referred to.

The chief obstacle from the first, however, was the difficulty experienced in examining the region while the patient was still alive. In Paris during the eighteenth century Levret made a number of experiments with this object in view, but after many futile attempts gave the matter up as impossible. In the beginning of the present century Bozzini made further attempts in the same direction, but without any better success. In 1832 Bennatti endeavored by various means to bring the larynx into view, and in 1844 Avery made several experiments in London, endeavoring to illuminate the larynx by artificial light conducted through tubes. In all these experiments the principle of the speculum was adopted, which had already been employed by gynæcologists with such gratifying results. A speculum is a hollow instrument made of metal or some rigid substance, either in the form of a tube, or of valves capable of dilatation, which, when introduced, holds the opposing sides of the region apart and, by reflecting light along the inner surface, facilitates the examination of the interior portion. In the attempt to examine the larynx by this means, however, the instrument used had so crowded the tongue and epiglottis, as both Trousseau and Bellocq had shown, that the orifice of the larnyx was almost closed, and any view of its position or condition thus rendered impossible.

The tenacity with which the attempt was renewed by scientific investigators, while explaining the ultimate success which eventually rewarded the repeated effort, also indicates how great a desideratum to the medical art was considered the exposure of the larynx in the living subject. In 1827 Senn of Geneva gave the matter the closest study, but after repeated experiments was forced to regard the difficulties as insuperable. Babbington of London in 1829, and Baumes of Lyons in 1838, devoted much attention to the matter, but were unable to overcome by any means which they could conceive the obstacles which had hindered the earlier investigators. In 1840 Liston made a number of futile experiments, and Warden imagined for a time that he had solved the difficulty with a contrivance which consisted of two prisms.

The peculiar difficulties of the problem lay in the anatomical position of the larynx, and its inaccessibility to light. The larynx is situated at the lower extremity of the hollow pharynx. The upper part of the vertical pharyngeal passage is situated at the very back of the mouth behind the tongue and is curtained from external observation both by the pillars of the fauces and the pendant uvula, which add still more to the difficulty by narrowing the passage.

To convey a clear idea of the position of the larynx, one may fancy the bottom of a deep well, about the ground surface of which a closed shelter has been securely built, with a very small window at one side only, and that removed so far from the edge of the well that upon looking in the window from without only the dark opening of the well shaft can be seen. From a position outside this shelter it would appear impossible to see clearly the bottom of the well, for not only would it be involved in darkness, but the observer's sight could not possibly be made by any ordinary means to turn at an angle. The physician's problem was no easy one therefore, for in just such a relation did he find himself to the larynx of his patient, situated at the bottom of the pharynx, and the upper opening of the same being at the very back of the mouth.

The only possible solution to such a difficulty seemed to be either by boring a hole downwards through the top of the patient's head, or else by forcibly drawing the pharynx forward by inserting within it a hollow speculum so that it could be brought within such an angle that the distal extremity could be observed by the physician's eye. As the upper portion of the passage was drawn forward, however, the middle tissues, acting as a fulcrum, caused the lower portion to be pushed back a little, which altered much the natural relation of the parts. That this was an impracticable expedient, the repeated failures already mentioned would indicate. The object in view was moreover to observe the larynx in its normal position, and unembarrassed by the presence of any foreign instrument. The earlier investigators could not, it appears, divest themselves of the idea of a speculum, the idea having once taken possession of them, and each in turn, therefore, taking a leaf from the gynæcologist, attempted to examine a structure placed in an entirely different position, with an instrument which had been originally designed for the examination of organs lying in a straight line from the observer's eye, and only obscured by the apposition of tissues. In examining the nostrils or the ear, for example, a speculum admirably accomplishes the purpose for which it was originally designed, but it was a bulky, a clumsy, and, as has been seen, an impossible contrivance for use in the examination of the throat.

It therefore remained for this most important medical, or rather anatomical, problem to be solved by a man who was not a physician at all, and who had therefore, fortunately, never heard of a speculum. Had the unlucky idea of a speculum ever got into his head, he also would very probably have attempted to have accomplished his end by its use, and, like his predecessors, have failed also. He was forced, however, to rely altogether upon his own common sense, and after much difficulty, probably many difficulties, overcame all the obstacles with which the others had been met, and by such simple contrivances as only come ever to the minds of children and men of genius. Probably, too, he did not know at the time how important the discovery was. That also was very fortunate. Had he been conscious of its importance, the knowledge might have awed him into inactivity, or, worse still, produced in him that impressive faculty for solemn pantomime, which was possibly observed in the ancient Oracles, and is to be still seen in some of the "eminent men" of the present day, from whom the world too confidently expects presently an abrupt unfolding of all the secrets of nature.

This man was Signor Manuel Garcia of London. He was a teacher of music and gave particular attention to voice culture and vocal exercises and scales and that sort of thing. The phenomenon of the voice had so deeply interested him that Garcia attempted to study the action of the organs in the living, and luckily began his studies, probably for want of another subject, upon himself. This called into requisition the use of a mirror. Hence Garcia, by the merest accident, started out with the idea of a mirror instead of a speculum. By one means and another he became quite expert in the demonstration of the larynx in the living, and no doubt extended the practice to others. His interest was still that of an instructor in vocal music, but the success of his endeavor possibly attracted the attention of some one who saw its more extended importance; and by their advice, probably, Garcia sent in 1855 a communication to the British Royal Society, in which he described in full the methods of observation which he had used, and the results with which his experiments had been attended.

The Society in question, however, which during the greater part of its history has continued to estimate the importance of the scientific discoveries communicated to it by the respectability and social rank of the discoverer, paid but scant attention to a communication which emanated from so contemptible a source as a mere teacher of music; and no attention whatever was paid, therefore, to one of the most important discoveries of the time. In a similar spirit, when a very useful device for the testing of minerals by the blow-pipe was recently brought before the attention of the infant society established in Canada in ambitious imitation of the one just mentioned, the colonial society was long in trembling doubt as to whether it should accept the communication, fearing that it might not be original, until one of their members had gone over to England and learned from responsible sources that the suggestion was entirely new. A knowledge of what science has done already, as well of what science still most needs, is a desideratum in scientific societies so-called. And the pearls mentioned by one of the sacred writers still no doubt remained pearls, though trodden upon in the way mentioned; the final criterion of a gift offered not necessarily being the opinion of the individual to whom it is offered.

Ludwig Türck of Vienna, chancing to come across the account of Garcia's discovery, immediately saw the significance of his methods, and began in 1857 to experiment with similar mirrors, and met with much encouragement until the onset of the winter season, when the difficulties of obtaining sufficient sunlight for his experiments discouraged him somewhat, and in his growing indifference he threw his mirrors aside for the time being.

Johan Nepomuk Czermak of Pesth, however, who had been visiting Vienna at the time, happening to be attracted by the idea, borrowed the mirrors from Türck and continued his observations through the winter. This also was a fortunate coincidence, for the gloom of the season which had discouraged Türck forced Czermak to think of some other expedient by which light could be obtained, and he accordingly hit upon the idea of artificial light. Czermak also employed a reflector, such as was used for the ophthalmoscope, and instead of depressing the tongue, a habit into which all the rest had fallen, he observed the anatomical structure of the part, and by a superhuman mental effort caused the tongue to be protruded instead of depressed. These slight modifications of Czermak made the discovery complete, and at last rendered the close examination of the larynx possible. Having added the final stone to the arch, he himself actually thought, or perhaps hoped to make others think, that he had built the whole fabric, and boldly claimed accordingly to have been the inventor of the laryngoscope.

Upon his pæan of triumph then broke rudely the clamor of the aggrieved and outraged Türck, who also claimed the invention as his own. The dispute gathering rapidly in force, the exceeding noise of the controversy disturbed the mental repose of the world of science, like a discordant alarum, and eventually drew attention to the bone of contention between the disputants. Rather indifferent as to who was the discoverer, the world saw the importance of the discovery, and promptly seized upon it for itself. Czermak had merely perfected the methods practised by Türck, and those methods had in turn been suggested to Türck by the original discovery of Garcia, the obscure singing-master in London.

The spirit of Corvisart seems to have been lost in modern science, if one is to judge by the mendacity shown by Türck and Czermak, who, like two rogues wrangling over a stolen purse, picked from the pocket of a third person, clamored in turn, with brazen faces, for the right of proprietorship in a discovery which belonged to neither.

By the aid of the laryngoscope the study of the diseases of the nose and throat have been since carried on upon a new and scientific basis. In using the laryngoscope the patient is seated facing the physician, while a bright flood of light is directed forward from behind the patient's head, leaving his face in shadow but shining directly into the face of the physician seated *vis-à-vis,* and with his chair drawn as close as possible to that of the patient. The physician then places before his face, by means of a band which encircles his head, a round, somewhat concave mirror, by which means the light is collected and reflected in a strong stream full in the face of the patient. In the very centre of this reflecting mirror there is a small round aperture through which the physician's eye readily views the face of the patient. Upon the latter opening the mouth to the widest capability, the tongue is extruded as far as possible and is held in that position by means of a towel or by some other device. The interior of the mouth is now brilliantly illuminated by means of the reflector and a smaller mirror, attached at an angle to a long slender handle, is inserted into the mouth. Similar mirrors are in constant use by dentists. This mirror with the face directed downwards is placed at the top of the pharynx at the very back of the mouth, and upon it one sees a clear reflection of the larynx. Having been heated so as not to be blurred by the sudden change of temperature, it serves in this position the double purpose of reflecting the rays of light down the throat to the larynx, and also of making that organ clearly visible to the eye of the physician. No extended experience is necessary to make this principle intelligible to any one. In almost every dwelling there is to be found some mirror so placed that the interior of a chamber can be seen which would not otherwise be visible from the same point of view. By the use of the laryngoscope the larynx may be readily seen by the tyro when the proper measures are adopted.

Upon the discovery of the laryngoscope, instruments for surgical operations in that region rapidly multiplied, and at present it is possible to detect and treat the various forms of morbid growth with which the larynx is occasionally attacked. The treatment of the diseases of the nose and throat have become recently the province of the specialist, who devotes his entire attention to that one branch of surgery. Rhinoscopy, or the examination of the nasal passages, both from the anterior aspect and from the posterior region, is conducted upon the same principle as in the examination of the larynx. To employ anterior rhinoscopy a nasal speculum is required and the passage is dilated to the necessary extent, and the portion beyond examined by means of reflected light. Many forms of speculum have been put forward for this purpose from time to time. The simpler ones seem to answer every end, and swelling of the turbinated bones is the only difficulty usually met with. Posterior rhinoscopy, or inspection of the vault of the pharynx, is practised by the same means as when examining the larynx, only the small mirror held at the back of the buccal cavity is directed upwards instead of downwards, and at a somewhat sharper angle. For this purpose Fraenkel has invented a useful mirror which, without being withdrawn from the mouth, may be turned at will to any angle desired by a simple device connecting the mirror proper with the outer part of the handle.

When performing surgical operations in these situations a special variety of instrument must necessarily be used; the handles of knives and forceps being much longer than usual, and with curved handles. The use of cocaine, already referred to in connection with the eye, has been of the utmost value also in both laryngology and rhinology. In removing growths and for similar operations, Chassaignac's invention of the écraseur has made much possible which otherwise could not have been attempted without the greatest risk from hæmorrhage, as the parts are inaccessible to the immediate applications of the ligature or even of torsion. The écraseur consists simply of a loop of rough twisted wire or a chain enclosed in a barrel, from one extremity of which the loop extrudes. From the opposite end a screw handle is placed by which the loop may be drawn tighter and tighter. In the case for example of a polypal growth the écraseur is placed in position, and the loop grasps the polypus. As the handle is turned the growth is constricted and presently torn through completely by the drawing in of the loop of twisted wire. Very little hæmorrhage follows this mode of amputation, for when the arteries are severed they are torn in a manner which suggests the idea of torsion, and of which the result would seem to be similar in principle.

In perfecting this branch of surgery Sir Morell Mackenzie contributed, and was at one time one of the most eminent English practitioners in this department of medicine. One of his cases excited profound interest at the time and has a certain historic interest still. The Crown Prince of Germany, having been attacked by the carcinomatous growth upon the larynx which eventually terminated his life, was in some danger of being prevented from ascending the throne, owing to a German law by which no one suffering from an incurable disease was allowed to become the emperor of that country. His political ambitions being thus endangered as well as his life by the cancer, Mackenzie, who represented the interests of the family of the wife of the Crown Prince, was dispatched to Germany for the purpose, it would seem, of proving that the cancer was not a cancer. The irritation felt by the medical profession in Berlin at the time was great and rather freely expressed. However, Mackenzie continued to affirm that the disease in the throat of his royal patient was not cancer, and therefore that it was a curable disease, until the Crown Prince, by the death of the Emperor, was able to ascend the throne, and up to the period of his death, which took place from the cancer shortly afterwards.

The most brilliant scientific accomplishments can scarcely blind one to moral turpitude of this sort; though possibly powerful national prejudices (to which the name patriotism is frequently applied) may do so. It is furthermore to be deplored that so many members of the medical profession have been ever found ready to show a similar posture of mind, which recalls a time, now so long past, when the physician was a fawning body-servant in the house of a wealthy and powerful employer, and expected, like a valet or a barber or any other sycophantic hireling below stairs, to do exactly what he was bid; his reward being the gold pieces which were contemptuously flung at his head by his patron when in an expansive or benevolent mood. Pride is also, possibly, a matter of evolution.

CHAPTER XXII.

ORAL SURGERY AND PATHOLOGY.

In the earlier years of the century the art of dentistry consisted in pulling out the teeth when they ached. The dream of the dental practitioner at that time was to be able to do this without causing pain, an advertisement by which his business would have become very extensive. From a beginning such as this, which can after all be only regarded as a form of handicraft, dentistry has developed during late years into a surgical specialty, based upon sound scientific principles. It might reasonably, therefore, be regarded now as a branch of surgical practice, were it not for the fact that its origin was separate and its development independent, and that those who practise it prefer to confine themselves to that one branch, and therefore have less knowledge of the other branches of science which constitute medicine. They cannot, therefore, be regarded as surgeons in the same sense of the word as the practitioners in the other special departments are, who, before embracing a specialty, have received a general medical training in all its branches. The distinction of this specialty in this way, however, refers to the practitioner rather than to the specialty, and for this reason the advances in this branch of surgery will receive the same attention that has been devoted to the other specialties, though its practitioners are not in a technical sense members of the medical profession.

The cause, the nature and the signs of the diseases with which the teeth are affected belong to the present study of dentistry quite as much, indeed, more, than their extraction. The modern surgeon treats instead of amputating diseased limbs, and in a similar manner the dentist of modern times gives special care to the treatment of the diseased tooth instead of pulling it at once. This frequently consists of filling the cavity which usually accompanies the disease in that structure. The tooth is only extracted when no surgical means can preserve it. The parallel between dentistry and general surgery is so far perfect. It extends even further. Just as the surgeon, after the removal of a limb or an eye, replaces the loss as best he can with an artificial limb or eye, so the dental surgeon, when the teeth are extracted, replaces them by various means with an artificial substitute. In this branch dentistry has made quite as much headway as in the other branches already mentioned, and during the present century may be said to have become a science, whereas it was formerly but a trade.

The theory that unsound teeth are an outgrowth of modern civilization is contradicted by the repeated mention from the earliest times of remedies and cures for toothache. It is quite true that among the uncivilized races the teeth appear to be more sound now than among the civilized, but this observation rather points to the fact that simple food and an outdoor life are favorable to strong teeth. In the days of Celsus the same immunity may have been noticed among the prisoners brought from barbaric Britannia which the English to-day observe in the wild inhabitants of Africa and Oceania. Celsus advised those who suffered from a hollow painful tooth to place a peppercorn in the cavity, which, when swollen by the moisture, may have possibly been the indirect means of giving the patient a little relief by bursting the tooth. Celsus also mentions the extraction of teeth by the use of the forceps.

As it has been customary for the bald to adorn their naked scalps with the hair of others made into wigs, so, even in the days of early Rome there were artificers of sufficient cunning to construct false teeth for their noble customers. These consisted of teeth drawn from the jaws of others and held in place by golden wire or by other means. Teeth artificially made for wearing were as old as the laws of the Twelve Tables. As it is easy for any one to detect false teeth at the present day because they are too good to be real, so it was no doubt easy to detect such deceits in that day because they were too bad to be of nature. Martial makes merry in an epigram over the teeth and other accessories employed by a lady of his time:

> " When thou at home and absent, borrowed hayre
> And tyres for thee the shops do still prepare :
> When teeth as cloaths, at sleeping times laid by,
> Thy face at night doth never with thee lie."

At the beginning of the century the art of treating the teeth was nevertheless so imperfect that the Empress Josephine, despairing of ever improving her own, of which she was senselessly ashamed, resorted to the use of a fan to hide them, by which incident that toy of the drawing-room has become a permanent part of the furniture of folly. Many centuries after the time of Celsus, Johannes Arculanus (Giovanni d'Arcoli) practised filling the cavities of his patients' teeth with gold, which possessed, he had discovered, thermal qualities which made it a suitable substance for that purpose, possessing also about the same durability as the dental substance. The cosmetic art of dentistry had for long proved a favorite field for charlatans, but in 1728 the publication of Pierre Fauchard's work *Le Chirurgien Dentiste, ou Traité des Dents,* indicates a distinct advance in the theory and practice of dentistry. Pierre Auzebi was a dental surgeon of considerable reputation in France, while Friedrich Hirschfeld in Germany and Franz Nessel in Vienna were influential in reclaiming the art to a certain extent from the quackery into which dentistry had fallen.

The anatomical structure of the tooth hardly needs description. Protected by an outer enamel, there lies beneath this a concentric zone of bone substance similar in many respects to other osseous formations, and this again encloses the tooth pulp of much softer consistence, in which lie the blood-vessels which nourish the tooth, and the nerve which renders it so sensitive to pain.

The tooth is peculiarly susceptible to caries, a disease which occurs, though less frequently, in other bones also. Dental caries consists of a "chemical disintegration of the teeth, molecule by molecule," a writer on dentistry explains, and it begins upon the surface, usually in some groove or point, whence it gradually spreads inwards, slowly destroying the substance of the tooth in its progress. Growing at first soft and spongy, the diseased portions are gradually disintegrated, and a cavity is left which, when coming in contact with the secretions of the mouth and the ingested food, more rapidly enlarges, unless some steps are taken to arrest its course.

Faulty tooth formations predispose to this condition, and in all the members of some families the teeth seem to have a predisposition to this disease.

Some morbid conditions of the mouth also give additional opportunities to the malady. Many micro-organisms have been found in the secretions of the mouth, but the *Leptothrix buccalis* is thought to have a direct influence in producing caries. This being the fact it goes without saying that the prevention of this disease which is caused by an organism may be insured by the same means as in general surgery; that is by the use of an antiseptic which will destroy the life of the germ. The most perfect cleanliness, while advisable, is not of itself sufficient to accomplish this purpose, and it is now usual to employ one of the Thymol preparations as a dentifrice, Listerine being undoubtedly the best preparation at present obtainable for this purpose. The scented pastes and cosmetics so much in vogue, even at the present time, are injurious by commission as well as by omission, and fail to benefit the teeth themselves, while allowing the germs to attack the dental substance without opposition.

There are certain practices which help to destroy the teeth. It would be a very surprising sight to see a man amusing himself after dinner by carelessly cutting and hacking his wrists with a rusty pocket knife. Yet the custom of freeing the teeth from the seeds of the raspberry and other small particles of food with the tine of a steel fork or a brass pin or a piece of pointed metal, such as a needle, works quite as much havoc with the teeth; not to mention the habit of cracking nuts with them and drawing nails. The teeth should not be subjected to sudden changes of temperature, for that causes the glazed enamel to crack. Neither should the teeth be touched with anything harder than a bristle or quill, for any rougher handling detaches portions of the enamel already cracked, leaving the dentine unprotected in any way from the fermentive secretions of the mouth and the *Leptothrix buccalis,* a state of things which is presently followed by dental caries. These facts should be impressed particularly upon the minds of children when there is yet time, by care and proper preventive means to save their teeth to them. It seems unfortunate that no systematic method of examination has yet been introduced by which the teeth of the children of poor people could be watched and treated while they are at school.

The dental pulp is often the seat of disease which may affect either the nerves of the part, as in the case of dental neuralgia, or the blood-vessels, as in hyperæmia. Inflammation may also arise in this situation followed by suppuration and abscess. The last should be opened like any other abscess to allow the escape of the pus; and this is accomplished by boring a very small hole through the tooth substance to the part affected. A neglected abscess in this situation leads to degenerative changes in the entire pulp substance. Hard formations, consisting of calcifications, sometimes gather within the pulp chamber, and other forms of tumor may be present also. Sometimes the pulp becomes gangrenous.

Besides the caries which affects the dentine, or the hard substance of the teeth, and the diseases of the pulp cavity just mentioned, the outer area of the teeth, or the peridental membrane where it lies within the socket, is also subject to disease. Chronic apical pericementitis sometimes gives rise to much distress, and often leads, as does also acute alveolar abscess, to the premature extraction of an otherwise sound tooth. Gingivitis may likewise be present, and consists of an inflammation confined to the gingivæ, or margins of the gums. Phagedænic pericementitis requires treatment when present. Sometimes these diseases of the outside of the teeth are precipitated by the injudicious fillings of an ignorant dentist. A wise practitioner of dentistry watches the tooth as he fills it as one does a restive horse, ready at a moment's notice to withdraw the filling should the tooth display the least sign of irritation.

A cavity in a tooth is identical with an abscess in the soft parts. In the latter region the duty of the general surgeon is to remove all the products of disease, to render the part perfectly aseptic until the progress of the disease is arrested, and then to bring the edges together and allow the wound to heal. The dentist follows this procedure as far as he can. He removes from the cavity the products of disease and freely uses antiseptics until the part is in a wholesome condition. Then, as it is impossible to bring the edges of the cavity together to favor healing, he fills it with some substance similar to the tooth substance in consistence and in its susceptibility to thermal influences. For a temporary filling tin-foil has been much used. For a permanent filling, gold-foil, very carefully packed into place and beaten hard and smoothed on the surface. More recently the preparations used have become very numerous, and, beside gold, consist of various cements and amalgams, many of which are for various reasons preferable to gold.

