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THE DOMINANCE OF THE NUCLEUS.

BY

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I take it that in opening this discussion I shall perform the greater service if I devote myself to a rapid review of the various findings which together compel the conclusion that the nucleus is the centre of cell activity, leaving it to those who follow me to enter more particularly into the evidence of one or other order.

Such a general survey is more especially demanded because, to my knowledge, it has not yet been attempted; or, more correctly, when attempted, what I regard as the inevitable conclusions have not been drawn. While individual workers have demonstrated the controlling powers of the nucleus in one or other respect there has been a curious disinclination to bring the various orders of data together and deduce their full significance. But here, as regards this morning's discussion, certain limitations must be introduced; the activities of living matter are to be divided into two categories, intrinsic and extrinsic, or vegetative and functional. The observations which have been made upon the nucleus in connection with vegetative activities, with cell multiplication and reproduction, are very abundant. To discuss these along with the data bearing upon the role of the nucleus in the functional activities of the cell would make this morning's debate altogether too diffuse. It has been thought wiser, therefore, to confine ourselves, save in one respect, in the main to the latter—the functional activities. Nevertheless, if I have correctly interpreted my duties as introducing the subject, in order to place in a clear light the controlling influence of the nucleus in the life of the cell, I cannot leave these vegetative activities out of account. As opener, I must as briefly as is possible, consistent with lucidity, bring forward the evidence of nuclear predominance as afforded by studies upon cell and individual reproduction. It was the studies upon mitosis that first revealed the high importance of this constituent of the cell.

We can, perhaps, best treat this section of the subject by means of a series of theses:

1. The properties which distinguish the individual of any race or family from the individual of any other race or family are to be traced back to the constitution of a single cell, the fertilized ovum, from which that individual has been developed.

2. There must, therefore, be something in the constitution of the germ matter of the parent stock which differentiates it from the germ matter of other stocks. Nay, more, no two individuals appear to possess germ matter of absolutely identical constitution.

3. In individuals of gamogenetic origin, resulting from sexual union, the material contributed to the ovum by the paternal spermatozoon and the maternal ovum is, physiologically speaking, of equal value. As demonstrated by Mendel in his observations upon hybrids, like orders of offspring result whether the male cells of stock A be employed to fertilize the ova of stock B, or the female cells of stock A be fertilized by the male cells of stock B.*

It is evident, therefore, that matter of like order is contributed to the fertilized ovum by the two parents.

4. In studying more narrowly the process of fertilization we find that the only matter contributed correspondingly by both parents is nuclear matter. Ovum and spermatozoon are cells of widely different appearance, and the result of fertilization is that the female cell affords the cytoplasm, or cell substance, of the fertilized ovum; the male cell provides the centrosome. The nucleus of the fertilized ovum or new individual is formed of corresponding amounts of nuclear matter (chromatin) from both parents.

5. Not only is this the case, but, most significantly—I shall take up a probable exception immediately—each supplies a like number of chromatin loops or chromosomes, and, as the fertilized ovum undergoes development and proceeds to divide and redivide, the like process of distribution is continued, so that each separate body cell of the fully developed organism contains equivalent parts of chromatin of paternal and maternal origin.

6. We can proceed yet further and recognize that in certain species, at least, the chromosomes supplied by or derived from either parent, while pairing with like chromosomes from the other parent, are not all identical in appearance and size, but vary among themselves, the variation being constant; that is to say, the same types of chromosomes

* In mammals intrauterine existence would seem to introduce a factor of differentiation. From their mother's womb male and female show constant differences.

are found in successive generations of cells. This peculiar variation, as has been pointed out more particularly by American observers (Montgomery and Sutton) is frequent in insects in the cells which ultimately give rise to the germ cells. As Moore and Arnold, of Liverpool, have just shown, a like constancy is to be made out in the types of chromosomes seen in the spermatocytes of mammals, even of man himself. The constancy of the varieties in individual species suggests that the chromosomes of different orders possess different properties and determine different characters or sets of characters in the cells to which they are distributed and in the individual formed from the aggregation of these cells. In support of this hypothesis are the remarkable observations first of McKlung, of Kansas, and later of E. B. Wilson, of New York, that the spermatozoa of sundry insects are of two orders, though there is but one type of egg. The one order of spermatozoon gives rise to males, the other to females, the difference between the two being in their chromosomes. In the maturing spermatocytes which give origin to the spermatozoa, either the one set of cells possess an accessory chromosome, or, in other cases, a particular chromosome in one half of the maturing spermatozoon is large, in the other half is minute. To quote McKlung, "A careful consideration will suggest that nothing but sexual characters thus divides the members of one species into two well defined groups, and we are logically forced to the conclusion that the peculiar chromosome has some bearing on the arrangement."