Gold is still very popular, however, for use in exposed positions, and much in the same way as the scented tooth pomades are popular, namely, by pleasing the universal weakness for cosmetics. Indeed, in this particular matter the custom has been carried to the height of the ridiculous, and is almost as barbaric as it is absurd. The smile of many people gives one a glimpse not unlike the window of a jewelry store. Five or six teeth are seen to be of pure gold, and others with caps and bosses of gold. May it be prevented that the custom should ever grow of wearing hand-painted floral teeth, decorated to match the other forms of porcelain used in dining. And as for the silly passion for loading the mouth with gold it will only mean that the cemeteries will become the gold mines of the future. However, even Midas became sick of the touch of gold at last. The worst of the matter is that many vain women have their own honest teeth all pulled out, because, like everything else in Nature, they are not of exact regularity, and replace them with the false product of modern dentistry which are too diagrammatically regular to be genuine, and too mathematically uniform to be beautiful. In abandoning one's teeth, he abandons something that portrays his character quite as much as the eyes, the hair, the hands, the face itself. The worst looking natural teeth are, when sound, better than the finest false ones made of china, like cups and saucers.

When not abused, however, by the silly and the vain, the art by which the aged or the unfortunate are supplied with an artificial means of masticating their food is one of great benefit to mankind, as it would otherwise be impossible for these individuals to enjoy sound health. The immediate transplantation of human teeth has not been a practical success. There are many instances where a foreign body, such as a rifle-ball, may become encapsulated in the body and remain there until death. But upon this body there is no strain, as there would be if a tooth were forced into the socket from which a tooth had already been drawn, and became fixed there. Dentistry does not appear to readily adapt itself to the principles of plastic surgery. For artificial purposes the ivory of the hippopotamus and the elephant were used. The use of artificial appliances of the sort did not become general until somewhat late in the century. A step of much importance was made when exact impressions of the palate were made to fit a plate which was to fit the mouth. The other step which finally brought the practice into every day use was the discovery of the process by which porcelain teeth could be manufactured. When all the teeth are not extracted it is difficult to wear a plate, and for the partial substitution the crown and bridge work of the dentist has been found of use. A crown is the false representation of the part of the tooth which is exposed, and which has been removed by the dentist, not with the forceps, but with a little saw. The crown is attached to the sound part of the tooth which remains, and which lies imbedded within the socket. A bridge is a contrivance by which a false tooth is supported between two sound teeth with a bridge which is concealed behind the teeth. A bridge may support two or three false teeth.

American dentistry has enjoyed an unmistakable pre-eminence for many years, and the art has been for the most part perfected in America. In the time of her extremity the Empress Eugénie had recourse to her dentist, who assisted her in her flight from Paris. The founding of the Baltimore School of Dental Surgery for the teaching of dentistry was also an important step, aiding considerably in consolidating the knowledge on the subject, and rendering the practice more uniform. Many other dental colleges have been established since that time, and several of the universities now grant degrees to dental surgeons. A National Association of Dental Surgeons has also been formed by which the curricula of the various teaching bodies are rendered regular, and to this association all the dental schools of America belong.

CHAPTER XXIII.

THE DISEASES OF THE SKIN.

Beauty is skin-deep. This adage will indirectly explain the fact that the care of the skin was in the first instance, like dentistry, a branch of cosmetics. The childlike repugnance which is usually experienced by the unscientific mind at the sight of actual disease is especially exercised with a form of disease which lies upon the surface, and, therefore, in full view. The lesions in many internal diseases would prove, if their nature were fully understood, far more revolting to the same persons, but being unseen they do not arouse any active dislike. Until the diseases of the cutaneous system were studied scientifically, which was not until the present century, any cursory study which may have been given to the matter was based upon either vanity or fear—the vanity which is as old as woman's beauty, and the fear which is older still.

As a branch of medical science the diseases of the skin remained very imperfect until the middle of the present century. Abernethy divided skin diseases into those which mercury would cure, and those which sulphur would cure, and those which the devil himself couldn't cure. The charlatan profited by the general ignorance of the surgeon in this branch of medicine as he had by his ignorance in other branches, and at one time the unguents and applications for cutaneous affections were innumerable. In his *Treasury of*

Wit, which was published more than two centuries ago, Cotgrave has furnished a description of such a charlatan:

> "My name is Pulsefeel, a poor Doctor of Physick
> That does wear three pile velvet in his hat,
> He paid a quarter's rent for his house beforehand,
> And (simple as he stands here) was made doctor beyond sea.
> I vow, as I am right worshipful, the taking
> Of my degree cost me twelve French crowns, and
> Thirty-five pounds of butter in upper Germany.
> I can make your beauty and preserve it,
> Rectifie your body and maintaine it,
> Clarifie your blood, surfle your cheeks, perfume
> Your skin, tinct your hair, enliven your eye,
> Heighten your appetite ; and as for jellies,
> Dentifrizes, Dyets, Minerals, Fricasses,
> Pomatums, Fumes, Italia masks to sleep in,
> Either to moisten or dry the superfices, Faugh, Galen
> Was a goose, and Paracelsus a patch, to Doctor Pulsefeel."

Many diseases of the sort still resist all the known forms of treatment, but there are others which once inspired the utmost terror, but which are now known to be without any danger; and some also which the physicians of the preceding century gave up at once which are now known to be of the simplest origin, and capable of being cured by the simplest means. As an example of the latter one may recall the Plica Polonica of the older writers. Allen refers to this affection in his *Practice of Physick,* and after describing its general appearance remarks naïvely that there is no known cure for the same, but that as it is a disease not seen in England no further consideration need be given to it. Yet this portentous malady was nothing more than a simple form of phthiriasis (lice) with which the heads of the patients were infested. The not over-clean scalp, by being constantly scratched by the filthy hands of the patient, naturally broke out into irritating sores, the purulent discharges from which accumulated in the hair and matted it thickly together, in which condition dirt from various sources gathered within it which rendered a spontaneous cure of the inflamed scalp impossible. The worst case of Plica Polonica could have been promptly cured by removing the hair and keeping the scalp perfectly clean. When perfect cleanliness is maintained disease of the skin is less common; or, when present, less severe than when attention is not paid to this particular.

With the growth of modern physiology the part played by the skin in the vital processes of the animal system began to be better understood; and its minute anatomical structure was made plain by the microscope. Beside being a somewhat durable and elastic covering for the protection of the tissues from contact with external influences, and a surface which supports the growth of the hair which is present in varying extent with different species, protecting the body from both heat and cold, moisture and irritating particles, the skin is also an excretory organ, aiding always, and sometimes, during loss of equilibrium in the presence of disease, reinforcing the renal excretory system. These statements are clearly illustrated by an examination of a portion of the cuticle from any part of the body. Within the cellular substance are found hair follicles from which issue these appendages of the skin. The follicles are always present, though in some regions the growth of the hair is almost suppressed, especially in the human race, where the habit of wearing clothing has acted as a strong factor in producing this inactivity.

Two varieties of minute glands are also to be found in the cuticle—the sebaceous glands and the sudorific glands. The sebaceous glands secrete an oleaginous substance which renders the skin more pliable and adds much to its durability. On much the same principle various dressings are applied to leather to prevent it from becoming dry and hard and cracking. A dry skin which readily cracks is the result of deficiency in these glands. The sudorific (sweat) glands are excretory, and aid incidentally in maintaining an equality of temperature. Suppression of the perspiration may be followed by disagreeable symptoms. Lastly, the skin must be regarded as one of the special senses, no less than the eye or the ear. The sense of touch is situated in the skin, and adjacent to it are placed the terminal nerve endings of the sensory system.

The skin is not, therefore, like wall paper, a simple homogeneous covering for the body, but an exceedingly complex texture which is actively engaged in performing physiological functions of great importance. Exposed as it is to so many external irritants and sources of injury, both by violence and from general wear and tear, it would not seem strange if the diseases with which it is afflicted were far more numerous than they are.

Absolute cleanliness is necessary. The skin may be said to require special attention in this respect for the double reason that it is subject to impurities from without as well as from within. Its excretory functions may be artificially increased by various means. Certain diaphoretic drugs act in this way; and hot baths produce the same result. In some forms of disease it has been discovered empirically that by increasing the excretory action of the skin much relief is felt, doubtless by reason of the expulsion of certain *materies morbi* from the blood by this avenue. Counter irritation of the skin relieves inflammation of the more deep-lying structures, though the exact cause of this well-known phenomenon has not yet been irrefragably demonstrated. None of these expedients of medicine should be too frequently resorted to. The functions of the skin should not be unduly taxed, and ill results often follow too intense a devotion to the theories of hydropathy.

Mineral baths are often probably very refreshing to the cutaneous system, but it is probable that much of the advantage sometimes claimed by celebrated establishments for mercenary reasons, if founded upon fact at all, are due to the change of scene and improved hygiene incidental to the hygienic pilgrimage. In modern times quackery is somewhat more respectable than in the previous century; and some of the most celebrated quacks of the present day, instead of travelling about with their peddled nostrums to the fairs and places where the public most resort, retire now to some picturesque locality blessed with "springs" (word of magic import to the common mind), and there in magnificent buildings entice the credulous public to them in great droves. Guy de Maupassant, in his *Mont Oriel,* has described this exceedingly common form of fashionable imposture with inimitable humor.

From the time of the Roman lady who bathed daily in the milk of a very large number of she-asses, and all the *"Dames du Temps Jadis,"* to the present time, when the beauties of the period, professional and amateur, confide to the public the excellence of divers soaps (either for a cheque or a lifetime supply of the latter), history is full of the lore of cosmetics; and various traditions which have come down from the past seem to form a substantial background for this branch of medicine, which in the field of cosmetics is even of more importance than dentistry. Pomades and powders, aromatic oils and mineral baths, while indirectly leading to cleanliness of the skin, are ineffectual when the surgeon has to deal with cutaneous disease of remote origin.

Many skin affections of totally different origin present points of similarity which formerly led to their confusion, but in the early part of the century a more intelligent classification of cutaneous diseases was arrived at and much progress made in their treatment. In France Rayer rendered valuable service to the subject by his writings, as well as by his Atlas; and the classification suggested by him was generally accepted by writers upon the subject. His *magnum opus* is an exhaustive account of every form of cutaneous disease known at that time; the descriptions being clear and succinct, and the remedial measures advised far in advance of the blind empiricism which had formerly been followed. In Vienna Hebra, who had been for a time the assistant of Skoda, devoted himself entirely to this subject, and exerted a wide influence upon this branch of medical knowledge. His labors were shared by Kaposi, and more recently Neumann and Unna, Bazin and Hardy, Vidal and Duhring, have devoted themselves to this specialty, which has at the present time been divested of all the earlier traditions and placed upon a thoroughly scientific foundation, based upon the physiological functions and the pathological changes of the skin as a distinct organ of the body, no less than an anatomical texture.

Though every race has its own distinguishing characteristics as regards the skin and the hair, which differ in color and in texture with every tribe and zone, there is not, oddly enough, the same racial susceptibility to or immunity from skin affection which is observed in other diseases, most of the diseases of the skin being found alike in all parts of the globe. Exceptions to this ruleare found in the susceptibility of negroes to leucoderma, yaws and keloid. Some few diseases of the skin also are peculiar to tropical countries, and some forms are only seen in certain localities, including verrugas, which is only found in Peru; pinta, in Central America; tinea imbricata, in Oceania, and pellagra, in Northern Italy.

Otherwise cutaneous diseases are very generally distributed. Few skin affections are hereditary, though the susceptibility to such diseases is probably inherited as in other forms of disease. Finally there are a number of general diseases which affect the skin in a secondary manner, and these should always be taken into consideration when deciding the treatment of any such affection. The fevers, for example, all affect the skin, variola, varicella, scarlatina, rubeola, typhus and enteric fever. In yellow fever, icterus and Addison's disease the skin is changed in color, while the changes in the skin which are of so-called "specific" origin are very numerous. An organ which, like the skin, is so intimately related to the entire economy of the body cannot fail to be more or less affected by any profound constitutional disturbance.

Recent writers usually divide the diseases of the skin into a number of classes including Congestions, such as erythema or roseola; Inflammations, such as eczema, lichen and herpes zoster; Hæmorrhages, such as purpura; Hypertrophies, such as scleroderma; Atrophies, such as albinism; New Growths; Neuroses, such as pruritis, hyperæsthesia and anæsthesia; Diseases of the Appendages, the cutaneous glands, hair and nails, and diseases due to parasites, such as craw-craw, scabies (itch) and Phthiriasis (lice). Great progress has been made in the treatment of these diseases, which may be looked upon as the direct outcome of the recent advances made in physiology and pathology.

With the placing of the subject upon a scientific basis much of the former repugnance which was felt for skin diseases has been overcome, and this has been due largely also to the dissipation of the old notion that most skin affections were "catching" or infectious: a survival possibly of the dread as old as the human race, which led men long ago to fly from the leper. On the other hand dermatology, with the accession of scientific methods, has by no means lost the guiding principle by which the earliest practitioners of the art were actuated; and while, as a specialty, it is still devoted chiefly to the cure of actual disease, it also at the present day contributes ingeniously to the cosmetic needs of the time; and to many practitioners, especially in the larger cities, the degree of B. D. might be irreverently applied. Nevertheless, even these beauty doctors are a great step in advance of the charlatans who advertise impossibilities; and their field of activity especially embraces a couple of diseases, canities and hirsutes, which while causing no inconvenience whatever to the patient, and not the remotest danger, seem to greatly disturb the peace of mind of a great many.

For canities, or gray hair, there is unfortunately no cure. It seems to be a perfectly natural change, though in the direction of decay, which so intimately affects the structure of the hair that it cannot be cured or opposed. In some rare cases the hair changes in color, as, for example, it may be gray in winter and the natural color in the summer. It may become gray in patches also, and the places affected afterwards regain their natural color. There are no doubt instances of the hair suddenly turning gray, though they are not perhaps as numerous or as common as poets and romantic writers would lead one to believe. One case is recorded where the hair changed from black to red and from that to white, subsequently falling out altogether. Many people are susceptible to early gray hair, just as others are susceptible to baldness, but there is no cause for alarm in this change. It causes no inconvenience and interferes neither with the health nor the comeliness of the person. Possibly a kindly Fate has afflicted youth also with gray locks sometimes that the sensitive vanity of age may gather comfort from the fact. When of a temporary nature constitutional medication sometimes restores the color to the hair. The use of all dyes is to be condemned in any case, as it injures the texture of the hair without restoring its natural color, which cannot be artificially imitated.

Hirsutes is a term applied to the presence of hair in unaccustomed places. Its removal is often eagerly desired, and fortunately effective means are at hand by which this may be accomplished permanently and without injury to the patient. This is by the use of electrolysis. A fine needle connected with the negative pole of a galvanic battery is inserted along the course of the hair which has been cut short. A magnifying glass is often necessary. Meanwhile the patient holds the opposite electrode in her hand, upon which fine bubbles of froth appear at the mouth of the hair follicle, and it is gently drawn out. Fifty can be so drawn at a sitting without any pain and inconvenience to the patient. The fraudulent depilatories so-called upon which so many have vainly relied in no case can accomplish this end. And thus dermatology ends where it began, as a minister to vanity.

CHAPTER XXIV.

MODERN GYNÆCOLOGY.

MORE perhaps in the past than in the present there has been felt a certain tacit contempt for the "woman's physician," whose popularity in that quarter was generally due to qualities extraneous to the scientific practice of his profession. A correctness in the matter of equipage and in all the trappings of life, a bland and insinuating voice, a smiling and unctuous manner, a pomposity bordering on dandyism, and a dandyism bordering upon solemnity, proved in his case much more to the point. Often, indeed generally, of somewhat superficial intellectual attainments, the fair sex have nevertheless been captivated by the grandeur of such a man's bearing, the sonorous roll of his platitudes, and above all by the intense respect which he has manifested towards them, not unmixed with discreet admiration, but controlled by that pure and exalted sense of propriety which makes for so much in the feminine mind. He deeply impresses by his vast store of erudition upon the most abstruse subjects, but does not awe. On the contrary he wears his wisdom lightly, but not too lightly; for the attention which the aches and trepidations of the timid patient inspire in a man so profound carries with it a sense of elusive flattery. Moreover he is a "physician extraordinary" or perhaps "in ordinary," and the Plutocracy or Peerage, as the case may be, have heard him gladly. The fashion is thus set, and the attendance of this doctor during sickness and health is one of the matters which it imperatively requires, just as it does the occasional manifestation of certain "fashionable diseases," such as gout, to give to the individual the hall mark of respectability. If this physician be a man of the required stamp he rises to the occasion magnificently and takes upon himself imperceptibly the importance which Beauty has thrust upon him. Then, favored with the fair breeze of Fors Fortuna, and basking in the golden sunshine behold him, led soon by lily hands to his place in the boudoirs of the aristocracy; where in his good set time he vies with his sacerdotal rival of high proclivities in amusing the caprices, listening to the dull prattle and copiously feeding the greedy vanity of shallow, silly, lazy, but very wealthy women.

It would be far off, however, to say that women are not frequently really ill because a certain class do not possess sufficient imagination to amuse themselves in any other way than by playing sick. Women are, if anything, more subject to disease than men. Likewise, because one very often finds a woman's physician an impostor and a fool, it does not follow that all physicians who devote themselves to the treatment of the diseases peculiar to women are ignorant and insincere.

The physiological rôle played by woman in the vital drama is in many ways an exceedingly difficult and wearing one; and her willingness to accept in good faith the entire part assigned to her by Nature is often followed by risks which may terminate in disaster and death. To her also the greater share of pain has been given, and though Nature has in her case, as elsewhere, made full compensation, the in-equality of her position has inspired the most sincere compassion, both now and in the past century, in men who, disdaining to profit by her frivolity when in the full enjoyment of her health, or make capital out of her ignorance when afflicted with disease, have set to themselves the task of studying the nature and the causes of the diseases to which she is peculiarly susceptible. Her case was almost entirely in the hands of the empirics in ancient times. Later, a law of Islam made it impossible for the Arabian school of medicine, during its ascendency, to be of any benefit to her. Toward the close of the eighteenth century, however, attention began to be paid to Gynæcology, and in France Garrangeot and Astruc led the way in special forms of treatment which anticipated the enlightened methods of modern times. Other writers of the same period were Denman, Clark and Hamilton, who after a certain crude fashion introduced into England somewhat similar methods of practice in the treatment of the diseases of women.

Up to this time Obstetrical practice had been in the hands of ignorant midwives, whose patients often called in vain to Lucina for safety during their time of travail. That the death rate should have been so very great is not indeed to be wondered at, for these creatures had scarcely any scientific knowledge of pelvic anatomy or of the physiology of parturition, and even when the first dangers had been safely passed, the death of the patient during the puerperal period often took place through the midwife's carelessness and lack of antiseptic precautions. Prudery and false modesty, as might be expected, opposed any change; but the practice of obstetrics by regularly qualified physicians, surely though slowly, became established towards the close of the last century, and with this change to more scientific methods of management, came a perceptible lowering of the rate of mortality.

Almost concurrently with the introduction of obstetrics into scientific medicine, came the invention of the obstetrical forceps by which expedient the most difficult complications were for the first time brought under the comparative control of the medical attendant. By this means also it became possible to assist nature when the vitality of the patient had become greatly exhausted, and though any form of procedure may be grossly abused by the rash or unscrupulous, it is probable that no invention of the time was the means of saving more lives than this. The ingenuity of many obstetrical surgeons has found expression in one adaptation or another of the original invention, but the fundamental principle has undergone but little change.

The two chief medical discoveries of the century also affected the practice of obstetrics profoundly. Sir James Simpson employed chloroform to alleviate the extreme pain, and in his works claims to have saved many lives by the use of an anæsthetic. That it has proved an extremely beneficial adjunct in obstetrical practice can hardly be doubted, although the indiscriminate use of chloroform, as of the forceps, has sometimes been attended with undesirable results. Though appealing less strongly than chloroform to the imagination of the patient herself, whose gratitude was naturally more quickly aroused by anything which promised to alleviate in any way the inevitable pain before her (consequent upon her artificial life and preposterous habit of constricting and distorting the shape of her body), the establishment of the germ theory and its practical application to obstetrics in the form of antisepsis may be said to have worked a revolution in obstetrical practice of far greater moment than the invention of the forceps or the use of anæsthetics together; or even the transference of this branch of practice from the care of the midwife to the skilled physician. During the puerperal period a very large number of women had lost their lives yearly through fevers and kindred diseases which it was possible afterwards to prevent almost entirely by a careful attention to antiseptic precautions. In this respect Semmelweis set an example of the most scrupulous care.

Furthermore, as the advantage of antiseptic surgery became more generally known, and the use of anæsthetics became more and more a general usage, physicians were emboldened to attempt operations which in former years would have been considered criminally reckless. The development of modern gynæcology has demonstrated, perhaps more strikingly than any other branch of medicine, the necessity that the surgeon should be a skilled mechanic, equipped with proper tools and perfectly at home alike with them and with the materials with which he has to work.

The remarkable success achieved by some practitioners who had formerly been actual mechanics, or who had inherited a high degree of mechanical skill, has repeatedly illustrated this fact. A profound knowledge of medical theory and an acquaintance with the scientific principles of pathology are absolutely necessary, but when not supplemented with that ready inventiveness of which Necessity is said to be the mother, and to which Dieffenbach so aptly referred, the surgeon is helpless in the presence of difficulties which would be readily overcome by a shoemaker, a carpenter or a tailor. The invention of the obstetrical forceps may be cited as an example. The perfect obviousness and the simplicity of their construction was accepted at once. Yet innumerable lives had been lost which might have been saved by their employment, before it occurred to any one to make and use such instruments. In this connection one is led to deplore the tendency of some of the professions and guilds to run in fixed class channels. Continued inbreeding destroys a branch of learning in the same way as it does a family. The accession of fresh blood from all quarters has done as much good in one way as it has done harm in another way to the medical profession. Invention has not since been idle, and the number of instruments in constant employment both for gynæcology and for other branches of surgery, can scarcely be enumerated, the difficulty of the gynæcologist of the present time being less what to choose than where to choose.

The repeated failure in the attempt to examine the throat by a speculum has been mentioned. The use of some hollow instrument by which the interior of a natural orifice might be examined is by no means new. Specula of lead have been found in Pompeii. The ancient " Sipherophot," which was of late Greek origin, seems to have been used for the purpose of detecting the source of internal hæmorrhage, by inserting through it a slender rod having a piece of charpil. In France Recamier constructed in 1801 a speculum upon much the same principle which he used for gynæcological examination, and which a few years later was adopted by others. This instrument underwent many improvements from time to time, and in 1852 an instrument for the purpose was invented by J. Marion Sims which was superior to the previous instruments of the kind, and which facilitated examination and operations which had been impracticable before. Subsequently, America may be said to have taken the lead in the practice of Gynæcology, and a very high degree of operative skill has been since reached by American surgeons. Earlier in the century, however, France presented the greatest degree of activity in this branch, and Colombat, l'Heritier and Imbert in turn rendered great service to gynæcology by their careful researches and improved methods of practice. Simpson and Bennett's work in England, meanwhile, marked an epoch in the gynæcology of that country, while in Germany Kiwisch, though without adding greatly to the general knowledge of the subject, introduced there many of the methods already in practice in France and England.