Here we are not discussing sex, and I do but note these recent observations in passing. There are other cases, not as yet fully worked out, in which, as in the Aphides, there would appear to be one type of spermatozoon and two types of ova.

The natural conclusion to be reached from all these data is that *the nuclear matter conveys and determines, or controls, the inherited peculiarities of the individual; further, the conveyance is through matter contained in the chromatin loops or chromosomes, while it may be that these individual loops, varying among themselves, determine particular conditions.*

What we know concerning the spermatozoon points very definitely to the conclusion that the *groups of chromosomes* distributed to the spermatozoa derived from a single spermatocyte are not identical, each spermatozoon receiving only one-half the number of chromosomes proper to the primordial germ cell, and to the cells in general of any particular species. The ovum on its part exhibits a like reduction. To enquire further into this remarkable reduction process would lead us

into the discussion of variation and the Mendelian doctrine. I do but mention these matters here to call attention to the fact that not merely inheritance but variation is seen to be most intimately associated with the nuclear material, and that, if we can trust our eyes, the one morphological constituent involved in and responsible for all cases of inherited peculiarities and gamogenetic variation is included in the nuclear chromatin. That the other constituents of the cell have an influence or can have an influence we do not deny. If in the fertilized ovum the nucleus influences the cytoplasm, so conversely the constitution of the cytoplasm must tell upon the nucleoplasm. The facts in our possession indicate that the latter is the subordinate process; the influence of the nucleus is dominant. This is best indicated by Boveri's remarkable observation that if the nucleus be removed from the sea urchin's egg and the enucleated mass of cytoplasm be fertilized by the spermatozoon of another species of echinoderm the resultant larva is of the type of the species that afforded the spermatozoon, that is the nuclear material; this has conveyed and determined the specific properties of the individual.

Now, if this be so, it must follow that the nuclear matter controls all the essential cell activities, and this because, studied narrowly, it is seen that the morphological properties of a cell are the expression of the constitution of the cell; it is the constitution that determines the properties and functions of that cell. All are bound together every whit as much as are the properties of any given salt and the constitution of the same. What is true of the cell holds also of the multicellular individual; the specific properties of the individual are the summation of the properties of its component cells. If, therefore, nuclear composition dominates the morphology of the individual cell it dominates likewise the properties of the individual.

It must now be asked, what evidence do we possess establishing that this is really the case? That evidence may be dealt with under many heads. We have to deal with the evidence afforded by:

(1) The natural and experimental enucleation of cells. (2) Gross changes observed in the nucleus as the result of cell activities. (3) The finer changes in the same which may be seen to follow functional activity. (4) The histological changes in the nucleus associated with morbid conditions. (5) The chemistry of nuclear and cytoplasmic matter respectively, and (6) The ferment actions of the cell and their relationship to nuclear activity.

I believe that we have the good fortune to see here to-day those who have conducted investigations along each of these lines. Let me now

lay before you the main data that have been gained under each of these headings and the conclusions that may reasonably be deduced.

(1) *The Effects of Removal of the Nucleus.*

The cell which, like the erythrocyte, undergoes natural loss of its nucleus may continue to exist for a considerable period, and, during that time actively perform function. The mammalian red corpuscle for example, according to W. Hunter, Quincke, and others, exists from fifteen to thirty days. While it exists we see no evidence of growth, and certainly it never propagates itself. The same holds good for cells artificially deprived of their nuclei; they do not necessarily undergo immediate disorganization; they can be the seat of certain metabolic activities. According to Klebs, the enucleated cells of the alga, Spirogyra, can in the sunlight produce new starch granules; can, that is, synthesize starch from the carbon, oxygen and water absorbed, the starch thus formed in the sunlight being used up in the dark; and this may continue for as long as six weeks. They may further continue to exhibit motion in response to external stimuli (Lacrymaria olor, Verworn); they may actively ingest food particles. But, on the other hand, the testimony is unanimous that higher metabolic activities are incomplete. Unlike nucleated portions of a vegetable cell, the enucleated is unable to develop a cell wall of cellulose. Among protozoa also Verworn has noted that enucleated pieces of Foraminifera show not the slightest capacity to form the internal calcareous skeleton. If the enucleated cytoplasm of Thalassicola pelagica ingest foreign particles, it is unable to digest them wholly, and while the enucleated cytoplasm can develop a new centrosome (E. B. Wilson) it cannot give rise to new nuclear material. It may be laid down that if it can form new paraplasmic substances, like starch, it cannot form new cytoplasm and cell substance proper; that is to say, it cannot increase in bulk and undergo cell division and multiplication; or, otherwise, *these observations conclusively prove that the nucleus is essential, not merely for the vegetative activities, but also for the higher metabolic activities of the cell and their due co-ordination.*