The improvement in no department of contemporary surgery can be regarded with greater felicitation than the improvement in this, by which the lot of woman has been alleviated in so many particulars. In ancient times, a painted slave or a useful chattel, though outwardly often even then the half contemptuous object of a dissimilated and hyperbolical admiration, her physical condition was often as dreary as her spiritual limitations. The decadent philosophers of decadent Rome denied her the possession of a soul, ignoring the fact that truth and honor is impossible in a marred and poisoned body. Even Juvenal blotted with lasting opprobrium the name of an unfortunate woman whose evil fate it was to be at once an empress and a sufferer from a malady well known and understood by physicians of the present day. The cruelty of ignorance is more bitter often than the venom of hate. And so the flower of

Athens, and in their turn the gilded youth of Rome, with words that sprang but from the lips only, fervidly hailed in song or in speech the trebly bartered maid as a goddess—as long as she looked like one. But like the rosebud of Tasso her triumph was but for an hour; and with the turn of a moment, as her spell lost its charm, she was cast aside. Emancipated now from the contemptible rôle which she has been forced for long to smilingly take in a splendid but sickening farce; strengthened and protected by a medical skill unprecedented in history; accorded by the changing moral ideals of the time, a life untrammelled, spacious, just, fair, it will be most unfortunate if she attempts to employ the ingenuity of the one and the liberty of the other to selfishly shirk the debt of duty, however irksome it may seem, which she owes to her own past, to herself, to the future and to the species, of which she is an integral, if not the most important part. When a race blackens, softens and rots in all its component parts, breaks and breaks again in all its seams of decay, its women alone stand between it and destruction.

Women have always been subject to a disease which usually attacks them in middle life and often in early womanhood, and which after four or five years terminates in their death. Medicaments from the first proved of no avail, and there was no known method by which when an ovarian tumor had once commenced its growth the life of the patient could under any possibility be saved. The physician could but temporize with the disease, rendering the journey to a certain death as easy as possible and by a roborant form of treatment postpone perhaps the inevitable end for a few months or days. The number of women who perished by this disease was very great.

Their plight was most pathetic. Moreover the disease was one which only affected a circumscribed area, and that, a region upon which the vital functions did not in any way depend. It possibly may have occurred to many surgeons that the removal of the diseased organ might have saved the life of the patient; but to have boldly entered the pelvis for the purpose would have seemed the height of fatuity. Indeed proofs were not wanting of what the inevitable result would be, for death speedily followed the appalling blunder of a certain Dr. Houston of Glasgow, who in 1701, by a preposterous series of mistakes, and hardly knowing what he was doing, actually removed one of these organs unintentionally, and when he had been about some other end. This unheard-of performance was not repeated. The surgical precedent, furthermore, to which Julius Cæsar owed his life had in a case like this no dual existence to justify the almost certain loss of life of the one who submitted to the operation. Besides, in Cæsarian section the operation had almost uniformly terminated fatally for the mother.

To John Bell of Edinburgh, however, it seemed that under favorable circumstances it might be possible to so perform the operation that the life of the woman might be saved. He is not known to have made the attempt himself, but he gave expression very freely to his theories in his lectures at the college, and one of his hearers was Ephraim McDowell, who had come over from America to finish his medical education at Edinburgh. Like Warren and Morton, half a century afterwards, in the experiment with sulphuric ether, McDowell appears to have had "the courage of his convictions" which is synonymous often with the courage of ignorance. Having returned to America, and while practising medicine in Kentucky, McDowell performed the first ovariotomy in the annals of surgery. This was in the year 1809. Nathan Smith in the year 1821 repeated the operation. In 1827 Dr. Granville performed the first ovariotomy in London; but it was not till 1842 that the first successful ovariotomy was performed in London, and that was by Dr. Walne. In 1846 it was performed successfully in St. George's Hospital by Mr. Cæsar Hawkins, which was the first successful operation of the kind performed in a London hospital.

During the next eleven years it was repeatedly performed both in America and Europe, but the subsequent mortality was so great that some of the more conservative members of the profession went so far as to intemperately denounce the operation as simply murder. This it was not by any means, but merely a desperate *dernier ressort* which on a few rare occasions had saved life; and which might on the occasion when it was performed possibly rescue a certainly doomed patient from a death rapidly approaching. Voice, however, was given to the feeling already described by Sir William Lawrence in an address before the Royal Medical and Chirurgical Society of London in which he asked if ovariotomy could be continued to be practised "without danger to the character of the profession." In spite, however, of the opposition with which the operation of ovariotomy met upon many sides, the need was so great, and the cases of patients fighting for their lives who were willing gladly to undergo the terrible risk so frequent, that the operation continued to be performed. At first almost invariably fatal, the mortality sank at last to fifty per cent., and in 1857 it was taken up by Spencer Wells, a surgeon who subsequently proved himself to be equal in an eminent degree to a responsibility upon which so much depended. By the strictest observation of antiseptic surgery, he reduced the mortality to such an extent that ovariotomy became recognized as one of the regular operations of surgery. Of the eleven hundred and seventy operations performed by him, twenty-three per cent. of the first thousand died, and of the remainder but twelve per cent.

Extraordinary as it may seem, even greater success was achieved in the same operation by Lawson Tait, who performed ovariotomy two hundred and fifty-one times with only two deaths, and, as it is said, without antiseptic precautions. In explanation of this it may be explained, however, that he probably observed the strictest cleanliness; and to keep the wound aseptic is in the end the same as rendering it antiseptic. It must be remembered that the hospitals of the early part of the century were not what they are now. Positively teeming then with all forms of germ life, it was necessary to kill the germs to ensure immunity from their action. In the hospitals where the sanitary conditions are perfect, the necessity for antiseptic surgery is not so imperative. It is hardly possible that the success of the last named surgeon was due directly to the neglect of antiseptic precautions. He more probably possessed the magic touch, given to few surgeons, by which he accomplished the desired purpose in the most direct manner, and with the least disturbance of the system. Possibly too, when there were so many operations and so many cases, he may have observed a wise discretion in the choice of the patients upon whom he operated. Lastly, when the end of an egg has been suitably cracked it is possible in the most brilliant manner to make it stand on end as was shown by the discoverer of America.

Regarding the very numerous lives which have been undoubtedly saved by this operation, Lord Selborne has amused himself, and others of kindred tastes, with a calculation of the years of life thus preserved to the sex, based upon the supposition that in each successful operation twenty-nine years had been added to the patient's life. By multiplying by twenty-nine a certain number which he had in his mind at the time, Lord Selborne got the answer forty-two thousand six hundred and eighty-eight. Now this means years, and that many years would make a very long time.

Besides the operation of ovariotomy, gynæcological surgeons have also been encouraged to attempt many other surgical operations in various regions of the pelvis, in which proceeding they have met with a success of which the ultimate results of ovariotomy under improved methods gave ample promise. In the Hippocratic mood, however, one may omit a description of these operations *in extenso* on the plea that it would be "tedious to state them particularly."

But not only has woman benefited peculiarly by the medicine of the present century, she has had the temerity to become herself an active part of it, and among the medical profession each year a larger number of women's names will be found enrolled. The first regular woman physician licensed in England was Miss Blackwell, an American lady who had studied medicine in America and received her license in 1858. In medical practice there is much no doubt that appears to call for the ministrations of a woman practitioner, though her superiority to the male practitioner, even in this particular field, is not by any means marked. Where women chiefly excel is in nursing the sick; and possibly the nursing profession may eventually be raised to such a pitch of excellence and proficiency as to offer to even the women most ambitious in this particular all the scope and the independence for which they long. Those very qualities of mind which fit her, as by an inspiration almost, for the duties of a nurse, disqualify her completely for the widely different responsibilities of surgical and medical practice. Indeed in the field of medicine proper the most celebrated women have excelled as quacks rather than as regular practitioners; a tendency shown by them both in this profession and in theology. Again in the healing of the sick, neither the man nor the woman can afford to do without each other's aid. Call them by the name of physician and nurse or by any other name, they still possess together qualities which are essential to the care and the healing of the sick; while either acts under great disadvantages alone. Possibly the present artificial distinction of physician and surgeon may eventually give place to the natural distinction of male operating doctors and female nursing doctors, acting of necessity then, as of necessity now, in intimate co-operation.

CHAPTER XXV.

PEDIATRICS.

THE health of the mother is the health of the child. The science of Pediatrics, or the care of children, and the treatment of the diseases to which they are subject, is, like modern gynæcology, a recent development. The customs of the ancients in this matter hardly need be repeated here. In Hindostan it was a common usage to fling new-born infants into the Ganges, or to dispose of them in some similar manner, often less humane. In this respect the Europeans differed little from the Orientals; the Lacedæmonians hurling many of their female children, and all the males who were born weak or delicate, into a convenient pit, the Romans into a convenient river. The founder of the city of Rome, indeed, experienced in a she-wolf a more kindly dam than his own had been; Daphnis and Chloe in a goat and a sheep.

This was done because among a warlike people the presence of a female or a feeble male child was unwelcome. The disuse into which these frank and direct customs of barbarism have fallen have not, unfortunately, marked any radical change in the race spirit which prompted them, for through succeeding ages and until the present day children still have continued under certain circumstances to be unwelcome; and though not publicly tossed into Taygetus, they are frequently neglected to such an extent and treated so harshly that life is impossible. A factor in contemporary sociology is the so-called "conscience" of modern civilization, with which conventional people sometimes feel it necessary to compound before they prepare to commit a truly despicable action. The frankness and the directness of the early nations have given place to the studied hypocrisy and the obliquity of action which may be observed for the going in most modern nations. The subject even has its philosopher. But fear and selfishness and pride are after all the great Malthusians of the present day.

Legally, however, the child, strong or weak, male or female, is the property of the state; and to the state any child, whether robust or delicate in the medical sense, a voter or a non-voter in the political sense, a combatant or a non-combatant in the military sense, an aristocrat or a plebeian in the social sense, legitimate or illegitimate in the theological sense, is alike welcome; for from all sorts and conditions of men, the most promising and the least promising, have sprung the hope and the light of the ages. Yet the care of innumerable children is left by the state to individuals whose private interests may not coincide with that of the commonwealth; to individuals who may frantically desire to suppress all knowledge of the possession of the child, because such knowledge would be fatal to the prestige, social or moral, which they enjoy, and for innumerable other reasons equally selfish and equally contemptible.

Witness, for example, the terrible mortality of the children which are born in a certain region of society. Starvation is too like a number of other diseases to be called murder, and with these other diseases it is generally confused. Filth, moreover, is too common an accompaniment of modern life to be denounced in

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set terms, yet how many children are cunningly starved to death, how many are deliberately poisoned by filth, which, though slower, is quite as sure as arsenic. In individual cases it is often easier to divine the state of things than to prove the same in a court of law. The weak and speechless little things, thus done to death for a consideration, have all the world against them and can raise no voice against the tightening fingers at their throat. In the disgraceful advertisements with which the newspapers swarm this sort of thing is called "adoption." The hags who make a business of the thing have on a few occasions been brought to judgment; but it is almost impossible to prove before the courts an actual intent to kill, even though the sum of ten dollars has been paid for the performance of that office, and so the frightful trade flourishes. And it flourishes because the social conventions in some countries make concealment imperative. In countries of a less frigid squeamishness the crime of infanticide is not so frequent, though the initial social irregularity is probably constant everywhere. This is however of no import in the present connection, which has to do with an aspect of the child question alone. Illustrative of the same phase of human character, witness also the spread of child life-insurance; examine the statistics before and after the introduction of the same and observe the increased mortality. Or all that aside, and conceding that there may be a plausible excuse for a parent to make bets upon his own life for the benefit of his kindred; observe the mental attitude of a person who insures the life of a little child so that he will turn a few dollars in case the child dies. In the case of the adult there may be an excuse for this form of gambling, but for a parent to cast dice upon the possible death of his child is revolting.

Turning from the foregoing considerations which refer particularly to the children of a certain class of the community only, the advance of Pediatrics during the present century has been very great. As will be readily inferred the diseases of children depend directly on the one hand upon their delicate constitutions and on the other hand may be referred back to hereditary conditions. All congenital diseases are noticed in the infant shortly after birth, and attempts are usually made in the first years of life to remedy defects of the kind. The so-called transmitted diseases manifest themselves at an early age. In surgery the same principles are followed with the child as with the adult, and so also in medicine, though the greater susceptibility of the child to drugs and to powerful poisons, including filth, must not be overlooked.

The hospitals for sick children are an outcome of the present time, and by means of immensely improved sanitation, scientifically prepared foods and careful nursing the lives of many children, who have been able to enjoy these advantages, in such institutions have been preserved. The handicap in many instances is no doubt too great to allow in any case of the ultimate survival of the patient, especially when the inheritance has been bad; but *cæteris paribus*, the present system of Pediatrics has been found thorough and efficient.

Orthopædic surgery has been in recent years practised extensively with children. This is a branch of surgery which aims to correct deformity by surgical means. Talipes, or club-foot, torticollis, and many other forms of deformity are now seldom neglected, and when intelligently treated give fair promise generally of complete cure, or at least of very marked improvement. This was a branch of medicine which was formerly resigned also to the empirics, from whose vicious manipulations the youthful Byron, who was affected with talipes, suffered. In the child the bones are usually affected by tuberculosis rather than the lungs; and hence arises coxalgia, or hip-joint disease, and the vertebral affections which culminate in curvature of the spine. Little or nothing was formerly effected in the treatment of these diseases, but the improved methods of recent years have been followed by the most encouraging results. The hospitals specially designed for the treatment of children, and equipped with every convenience to that end, have already been referred to. Asylums for idiots and imbeciles have also been established in most countries where children of the sort are cared for in a manner much better than is possible in a private home. A certain degree of education is inculcated and the health, happiness and cleanliness of the individual ensured. No doubt some grave mistakes of theory have been sometimes made in the treatment of idiots, but taken on the whole the lot of the idiot and the imbecile is at the close of the nineteenth century better than it ever was before. Moreover, the recent development of brain surgery has accomplished so much in other branches that one looks forward with considerable interest to the outcome of surgical as well as medical and hygienic treatment in the case of the idiot.

Much attention has of late years been called to the present modes of rearing children in the home. In America especially, the child from the hour of birth until early youth is in constant domicile with the parents. The intimate association of the child with adults is not probably altogether to the child's advantage, and has led undoubtedly to the unnatural precocity and many other morbid conditions sometimes noticed in American children. The single child of wealthy parents, spoiled and pampered, and from the first accustomed to every form of luxury, is as much to be pitied as the child of the poor man's family, packed in close and often noisome quarters, and subjected to all the unwholesome influences of the street. The atmosphere of excessive wealth operates as unfavorably upon the healthy growth of the child's mind and body as the cramping conditions of extreme poverty. The schools maintained by the state are by no means as efficient as they might be. They are usually accepted by the poorer class as a convenient receptacle for the child during hours when his presence in the house would be inconvenient. The mind of the child is no doubt trained to go through a certain number of useful exercises; but the teacher's control is limited to the hours when the child is present in the school building, and is therefore imperfect and incomplete. Indeed, in a very large number of cases, the teacher finds it impossible during the short time when the pupil is subject to his discipline to correct the unfortunate influences constantly at work in the child's home, or to counteract the evil influences of the street which in the larger cities is too often the child's only playground.

Furthermore the period of the child's life chosen for the education of his mind is almost invariably an artificial one, coinciding rather with the convenience of the domestic life of which he is an unimportant part, than with the physical and mental development of the child. His intellectual training incidentally comes to a termination when his physical stature is such as to allow of his being placed in some situation where some financial return may be gained. More than one genius has owed his career to the chance which a weak body or delicate health gave him to continue his mental development when his more robust companions were forced to give up all intellectual pursuits for something more immediately lucrative. The first mistake of forcing a child to develop his mind according to a set schedule, and to make a certain point at a certain time, as a railway train does, is followed by the still worse mistake of treating the young mind like a store-room instead of an instrument, and attempting to cram every inch of space with a mass of heterogeneous material, which changes from time to time like the fashions in clothes, instead of treating it as an independent quantity to be independently developed, tempered and strengthened, reinforced and controlled.

In spite of the sentimental considerations of home ties, which are often dilated upon at the expense of the exact truth, it is altogether possible that in the majority of cases the isolation of the child, which is practised in some of the best institutions of learning, would be on the whole advantageous to the child. The care of children should occupy the entire time of experienced people, and this the parents can seldom give. Indeed it is questionable if the authority of the parent is always best. The child should neither fear his custodians, nor on the other hand should he treat their control with contempt. These considerations can only be cursorily touched upon in this place, but it would seem, briefly, that the education of the child should aim at keeping him a child until he is physiologically an adult; of keeping him untainted by vice, or squalor, or ignoble passions; of assisting his mind in its natural growth and ministering to the needs of that growing mind as occasion suggests; in a word, of rearing the child in physical strength and mental purity, while preparing him in an eminently practical manner to live well and nobly the life that is before him.

This is not an ideal at all. It is a very difficult task; but the only obstacles to its accomplishment are the heavy conventions and traditions of society which insists upon adhering to long established habit. It is a great indignity to a child to make of him a house-pet like a spaniel or a canary, and the parent who calls this by a much finer name should not cloud his mind to the fact that his own selfish inertia often operates to blight the character of his child. The punishment of children is as barbarous as the punishment of the insane, and reflects most harshly upon the character of the person who practises it. For the training of children, both mentally and physically, certain qualifications are necessary which approach very near to genius, and, though fortunately not so rare, are still not possessed by everybody. The teacher is born, not made. The Abbé de L'Epée possessed this quality. Happily there are many who possess the same gift which, like that of the nurse, is largely intuitive. In the hands of such persons severe punishment of children is not found necessary. Many well-meaning individuals are possessed of a certain quality which brings to the surface the latent savage in every child almost at once. Such persons do not probably intend deliberately to produce this phenomenon, but whatever their intentions are it is very unfortunate when the care of any child is left in their charge.

CHAPTER XXVI.

SCIENTIFIC MEDICINE OF TO-DAY.

In tracing the course of medical doctrine from the beginning to the close of the nineteenth century, it is like tracing the progress made in some work of modern engineering to a certain point in the construction. Though an arbitrary division, it is still a definite part of a definite whole, each succeeding addition to the structure proper having followed in a certain expected sequence what had been laboriously set in place before. Still incomplete in every way, the future of medicine is not by any means a vague or a hopeless endeavor. There are no doubts as to what is still lacking, and the investigations and researches of medical science are intelligently carried on in a given direction with a view to supplying wanting parts or to spanning existing gaps. In the nineteenth century medical doctrine has more nearly approached to what may be called an exact science than ever before. In the first year of the century the keynote was struck by François Xavier Bichat. In the last year of the century medical science maintains identically the same attitude. In the main body of the profession there has been no vacillation, no wavering, and the studies of an Allbutt or an Osler are conducted along the same lines, and in the same spirit as laid down a hundred years before by Bichat.

Defections, and numerous ones, from the authoritative body of medicine there certainly have been, but upon closer scrutiny these are not found to have been scientific but commercial. The homœopathy against which Oliver Wendell Holmes so earnestly raised his voice; the various pseudo-sciences; the eclecticism; the magnetic and the faith-healing, are not based upon new departures of science, but may rather be regarded as the tricks by which the unscientific, the sordid and the mendacious have attempted to turn the practice of the healing art to their own account. To deplore the ignoble littleness of such conduct, or to refute the superficial lies of this irresponsible class of medical camp-followers, does not fall within the range of a volume like the present one. The great body of medical science is not sensibly affected by the rôle of the quack, or by the senseless vagaries of an ignorant public, in whose amusement and entertainment the serious charlatan finds his undignified *raison d'être*.

With the medical doctrine of the nineteenth century contrast the medicine of the previous century. The work of the present epoch appears in the light of a symposium, a concerted plan, and forms in itself a distinct unity, as does a book of Euclid, followed up to any given point. The medicine of the eighteenth century on the other hand presents the confusion of the tower of Babel. It abounds in pompous beginnings, in pretentious departures which lead nowhere. The ingenious dreamer distracts the practical worker. The practical worker furnishes new food to the eloquent man of speculations. It is a tiresome and unprofitable spectacle. The babble of the nursery as to the cause of thunder. Lastly, it demoralized the susceptible public, who have not even yet lost their insatiable appetite for erudite nonsense and oracular absurdities.

One of the most important medical discoveries in the beginning of the century was that of the stethoscope. At the close of the century that method of diagnosis is still in constant use. Various other means of diagnosis have also been added to it. In 1863 E. J. Maray introduced the sphygmograph. This is a small instrument which is bound upon the wrist of the patient and contains a clock-work apparatus which causes a sensitive slip of paper to move slowly, while the beat of the pulse causes a needle to trace upon it a visible representation of the heart's impulse as felt in that artery. The sphygmograph, while always interesting as a scientific toy, and sometimes useful as an aid in diagnosis in a few diseases, has not been found to be necessary or generally useful in active practice. Its invention, however, indicates the same tendency to exactness which led to the conception of the stethoscope. Other mechanical devices for use in the diagnosis of disease are exceedingly numerous. The ophthalmoscope and the laryngoscope have already been mentioned. The obscure signs of nervous diseases have received very close attention, and many physical appliances have been introduced as aids in this department of medicine. In the study of criminology, which is closely allied to insanity, an elaborate system of measurements have been employed by Bertillon, whose methods have proven of no little value, though much ridiculed at the recent Dreyfus trial, where his theories were made to appear in an unfavorable light. For that matter the scientific labors of the savant are seldom of a nature to appeal to the flippant and shallow rabble of a court-room, and the theatrical part in the field of medicine has generally been left to the quack or the mountebank.

Beside the external means of examination employed in cases of crime or nervous disease, a very important advance was also made with the introduction of Cerebral Localization. By long experimentation in the physiological laboratory it was discovered that irritation of particular regions of the cortex of the brain was followed always by motor phenomena in a certain part of the muscular system. It was thus possible to establish a relationship existing between various regions of the cerebrum and the entire muscular system. And by this means when certain muscular phenomena are seen to take place in a formerly healthy patient the physician acquainted with these rules of cerebral localization is enabled to refer the symptoms back to some lesion existing in a known region of the brain. This system of diagnosis is as yet only in its incipiency. Some information has also been gained by a close observation of the skin and the tendon reflexes.

The use of the electric current has not only been exploited, and to an unreasonable extent almost, as a remedial agent, but the electrode has also been employed by Erb and others as a means of diagnosis, and has been found to be of signal service. Of as great value to surgery as a means of diagnosis is the application of the Röntgen rays which will be more fully described in another place.

With Bright's discovery, and the subsequent investigations which were directed to renal diseases, a growing need was felt for some accurate means by which disease of these organs could be detected. The kidney is deeply seated, is not very large, is solid, and neither in health nor in disease performs any function which by the auscultation of Laënnec or the percussion of Auenbrugger can be demonstrated by the physician. Palpation is not always possible. And so the ancient custom of observing the symptoms appearing in and complained of by the patient was the utmost that the physician could follow until Vogel and Neubauer published their experiments upon the chemical examination of the renal excretions. In diabetes, sugar, and in parenchymatous and interstitial nephritis, albumen, are found in the renal excretion; while in some other diseased states blood may also appear. During recent years the chemical tests by which the presence of these and other substances may be demonstrated have multiplied very rapidly. Gmelin's test, together with Rosenbach and Pettenkofer's modifications, have been frequently employed in distinguishing biliary substances, while the Salkowski-Leube test for sugar with Fehling's solution has been adopted very widely. Soleil and Ventzek's saccharimeter has also proved a useful instrument for the achievement of the same purpose. Casts were discovered in 1840 by Henle, but more recently the experiments of the chemist have been reinforced by the microscopist in the examination of renal excretion, and the means for diagnosing grave forms of disease in an obscure organ, the very existence of which, as separate diseases, were not suspected at the beginning of the century, may now be said to be quite abreast with the diagnostic procedure when cardiac or pulmonary diseases are present.

Beside the aid of chemistry the urinometer has been found valuable as a reliable instrument for ascertaining the specific gravity of the excretion. Another instrument which has greatly facilitated the investigations of the diagnostician is the Centrifuge which was extensively used by Stenbeck. This instrument has been found to be very useful in examining the excretion of the kidney, but it may also be used generally for any liquid. Test tubes, three or four in number, and narrowed somewhat at the *cul de sac,* are filled with the liquid to be examined, and placed in a metal appliance of great rigidity and strength, which is rapidly revolved. When a certain speed is reached the tendency of the test tubes to assume a horizontal position is allowed by the appliance. The extreme rapidity of their revolution causes all the solids in the fluid, consisting of blood corpuscles, bacteria, crystals of mineral salts, epithelial cells, pus cells, etc., to gather in a few moments at the narrowed extremity of the test tube, leaving the remainder of the fluid clear. This rapid separation of the materials floating in the liquid conveniences greatly the microscopical examination which accompanies the chemical tests already referred to. The contents of the stomach and the intestine are also examined chemically for purposes of diagnosis, together with the secretions of the other glands. The interior of the stomach has also been illuminated by electricity and observed.

To the temperature of the body and its variations during a given period great attention has come to be attached. Boerhaave employed a thermometer for the purpose of taking temperatures; but the practice seems to have fallen into disuse until the middle of the present century, when it was again revived by Wunderlich and others. The clinical thermometer is now an instrument in constant requisition, and part of the nurse's routine duty in the hospital is to take the temperature of the patients under her care at certain times of the day. During the course of a fever a temperature chart is always used, and the variations from hour to hour are recorded upon it in a way which can be followed by the eye without difficulty. Nor to the temperature alone which indicates a condition of the blood, but to the composition of the blood itself, does the diagnosis of the present day direct its observation. The hæmometer of Malassez and Hayem was subsequently replaced by Fleischl's instrument, while the hæmoglobinometer was introduced by Gower. More recently still the hæmocytometer of Thoma, and constructed by Ernst Leitz, has been commonly employed both in hospitals and in private practice. By the use of such an instrument the physician is enabled to tell the proportion of blood corpuscles to a given volume of blood, and thus knows whether there is the normal quantity or less than the normal quantity. A quantity of blood is placed for observation in a defined space beneath the microscope. This space is divided into small squares, and the corpuscles lying within each square are counted. The most appalling conclusions are sometimes arrived at by students and inexperienced observers, but upon the whole the hæmocytometer has been found to be of much practical value. Another method of computing the number of blood cells is by the use of the centrifuge already referred to. The tubes used are exceedingly slender and are graduated. This instrument is known as the hæmatokrit. Löwy and Zuntz have also described an apparatus for determining the alkalinity of the blood which is resorted to for purposes of diagnosis. The blood may be examined furthermore by the spectroscope and the spectrum may afford assistance, though the practice is more general in the physiological laboratory than in the sick-room or the hospital. An accessory, often very useful in the analysis of foods, will be found in the polarizing apparatus constructed by Leitz for use with the microscope.

Recent bacteriological research has incidentally furnished some useful means of diagnosis. Pfeiffer observed that the blood serum of patients afflicted with typhoid fever arrested the motility of bacteria, and an application of this principle, known as Widal's test, is now in frequent use. Koch also, in his attempt to discover a specific remedy for tuberculosis, introduced in his tuberculin, if not a certain cure for the disease, at least an excellent means for its diagnosis. In the detection of tuberculosis the use of the stethoscope had in some measure given place to the microscopical examination of the sputa; but as tuberculosis may occur in all parts of the body, neither of these measures has any diagnostic utility except when the disease is confined to the lung.

Any account of the chemical and physical means of diagnosis in common use at the present time must of necessity be partial, and the foregoing enumeration is suggestive rather than complete. The same also may be said of the pathological field at the present time. Since the days when Bichat began to advocate autopsies and Andral and Rokitansky sketched the first systems of morbid anatomy, the changes in this subject have been almost infinite. The earlier observers could only describe the gross changes which had taken place in the diseased organs. They thus only saw the vestiges which had been left by the destroying process in its passage. The exact nature of disease was quite unknown and the surmises made by them were unproductive. Then came the cell theory, with the use of the improved microscope, and this gave a reasoning basis to medical logic. Next came the establishment of the germ hypothesis, and the gross changes in the organ became subsequently of secondary importance to the microscopical changes.

During the last fifty years germs have been discovered in the affected tissues of those suffering from most infective diseases. The discovery of the tubercular germ may be said to have marked an era in pathological research. A few diseases have up to the present time resisted every attempt of the bacteriologist, notably carcinoma; though at the present moment of writing Maximilian Schuelter claims to have discovered the cancer bacillus also. To understand the cause of disease is the first step towards discovering a cure for it, and though little more than a beginning has as yet been made, medicine at the close of the century may be excused for looking back over the last fifty years with a certain degree of complacence.

In the search, however, for extrinsic causes of diseases, or one might more correctly say the exciting causes of disease, the intrinsic causes of disease, which have apparently a spontaneous beginning, should not be overlooked. In searching for extrinsic causes one is prone to forget the intrinsic causes which are equally important and equally numerous. Malnutrition, hardship and age, separately or together, may operate in producing the degenerative changes with which most processes of disease are inaugurated. The study of embryology, which has only in the last few years begun to receive much attention, promises in the future to cast a new light upon many forms of disease, and the development of this new field of investigation bids fair to unlock many of the secrets which have up to the present eluded the researches of science.

The development of physiology along histological lines also occupies a large part of the attention of modern medical investigators, and during the last ten years of the century the literature upon the histology and physiology of the nervous system alone has been as brilliant as it has been prolific. The subject indeed seems to have a peculiar fascination for the modern savant, just as it had in the earlier days of Bell and Marshall Hall, and no complete enumeration of the works upon this subject can be attempted here. Foremost in importance among the neurologists of recent years may be mentioned Charcot, Golgi, His, Ramon y Cajal, Retzius, Monakaw, Deiter, Tuczeck, Studniczka, Broca, Zuckerhandl, Nissl, Onufrowicz and Déjèrine.

The neurone theory is at the present time one of the most important questions before the scientific world, and from the studies suggested by this theory, results of the utmost significance to psychology and medicine may reasonably be expected in the next few years. This developmental unit, which comprises a ganglion cell, neuraxone, dendrites and their ramifications, is called a neurone. It is probable that the entire nervous system is composed of numerous neurones built one upon another. The majority of the neurones appear to stand isolated, though connected with neighboring neurones by a contact so intimate as to make possible the transmission of physiological processes. The basis of nervous activity seems to be in the ganglion cells and their inter-relationship; and the theory is that ganglion cells have the property of storing up and retaining irritations coming to them until the accumulated irritation is too great, or some new irritation arrives from some new direction, when they suddenly discharge. In this wise it is explained how a single sensory impression may lead to a complicated movement, in which many different muscles may take part. What kind of motor reaction occurs from a sensory impulse depends upon which of the sensory nerves are irritated, and especially upon the relationship between the cells which form the motor apparatus excited. There is some evidence in favor of the view that such relationships, when once established in the course of evolution, are afterwards inherited, so that the structure of a single nerve centre is practically the same for each individual, and that, through this inherited apparatus, numerous apparently complicated actions are made possible once for all. But there are experiences which teach that in certain portions of the nervous system constantly new associations are being formed by exercise. The central nervous system would, then, consist of one part, which is congenital and arises from primordial racial exercise (phylogenetic) and of other parts which, only by use during the person's life, derive their relationship (ontogenetic).

The cortex may be accepted as that part of the brain which serves as the basis of the highest psychic functions. Upon the normal existence and condition of the brain cortex depend all those abilities which may be acquired by study, nearly all of those activities which are executed by the employment of memory pictures, and especially all of those psychic processes which are termed associations. One may conceive the whole cortical apparatus as a gigantic association centre to which from without, through relatively narrow tracts, such impressions may be conducted as have already found their first termini in deeper or primary brain centres. From this cortical association centre, tracts pass down to more posterior brain regions which are adapted to call forth movements and the like through their agency. The sum of all these tracts is designated *Corona radiata* (Edinger).

The improved methods of diagnosis, the clearer light thrown upon the physiological processes of health and the pathological processes of disease, have given rise, as might have been expected, to many changes in hospital management. Not only is disease recognized in its beginnings, but its spread is limited by the laws of quarantine which have been established in late years.

The treatment of disease also is more effective than formerly, and remedies are not administered at haphazard as in earlier days, but with a definite knowledge of their action, of the drug and the object to be accomplished by it. The therapeutics of the close of the century differ much from the therapeutics of a hundred years ago, or even of twenty years ago, which may be seen by comparing the early and the later works of Lauder Brunton, one of the leading living authorities upon this subject, and one who has done as much, if not more, than any person else during late years to eliminate from the old system of drug-giving many of the abuses which were so long bound up with the practice. The physiological action of the drugs themselves is much better understood than formerly, because the physiology of the organs or tissues affected by the drug is also better understood. There are also many new drugs, and new and more efficient pharmaceutical preparations of the old drugs. The physician and the apothecary no more gather their own simples as formerly, and the oracular herbalist of the earlier generations has fallen into oblivion.

CHAPTER XXVII.

CONTEMPORARY MEDICINE AND CIVILIZATION.

THE cosmopolitan nature of the medicine of the present day is what, almost more than anything else, first strikes the student of medical history. The oneness of purpose which has distinguished the medical development of the present century has totally suppressed the national element which, if it exists at all, can only find an existence possible in some obscure provincial locality which is cut off from the main centres of thought. The interest in a common science has thus accomplished what few other interests in the world's history have ever before been able to do. The man is first a scientist. After that he may be Celtic, Slavonic or Semitic; but his first allegiance and his absorbing interest are in the subject to which a large part of his life has been devoted. Any new scientific discovery is known and discussed in the antipodes the same week that it is known and discussed in the city where the discoverer has his residence. The investigations of Cajal elicit an interest in America equal to that which they inspire in Spain; the experiments of an Osler are described in Berlin and Constantinople the same week that they are repeated in San Francisco. From Japan, from Hindostan, from all the countries of Europe, scientific contributions are constantly flowing, and innumerable confluents swell the general stream of medical doctrine which is of no city and of no race, but the pos-

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session of all alike, by virtue of the medical press which circulates both in the metropolis and the remotest outpost. The stimulation to scientific research is thus ever present.

This condition may be readily explained by the rapid growth of medical associations, and by the extensiveness of medical literature. Every town and every county has its medical society, where every week the latest theories are discussed by a profession which may reasonably claim to be the least biased of any learned body. Medical periodical literature has reached vast proportions. Medical weeklies and monthlies are published in almost every city of any size. Indeed, the supply may be even said to be somewhat in excess of the actual need, though this fact may hardly be said to operate unfavorably in the spread of medical knowledge.

A hundred years ago the original investigator published privately at his own expense a modest pamphlet in indifferent Latin wherein his views were detailed. Years would often pass before the author's discovery succeeded in reaching the world at large, and then long after the writer was dead and his name fallen into oblivion. An example of this may be seen in the work of Auenbrugger which was eventually, more than half a century afterwards, brought before the attention of the world by Corvisart. A medical discovery in the present day is circulated more rapidly. A Koch or a Röntgen reads a paper before a learned society in which he makes known the result of some private experiments. His paper is at once reprinted by scientific periodicals all over the world, and if the discovery be momentous, his fame is instantaneous. Beside the periodical literature of medicine there are also many publishers who devote themselves entirely to the circulation of medical works; edition rapidly following edition, and corrected up to the latest information upon the subject. So rapid and sweeping are the changes which are constantly occurring that to keep up with the advance of medical learning in all its branches may be likened to a fierce race which very few can expect to maintain for long. It has thus been found convenient to divide the body of medicine into a number of separate departments, and to keep constantly *en rapport* with even a specialty, in its swift and unceasing phases of development, taxes the powers of the ambitious practitioner to the utmost.

Beside the published literature already referred to, there are also a number of publications devoted wholly to recording scientific progress, and divested of any commercial interest. The Johns Hopkins Press of Baltimore, and the publications of the Sydenham Society, together with the annual publications of a number of other learned societies, may be mentioned as examples. These publications by reason of their authoritative source are of great assistance in the spread of medical knowledge, placing as they do the stamp of approval upon theories which after their first introduction have been fully discussed and carefully sifted.

A tendency very long delayed, but coming even now not too late, calls here for commendation. This is the tendency to regard the scientific man of genius, not as a madman as was usual in the past, but as a public benefactor, and to give private and public assistance to the investigator whose labors have often been followed with peculiar difficulty and made possible only by the constant diligence and self-denial of the student. In his devotion to the science he has often lost heavily in the game of life, and when his researches have been crowned with success, and his name illuminated by the glamour of fame, he too often goes into retirement without emolument, his only reward being the wind of empty praise, while the sordid inventor of a new food adulteration, by shrewdly turning his nefarious trickery to commercial advantage, towers disgustingly over the benefactor of humanity in all the material flash and grandeur of a Plutocrat. It is time, therefore, quite time, that the state should give encouragement to the original investigator, and not only that he should be furnished with the means for research, but that he should be fairly rewarded for the benefits which he has conferred upon his kind. "Many continental cities," Robert Brudenell Carter remarks, "support laboratories and professorships which afford leisure and opportunity for forms of scientific research of the highest value which are not in any direct sense remunerative to those who are engaged in them, and which in England can only be pursued, under impediments from silly legislation, amid the anxieties of early struggles for subsistence, amid the cares and fatigues of practice, or with the diminished physical and mental energy incidental to the decline of life. The scanty and inadequate rewards or honors which have been bestowed upon physicians and surgeons have seldom fallen to those who were in the van of scientific progress, unless, by a coincidence which fortunately has not been too uncommon, they are also the personal advisers of the great. The master of Sanitary Science, the organizer and for many years the official head of a system of public health preservation which is without equal in the world, the philosopher whose teaching has saved the lives of hundreds of thousands of people, whose name is a household word wherever preventive medicine is studied, and whose writings form the classical literature of the subject to which much of his life has been devoted, this man has been suffered to retire from the public service of his country with the pension of a meritorious clerk, and with no other privilege or distinction than that of being styled a Companion of the Bath!"

Though the trammels of caste have been thrown off in America as far as the name of the thing goes, no feudal period ever witnessed a stronger line of demarcation between the classes who "have" and the classes who "have not." As might be expected, therefore, the maladies with which contemporary physicians have to grapple may be roughly grouped first into those which are common to all classes of individuals, and the diseases of opulence and the diseases of poverty, in which last may be included the diseases of overwork, of places (unhealthy places) and of occupations (unhealthy occupations). The idle and self-indulgent may be said to die of various forms of degeneration—processes which may be suggested by the word decay. The indigent, the overworked and the underfed, on the other hand, may be said to die of diseases which are produced by filth poisoning, wear and tear and inanition. A comparison of the death rate in the pauper and the pay wards of any large hospital will indicate, nevertheless, how much more susceptible the poor are to nearly all forms of general disease than are the rich. Some diseases seem to be equally the result of dissipation and of unremitting toil, and of these may be mentioned the ever fatal paralytic dementia which attacks the rich and the poor alike. Equally true is it that even sanctity has its special diseases as well as vice. Asceticism, if not the result of nervous disease already existing, soon produces morbid conditions both of the mind and of the general constitution which are unmistakable. The mysticism frequently observed indicates the presence of incipient mental disease, which may develop into unmistakable insanity in the life of the individual, or may be postponed until the next generation, when it manifests itself more emphatically in the form of mental alienation or crime. The unnatural and long continued emotional excitement which is encouraged by some sects tends in the end not only to exhaust entirely that elusive element in the psychic apparatus of the individual which makes sincere and sound religious feeling possible, but to deprive the descendants also of some necessary mental quality which individuals of more wholesome heredity possess; the result being a marked neurotic condition, which hovers very near to mental alienation. A David Harum (to illustrate the point with characters from contemporary romance), honest and staunch, sound-hearted and sound-headed, is never the offspring of a John Ward, ascetic, transcendental, self-conscious, abstemious and hysterical. The first represents a healthy man; the second a potential lunatic.

With sociological factors such as the foregoing the medical profession of the future will of necessity have more and more to reckon, for while each individual must be studied independently by the attending physician, it is necessary to understand at the same time the various points in which the patient is identified with the life and class in which he has been born. Disease, or susceptibility to disease, which is directly the result of a social condition is best treated by modifying or altogether removing the causative condition. It is surely a thankless task to treat and cure maladies which are designedly, and with full knowledge, contracted by either an ignorant or a foolhardy victim to the selfishness or the cupidity of others. Of these conditions the easiest to remove would be that of idleness, which is indirectly the cause of disease by affording an incentive to and certainly an opportunity for vice.

The case of the overworked is a more difficult matter. And of all this great army the condition of the overworked housewife calls most strongly for some form of alleviation. When one considers the very large number of able-bodied men who do no work at all, and who, while claiming to adorn society, certainly cannot be said to have ever been personally of any use to it, it seems unjust in the extreme that so many should be forced to do two men's work that they may thereby ensure themselves, as long as they are equal to the strain, a frugal livelihood. But far harder than even this is the lot of the poor laboring man's wife, who, fettered in every possible way, and with no prospect whatever of any future emancipation, drags out an existence that would certainly appear intolerable if leisure for reflection was ever vouchsafed to her. A dull and comfortless lot is hers, achromatic, hopeless, and ever without the faintest sweetness and light. To the drain upon this poor woman's strength entailed by the physiological incident of maternity, is added the endless irritation and drudgery of her domestic duties which have but one possible termination, when the vitality is at last completely exhausted, and the charm of living, which is the chief incentive to life, destroyed. With the waning of the physical strength the daily routine is performed more weakly and more perfunctorily, until at last she falls suddenly some day beside her wash-tub and is taken from the dirty kitchen to the ill-lighted, stuffy bedroom to die. This is the price of the Club House. In the deprivation of the laborer of his due share, the women of the poor suffer. And the offspring of such women, nurtured in such squalid and unwholesome surroundings, suffer also.

The cooking of food and the washing of clothes (though the cooking is generally bad and the clothes seldom clean) form the chief tax upon the housewife's strength, and the sentimental traditions with which the air is vocal as to the sacredness of the residence (the word "Home" is usually employed, the full vowel sound lending itself readily to elocutionary effects) seem to have blinded a large part of the (comfortable) community to a fact that was learned long since by manufacturers engaged in extensive commercial pursuits; namely, that there is a saving of time, money and labor by operating upon a large scale, and assigning to each a specialty of labor. In the house of the workingman the woman attempts to do everything, and never learns to do anything well. It is impossible. In a large institution a thousand persons are provided for and maintained in comfort by perhaps twenty employees. In a village of a thousand inhabitants the same work is done badly by two hundred women who shorten their lives in the endeavor. The piecemeal system of living is responsible for the greater part of the nervous exhaustion of the time. While a little wide of medicine proper these considerations are nevertheless of no little importance to it.

The same principle applies also to other vocations, and particularly to the overworked population of the farm. Here indeed there is a deficiency of population, when the labor to be performed is considered; while city life on the other hand is marked by an excess of population which allows the principle of competition to assume the abnormal proportions of the grossest tyranny. The result is an overpressure and an overwork in both the city and the country. The sweatshop system may be instanced, the keepers of which, when they defy their blackmailers, being occasionally brought before the notice of the public. Another result is the fatal discouragement which first overtakes the weaker and produces the vast army of parasites at the nether extreme of society. Both extremes of society are parasitical. To designate these as the incapable class is not strictly in the line of truth. Defect possibly exists, but it is not necessarily a hopeless defect. Moreover the microbe cannot exist unless it finds the proper medium for its propagation.

Contrasted with these more sombre considerations one finds in the public and private charities of the present time a cause for felicitation, for although they are partial, inefficient and conducted upon the narrowest principles, the very existence of such efforts indicates a growing consciousness upon the part of the public of the desperate straits into which a considerable portion of the community is driven. These institutions of charity and societies of reform are chiefly inefficient because they are directed to the immediate results rather than to the more remote causes. Intemperance is for example the outward result of a number of anterior causes which have operated to produce that morbid phenomenon. It cannot be cured by the will of the individual afflicted any more than malarial fever can be cured in that way. Much labor of the sort while carried on in the most humane spirit may be likened to the careful disinfection of the mouth of a sewer. The problems involved, however, are far from simple, and the methods adopted by the philanthropic call for only the most kindly encouragement.

The *index expurgatorius* of incurable disease has undergone many emendations during the last few years. This means but little, notwithstanding, as disease remains an unknown quantity which has never been satisfactorily measured by any medical nomenclature. More than one malady of yesterday is found to be only a symptom to-day, and *vice versa*. The old tradition, that for every disease there existed somewhere in the vegetable kingdom a beneficent remedy by which it could be cured, has fortunately been overcome at last, and the means of cure has been found in studying the disease itself with a view to preventing it and not in a blind search for a drug with which to cure it. The primary cause of a disorder which has resisted all drugs may often be removed in the simplest manner without resorting to the use of drugs at all. For example the establishment of farms for epileptics has met with the most encouraging results. This class of patients have been found to receive far more benefit from a life in the open air, attended with healthy exercise, than from all the drugging conceivable in the secret confinement of the home or the institution.