That the nucleus alone deprived of surrounding cell substance cannot regenerate the cell is another matter. It has freely to be admitted with Verworn, Boveri, and Lillie, that there must be a certain minimal quantity of cytoplasm associated with the nucleus before regeneration can take place. But what this proves is not that the nucleus is not the dominating portion of the cell complex, but only that the association of nucleus and cytoplasm is essential for full cell activity. By the lack

of perception of this distinction it may be noted that Verworn's treatment of the whole subject of cell processes is greatly weakened, if not vitiated. His facts prove that nucleus and cytoplasm are equally essential for the full function of the cell, not that they are of equal value. We may as well argue that in the community of bees the individual drone or worker is of importance equal to the Queen, because we find that the Queen-bee, if separated from the rest of the community, is incapable of obtaining food for herself and so starves to death. I shall refer later to what I regard as the right conception of the relationship between cytoplasm and nucleus.

(2) *Gross Changes in the Nucleus during Activity.*

Among these may be noted, (1) alteration in the position of the nucleus in cases in which there are indications of localized as distinct from diffuse cell activities, and (2) alteration in size and shape of the nucleus accompanying active function.

In the animal organism possessing cells with a body which is small in proportion to the size of the nucleus, examples of the first order would appear to be rare, though they are not entirely wanting. Thus Korschelt has shown that in the egg rays of the water scorpion (Nepa) with their cells having remarkable branching nuclei; long branches from two adjoining cells send out processes which come into close proximity. In the space between these a chitinous deposit gradually shows itself, and when the mass of chitin is fully formed the processes are withdrawn. In the plant, movement of the nucleus towards the area of new formation in the cell is relatively common; thus when there is the active formation of a thick cell membrane along one aspect of the cell it has been noted that the nucleus becomes eccentric and approximated to the region of new development. There is a similar eccentric localization of the nucleus during the development of root hairs (Haberlandt). I need but mention instances of the second, viz.: of alteration in size—they are now so well known. The earliest observations were those of Heidenhain years ago upon the different appearance of the nuclei of salivary glands when at rest and after stimulation. In more recent years we have had the striking observations of Hodge, confirmed by Gustav Mann, Lugaro and others, upon the nuclear alterations in the motor ganglion cells of bees, birds, cats and other vertebrates, brought about by natural and experimentally produced fatigue.

These observations also clearly demonstrate that *the nucleus is not merely the vegetative centre of the cell, but is involved in its functional activities.*

(3) *Finer Changes Occurring in the Nucleus During the Course of Cell Activities.*

If I am not mistaken it was a native of what we regard as the youngest of the civilized great countries of the world—Professor Ogata—who first, in 1883, clearly recognized the finer nuclear changes associated with secretory activity. He called attention to the granules or plasmosomes appearing in the nucleus at the beginning of secretory activity, granules which take on the characters of nucleoli and pass from the nucleus into the cell body. In these he held that the zymogen granules are developed, which eventually become (part of) the protoplasm of the cell. In 1887 Lukjanow made confirmatory observations. He noted in the secreting cell outside the nucleus an agglomeration of little spherules which in form, size and reaction to dyes, were closely related to certain nuclear bodies (Kernkoerperchen). He drew the cautious conclusion that "it appears in any case that the hypothesis of a connection between the nucleus and the cell body has in itself nothing improbable, a connection shown outwardly by certain structural elements of the nucleus passing over into the cell body and there undergoing further change." In the following year F. Hermann noted the apparent discharge of similar minute globules in mucous goblet cells during secretion, and also called attention to the fact that these in staining powers resemble the nucleolus. These he found were absent from the resting cell. In 1890 Professor Macallum made his first report upon similar phenomena. He pointed out that in the nuclei of developing ova of Necturus (the Lake Lizard, found here in Lake Ontario), as also in that of the frog, at one stage the chromatin is principally collected in the form of nucleoli at the periphery immediately beneath the nuclear membrane. These nucleoli are usually spherical and vary somewhat in size. At this stage yolk granules are absent from the cell. With an indigo carmine dye he found that the nucleus and cell body stained red, whereas the nuclear bodies took on a deep blue. At what appeared to be clearly a later stage yolk spherules made their appearance, and when this happened the whole ovum stained blue, the nucleoli being diminished in size. What appeared to be an intermediate stage was seen in ova in which the nucleoli and the cell substance in their immediate neighbourhood exhibited a blue stain, while the rest of the nucleus and the main mass of the cytoplasm still stained red. It was difficult from these observations to arrive at any other conclusion than that the nuclear matter becomes differentiated into nucleolar, and that this diffuses gradually through the nucleus and then into the cell substance, the diffusion