CHAPTER XXVIII.

THE SURGEON OF TO-DAY.

THE general introduction of anæsthetics into surgery about the middle of the century, and the subsequent application of antiseptic principles suggested to Lister by the germ hypothesis of Pasteur and others, have made possible all the varied operations of modern surgery. Until the use of anæsthetics had become established the prolonged operations which are now of everyday occurrence would have been deemed out of the question, and without antiseptic precautions such operations, even if performed, would have been sure to have ended unfavorably. Reinforced by these two discoveries, however, the development of surgery during late years has been truly remarkable, the most striking progress having been made during the last quarter of the century.

Previously the surgeon had amputated the limbs when necessity required, and very often when it did not. He had set broken bones and reduced dislocated joints. He had tied the arteries with varying success, dressed wounds, and when possible removed bullets, though often with fear and trembling. Calculus had been removed by the knife, and Civiale had contrived an instrument for crushing it without operation. Tumors of external growth had been removed, and a number of operations, which were confined to the surface, had been performed by Von Graefe and others. Before 1850 Dupuytren and Detmold had even gone so far as to open abscesses situated in the brain, and the operation of ovariotomy had been performed on a few occasions; but such operations had been few and far between, had only been attempted when life was in imminent danger, and had generally been followed by a fatal result.

In 1854 the use of the galvano-cautery was advocated by A. Th. Middledorpff, and in 1858 écrasement was practised by E. Chassaignac. The écraseur proved of the greatest value in removing certain small tumors which were situated in positions where the prevention of hæmorrhage by the usual means had been found difficult or impossible. The silver wire suture for drawing together the edges of wounds made by accident, or in the course of an operation, was introduced by Marion Sims in 1857, and two years later, as might have been expected, Sir James Y. Simpson, after deep thought as usual, introduced in its stead the suture of iron wire. In 1869 Lister first began to employ antiseptic dressings to prevent suppuration after surgical operation. A solution of carbolic acid was the agent first employed. The micro-organisms, already described as existing everywhere in the atmosphere, but probably more prevalent in the hospitals of that time than in the institutions of to-day, readily found their way into wounds at the moment of accident or operation, and in multiplying in the tissues of the part produced the suppuration which so greatly delayed the healing of the wound, and sometimes even produced the septicæmia which proved fatal to so large a number of patients in the earlier days of surgery. Indeed suppuration was so much the rule that it was commonly regarded as a necessary accompaniment of the healing process, and a phenomenon intimately connected with it. When the extent of the suppuration was not such as to occasion any alarm to the surgeon the pus present was known popularly as "laudable pus." With the advent of antiseptic surgery no pus was regarded as laudable. It was early found that a mild solution of carbolic acid readily destroyed the germs, and by conducting the operation in an immense spray of this substance, and freely washing the hands and the instruments in it, washing the wound with it at the time, and covering it with dressings permeated with the same substance afterwards, the surgeon was able to perform an operation which was not followed by suppuration of any kind, and which healed readily in a short time without any further complication.

The suppuration which followed the amputation of a limb did not necessarily lead to a fatal termination, but in cases where there had been a wound in the abdomen, and suppuration had set in in that situation, the results were quickly fatal. The contents of the abdomen are surrounded in great part by a lining membrane known as the peritoneum. This delicate serous membrane is peculiarly sensitive to suppuration, and surgeons had early learned the wisdom of never interfering with it. Hence all diseases of organs connected with the peritoneum had been referred with a glad heart to the physician, whose peculiar province it was to deal with "internal diseases." It had been his custom to deal with them after a manner of his own, and if the patient died, no blame was attached to the mysterious pills and soothing treacles of the physician, as would have been attached to the surgeon's knife had he had the temerity to operate.

But as the facilities for diagnosis multiplied it became possible at last to diagnose accurately the presence of disease within the abdomen which no draught or electuary could possibly cure, or had ever cured, and which required, and that promptly, the intervention of the surgeon. The first operations of the sort were attempted with considerable doubt, but when the use of an anæsthetic afforded the leisure for careful work, and the employment of antiseptics had obviated the danger of subsequent suppuration, it was found that abdominal operations might be performed, other things being equal, with the same assurance with which one commenced an operation in any other anatomical region. At the present time there is no part of the abdomen or no organ within it which the surgeon has not operated upon. The spleen, either of the kidneys at a time, and either of the supra-renal bodies have been repeatedly removed in different cases. The intestines have been severed, portions entirely removed and the ends sewn together with the freedom that might be employed by a seamstress in the reconstruction of a gown. A contrivance has even been invented for holding together the loose ends of the severed intestine after operation. This is known as the Murphy "button," a mechanic's term. At an earlier period such a device would have been given a more impressive name constructed from the Greek, a dead language, by the way, which an ardent admirer of the classics now strongly implores the medical profession, as a class, to learn and speak all the time, to their families, on the street, at operations, when talking among themselves, and especially at medical conventions. It would certainly be very nice. And if the legal profession should take it into their heads to talk and write in Latin and the ecclesiastical fraternity declined any more to use the vernacular and solemnly turned to Hebrew, the learned professions would be then very learned indeed. In spite of the agitation to talk no more English, the use of simple terms like the above is suggestive of the simple and eminently practical aspect of modern surgery. The late Dr. O'Dwyer, in a manner equally practical, employed a tube which was inserted in the larynx when the diphtheritic membranes made breathing perilously difficult.

One of the most frequent abdominal operations, and one more familiar to the general public probably than any other, is that of the removal of the appendix when it has become inflamed. Appendicitis may possibly be of more common occurrence at the present day than formerly, though the giving of a name to a disease, and of performing an operation for it, does not imply that it did not exist before it had a name or an operation. The appendix is merely rudimentary in the human subject and performs at present no physiological function, though at a remote period in the evolution of the species it probably enjoyed an importance, by reason of the part played by it in the physiological processes of the system, no less than the importance now attached to it by reason of the part played by it in the production of disease. It is situated near the juncture of the large and the small intestine, a cornual-shaped appendage which opens into the alimentary canal but leads nowhere. The seeds of lemons and cherries and all the other indigestible substances, against which children and reckless adults are so gravely warned, may possibly become lodged in this portion of the vestigial anatomy and cause inflammation of its substance, though the latter calamity it has been discovered may occur without any such provocation. The alarming symptoms experienced by the patient upon the appearance of appendicitis may sometimes pass away and health be restored without operation; but when the trouble does not terminate in this favorable manner the suppuration may presently spread to the adjacent parts and death occur with terrible suddenness. The operation for removal of the appendix is attended with such slight danger, however, that this proceeding has of late years become very common, and when so much is at stake it is wiser, as it would appear, to be on the safe side and to take no chances.

Pelvic surgery has also been brought to a high state of perfection. Civiale's operation of lithotrity has been more recently elaborated by Bigelow and others, and with better instruments, more satisfactory results have been obtained. With the passages of the genito-urinary system the surgeon has made quite as free as with the alimentary canal, and the modifications and re-adaptations of the original handiwork of nature have been ingenious, novel, startling and in some cases eminently satisfactory to the patient. A large number of the operations in the pelvic region have been performed upon women, and have already been referred to in the section devoted to gynæcology. Similarly, the surgery of the eye and of the throat as well as of the skin have been referred to at length in the sections devoted to those specialties.

In 1872 surgical operations were performed upon the nerves by Schuh, Wernher and others. The great nerve trunks are often subject to the most painful diseases, and many expedients have been tried with a view to giving relief. The practice of nerve stretching is well known. In neurotomy and neurectomy a more decisive measure is attempted, and these operations called attention to the fact that nerve tissue is subject to the same laws by which other tissues are governed, and led the way to the brain surgery of recent years, which a century ago would have been regarded as incredible. There are frequent occasions which call for operation within the calvarium, and life and sanity have frequently been prolonged and preserved by such procedure. When the operation is performed with due care, and the proper antiseptic precautions are taken, it has been found that the skull cap may be opened and the brain tissue freely examined without imperilling the life of the patient in the least. Epilepsy of the Jacksonian variety, when following injury to the head, has been cured outright by operation. For the removal of blood clots upon the brain, the opening of abscesses and the excisions of tumors, operation is necessary, and in cases of imbecility the operation of craniotomy has more than once been followed by recovery. But even after the discovery was made that entrance into the brain cavity was not immediately followed by death, a great difficulty remained in knowing what part of the brain was affected with disease. The organ, except in the young infant, is completely shielded by a thick plate of bone through which no impressions from without can pass. This difficulty was solved by the very valuable experiments of Hitzig in cerebral localization already described. The part of the muscular system in which the symptoms of cerebral disease were reflected gave a clue as to the exact region of the brain in which disease would probably be found.

In operating upon the brain the entire dome of the skull is not removed, as at an autopsy, but only the smallest possible portion which will allow of the operation being performed. The removal of the bone was formerly accomplished by an instrument known as a trepan, which somewhat resembled a wimble and was furnished with three different adjustments, the *perforatife*, the *exfoliatif* and the *abaptista*. The modern surgeon uses a trephine, which consists of a centre pin and a small round saw which cuts out a distinct circle of bone, much upon the same principle as an auger. These are made to cut completely out from the calvarium a small disc of bone ranging from half an inch to two inches in diameter. When necessary two round plates of bone are cut out, and the opening enlarged still further, if desired, with a rougeur. The electric motor saw may also be used. This is a circular saw which cuts in a straight line, and has the advantage, when used with the necessary care, of not tiring the surgeon to the same extent as the rougeur or even the trephine.

The early work of Durante, Horsley, Weir and other brain surgeons has been subsequently followed up by such operators of the present time as Von Bergmann, Czerny, Championnière and Gerster, who by their brilliant technical skill and the frequent success which has followed operation have placed brain surgery upon a sound basis. Among a large number of cases recorded by Starr, one may be taken at random to illustrate a typical case which calls for brain surgery, and which may reasonably be expected to be benefited by it. A youth received a very severe blow upon the head. The full extent of the wound was not ascertained at the time, and when it had healed without any complication, no further attention was paid to the matter until at a subsequent date epileptic phenomena made their appearance. These were confined to one arm, in the finger and hand of which tingling sensations were first observed. By the system of localization the surgeons under whose notice the case had been brought, concluded that some morbid change, amenable to surgical treatment, was in progress at a certain point in the brain. When the calvarium was bared at the operation it was found that the site of the original wound in the bone did not coincide with the point already decided upon by them as the seat of disease. They disregarded, however, the indications of former injury still present upon the surface of the bone, and opened where they had intended when making their original diagnosis. The brain membranes were found here attached to the cranial bone, a splinter of bone was found to have been driven inwards at the time of the injury, and was imbedded in the brain tissues. Much thickening was found and also a cyst. The operation was attended by no untoward circumstances, and healed in due time. Subsequently the epileptic seizures entirely disappeared.

The cortex, or outer surface of the brain, appears to be the part most commonly affected by disease. Obvious circumstances may have led to this conclusion. Gliomatous, sarcomatous, carcinomatous and cystic tumors are found here beside tubercular and gummatous growths. Abscess may also be opened in this situation and clots from former hæmorrhages removed. The operation of trephining is exceedingly simple, and is conducted upon general surgical principles.

The scalp is first shaved and washed with soft soap, sulphuric ether, absolute alcohol and finally with a one in a thousand solution of bichloride. Chloroform is the anæsthetic usually preferred, on account of the difficulty of controlling hæmorrhage in this region. Morphine is also advised by some surgeons and ergot which reduces the calibre of the blood-vessels. The calvarium is bared by a horseshoe-shaped incision directed upwards so as to interfere in no way with the cutaneous nutrient vessels. Then upon the surface of the bone itself guiding lines are drawn to correspond with the fissures of Rolando and of Sylvius in the cerebrum beneath, which are the principal landmarks of the brain, and the place where the bone is to be opened decided upon accordingly to the diagnosis already made. A disc of bone an inch and a half in diameter is often sawed out and removed, while if necessary the aperture may be enlarged by a second incision. To chip off further quantities of bone with a chisel and a mallet is sometimes necessary, though some surgeons object to the practice as disturbing to the patient, and entailing considerable risk in case of a miss. The removed plate of bone, if preserved in the proper manner, may be after the operation replaced in the original position and will grow there. The small chips of bone, however, have, if replaced, a tendency to necrosis. The pieces should be sterilized and kept in a warming box at a temperature of ninety-nine, or in warm water. Some surgeons prefer to make an omega-shaped incision and pry the bone up. Hæmorrhage of the vessels of the diploë is controlled by pressure usually and Horsley's wax may be used.

Beneath the aperture thus made lie the membranes of the brain itself. The division of the dura mater is the next step. It is held up by a fine tenaculum and divided with a curved bistoury or an ordinary scalpel. The brain is now exposed. When cutting the brain substance it is impossible to tie the little brain arteries, and hæmorrhage is usually controlled here by continued pressure with a sponge, or when that does not suffice by the use of the Paquelin cautery. Antipyrine and cocaine are sometimes found useful in the suppression of hæmorrhage. For the exploration of the exposed brain palpation is resorted to, and by this means it is often possible to discover the seat of disease. The brain substance may be cut into with impunity, though consideration should always be taken of the speech and motor areas, which are situated upon the cortex. Holes made in operation, or by the removal of tumors or the opening of abscesses, should subsequently be packed with iodoform gauze which is gradually removed at subsequent dressings as the wound slowly heals.

The limits of surgery do not seem even yet to have been reached. The surgeon's knife and saw, Capaneus-like, have dared to enter into the very citadel of life, and all ignorant of the mysteries of that strange temple have come away scatheless. The breast he has also opened and has not feared to practise his art upon the living and pulsating heart. Every organ of the living body he has inquisitively uncovered of its vestments, whether they be of ivory or of more yielding tissue. His operations have always been daring, often brilliant and sometimes beneficial to the patient, by limiting disease or prolonging life. To describe his incomparable armamentarium would be impossible, so numerous and so ingenious are the weapons which he uses in his Protean warfare. Another Briareus, he comes with a hundred arms to the aid of Hygeia.

There is but one difficulty. It is a very old one, and one to which the favored of the gods, flushed with repeated victory, have been ever found to be very prone. The surgeon is in perilous danger of becoming dramatic—of forgetting the simple and practical *end* in the brilliance of the *means,* and the applause and amazement which it inspires. The patient's life should be ever and always first of all, and he who overlooks this primary fact, and allows his pitiable vanity to advocate a course which will display his own prowess to the patient's hurt, must in the end be given over without clemency as a lost deodand to his own self-accusation and the just contempt of the world.

CHAPTER XXIX.

DISCOVERIES INTIMATELY AFFECTING THE ART OF MEDICINE.

As pointed out long since by Sir Benjamin Brodie the relationship existing between medicine and other branches of science is often very close, and on more than one occasion a new discovery in some ancillary department of research has marked an epoch in the progress of medical practice. In the branches of Physics, Chemistry and Botany this fact is particularly noticeable.

The study of Physics, besides throwing light upon physiology in a general way, has contributed more than one link in the chain of knowledge, which was absolutely essential to the advance of medical doctrine and medical practice. In this connection electricity may be mentioned in its various forms. Ignoring the empty pretensions of Mesmer, Count Mattei and other charlatans, the electrical current has been occasionally of actual use as a remedial agent. It has also been found of great value by Erb, Hitzig and others as a means of experiment and of diagnosis, while, in the future, electricity promises to prove of even greater service to medical research and treatment than it has in the past. Beside electricity, Physics, in the branch of optics, has also assisted medicine with more than one valuable instrument of research, of which the spectroscope, photography and the microscope may be mentioned.

Scheele, the Swedish chemist, seems to have been one of the first who had his attention called to the phenomenon from which the art of photography had its birth, and in the latter part of the last century refers to the darkening action of the sun upon silver chloride. About the beginning of the present century the researches of Scheele were considerably extended by Count Rumford, Ritter and Berard. The first, however, to found a process of actual photography, where the impressions taken were permanent and not subsequently affected by light, was Nicéphore de Niepce, who made a study of the matter as early as 1814, and afterwards continued his researches in conjunction with Daguerre, who, it is complained by Isidore Niepce, the son of the former, subsequently appropriated as his own many of the discoveries of Niepce after his death, when a number of his papers had fallen into Daguerre's hands. This was in 1830. Instances of the kind are not at all uncommon, and the moral merits of the case call for the same comment as did the action of Sir Everard Home, the surgeon and kinsman of Hunter, in whose hands, upon his death, the papers of the latter were left, that they might be edited by him. Like Daguerre, this eminently respectable thief perceived the value of the material that had been left in his charge. Sir Everard Home proceeded, therefore, to publish most of Hunter's remains as his own, and when at last importuned to publish the works of Hunter, was driven to the desperate expedient of burning them. The disgrace of dishonest rogues is, however, no part of medical history. Photography has, since the time of Niepce, developed very rapidly, and has been extensively employed in pathological and bacteriological research, beside being in constant use as a means of accurately illustrating normal and abnormal conditions in the literature of medicine.

In the year 1895 Professor W. C. Röntgen, of the University of Würtzburg, published in the *Physikalisches Institut du Universitat,* a paper in which he described some physical experiments which he had been conducting, and which have since made his name famous over the world as the discoverer of the rays which bear his name. There is nothing of exultation in his words. It is simply a plain statement of facts, accurate, bare, pervaded by the dry light of science.

"If the discharge of a fairly large induction-coil," Professor Röntgen begins, "be made to pass through a Hittorf vacuum-tube, or through a Lenard tube, a Crooke's tube, or other similar apparatus, which has been sufficiently exhausted, the tube being covered with thin black cardboard which fits it with tolerable closeness, and if the whole apparatus be placed in a completely darkened room, there is observed at each discharge a bright illumination of a paper screen covered with barium platino-cyanide, placed in the vicinity of the induction-coil, the fluorescence thus produced being entirely independent of the fact, whether the coated or the plain surface is turned toward the discharge-tube. The fluorescence is visible even when the paper screen is at a distance of two metres from the apparatus.

"It is easy to prove that the cause of the fluorescence proceeds from the discharge apparatus and not from any other point in the conducting circuit. The most striking feature of this phenomenon is the fact that an active agent here passes through a black cardboard envelope, which is opaque to the visible and the ultra-violet rays of the sun or of the electric arc; an agent, too, which has the power of producing active

PROFESSOR CONRAD WILHELM RONTGEN. 3

fluorescence. Hence we may first investigate the question whether other bodies also possess this property. We soon discover that all bodies are transparent to this agent, though in very different degrees. I proceed to give a few examples: Paper is very transparent; behind a bound book of about one thousand pages I saw the fluorescence screen light up brightly, the printer's ink offering scarcely any noticeable hindrance. In the same way the fluorescence appeared behind a double pack of cards, a single card held between the apparatus and the screen being almost unnoticeable to the eye. A single sheet of tin-foil is also scarcely perceptible; it is only after several layers have been placed over one another that their shadow is distinctly seen on the screen. Thick blocks of wood are also transparent, pine boards two or three centimetres thick absorbing only slightly. Sheets of hard rubber several centimetres thick still permit the rays to pass through them. If the hand be held between the discharge-tube and the screen, the darker shadow of the bones is seen within the slightly dark shadow-image of the hand itself. The retina of the eye is not sensitive to these rays. Even if the eye is brought close to the discharge-tube, it observes nothing, although, as experiment has proved, the media contained in the eye must be sufficiently transparent to transmit the rays."

The obvious value of such a discovery to surgery need hardly be dilated upon here. In subsequent papers Professor Röntgen described further properties of the rays, and contributed considerable additional matter to the physical aspect of the subject. More than one apparatus has also been devised for producing skiagraphs instantaneously for surgical purposes, and these have been resorted to by surgeons for the most diverse purposes. In the use of the rays the physician has found one of the most useful auxiliaries to diagnosis. In cases of fracture the exact location of the injury can be found by the X-rays at a glance, and the presence of foreign bodies, such as bullets, whose place of lodgment may have eluded the most searching examinations by the former methods, defined in a moment. The further elaboration of the law, and the apparatus for its demonstration, will in all probability enlarge its future field of usefulness to an extent which cannot at the present time be well anticipated.

Turning from physics to chemistry, it will be found that this science has also been of the utmost assistance to medicine; chemistry having been put, like physics, to a twofold use, that of suggesting remedies, and of aiding in physiological research. While the use of anæsthetics was not proposed by a chemist, the agents afterwards employed were first discovered by the chemist in his laboratory. The service of chemistry to the pharmacopœia and to pharmacy has been mentioned. In the application of chemistry to physiological phenomena also there may be a possible solution to a number of unintelligible problems which at present disturb the equanimity of speculative medicine.

Biology is so closely connected with medicine that one almost forgets that it is a distinct science by itself. The study of Botany, like chemistry, is identified largely with the pharmacopœia, and from the study of the lowest forms of vegetable life the germ hypothesis may be said to have taken its rise. In the same connection may be mentioned the principle of serum therapy which has attracted the attention of savants during late years, and which may be almost said to have been an outgrowth of this hypothesis. The tuberculin which was employed for tuberculosis, the haffkine virus for the plague and the use of antitoxin in diphtheria, have demonstrated the importance of the theory. This, in a word, consists in using a substance contained in the blood of an animal affected with a certain disease to check the same disease when occurring in a human being. A modification of theory which may in the next century lead to profound changes in the entire system of medical treatment consists of using a toxin obtained from the system of a person affected with one disease for the treatment of an altogether different disease. In years past when hospital arrangements were more negligent than they are now a case of carcinoma and a case of erysipelas sometimes happened to be placed in such close contact that the patient suffering from cancer contracted erysipelas from the other. It was observed that for some inexplicable reason the attack of erysipelas often proved distinctly beneficial to the cancer patient. The writer remembers hearing attention called to this phenomenon by Irving H. Cameron nearly twenty years ago. The natural inference was that some obscure antagonism existed between the *causa morbosa* of erysipelas and of cancer. As an empirical procedure a toxin has been prepared from erysipelas for administration in cases of cancer. Until the practice has been further tested it will be impossible to know for a certainty whether in this expedient a cure for cancer has been discovered or not, or how far the principle of antagonizing one disease with the products of another disease may be carried. It hardly seems an unreasonable speculation that one disease may hold in check another. A deeper and more complete knowledge of these considerations will constitute an important part of the Sanitary Science of the next century.

At the present it certainly seems that medicine is on the threshold of a new era, though possibly there has been no time during the century when those who had followed its history did not think that medicine was in a position equally auspicious. So rapid, indeed, have been the discoveries, and so swift and so sweeping the transitions of theory and practice, that it would be hard to find a time during the century when medicine was not entering upon a new era.

The discoveries, however, which have been referred to in the present and in the immediately preceding sections are yet only partially developed, though momentous in what they suggest to the reflective mind. As these pregnant ideas, which are only now taking form, become more defined, and many shadowy theories only half spoken now and half grasped are boldly put into practice, man may yet, awed and bewildered, hold terribly in his hand powers undreamed of by Paracelsus and all the alchemists—powers even to Doctor Faustus inconceivable. There is all the more necessity, however, at the present epoch, for a careful sifting of facts and impartial discrimination. No advance can be accomplished by florid speculations, no scientific discovery of value to the race can be made by poetic intuition. A scientific imagination is necessary, but it is barely a preliminary, and is essential only as the martial music is essential by which a troop of foot move to battle. In the meantime the more flighty camp-followers in the march of science suffer from periodical exacerbations of acute mania upon the appearance of any new project or theory however absurd. The credulity of the profession itself almost exceeds that of the laity, and speaks poorly for the scientific acumen of the class. The way to scientific discovery is not by the broad and meandering prairie of sentiment and philanthropy and general beneficence, but by the straight and narrow, dry and silent path of logical induction. There are no lyrical interludes, and the end is diagrammatic, colorless, inevitable, but sublime.

CHAPTER XXX.

THE WHITE PLAGUE.

The average death rate from phthisis pulmonalis is in England about fifty thousand a year, with about twenty thousand in addition from other forms of tuberculosis, making a total mortality of seventy thousand annually from this one disease. This proportion does not differ materially in other countries, and in spite of the great improvement which the medical treatment of late years has undergone in respect to consumption, there has been no falling away of the death rate, the improved methods of treatment being counteracted in their effect by the increased overcrowding and unwholesome mode of living.

The history of this disease which terminates the lives of a larger number of persons than any other disease is very ancient. Herodicus, the Thracian, who was the preceptor of Hippocrates, suffered himself from the affection, and advised for phthisical patients a life in the open air and wholesome hygienic habits such as are at the present day regarded as the best form of treatment. For many centuries it was regarded as incurable, and the helplessness of the medical profession may be gathered from the lines of an American poet, whose father was a practising physician, and so devoted to his profession that he named the future poet William Cullen after the most distinguished medical teacher of the time. The verses were probably written before the introduction of cod-liver oil, though the omission of this remedy can scarcely be regretted in lines like the following:

> "The fields for thee have no medicinal leaf,
> And the vexed ore no mineral of power;
> And they who love thee wait in anxious grief
> Till the slow plague shall bring the fatal hour.
> Glide softly to thy rest then; Death shall come
> Gently to one of gentle mould like thee,
> As light winds wandering through groves of bloom
> Detach the delicate blossom from the tree."

The use of cod-liver oil seemed for a time to inspire the world with a hope that at last a possible cure had been found for consumption, but experience too soon showed that death in most instances could only by this means be postponed for a short time. The oil was in the early days so carelessly prepared, moreover, that it readily became rancid, and the repugnance felt for it was in many cases so uncontrollable that the patient almost preferred the disease to the remedy. It was in any event an empirical medicament, and its sometimes beneficial action, though welcomed, was never exactly understood. Watson, as usual, expressed himself, when it was safe to do so, with an ingenious array of negatives, which, if carefully counted, balanced in favor of the oil. The knowledge of the disease was still very incomplete, though Laënnec had done so much to facilitate its diagnosis, and Bayle, with others of the French school of pathological anatomy, had called attention to some of the more salient morbid changes.

The tendency to form the so-called miliary tubercle, which is the typical lesion of the disease, was early noticed and was the origin of the present term tuberculosis which has been applied to the general disease. According to Laënnec the disease presented itself in two forms, tubercular infiltration and tubercular granulation. By Lebert the tubercular corpuscles were first accurately described. Reinhardt claimed that tubercle was one form of an inflammatory product in process of transformation, the tubercular matter being merely the residual portion of pus which had been deprived of its liquid. Rokitansky, Van der Kolk and Paget each advanced an independent theory, and, in his cellular Pathology, Rudolph Virchow describes the tubercle as a granule or a knot which constitutes a new formation, and which from its earliest development is of a cellular nature, and like other new formations has its origin in the connective tissue. "Tubercle," he says, "is always a pitiful production, from its first outset miserable."

The miliary tubercle is a minute rounded body, composed of cells and devoid of blood-vessels. A single tubercle is scarcely visible to the naked eye, but larger nodules are sometimes formed by the confluence of a number. Three forms of cell are present: the giant cell, which is a large body, and is situated near the centre of the tubercle. It always exists in the early stages and there may be one or more in a single tubercle. Beside the giant cells there are also the epithelioid cells and leucocytes of the polymorphonuclear variety.

The infective nature of the disease was demonstrated in 1865 by Villemin, who inoculated rabbits with the pathogenic material of tuberculosis and produced the disease in them. This experiment was subsequently confirmed by Waldenburg, Klebs, Tappeiner and a number of other investigators. The disease has since been induced or observed in nearly all the commoner warm-blooded animals, and Koch is authority for the statement that no bird or mammal is capable of permanently resisting infection, though some species show far greater susceptibility to the disease than others.

In the year 1882 Robert Koch of Berlin discovered the bacillus of Tuberculosis. This may be justly regarded as one of the most important medical discoveries of the century. The development of the study of bacteriology which led up to this discovery has already been described. The fact that the phthisical tissue-changes in the lung were caused by the entrance into the system of a micro-organism from without, and that they were not spontaneous in origin, or an adventitious circumstance connected with ordinary inflammation, was an important addition to the pathology of the subject, but the plight of the unhappy patient was in no way benefited by this exceedingly interesting scientific detail. The treatment and possible cure of the disease naturally formed the next consideration, and all steps in that direction had necessarily to take into account the cause of the disease. Jenner, oddly enough, at the beginning of the century, had, without the remotest notion of what caused variola, been able to propose an efficient means of prevention. At the time of Koch's discovery, and indeed at the close of the century, the causative agent of variola still remains *sub judice,* some maintaining that the cytoryctes vacciniæ Guarnieri, or "vaccine bodies," which are found in large quantities in the lymph, are protozoa, and others that they are merely the product of contagium. The principle of vaccination, however, remains unaltered by the various speculations as to the actual cause of the disease.

Koch, on the other hand, having over Jenner the advantage at the outset of a clear notion of the pathology of the disease for which he was seeking a cure, devoted some years to earnest investigation, and on the 15th of January, 1891, published his first communication regarding a lymph, since known as tuberculin R, which was the result of his experimentation, and with which the most sanguine hopes were expressed at one time that a cure of as well as a prevention against tuberculosis might be found.

"Originally I intended," Koch remarks in this communication, "to complete my investigations, and especially gain sufficient experience concerning the practical application of the remedy and its production on a larger scale, before I published anything concerning it. In spite of all precautions too much has already been published about it, and that distorted and exaggerated, so that I was obliged, in a way, to prevent false conceptions, to give even now a synopsis of the method as far as it has progressed at the time being. Under present circumstances it must necessarily be short and leave unanswered many important questions. As my work in this difficult and responsible investigation is far from being completed I cannot as yet make any statements relating to the origin and preparation of this remedy, which does not act through the stomach, but must be applied subcutaneously, beneath the skin of the back between the shoulder-blades being a favorable site for its administration."

The tubercle-bacillus grows slowly and only at a temperature approaching to that of the living body. We may therefore infer that it does not to any appreciable extent multiply except in the body, as the conditions will seldom be favorable, as regards soil and temperature, unless these are carefully arranged for experimental purposes. On the other hand, the bacilli, and especially the spores, are very resistant to external influences, so that they retain their vitality under adverse circumstances, and are ready to begin growth when they obtain a fitting locale. The bacilli and spores survive even when dried, and they may be suspended in the air and carried as dust, ready to deposit on surfaces or to be inhaled during respiration. Tuberculosis is not commonly produced by direct communication by contact between person and person, in this respect contrasting with syphilis.

The bacilli in themselves, consisting of minute threads, cannot be supposed to have much effect upon the tissues. They produce their results by means of irritant products which they evolve. These products are present in cultures of the bacillus, and are separable from the microbe itself. The so-called tuberculin, which Koch introduced for the treatment of tuberculosis, is a glycerine extract of such cultures. It is an exceedingly active agent, an extraordinarily minute dose introduced hypodermically inducing serious general symptoms in a person suffering from the disease, but having no effect upon one free from the disease. It does not moreover so much affect the germ itself as the morbid tissue in which the germ has established itself. It has not been found to be a remedial agent, though useful as a means of diagnosis. (Coats.)

Until, therefore, a cure has been discovered for those who actually suffer from the disease, and some means of prevention has been devised which will rendered others immune to it, all that can be done is to observe the laws of preventive medicine. A contagious disease may be stamped out more readily than one which is not contagious. The means may often seem cruel, but the end is just. An example of this principle may be seen in the leprosy which some centuries ago had gained a very strong foothold in Europe and threatened to overspread the entire Continent. The measures observed for its suppression were no doubt drastic, but when the lives of millions of individuals are at stake, the comfort or the indolence of a few cannot be taken into consideration.

Cod-liver oil, iodoform, creasote and nearly all the drugs in the pharmacopœia have been employed for tuberculosis, and all have been found at times to be beneficial to a certain degree. Pulmonary consumption is not, however, to be cured by drugs. Yet under favorable conditions it may be said to be a curable disease. Indeed there is a German saying to the effect that every one has had at some time tuberculosis. The fatality of the disease depends upon the extent of the invasion. It may readily be conceived that a few of the micro-organisms might gain a lodgment within the system and set up temporarily the characteristic signs of disease, but upon such a small scale that the individual was never conscious of any inconvenience, the little colony of organisms being destroyed subsequently by the vital processes of the body. That such limited and temporary invasions are common would seem altogether probable when the omnipresence of the germs is considered. It is only in those who have inherited that almost indefinable congenital defect, known as susceptibility, that the extension of the colony of tubercular parasites to a dangerous extent is likely to occur. This defect may be produced artificially in a person of apparently the best antecedents, by disgust of life, prolonged overwork, nervous exhaustion, sedentary occupations and crowd poisoning or residence in an unfavorable climate.

It is in every way to the advantage of the patient to be withdrawn from the surroundings which have proved so unfavorable to his health. To the remainder of the community his immediate withdrawal is equally advantageous. This practically comes to the isolation of the tubercular patients, and differing in practice somewhat from the isolation insisted upon in plague, leprosy and variola, it is quite equivalent to the same in principle. The conveyance of the infection from the patient affected to others is difficult to trace; indeed, in many cases impossible. The germ spores in the dried expectoration of a patient's handkerchief may be conveyed by the medium of the public laundry to an entire stranger, and it may be weeks afterwards before he chances to receive the infection into his system, while months may elapse before he begins to complain of any symptoms of disease.

The vitality of the germ and the remarkable resisting powers of the spores must always be kept in mind, as well as the ways by which the disease is contracted. Tuberculosis has been induced by inoculation by Cohnheim, Koch and Baumgarten. It has been induced by inhalation by Tappeiner. This is probably the way in which it is most frequently contracted, the air in cities being literally filled with minute particles of dust, including germs which are drawn constantly into the lungs. The germs, moreover, may be received in the food and the disease has been induced by feeding by Wesner and Bollinger. In view of these facts it will be seen that every consumptive patient is a perpetual source of danger to the community, conveying in countless ways the infection of the disease which is slowly killing him to others.

In this connection E. Herbert Adams, who has given attention to this subject, and contributed to its literature, strongly recommended a system of disinfection, which if carried out would limit to a considerable extent the spread of the disease. These measures referred particularly to the sputa and the other infectious products of the disease. In New York, Chicago and other large American cities the preventive measures advocated by Adams are now enforced by law, and in public conveyances, public buildings and even public thoroughfares the practice of expectoration has been prohibited to a certain extent. The most stringent measures of the sort can only be effective up to a certain point, however, and eventually the complete isolation of the patient will be found to be necessary. Many sanitaria and consumptive hospitals already exist, but they are for the most part only accessible to the very wealthy. Public institutions capable of accommodating all classes of consumptives should be established by the state, and as soon as the disease is detected the patient should be forced to enter such an institution and not be suffered to return until he had recovered from the disease. The soft and balmy climates, formerly regarded as beneficial, are not necessarily favorable always to the consumptive's recovery. A residence where there are rapid changes of temperature and a damp and raw climate is contra-indicated. A dry atmosphere, even though cold, together with an equable temperature, is all that is necessary, and these conditions are to be obtained in many regions of America.

The patient should not overtax his strength. But neither should he lose interest in his surroundings and take to brooding. The clothing should be light but of material capable of maintaining an equal temperature. The diet should be nourishing and copious.

A cheerful frame of mind should be cultivated. As much time should be spent in the open air as possible. If the season admits, the entire day should be spent thus. Singing, elocution or even conversation will prove beneficial, within certain limitations, and when the locality furnishes the opportunity it will be found that the air of a pine forest is advantageous. It will thus be seen that while the banishment of the consumptive is really essential to the public health at large his own chances of recovery are materially increased by such a change. Even when the patients have been isolated in comfortable and homelike institutions where they will enjoy advantages which would have been impossible in their former residence and receive better care, it must not be forgotten that all the domestic animals are also susceptible to tuberculosis and often suffer from it, and may also convey the infection of the disease. They should therefore be watched and seasonably killed.

When all this has been accomplished it will then be time to conceive of some way by which cities may be rendered more sanitary. The first reform should be in the pavement of the streets, which should be of granite setts, macadam or asphalt. Decaying blocks of soft wood, with which a few backward provincial cities are still paved, form a steady menace to the health of the community. In instances of very pronounced municipal frugality it would be far better to tear up the blocks at once and use even the original clay as a highway. The ultimate disappearance of the horse from the streets of cities will make clean streets at last possible, and with clean streets and sanitary sewerage and thorough isolation of disease, life, even in a city, may become comparatively healthy, and be accompanied with a death rate less gruesome.

CHAPTER XXXI.

MODERN CENTRES OF MEDICAL LEARNING.

The degree of a university is no more a guarantee of wisdom than the taking of ecclesiastical orders is of sanctity, or the patent of nobility engrossed by the college of heralds is of honor. Wisdom and morality and nobility cannot be measured. The presence of the first may be almost said to imply the others; and where one stops and another begins is so difficult a question to decide that no one who understands the meaning of the qualities in question would attempt it. Each, moreover, is full of contradictions, which deceive the shallow observer, who sees but what is on the surface.

In medicine, as in other departments of learning, the erudition of the past has been fostered by teaching bodies, not always in a reverent or self-denying spirit, but to sell. A market gardener is not particularly interested in botany. But he can sell all that will grow in his garden. The moral aspect of many teachers of medicine is much the same as that of a market gardener. However sordid the object, it must still be granted that medical learning has been preserved in a fairly efficient manner. Possibly it is not to be expected either that the commercial instinct should ever be entirely removed from the inner souls of some men. Hunter, the admirable surgeon, died during a pitiable dispute about lecture fees with some rival pedagogues in medicine, during which brawl he was probably more deeply moved than he had ever been by any of his researches in science. And so, who can tell, this vision of the guinea may have been at the bottom of many achievements apparently the noblest. It is unfortunate, though, when the baser motive is displayed in too bald a manner.

None of the foregoing reflections can be applied to France, which, above all other countries, has maintained its education free from class distinctions and above financial considerations. In Paris, learning, as well as art and literature, has ever been fed by the most exalted traditions; presenting in this way a stability in intellectual matters in marked contrast with the political restlessness and inconsistencies which have distinguished that brilliant and wonderful race. The history of medicine in France during the present century has already been sketched; and it is enough to say that the present system of teaching there is worthy of the men who have aided so largely in raising the world's fabric of scientific knowledge to its present dimensions and beauty; worthy of Bichat, of Corvisart and Laënnec, of Larrey, Dupuytren, Bretonneau, Bayle, Trousseau, Andral, Cruveilhier, Magendie and Bernard; worthy of the Abbé de L'Epée, of Pinel and of Pasteur.

Paris is the great French medical centre; and after Paris may be mentioned Lyons and Montpellier. In Paris there is one great school, L'Ecole de Médicine, and this is entirely under government control. The professors are not appointed by a wretched system of nepotism, however, according to the caprice of those in authority, and for personal considerations; but are elected after public competition, and devote much time to their lectures, in time reaching a very high degree of perfection. There are thus few incapable and mediocre members of the teaching staff who have been foisted upon the faculty, as a sinecure. It is not a common spectacle either to find the teaching staff composed chiefly of "successful practitioners" who attend indifferently to their professorial responsibilities, and use their connection with the college merely as an advertisement for practice. The student is in Paris consigned to a particular hospital where he is allowed to carry on his studies. All the appointments in the hospital, as in the university, are by public competition. Indeed this is the great feature of the French system. The result is a body of teachers of very great eminence; not only as scientists and as practitioners, but also as lecturers.

Again, while in England, Germany and America the hospital authorities deliberately organize schools of medicine for commercial purposes, which are rendered efficient in proportion to the opportunity for making money out of them, the great French hospitals of Paris provide the faculty of medicine free of charge, and with all the necessary elements of instruction, museums, lecture-rooms, laboratories, dissecting-rooms and the like. Appointments are also given by the hospitals to its physicians and surgeons; and a liberal salary to the professor, the prosector and staff of the anatomical school at Clamart. France has thus disentangled its system of medical education from the petty mercantile element which largely characterizes the methods of instruction in England and America.

Medical teaching is almost entirely practical in its nature; and to be successful should be altogether so. Surgery cannot be taught by chart or diagram, but at the operating table. Disease cannot be learned from picture books, but at the bedside. It thus follows that only the hospitals of large cities can furnish the necessary quantity and variety of disease for efficient teaching; and the most famous schools of medical doctrine have been associated with some large city, either Paris or Vienna or Berlin. In spite of this the medical departments of some universities situated in small towns have at times exerted considerable influence, and have attempted to make up for the paucity of clinical material by the excellence of their laboratories and teaching staff.

In Germany, where most of the medical colleges are of this sort, a classical examination, the "*Arbiturienten-Examen*," is followed in two years by the "*Testamen-Philosophicum*," and five years after that by the "*Examen Rigorosum*" of the university, which must also be supplemented by the state examination before the student can practise his profession. The length of time occupied in study no doubt compensates for the disadvantages already mentioned, and also is designed to limit the number of practitioners by discouraging large numbers, who have neither the means nor the patience for so lengthy a period of preparation. It can hardly be said that it has raised to unusual pre-eminence the standard of professional accomplishments; for France and England have in turn enjoyed a certain supremacy in this branch of learning, though at the close of the century this distinction is probably being again enjoyed by the German school of medical thought.

The best known of the German medical colleges are those at Berlin, Heidelberg, Göttingen, Leipzig, Jena and Bonn. In the early years of the century the young medical student started out on his journey to the university town on foot, with his knapsack containing a few clothes and books over his shoulder and his heavy stick in his hand. It is a pleasing picture, and forms an appropriate beginning for a profession that is full of labor and responsibility. Men of this stamp will not find their first enthusiasm cool in seven long years, nor feel much dread of even the *examen rigorosum*. Many of the student verses still preserve the characteristic views of the academic life of the time.

"Wer von Tubingen kommt ohne Wieb,
Von Jena mit gesundem Lieb,
Von Helmstädt ohne Wunden,
Von Jena ohne Schrunden,
Von Marburg ungefallen,
Hat nicht studirt auf allen.

"In Leipzig ist man Tag und Nacht
Auf Mädchens Putz und Pracht bedacht:
In Halle gibt es viele Mucker
In Wittemberg Kaldaunenschlucker,
Nur Jena ist von diesen frei,
Und setzt es gleich oft Schlägerei."

In Austria, beside the college of medicine at Vienna, rendered famous by the labors of Rokitansky and Skoda, there are schools of medicine at Buda-Pesth, Trieste and Prague. The Vienna Krankenhaus has long been found exceptionally useful for clinical research, affording as it does a very large variety of cases in an exceedingly short time. The complaint has been made that the Viennese surgeons did not scruple to perform operations of particular scientific interest for the edification of their professional audience, and when the health of the patient did not require any such operation. However great the needs of the medical teacher, it hardly seems a moral proceeding to sacrifice the poor and ignorant patient, even for the enlightenment of science. This is a sort of vivisection that should not be tolerated. Some comment was made when a condemned criminal was recently inoculated at Honolulu with the virus of leprosy, by way of establishing the infectious theory of that disease. Yet it would seem an even greater offence to take advantage of the ignorance of some simple-minded and trustful peasant, whose faith in the honor of the learned professions was without limit, to practise experiments which endangered his life or left him a cripple ever afterwards merely to satisfy the curiosity of the gallery of an operating theatre.

The Helvetian schools of medicine at Zurich, Bâle, Berne and Geneva closely resemble the German in their methods of teaching, and in their administration, as does also that of Copenhagen. In Spain, which was at one time the great medical centre of Europe, the colleges of medicine are connected with the *Protomedicato,* which dates from the fifteenth century. The instruction is given at the residential schools connected with the universities of Madrid, Barcelona, Granada, Santiago, Vallalolid, Valencia, Seville and Saragossa. The educational defects mentioned at the beginning of the present section are not absent from the Spanish system, it would seem, for it is said that Ramon y Cajal, the only Spaniard who for a couple of centuries has been known in medicine outside of his own country, failed to receive either employment or encouragement by the university teaching bodies of his own country and was forced to make the investigations which have made his name famous, in private and without any assistance. The future maker of science, as well as of art, has not infrequently in the early portion of his career been contemptuously repudiated by the servile curators and officials who make a parasitic livelihood out of the learning or the art, in the construction of which they have done nothing, and the very spirit of which they frequently do not understand. Huxley met with a similar rebuff from a comparatively unknown provincial university, and many others whose names honor the race to which they belong have been exposed to the silent tyranny of ex-officio scientists in power at the time. The visible world of science has often been peopled with shallow and supercilious hirelings and parasites. In every way like Irus, the beggar, in character, it is unfortunate that the lesson taught to him by Odysseus cannot be taught also to them.

In Portugal, beside the surgical schools at Oporto and Lisbon, there is also a medical faculty connected with the university of Coimbra. In Sweden there are medical schools connected with the university hospitals of Upsala and Lund. In Turkey a medical and clinical school was founded by Soliman, the Magnificent, who erected buildings for them near his own Mosque in Constantinople. There are also schools connected with the two hospitals at Stamboul. In South America there are some excellent medical colleges, there being a state school of medicine in the Argentine republic connected with the De Clinicas hospital. The curriculum extends over six years. There are also two medical colleges in Brazil, one at Rio de Janeiro and the other at Bahia dos Todos Santos.