coinciding in point of time with the formation of the yolk granules. Macallum thus regarded the yolk granules as formed by the union of a derivative of the nuclear chromatin with a constituent of the cell protoplasm. And we here note that these yolk granules chemically are composed in the main of lipoid material, of lecithin, a compound to which I shall refer later. In the pancreatic cells Macallum found—and Steinhaus has made similar observations—that the nuclei possess safranophilous nucleoli, while the rest of the nucleus with double staining takes on a deeper red colour of hæmatoxylin. As the nucleus loses its safranophilous substance the cell protoplasm acquires safranophilous granules. He concluded that the chromatin of the nucleus gives rise to a substance prozymogen; sometimes it is dissolved in the nuclear substance, sometimes collected in masses (plasmosomes); finally it diffuses out into the cell protoplasm, there meeting with a constituent of the latter to form the zymogen proper.

I might proceed to detail a long series of confirmatory observations by Carlier, by Bensley—made here in Toronto—by Maximow, Solger, Nicholas, E. Muller, Krause, Galeotti, Vigier, Garnier, Greenough and others, all agreeing—save *in minor* details—and all bearing upon the processes seen in gland cells. All describe the youngest, smallest, most deeply situated granules as situated in the immediate neighbourhood of the nucleus; describe these as identical in character with the plasmosomes or nucleoli seen without the nuclear membrane, and have observed that as they pass to a further distance from the nucleus they enlarge into definite secretory granules. It is with the exact stages of this process that there has been and still is some debate; whether they project as buds from the nuclear membrane or make their way out from pores opening into the same; whether they finally dissolve within the cell or undergo solution when discharged into the external medium. But Professors Macallum, Carlier and Bensley are all here, and I must not further steal their fire. I would only add that what has been determined in the animal cell holds for the plant cell also. Thus Torrey has described a succession of changes in connection with the nucleus and cell body in the germinating maize seed associated with the production of diastase. The processes are of an identical nature: deep staining granules are first seen in the nuclei whence these exude in small streams into the cytoplasm: scattered at first through the cell these later become collected at that end next to the endosperm where they become ultimately dissolved. It is following upon their dissociation that the first action of a ferment upon the cell wall and matrix of the endosperm becomes evident.

Nor is it only in connection with secretions possessing ferment action that we have evidence of nuclear function. In plants Schniewind Thies has observed nuclear changes in the nectar cells of flowers in connection with the elaboration of nectar. In animals, the curious vacuoles in the nuclei of fat cells which have been known for several years have more recently been shown by Shattock to contain and to give the reaction for fat.

These data almost justify us in accepting Claude Bernard's remarkable prevision of more than a quarter of a century ago that the cell substance is the seat of vital expenditure—while in the nucleus resides the power of organic synthesis. This does not, however, in our opinion, exactly represent the relationship, for the nucleus is also the seat of expenditure, nay, appears often to determine that expenditure. But clearly the indications are that the higher syntheses, those associated with growth and those governing the specific enzyme actions of the different forms of cell, are determined and initiated by the nuclear matter.

(4) *The Nucleus in Pathological Conditions of the Organism.*

Purposely when passing in review vegetative and proliferative phenomena I did not call attention to the evidence afforded by the study of the nucleus in cases of aberrant cell growth. It appeared advisable to consider the pathology of the nucleus by itself and from all aspects; and that more particularly because while the normal vegetative activities are not subjects for discussion this morning, there are those here present who, from their studies upon tumours, are prepared to speak upon the abnormal. At this point we have to call attention to the evidence of nuclear dominance afforded, (1) by cases of abnormal cell growth, (2) by cases of disturbed function.