At Oxford and Cambridge the local infirmaries do not afford sufficient clinical material for a thorough medical training; and though there are medical departments connected with both these universities, by far the larger number of the students prefer to carry on their studies at the hospital schools of London, of which there are a number. The students are a great advantage to the authorities of the London hospitals, for besides the extensive revenues derived from the large fees exacted of them, the hospitals are saved the expense of keeping dressers and clinical clerks to do the menial work which the surgeon or physician refuses to do. This sort of work is performed by the student; and the usage is such that an English medical student is quite willing to act as an unpaid servant, or even, indeed, to pay privately a large sum for the privilege of being such a servant, on account of the experience which he may happen to pick up during the performance of his little duties in and around the beds of the sick.

The university of Edinburgh has the largest medical department in Great Britain, in which the splendor of its past prestige seems to comfortably compensate for the difficulty of obtaining, in so small a city, the necessary amount of clinical material for the purposes of demonstration. There are also schools of medicine at Liverpool, Manchester and Leeds. In Dublin there are several distinct schools, but none of the hospitals of that city are specially affiliated with any one school. In Dublin, as in Edinburgh, there is only a limited supply of clinical material; but the national sentiment is so strong in Ireland that the graduation of the physician from an Irish college does not appear afterwards to stand in his way to success as a practitioner in that country.

In the British colonies, the opposite is most strikingly the case, and the colonial public consult often unwillingly a colonial physician; the preference being for an Englishman who has received his training in London. Indeed, an assumption of the mannerisms and the accent and the clothes of the mother country by the colonial physician is found to be an important element of success. For many years the profession in the colonies was supplied almost wholly from the mother country; and when the gradual growth of the colony became such that a larger number of physicians was required than would condescend to make their home in the colony, it was usual for the colonial students to go to London to study, not only the medicine, but the dress and speech and elegancies of the metropolis, which last qualifications, even more than sound learning, made a profound impression upon the rustic inhabitants of the remote colony. The expense of such a proceeding was so great that at last a number of medical colleges, several of considerable reputation, have been established of late years in the colonies where a certain preliminary training is given, though little respect is shown for any practitioner who has not a London degree. In India these colleges are fifteen in number and are situated at Calcutta, Madras and Bombay. There are also medical colleges connected with Melbourne and Adelaide universities, Australia, and a medical department of the university of New Zealand. In Montreal, Canada, a college of medicine has been for a few years past connected with McGill university; and about ten years ago a dental, medical and veterinary department was added to the provincial university at Toronto; where there is also a medical college for women with excellent facilities for teaching the principles of medicine. At Winnipeg and at Halifax there are also small schools of medicine.

The medical colleges of the United States are exceedingly numerous, and judging by the number of colleges in other countries, altogether in excess of the needs of the population. They are sometimes independent ventures, the private property of the doctors who, for commercial and advertising purposes, have constituted themselves professors. They are managed usually very much like a hotel. An inverse ratio exists between the scale of fees and the scientific standard aimed at. The "professors" are also the examiners, and they have, it seems, the authority to grant diplomas on the strength of these examinations. These colleges are not connected with anything, but maintain an isolated existence by themselves. A few of them are known as "Correspondence Universities," and the advertisements of the latter are to be seen in all the newspapers and consist usually of an ardent exhortation to everybody to "study medicine at night." Little is known of the methods of instruction—less of the examinations upon which diplomas (very large and exceedingly ornate) are granted by the proprietors. In other medical colleges where the student has to attend actual lectures and demonstrations and read actual books of medicine, the professors usually add considerably to their private revenues by instituting private classes of those who will pay the required price for the instruction. In a Vermont college these private classes of the examining professors were regarded by the students as far more *important* than the regular lectures, the truth of which was indicated by the success which those students who took the private course (and paid the private fee) always met in obtaining a degree. The truly wise man knows when to tip the hotel waiter.

While maintaining some of the poorest apologies for medical colleges of any civilized nation, America also possesses some of the best institutions for medical instruction in the world. The medical departments of the university of Pennsylvania and of Harvard university are excellent. The colleges connected with the universities and the hospitals of New York have improved greatly during the past few years. The Johns Hopkins Hospital, College and Press at Baltimore is the chief institution devoted to medical research and education in America, and compares favorably with any similar institution in Europe. The influence of this celebrated seat of learning upon the medical profession of the country has already been very marked and has set a higher ethical and scientific standard than was either desired or understood before.

By present indications it is not improbable that the early years of the coming century will witness the gradual disappearance of the worthless colleges and inferior degrees which have in the past so greatly retarded medical learning in America. The present tendency seems to be towards enforcing a more thorough curriculum, and even the western colleges are now announcing a twenty-four month course of study. When the mercenary element is at last overcome and colleges for medical instruction are not established for purposes of gain it will be reasonable to expect a medical profession in America equal to any in the world; and at that time, and not till then, will the physician learn to regard his profession, not as a trade by which to make money, but as a trust and a singular honor, to keep untarnished and unstained. He will not feel himself then to be an independent money-maker, and a driver of dubious bargains, responsible to no one, but a member of an order as old as history, receiving honor from it and striving himself to add honor to its traditions.

CHAPTER XXXII.

SOME FORMS OF MEDICAL IMPOSTURE.

"We shall understand the different symptoms of hypnosis much more easily," Albert Moll observes in his explanation of the Theory of Hypnotism, "if we first examine two phenomena. The phenomena might be laid down as laws of the physical state of human beings, though they would be laws with many exceptions. They are not generally enough considered, but they are of immense importance to psychology, physiology and medicine as well as to hypnotism. These rules are: (1) *Men have a certain proneness to allow themselves to be influenced by others through their ideas, and in particular to believe much without making conscious deductions;* (2) *A psychological or physiological effect tends to appear in a man if he is expecting it.*"

Taunted for centuries with this weakness by the satirist, and gravely admonished of the fact by didactic writers, human nature has ever continued, and still continues to be, a ready dupe to the impostor through this inherent defect. Hypnotism itself depends upon this weakness, and the quackery and imposture of the past and of the present depend upon this form of hypnotism. The observation of the phenomenon, as seen in daily practice everywhere, might be carried into politics and religion, but in the present section the relation of these mental laws to medicine alone will be considered. Before medicine had been placed upon a stable scientific foundation the leading practitioners were doubtless mainly successful by means of the power which they wielded over the imaginations of their patients. The sorcery of antiquity and the witchcraft of the middle ages succeeded for the same reason, the dread and the dislike which they inspired in no way lessening, but rather augmenting, their control over the minds of their victims.

The success of imposture depends furthermore upon the co-operation of a certain class of individual —not only the persons upon whom the imposture is practised, but the vast numbers who afterwards go about proclaiming voluntarily the marvellous nature of the new wonder whatever it may be. These criers cannot certainly be all paid for doing this, though their work is of the utmost value to the impostor himself. One asks himself, therefore, why they do it, since they gain nothing by it. The reason, upon reflection, is found to be far from a subtle one. To be the bearer of remarkable tidings invests the speaker for a moment with an importance and an interest in the eyes of others which is grateful to him and which he seldom experiences. This attitude of mind is of frequent occurrence among children and fools.

Avicenna declared that he preferred self-confidence in the physician before art, precepts and all remedies. Burton claimed that this "strong imagination, or conceit, is *astrum hominis*, and the rudder of this our ship which Reason should steer, but, overcome by Phantasie, cannot manage, and so suffers itself and the whole vessel to be ruled and often overturned." It appears, therefore, that to enjoy the fullest success the physician must master the mind of the patient by the force of his personality, as well as control the process of disease by the drugs or instruments which he employs. When the disease is not virulent and not concentrated, so to speak, but consists merely of a general malaise due to a vague disadjustment of the system, the patient is prone to think entirely of himself and to dwell upon his symptoms, which he multiplies at will. In cases of this sort the control of the patient's mind is the most important factor in the medication. Patients of this sort are reassured as soon as they see the physician, and by frequent visits are maintained in a state of comparative contentment. This is merely a form of hypnotism, though unconsciously practised by the most respectable old gentlemen, who come in their carriages every afternoon, and, while toying with their gold eyeglasses, draw largely upon their copious repertoire of platitudes. It goes without the saying therefore that the sick may be perfectly satisfied, and in that fact much benefited by imposture of this sort. A knowledge of medicine is not required, is superfluous indeed, and as the power to lie and to cajole is given by nature to a multitude of individuals who lack the intellect for profound thought or serious study, the quacks of all time have been drawn from this multitude, and have often had great apparent success in making cures (and in making money) out of the class of ailing people whose ailments were largely the result of their own imaginings, but whose tractable imaginations could readily be brought under the control of the impudent and brazen-faced empiric.

The credulity of the ignorant is only exceeded by their suspicion. With their suspicions, however, the thorough-going charlatan knows how to deal. He has in himself some such instinct as is given to insects, about keeping out of the rain when it does not look as if it were going to rain, and he allays every thought of distrust, and with florid lies and a certain plausible manner inspires such faith in himself as no man of learning or honor could possibly call forth, or could well endure if called forth. Superstition is a belief in what is impossible. Credulity is a far greater source of error than superstition. The physician described in the Canterbury Tales has all the qualities which are to be found in the modern quack, and Chaucer's Doctor of Physic was probably a very fair type of the class.

> "With us there was a doctour of phisike,
> In all this world, ne was there none him like
> To speake of physike and of surgerye;
> He knew the cause of every malady
> Whether it was of cold, heate, moist or dry,
> And whereof engendered was each humour,
> He was a very parfit practisour;
> Of his diet measurable was he
> For it was of no superfluitie:
> But of great nourishing and disgestible.
> His study was but little of the bible.
> But gold in physike is a cordial
> Therefor he loved gold speciall."

The principle of quackery is also to be found in the popular beliefs which have enjoyed so extended an influence at various times. Though possessing in themselves no value of any kind whatever, the belief in their efficiency was so strong that the patient was no doubt benefited by imagining that he was benefited. To draw one's hand nine times across a drowned man's throat was, for example, considered to be a sure cure for wens. A ring made from the hinge of a coffin was said to cure cramps. A halter by which a criminal had been hanged was known to be a cure for headache when tied around the head. Tumors of the glands could be cured when touched nine times by the hand of a corpse. Ague could be prevented by wearing in a small bag about the neck some chips from a gallows. A "hag-stone," which was distinguished by a perforation, was worn at the head of the bed for nightmare. The "toad-stone" was another. It was semi-transparent and of a dark gray color. It was usually set in a massive silver thumb ring, and was used as a specific for kidney disease, the patient drinking water in which it had been immersed. Numberless amulets were worn against disease, and phylacteries to keep off evil. A rabbit's foot is still highly prized in the southern states. The purchase of an infant's caul was thought to ensure against drowning, equally with a destiny to die on the gallows, mentioned in the "Tempest."

There were also many spoken charms, such as the following which was employed for the staunching of blood:

"Sanguis mane in te,
Sicut Christus fuit in se,
Sanguis mane in tuâ venâ,
Sicut Christus in suâ pœnâ;
Sanguis mane fixus,
Sicut Christus, quando fuit crucifixus."

The King's Evil, or scrofula, was thought to be cured by the touch of royalty, when a golden coin was placed about the neck of the credulous patient. In the English prayer book of Queen Anne the following occurred: "Then shall the infirm persons, one by one, be presented to the queen upon their knees; and while the queen is laying her hands upon them, and putting the gold about their necks, the chaplain that officiates, turning himself to her majesty, shall say the words following: 'God give a blessing to this work, and grant that these sick persons on whom the queen lays her hands may recover through Jesus Christ, our Lord.'" In spite of its ludicrous side there is something singularly pathetic in this simple faith of the peasantry in the queen: less perhaps in her abounding faith in herself. Queen Anne was from her girlhood a very easy victim to every form of charlatanism. The ecclesiastical proceeding was afterwards omitted from the breviary by William of Orange. Somewhat allied to the king's touch was the ordeal by touch, the wounds of a corpse being said to suddenly bleed anew when touched by the hand of the assassin.

The remedies employed by quacks are without number. The Mithridate contained fifty-four ingredients and the Venice Treacle nearly as many. Dr. Mantaccini claimed to revive the dead with his celebrated *Baume de Vie* and, without actual demonstration, inspired so much confidence in his skill in this direction that he was paid a round sum by a number of well-satisfied widowers and ungrateful orphans to leave the dead alone. Stones existed which were supposed to cure the bite of a mad dog, and though he denied that they had any value, Dr. Richard Mead always kept one at hand. There was also the Sympathetic powder, which, when applied to the blood-stained garments of a wounded person, produced a cure in the person, however remote. Beside this there was also *Unguentum Armarium,* which upon being applied to the weapon with which the person had been wounded caused the wound of the person, wherever he was, to hasten to a favorable cure. A decoction of flint stones saved large numbers from premature death, and the universal antimorbus drops prolonged numerous suffering lives. The desire for health, as Pott remarked, like the desire for money, put all understandings upon the same level. There is a peculiar charm also in the idea of a mystery, and, as Pliny announced, "minus credunt quæ ad sum salutem pertinent, si intelligunt."

For some reason quacks seem to spring at once into fame, like Minerva, full armed. They do not appear to ever need to study and to practise for a while to get experience as doctors do. In the quack's academy ample directions are given, by carefully following which any person, who possessed natural gifts in that line, might reasonably expect to lift himself suddenly into fame and affluence: "To support this title there are several things very convenient. Your outward requisites are a decent black suit and a plush jacket; not a pin the worse though threadbare—it shows the more reverend antiquity. Secondly, like Mercury, you must always carry a caduceus, or conjuring japan, in your hand, capt with civet box; with which you must walk with Spanish gravity, as in deep contemplation upon an arbitrament between life and death. Thirdly, a chamber hung with Dutch pictures, belittered with empty bottles, gallipots, and vials filled with tap-droppings, or fair water colored. Any sexton will furnish your window with a skull, in hope of your custom, over which hang up the skeleton of a monkey, to proclaim your skill in anatomy. Further let your table be never without some old musty Greek or Arabian author and the fourth book of Cornelius Agrippus, *Occult Philosophy,* wide open to amuse spectators, with half-a-dozen of gilt shillings, as so many guineas received that morning for fees. Loquacity and impudence are further advised, the peculiar gifts of all quacks, but when there exists an impediment in the speech, preserve a mysterious silence, rendered impressive by grave nods of the head."

Addison tells of an elderly man and a child who in a shrill voice screamed, "My father cures all sorts of distempers." To which the dignified quack doctor added in a benevolent and a grave manner, "The child speaks the truth." The distinguishing features of empiricism are large promises, bold lies and affected sanctity. Certainly if physic be a trade it is of all others cut out for rogues. Madame de Sevigné defines the pretensions of medical impostors as *"Pompeux galamatias, specieux babil de mots pour des raisons, et des promesses pour des effets."*

Early in the last century an official document divided the practitioners of the healing art into, I. *Physicians in general,* including commissioned, court, field, hospital and plague physicians; surgeons, midwives and apothecaries, and II. *Impostors,* including old women, village priests, hermits, quacks, uroscopists, pseudo-paracelsists, pyrotechnists, Jews, calf-doctors, emetic peddlers, crystallomancers, mountebanks, vagrants, magicians, exorcists, monsters, wood-hermits, rat-catchers, bankrupts, jugglers, gipsies, veterinary physicians and the like. The list of impostors enumerated in the foregoing is meagre and small compared to the almost countless forms of medical fraud which have been practised in recent years. The empiricism of the present century began very auspiciously with the teachings of Rademacher and the homœopathy of Hahnemann, with Isopathy, Mesmerism, Perkinism, Phrenology, the electric doctrines of Count Mattei and the "Od" of Baron Karl von Reichenbach, which last was something between magnetism and electricity, while embracing much that is claimed by the recent followers of spiritualism. The vaguely understood principles of magnetism and electricity appealed very strongly to the lay mind during the first half of the century, and the terms were very largely used by the quacks of the time. Even at the present day the notion does not seem to have altogether lost its charm, for a very largely advertised nostrum claims to be very simple, no secret at all, merely liquid electricity, which passes directly from the stomach to the nerves and soothes them a great deal. Another fraudulent person advertises little belts with pieces of brass tacked on which are very electric, and, whatever the ailment, will "cure you while you sleep." The wonderful auxiliary powers of such catch phrases as the above, for selling purposes, are vividly recognized; and the shrewd inventor who sells the belts has also patented the words "cure you while you sleep." It is like the title of a proprietary remedy.

Disregarding the fact that there can only be one true science of medicine, as there is only one of chemistry or astronomy, which is ever ready to embrace new truths and correct or abandon old errors, whole herds of quacks who have one point of fraud in common have often the insolence to style themselves as a special "school" of medical thought. These individuals cannot be regarded as *bona fide* dissenters from the beaten path of scientific medicine, for they were never actual members of the medical profession in good repute. One of these self-styled schools, disturbed greatly in their greed lest, by claiming to be of one school, they might miss some of the fools who had rendered their allegiance to another school, claimed boldly to practise all that was beneficial in all schools. These were the so-called eclectics, who, like the mechanic in the proverb, are jacks of all schools (of quackery) and masters of none, though no doubt finding numerous dupes in the ranks of all medical believers.

Phrenology at one time bade fair to extend its benign teachings to the healing of disease, but the public, who were already fully occupied with other phases of humbug, insisted that it should confine itself to the department of sociology, which Phrenology did, though with a strong notion that if it had received encouragement it might nevertheless have accomplished much in the healing of disease. Christopher North suggested that the heads of growing children be moulded from the first, so that all that was undesirable should have no opportunity to make its appearance in their little crania. This ingenious theory, though thrown out in irony, was eagerly taken up by the ignorant and dull writers on this senseless subject, who saw in the procedure the possibility of universal morality and goodness and respectability. The new gospel, however, proved an ill omen for many, as people in England began to dismiss their servants and clerks and employees on account of their bad bumps. Many individuals were socially ostracised because it was evident by the shapes of their heads that they had a tendency to larceny, were homicidal at heart, and were not good Greek and Latin scholars. The delusion at last reached a point where it was proposed to elect members of parliament on the principles of phrenology, and imprison phrenological criminals lest they should do something horrible later on.

During the last forty years a change has been slowly taking place in the world of quackery, and in place of the pseudo-science, which has been abandoned little by little as it became less lucrative, a pseudo-religion has been substituted. The general popularization of scientific knowledge consequent upon its extensive application in the useful arts partially accounts for this. In spite of the electrical humbugs which are still perpetrated, it is possible that a few individuals know that electricity is not a ponderable substance which can be eaten like sugar. The quack's only chance is to maintain an unassailable position, and leave the rest to his inherent gift for telling lies. He must at all hazards be a transcendentalist. When the theory of the religious emotions is established upon a scientific basis, the quack will decamp with alacrity from this ground also, as he has already done from science. At the present time, however, tænia-like, he has made religion his parasitic stronghold, and has attempted to identify with himself and his nefarious practices all that is dignified and honorable in religion. The quack, like other petty criminals, is capable of any contemptible subterfuge by which he may protect himself from assault. His career is commenced in contempt, continued in cowardice and ended in contempt.

The religio-medical conception is not even original. Last century a certain Mrs. de Loutherbourg and her husband stated modestly that God had imparted to them the gift of healing the sick by applying the hand. They refused all fees at first in the most lofty manner. The novelty of the thing appealed to the popular mind and their house was thronged. When sufficiently advertised they refused to further see patients except by ticket, though still performing their sacred functions free of charge. The tickets, which were very plentiful, always seemed, however, to be in the hands of individuals who wanted to sell them, and the evangelical pair in all probability amassed a comfortable competency. This form of quackery seems to be especially adapted for the female offender, and calls at once to mind the contemporaneous impostures of Mrs. Eddy along similar lines. According to the teachings of this person, who may possibly have somewhere read an argument of Berkeley's philosophy, there is no such thing as disease, and when a person wears a wooden leg, he only thinks that he does, but doesn't. A cancer isn't a cancer, and at the same time it isn't anything else. There is no such thing as being blind or deaf. These tricky people really see and hear just as well as we do, but for some reason which they never like to explain, they will not admit that they see or hear. There is no such thing as smallpox either, and when a man is cut in two by a railway train, he still lives and walks around and raises a family. Things are not, therefore, in this world quite as bad as they seem.

Unlike less liberal forms of quackery, every adherent of Christian Science may also practise its beneficent teaching, and in that way earn a few dollars in an easy and genteel manner. The practitioners are everywhere, and what they claim to do is—to cure all diseases—the simple creed of the sect being that there are no diseases, and that they can cure them.

With this delusion may be classed the annual pilgrimages to the shrine of St. Anne de Beaupré, where, revived by the excitement of the journey, the beauty of the scenery and the freshness of the air, many hypochondriacs feel such a return of health and spirits as to consider themselves recovered from ailments which were chiefly imaginary. No serious refutation of the preposterous claims of quackery need be attempted. Most of the recoveries recorded are from diseases which never existed except in the mind of the patient, and all benefit claimed to have been received may be explained by the general rules with which the present section commenced.

CHAPTER XXXIII.

THE PERSONAL ELEMENT IN THE MEDICAL PROFESSION.

The personal element is more prominent in the medical profession than in any other vocation. The remarkable success achieved by some surgeons and physicians is readily seen to have been due less to the wisdom or scientific acumen of the practitioner than to some trick of personality. The physician perhaps possessed an austere and forceful manner, which inspired all patients with complete confidence. On the other hand he may have had a benignant and kindly aspect which soothed the irritation of the patient. His constituency depended probably upon his mannerisms, and in sickness his presence was a *sine qua non*. No one, the patient felt assured, could understand her particular case as he could, and she was well on the way to recovery as soon as she heard the rumble of his carriage wheels. Very few physicians have the courage of Dr. Radcliffe, who, when called by the Princess Anne, afterwards Queen Anne, refused to stir from the chamber, where, with a few friends, he was enjoying sundry bottles of sherry. "Tell the Princess," he sent back word, "that there is nothing the matter with her but the vapors." Queen Anne never forgave him the use of the word "vapors," and he was dismissed accordingly from his court position. A few physicians possibly find themselves above emolument and rank, but the majority are forced constantly to the employment of the *suaviter in modo*. Idle and silly women occupy a great part of a physician's time. Their maladies are for the most part imaginary, their notions and fears are multitudinous, and the physician is summoned upon the most ridiculous pretexts. The truth at the bottom of the matter is probably that these middle-aged ladies are bored, and find a certain amount of diversion in the company of an intelligent physician to whom they can freely unburden their woes, their doubts and their dislikes in a perfectly open manner. This is probably not the most elevating office of the medical profession, but it is certainly one of the most remunerative. In old and wealthy countries this class of patient is exceedingly numerous, and physicians of sound learning and the highest principles are often found in this manner to be quacks in spite of themselves. The wife of a millionaire or of a duke cannot be expected to employ herself at any useful labor, and idleness begets the nervous condition of *ennui* and mental apprehension already referred to. The round and rubicund face of her doctor, suffused with genial smiles, is very comforting to her, and she attributes to the simple *placebo* which he has left her the improvement of spirits which his call has inspired. It thus often happens that a physician is not allowed by his patients to be perfectly sincere even when he wishes to be. Furthermore, a considerable accuracy of observation is seldom possessed by the untrained, and their notions of cause and effect are very seldom correct. With conscientious treatment, according to scientific principles, they may very soon become impatient; while deeply impressed and lending themselves readily to useless expedients, craftily suggested to meet with their own preconceived opinions. But it requires a Radcliffe to refuse to attend upon a princess and to send word to her bluntly that she has an attack of the vapors and nothing more. Very few ever rise to a similar pitch of common sense or independence.