Regarding the first of these I shall be brief.

It may be stated unhesitatingly that the majority of pathologists at the present moment regard neoplasia or blastomatosis as essentially a condition of aberrant cell growth, brought about not by the constant stimulus of intracellular parasitism, but by some primary alteration of cell environment. As a consequence of such alteration, if I may quote myself, the energies which, had the cells remained in their normal relation, would have been devoted to functional activities, become diverted to vegetative and proliferative. Your active malignant tumour cell has characteristically all the attributes of a vegetative cell, or, as it is usual, perhaps unfortunately, to express it, is of the embryonic type. Associated with this we find that the growing tumour exhibits abundant

mitoses, and what is more, the growth being aberrant, we find a well pronounced tendency for the mitoses also to be irregular. We thus encounter a great variety of changes, (1) dispersion of chromosomes in the cell body as the result apparently of rupture of the threads of the achromatic spindle, (2) asymmetrical mitoses, (3) multipolar mitoses, (4) hypochromatosis with diminution either in the number or in the size of the chromosomes, (5) hyperchromatosis with increase whether in number or size of the chromosomes. (6) Associated with degenerative changes and rapidly growing tumours we may encounter the development of paranuclear bodies (Nebenkerne), sometimes of large size and modified staining properties, lying in the cytoplasm and clearly derived from the nuclear matter.

The existence of these abnormal nuclear conditions in connection with tumour growth is most significant. Beyond this statement, that it is difficult to arrive at any other conclusion than that there is an intimate relationship between these nuclear vagaries and the abnormal cell growth seen in malignant tumours, I feel it is unsafe to venture; for, as Dr. Bashford, who is here with us, has frankly acknowledged, more advanced hypotheses based upon these abnormalities have not stood the test of extended investigation.

Turning now to observations upon the nucleus in pathological conditions other than those associated with aberrant growth it may, in the first place, be noted that cases may be recalled bearing upon the cell when it passes into a latent or dormant condition. While we cannot go as far as Grawitz and accept the existence of "slumber cells," in which the nucleus and its chromatin have become so shrunken as to be invisible, we can, I think, note that with the arrest of cell function and passage into an inert state, the nuclei undergo shrinkage, becoming extremely small and attenuated, as in the fully formed connective tissue, fully formed fat cells, etc.

It is in connection with cell irritation and the commoner acute degenerations that the nuclear changes become most evident. It is a matter of familiar knowledge that pronounced changes take place in connection with cloudy swelling and, to employ the old term, fatty degeneration, as distinct from fatty infiltration of the cell. In cloudy swelling, which so commonly accompanies the acute fevers and conditions of intoxication, we note, more particularly in the cells of secretory glands, that the nuclei, which in the first stage of irritation may become more intensely stained, rapidly lose their staining property and become indistinct, and the cell body becomes filled with granules of albuminous nature. Stolnkow was apparently the first to make accurate studies upon the changes that occur in these degenerative processes;

many others have since noted the same collection of the chromatin in the region of the nuclear membrane, the discharge into the cytoplasm (well seen in phosphorus poisoning), have described these little masses as first staining like nuclear substances, and later losing the nuclear stain completely, the cell body becoming filled with shell-like clear staining globules. The more recent work of Schmaus and Albrecht, Lubarsch and others has confirmed and extended these observations, the former observers calling particular attention to the formation of nuclear buds, as also to the hyperchromatosis and karyorrhexis in gradual death of the cells of various organs. There are, needless to say, other changes seen in the degenerating cell—Pyknosis, or contraction and clumping of the nucleus and nuclear material—Karyolysis, or complete disappearance of the chromatin; these are evidently post-mortem conditions (*i.e.*, in the cell), and need not here be considered. From those first mentioned it would seem that the cell may recover. They represent exaggerated conditions of normal processes, but where the latter stages show themselves regeneration of the cell becomes hopeless.

As to the significance of this discharge of nuclear material I shall have a little to say after we have discussed the chemistry of the nucleus. Professor Ewing is here, and he and others will, I trust, discuss the relationship of these modified nuclear discharges to the intracellular appearances which have by many been regarded as cancer and vaccine or variolous organisms.

(5) *The Chemistry of Nuclear and Cytoplasmic Matter Respectively.*

Here in studying the chemical composition of the two components of the cell we meet with certain remarkable facts, for not a few of which we are indebted to our colleague, Professor Macallum. There are certain substances of great chemical activity bound up in the nuclei which are present to but slight extent, if, indeed, at times they can be recognized in the cell body. Notably is this the case with phosphorus (Lilienfeld and Monti, Macallum) as also with "masked" iron—iron, that is, in fairly firm combination so that it is only loosened and made to respond to the tests for free iron after having been subjected to preliminary dissociative treatment. On the other hand, certain substances found to be present in the cell body are absent from nuclear matter; among these, as Macallum has pointed out, is potassium. When now we come to study the proteid contents of the nuclei we find that these, unlike ordinary proteids of the cell body, are undigested by gastric juice, and that the undigested material consists of the nuclear network and its chromatin and the nucleoli. We owe especially to Kossel's investigations the explanation of these peculiar features. Cell

nuclei, that is, contain as a main constituent, a special group of proteids—the nucleoproteids. These nucleoproteids split up into albumen (histon) and nucleins, and it is these nucleins in particular that resist the action of gastric juice and further are characterized by high phosphorus content. These, like the nucleoproteids, are of a proteid nature; upon further decomposition they yield albumen and nucleic or nucleinic acid, and can be further broken down into the xanthin bases or purin bodies. It is more particularly the existence of phosphorus and these xanthin bases that differentiate the nucleus from the cell body. How the iron is combined is as yet undetermined. We know at most from Spitzer's observations that it is the iron containing products of dissociation of the nucleoproteids that retain the oxidative properties. But clearly in the nucleus we have as essential constituents compound proteids of great complexity of organization. As Spitzer, Herter and others have indicated, the iron is of the utmost importance in bringing about oxidative processes, while the phosphorus likewise would appear to favour oxidative changes. *These and other chemical considerations tend to the conclusion that nuclear material possesses in itself potentialities superior to those of any ordinary constituent of the cell body,* and again support the view that the nucleus is the centre or source of the higher cell activities. Jacques Loeb, indeed, has been led to the conclusion that the nucleus is the centre of the oxidative processes of the cell, and the correctness of this view has of late been demonstrated by his pupil Lillie.

(6) *The Ferment Actions of the Cell and their Relationship to Nuclear Activity.*

It would open up too large a field to detail and weigh the data indicating that nuclear matter is the essential source of those bodies which afford the enzyme actions of the cell. We would merely note in passing that it is now universally accepted that much of cell function—I do not say all—is the outcome of enzyme action, and I would recall the data already brought forward to show that in the absence of the nucleus the higher specific cell activities are at a standstill; the evidence also of the relationship of the nucleus to the formation of zymogens.

Referring to the discharge of plasmosomes or spherules of nuclear matter into the cell body it may now be asked what chemical processes do these indicate. It is suggestive that under normal conditions this discharge has been noted in cells affording specific secretions, and in abnormal conditions accompanied by the accumulation in the cell body of modified paraplasmic granules or globules. It is at least suggestive that in autolysis (the self digestion of tissues removed from the body

under aseptic conditions) we note a diffusion out of nuclear chromatin, and following upon this the formation in the cell body of myelin granules and masses. Everything indicates that these myelin masses so formed are complex lipoid bodies; they contain fatty acids, more particularly oleates, and studying the composition of what is regarded as the simplest group, the lecithins, we find that they are compounds of a nitrogenous base (cholin) with glycero-phosphoric acid and a fatty acid. Where these make their appearance in the cell undergoing autolysis, and probably in other conditions, we must conclude that the glycero-phosphoric acid is of nuclear origin, and, leaving aside for the moment the question of the seat of origin of the nitrogenous base, remembering that the nucleus of the ordinary cell is devoid of fat, we are led to regard these lecithins as combinations between matter of nuclear origin and fatty matter from the cell body. These lecithins are bodies having very remarkable properties, both chemical and physical; they have great powers of holding other substances in solution, and this is true of all the myelin bodies. It may well be that the suggestive series of nuclear changes and cell accumulations which we find in the cloudy and fatty groups of degenerations, represents successive stages in which the development and dissociation of bodies of this type play the essential part. In our studies in Montreal during the last three years on calcareous and fatty degeneration this matter of the formation of compounds of albumen and fat has constantly been brought before us. Dr. Klotz (in this following upon the conclusions of Brücke long years ago) has brought forward data favouring the view that direct union may occur between the two; but he will be the first to admit that an absolute chemical proof of the existence of such compounds is singularly difficult to adduce. It is true that working with Professor Aschoff at Marburg, we have recently demonstrated the combination between nitrogenous bases, such as cholin, and oleic acid, but this is another matter—nitrogenous bases while built up into proteids are not proteids. If then we are not as yet wholly certain of the existence of oleates of albumen, it is a well ascertained chemical fact that lecithin can combine directly with albumen to form albuminates. Thus, lipoids of the nature of the lecithins afford us the necessary linkage bodies between various albumens and between albuminous and fatty acids.* As regards their importance in this connection we would only call attention to Preston Kyes' remarkable observations upon the part played by lecithin as complement, or linkage body, between certain