Anecdotes innumerable are told of great physicians at critical moments. At the time when Queen Anne was on the point of death the Jacobites desired to gain time, but were frustrated by Mead, who boldly asserted that the queen could not possibly live out the hour. She did not, however, expire until the next day, but Mead's decisiveness, though perhaps reflecting little upon his scientific skill, had no little political importance. During the final illness of the late President Garfield and the Crown Prince of Germany the daily prognostics of the physicians in attendance were awaited with the most intense interest, and the position of the physician, by reason of the political interests attached to his decisions, was one of great delicacy.

Many deeds of uncredited heroism are probably performed daily by physicians the world over. What physician can count the number of times that he has risked his life in attempting to save that of his patient? Occasionally when the physician actually loses his life during the performance of his duty this fact is more prominently brought before the notice of the public, as, for example, when a surgeon contracts blood poisoning from one of his patients and dies from the infection. The annals of the army and the navy abound with instances of this sort, to which attention has already been more particularly called when describing the career of Baron Larrey.

The ethics of the medical profession refer to the physician's relations with other physicians, and to his relations with the public at large. The rules bearing upon his behavior towards other physicians, though complained of sometimes by young physicians who have embraced medicine evidently as a commercial venture, and who are dissatisfied because the usages of the profession prohibit wholesale advertisement, and the rapid formation of an adventitious practice by such means, are on the whole calculated to raise the standard of the profession and to maintain its dignity. There is no system of medical police to enforce these unwritten laws. They are merely usages which are likely to appeal to the dictates of a gentleman. When individuals, for purpose of gain, degrade the profession into which they have sought admittance, by unseemly conduct, through which they hope to attract the attention of the common herd, and by publicly advertising that they can perform cures which they cannot perform, they place themselves upon the level of the quacks and the impostors already referred to, and are acting in a manner which a man of honor finds repugnant to him. If ostracised then from the profession it is only what might be expected. No man who admires honesty and sincerity can be expected to willingly allow himself to be classed with an individual who has shown himself to be a liar and a fraud. A straightforward man finds it easier to be poor than to be a rogue.

While complaining of the acknowledged charlatan, the masked impostor should not be allowed to go free. He is generally strongly entrenched in the profession, and does nothing openly which can give cause for complaint, though he is regarded with vague misgivings by the more honorable members of the body. This individual is usually associated with some religious reform, such as the prohibition of beer. He is invariably a "total-abstainer" himself from all forms of bock, in public, and by working up a constituency among the class of people who are impressed by such forms of mental immaculacy, he succeeds, by the same methods as the quack, and is himself a quack in principle, if not in open practice. Woodcut portraits and glowing biographies of such individuals are found constantly in religious periodicals. They frequent personally all religious and charitable gatherings, they are called "grand, good men," and their recorded cures are generally so remarkable as to recall the Acts of the Apostles. Indeed, they reverently admit, like the said apostles, that they do not perform their miraculous cures unaided.

CHAPTER XXXIV.

MEDICINE IN LITERATURE AND ART.

At the present time it is almost impossible to take up a book or to go to a play or police court, or to enter a picture gallery, without being met sooner or later with some reminder of the medical profession. This was also the case, though to a much less extent, in the preceding century. The physician was occasionally called into requisition then to perform his part in the machinery of the drama or of the novel, and in some few instances Medicus was himself the subject of the play or the story, though in the art of that time what strikes one at once, because in such marked contrast with present conditions, was that the physician of the past was an unfailing object of satire. He belonged to the literary stock-in-trade of the period, and a smile was ever ready at the mention of the leech's calling.

The tendency in literature and art has become more realistic with the progress of the nineteenth century, and general types are not used by literary men as unfailing symbols to elicit easy laughter or easier tears. How thick-witted the public of a former century must have been may be gathered by glancing at the objects prized by them. The physician in the literature of the present day, instead of being a conventional butt, and an unfailing source of amusement for slow brains, is in the drama, in the novel and in the art of the present portrayed as he really is. Furthermore, as the part which he now plays in life has become so extensive, any description of life must necessarily contain frequent references to the profession of medicine.

The tendency of Dickens in his writings to oscillate continually between "pathos" and burlesque, incidentally explains the fact that the physicians described by him should have all been caricatures. A writer whose ruling passion it was to act upon the risorius muscle or the lachrymal gland would hardly be expected to pause over a matter which appealed to emotions more involved. Indeed all the literature of the early Victorian period produces, when one looks wearily back upon it, a dismal impression of stupid, gluttonous, smug respectability, which is almost insupportable. Dickens has left an account of a meeting of physicians, such as a newspaper humorist might write to-day, and a description of a coarse medical student, who was possessed of an extraordinary number of most objectionable characteristics. A more edifying picture is that of Thackeray, of the old, hard-worked and worn-out physician, who was slowly dying of an incurable malady, and knew it, but without speaking of the matter to those for whom he cared most, went on bravely upon his daily round of duties, waiting stoically for the end which might come at any moment. Equally pleasing is the character of the old doctor in Mr. Page's story of *Red Rock,* or the physician described in Ibsen's play, "The Doll's House," who without any false display of emotion left his card quietly in farewell at the house of a friend, and went home without a word to die.

The "plots" of many modern novels seem to require the agency of a physician, but the personality of the man in such cases does not attract the attention of the reader so much as the solecisms of the author. The most absurd notions are sometimes perpetuated by uninformed writers of the sort. A good example of this is the chloroform of the romantic drama. One whiff of this remarkable substance administered suddenly by the villain of the play is always found quite sufficient to produce profound anæsthesia. The readiness and the thoroughness with which the chloroform of the stage produces its effect is a constant source of amazement to the physician who has administered the anæsthetic of the pharmacopœia, in which act he was generally met with the prolonged struggles of the patient. The action of poisons will also be found to be far more subtle in general literature than in scientific experiment, and the methods of medical research more far reaching and ingenious, alas, than is really the case. More recently the toxines have been received by the world of polite *belles lettres* into its repertoire and described in a manner which would profoundly surprise Pasteur or Koch. Many years ago attention was called to the fact by an acute observer, that "a little knowledge is a dangerous thing," and to no branch of learning does this more strongly apply than to medicine.

A number of physicians have been literary men in their time, and an odd fact is that so few of them have said anything of medicine. Abraham Cowley, it is true, referred to Harvey's discovery; Garth wrote a mock-heroic poem commemorating a squabble between the physicians and the apothecaries. Armstrong saw fit to preserve his golden precepts in a didactic blank verse poem on the Art of Preserving Health, which was probably better than adding another Ars Poetica to the immense number then in existence in England. Sir Richard Blackmore's writings were also poetical, but were not medical in their tone, consisting as they did of a goodly variety of epic poems upon various subjects. Erasmus Darwin did not celebrate the physician either, or even medicine, but went so far out of the beaten path of poetry as to make botany the subject of his muse, profitably employing the time spent in rumbling in his chariot from one patient's house to another in the diligent construction of those deathless numbers which were afterwards published in two large quarto volumes under the titles of *The Botanic Garden* and *The Loves of the Plants,* and which can hardly be said to outshine even the English translation of Cowley's long poem in many books upon the same subject. Oliver Goldsmith scarcely mentions the profession in which he received considerable training. Mark Akenside in his severe (and exceedingly lengthy) odes does not say a word about the medicine of the time, nor does he mention it in his *Pleasures of the Imagination.* And yet the medical treatment of that time had a great deal to do with the imagination. Indeed more than one of Akenside's Latin treatises upon medical subjects are more imaginative than learned. The grammatical structure was correct, and syntax was the principal study of the last century, and even in this century is indulged in by certain moribund individuals like whistling—"for want of thought." Of medicine Keats was equally silent.

Possibly it is not to be expected that the physician who may have produced a scientific work of the greatest value to the race should afterwards take up his pen in a lighter vein and attempt to describe himself. At present the best descriptions of physicians and their works have been written by those who were not members of the profession.

Among the physician's duties are many which are painful to him because they cause pain, and that for the sake of the patient it has been found best to proceed at such times with dispatch. In trying moments, when there is little courage in the atmosphere, the surgeon must muster all his own, and confidence is not inspired in the patient to undergo the inevitable, when the physician comes to his difficult task with eyes suffused with sympathetic tears, and a hand shaking with emotion. For the patient's sake the surgeon must act a masterly part, inspiring shame in the overtimid by his apparent unconcern, confidence in the fearful by his precision, and obedience in the silly and the refractory by his firmness.

The physician is forced to act a part to a great extent all through his life. It is impossible to give a loose to his feelings. Not long ago an American surgeon, assisted by his son, was conducting an operation, in the midst of which, when the slightest error of technique might have resulted in the death of the patient, the physician grew suddenly white, and turning with a groan, dropped his knife from his hand and sank to the floor, dead. He had been troubled with heart disease and the end had come at an unexpected moment. In the stillness of the operating theatre, as the father's body was borne from the room, and without the delay of a moment, the son took the place of his father, and with nerves of steel and face unmoved, went on with the operation. Without an error, without a pause, every detail was attended to and the patient at last removed to her cot in the ward to recover. Then the young surgeon may have gone to his father's side. Repression, concentration, control,—these are the habits that medicine teaches. There is no encouragement here for egotistic attitudinizing, mawkish self-pity and any of the other forms of emotional weakness which are cultivated and admired by the gaping herd in the general walks of life.

It is such men as these who are seen in the art of the time, and there have been many celebrated pictures which represent the surgeon and the physician in the pursuit of their daily avocations. The perfect physician and surgeon is negative. He stands for a knowledge and a force shorn of all extraneous personalities. The bringing in of the personal element is the first step, and a long one, towards quackery. It is thus perhaps that the true spirit by which these most noble men are actuated has been so often misunderstood and so seldom described. The negative qualities lend themselves to the bust of the sculptor or the brush of the artist rather than to the pen of the poet. The writer uses the *work* for his plots, but fails to reproduce the man himself.

There is a type of physician, however, which lends itself more readily to literary treatment, and this is the old physician who has practised for many years and who regards his patients much as a *curé* does his flock. He is not very brilliant in a scientific way, incapable, no doubt, in many matters, but by the kindness of his disposition, inspires confidence and comfort in the sick. Many beautiful poems and stories have been written upon this subject, and both in prose and verse the good old family physician of the good old school has been affectionately referred to a number of times. It is to be hoped that the personality of the kind old man, who really exists in many localities, will not be degraded to a "type" and adopted as a part of the stock-in-trade of the professional teller of "pathetic" tales.

" He was a country doctor and his hair was white as snow;
One of the old profession, who practised years ago,
Out in the smoky clearings ere life became so fast;
One of the last survivors of a race that's almost past.

" He couldn't clearly understand all that he heard them say,
For medicine had changed so much since his empiric day;
And so he sat in silence, gazing with uneasy eyes,
And tried to look, as doctors do, unfathomably wise.

" Amid the clink of glasses and the aromatic smoke,
The long chain of remembrance from forgotten years awoke;
And when they drank the old man's health with deference sincere,
He could not see their faces, for their kindness brought a tear.

" 'I thank you, gentlemen,' he said, 'your kindness reassures,
And makes me think you of my time, or think myself of yours;
And yet an old physician of a rude unlearnèd day,
In such a gathering as this cannot have much to say.

" 'For all is changed since I began, and nothing is the same;
You've given each old familiar ache a scientific name;
On horseback twenty years, and in my sulky twenty more,
I practised in three counties, and was known at every door.

" 'The early pioneers were sometimes ignorant and poor,
But still I tried to do my best, for it was kill or cure.
The cholera lurked in our midst, ship-fever and despair,
And pus was not as laudable as my intentions were.

" 'I've often forded winter streams, beneath the midnight stars;
I've wakened when the horse I rode stopped at the homestead bars.
My day's work in those early years perhaps will make you smile—
I've made a hundred visits and I've covered fifty mile.

" 'For ten years past I've tried my best to quietly retire,
They do not need me any more, and rest is my desire;
But when it is lung-fever or typhoid it's sad to see
The foolish way they have of posting out of town for me.

" 'I say I'm an old fossil, but they smile and will not heed,
And yet, thank God, I think I've sometimes cheered them in thei need.
But all is new and strange to me, who, while old customs wane,
In a new order of ideas confusedly remain.

" 'Linnæus is forgotten now; no prudent hand disturbs
The simples that we used to prize, and irritating herbs.
We used to bleed them in the arm, but you the plan reverse,
And spare the supplicating arm to bleed them in the purse.

" 'We weren't bacteriologists, but yet we understood,
Somehow, life's secret sympathy, and did the poor souls good,
Wherefore I sometimes fancy, though from pride I must refrain,
That taken so, with all our faults, we did not toil in vain.' "

Belles lettres has never, however, appealed so strongly to the imagination as the lives and writings of some of the men who have actually existed—the honor of Corvisart, the unaffected simplicity of Jenner, or the earnestness of Basil Valentine. The *Currus Triumphalis Antimonii* of the last mentioned opens with pious exhortations to prayer and contemplation, to charity and benevolence. As he gets on in the subject Basil Valentine shakes himself free from his exordium, and the mildness of his first manner disappears. "Ye wretched and pitiful medicators," he exclaims, "who, full of deceit, breathe out I know not what! Thrasonic brags! Infamous men! More mad than Bacchanalian fools! who will neither learn nor dirty your hands with coals! Ye titular doctors, who write long scrolls of receipts! Ye apothecaries, who with your decoctions fill pots! You, I say, who have hitherto been blind, suffer a collyrium to be poured into your eyes, and permit me to anoint them with balsam that this ignorance may fall from your sight!"

These are real persons. No less real appears the aged Boerhaave. He is about to die and the simple acceptance of the fact is worthy of so great a man. In 1738, shortly before his death, he writes thus to his friend, Baron Bassaud, who was physician to the Grand Duke of Etruria: "Me prehendit vomica in Pulmone, spiritum præfocans ad levissimos corporis motus, a tribus adhinc mensibus quotidie increscens. Si causa augetur, opprimet, si vero rumpitur eventus incertus. Quicquid fiet, id omne continget ex arbitrio superioris numinis. Cur ego metuam, quid cupiam aliud! Adoremus Deum! Sufficit. Interim curo sedulo ut lectissima ad hibeam remedia, ut leniam et maturem, securus de exitu. Vixi ultra 68 annos, semperque lætus."

CHAPTER XXXV.

THE MEDICINE OF THE FUTURE.

THERE are detractors now, as there were at the time of Cabanis, who carp at the teachings of medicine, but to them a briefer answer than that which was made by Cabanis, and one possibly ..s just, may be made in the reminder that medical thought is at present in process of formation. As from time to time new truths are added to the sum of medical knowledge, there necessarily follows a brief pause and a period of reconstruction. Every new discovery casts a shadow of doubt upon some old belief, and at the close of the nineteenth century the physician, more than at any other time in the history of medicine, finds himself between the double duty of learning and forgetting. There are new theories and forms of procedure for him to accept. There are old ones which he must lay aside. It has been so in all knowledge from the beginning, and it will always be so. In the past, as in the present, the wisdom of man has been full of transitions: of receiving new ideas or of discarding old ones, or of reconciling the old with the new. Hence in speaking of the medicine of the future, there is little hope that it will be free from the disquiet which disturbs the medicine of the present. It also, as far as the observer can see, will represent but a period of formation, somewhat more advanced, perhaps more closely bound together than that of the present, but still only a phase, a link in a chain that bids fair to be co-extensive with the history of the human race.

At present one of the most striking developments of the healing art is the ascendency of surgery, which is gradually invading the fields once given over to the physician alone. Many of the internal diseases are now within the province of surgical operation. It would seem, furthermore, that this tendency is only in its incipiency as yet, and that as the resources of surgery extend, so will the field of surgical practice. The ultimate result will possibly be a merging of medicine and surgery into one, and this, too, will not be an unfavorable termination; the original division of the healing art into these two branches having been, as was pointed out in an earlier section, an artificial one, effected by constraint in the first place.

In the future, the science of medicine will become less and less esoteric, and the general education of all civilized communities will become permeated with its fundamental teachings. While continuing, quite to the same extent as at present, an operative art, and a course of practice for the specially trained, it will also become more and more a didactic science, not narrowly limited to the cure of actual disease and the refuge of the unfortunate, but a "science of living," with an influence which will extend into every branch of domestic and of civil life. Then, indeed, it is to be anticipated that much of the sacerdotal authority and power of the past may fall upon the physician, and that those departments of life which ought naturally to be his peculiar province will be placed beneath his control.

To speak more plainly, the problems of human life are only difficult of solution when the attempt is made to solve them in a literary way, by notions gathered from literature, and the thing becomes especially difficult when the literature is in a foreign tongue, for then it is very hard to know what it really means, and the wise men who devote themselves to the matter seldom get beyond grammatical disputes between themselves, such as one expects and usually finds in a class-room. And there it all ends: in a tournament of syntax and a war of lexicons. But the problems of human life are very simple, and they have nothing to do with literature or ancient history. Pasteur did not make his discoveries by a study of Aristotle or the Septuagint. The race is merely a part of Nature, and is governed by the same laws; nor are her ordinances hard to obey. It ought then to be the office of him who knows Nature best to expound her law to a race who must suffer most bitterly if in ignorance they disobey it; to a race whose presence in the world is but a manifestation of her operation.

To assume responsibilities so singularly sacred would require that such an one be, like the higher tribunals of the upper courts of law, a man above narrow personal motives, a man of pure and upright character; in his sympathy with the race and with the infirmities of human nature, warm, yet just and calm; in his wisdom, profound, yet not one-sided; a man acquainted with life as well as with books, and, above all, a man stable, yet open; moral, yet not pharisaical; fearless, yet not tyrannical; devoted to the science which he represents, yet not standing aloof from the tide of humanity, of which he is but a modest part, and for which he should labor, with or without reward, as long as life and strength remain to him.

To say that disease results from ignorance and immorality, though true, is a confusion, for these three together form the dark tripod upon which ever has been reared the sorrow and the shame of the ages. All vice is after all but the violation of the law of nature. In a sound body the mind is sound. But if through ignorance the body becomes impaired in strength, flaws in the clearness of the mind speedily follow, and the grotesque condition of the mind and body which is called disease is reflected in the conduct of the individual, and is called crime, and sometimes insanity, by those who do not understand the whole, but only see the surface, and but a part of that. Nor will civil law prevent, though it may limit in an external way, the perpetration of crime. Equally inefficient are the dissemination of the most lofty ethical ideals in the correction of those lesser defects of conduct which fall short, to a degree, of those of which the civil law takes cognizance. It is, therefore, for the physician, because he can see the whole and not the surface only, to extend his medications as well as his teachings to the source of ignorance and of disease; to cut off in their incipiency, to obstruct in their very beginnings, the conditions which long afterwards terminate in outward disease and in outward crime. It is for him to study the primary causes of these conditions, to understand their nature and to establish acceptable methods of prevention and cure.

One cause for complaint against the medicine of the present time, and an unreasonable one, is that the physician is expected to interrupt the course of disease when in full tide, and succeeds in doing so only in a partial and imperfect manner. As well might the responsibility of a wreck be placed upon the shoulders of a pilot whose aid was only called at the last moment, when the ship was in the act of foundering. The most devastating epidemics, and the course of disease whose origin has been remote and insidious, can scarcely be held in check when fully under way among the bewildered and panic-stricken populace. To the teachings of medical science men must learn to give ear, not when *in extremis* alone, but at all times, and to the authority of the medical profession they must learn to more patiently submit. Above pecuniary motives, and not desiring, as now, to see disease or profiting materially by its presence, the physician will then find himself in this department of human life a statesman with the destinies of his people in his hands no less than he who directs the policy and the laws of the state. It may then be possible for him to so govern the inner life of the race, removing what is impure, preventing what is perilous, bringing rest where there is weariness, soothing where there is pain, and so strengthening, controlling and directing the intricate fabric of society in its more private adjustment, that the life of the community may become free from taint, noble, puissant, and suffused with that health and that happiness which is the glory and the dream of life, the bulwark of strength and the antidote to crime and vice.

This is no Utopian vision. Still it is a vision, for such a state of things does not at present exist. Possibly it expects much of the race. It expects no less of the physician. There is, however, a standard for him to keep before his eyes which is as old almost as written medicine. This is the Oath of Hippocrates—the oath exacted by the sage of Cos from those who had listened to his teachings. In no nobler, no more fitting words can these manuscripts be brought to a close than with those words which have come down to the present day through twenty-five centuries of time—words that were whispered before Christ sailed with his fishermen by the shores of Galilee, or Cæsar led his legions into Egypt.

"I swear by Apollo, the physician, by Æsculapius, by Hygeia, by Panacea and by all the gods and goddesses, that I will fulfil religiously, according to the best of my power and judgment, the solemn vow which I now make. I will honor as my father the master who taught me the art of medicine; his children I will consider as my brothers, and teach them my profession without fee or reward. I will admit to my lectures and discourses my own sons, my master's sons and those pupils who have taken the medical oath; but no one else. I will prescribe such medicines as may be the best suited to the cases of my patients, according to the best of my knowledge; and no temptation shall ever induce me to administer poison. I will religiously maintain the purity of my character and the honor of my art. Into whatever house I enter, I will enter it with the sole view of relieving the sick, and conduct myself with propriety towards all the members of the family. If during my attendance I happen to hear of anything that should not be revealed, I will keep it a profound secret. If I observe this oath, may I have success in this life, and may I obtain general esteem after it; if I break it may the contrary be my lot."

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