* The mucins would seem to represent a parallel group of carbohydrate-proteid compounds, and the histological observations of Steinhaus, Maximero and others demonstrate most clearly that nuclear matter is concerned in their development; indeed, in goblet cells, according to Steinhaus, there is a total conversion of the old nucleus of the cell into mucinogen.

serum- and cell-proteids and snake venom. It is interesting to note how almost simultaneously during the last few months independent workers in Germany, France, the United States and England, approaching the subject from widely different points of view have converged to the same conclusion that the lipoids are of singular importance in the cell and in relationship to metabolic processes. We seem at the threshold and in its shadow, and see already the light within. But here at the threshold I must stop.

Before closing, however, there is a question which I doubt not has arisen in your minds, and one which must be answered.—"You arrogate," it will be said, "all these powers to the nucleus—what part is played by the cytoplasm?" To this I would answer that passing further and further backwards in our endeavour to comprehend what is life, if we believe in living matter and that vital phenomena are the expression of the effects of physical and chemical forces acting upon that matter, then our ultimate conception of life must be that it is the function, or the sum of functions, of a special order of molecules. For convenience we would term these ultimate molecules of living matter, *biophores*. However much we strain our imagination it would seem impossible to conceive the existence within the cell of two orders of molecules of widely different type, but of equal value, which, by their interaction, initiate vital processes. We must premise that there is in each form of life one order of living matter. If so, the biophores must be contained either in the nuclear matter or in the cytoplasm, and as we have shown that the higher vegetative powers of the cell are intimately associated with nuclear matter, it is in the nucleus that we must locate these biophores, and we must therefore regard the cytoplasm as composed of subordinate matter and as having what must be termed sub-vital functions.

Now, the simplest conception that we can form of these biophores—and even in the very lowest forms of life they must be singularly complex—is that they are rings or rings of rings, carbon and nitrogen containing, and of the benzol type. The only satisfactory conception of growth, of multiplication of these molecules, is that the pre-existing rings possess unsatisfied affinities and attract side chains of various ions, simple and compound, from the surrounding media, and that these become grouped in a manner identical with the grouping present in the pre-existing biophore. In other words, we must regard the building of the new biophoric molecules as obeying laws of the same order as those which determine the building of ions out of a solution to form crystals of a particular form of salt, but with this difference,

that so far we have no evidence of biophores becoming formed anew save under the influence of pre-existing biophores—we know no case of spontaneous generation. Thus, growth demands affinities and side chain formation on the part of the biophores. As with evolution the biophoric molecules have become more complex we would suppose that ions and radicals have become attracted and attached not in ring arrangement but in loose series and loose connection with the biophores. As in growth new biophoric molecules are formed in association with the pre-existing the result is an inevitable tendency towards the grouping of the biophores in a central mass surrounded by a zone of other attracted matter. With the development of such a complex the biophoric molecules proper are no longer in direct and immediate relationship with the outer medium; there is interposed between the two an intermediate mass. The direct attraction of new matter is, in the main, accomplished by the intermediation of this outer cytoplasmic zone. So that eventually we reach the stage in which with increasing complexity of organization the biophoric molecules proper deprived of the outer cytoplasmic zone are unable to attract ions to themselves in the proper order—these must first have been built up into particular orders of radicals within the cytoplasm. In other words, the presence of preformed cytoplasm becomes essential for the continued existence and growth of the nucleus—of the nuclear-biophoric matter. Each becomes essential for the continued existence of the cell as a whole.

This, frankly, is all hypothetical, but it is the hypothesis which seems best to throw light upon and to harmonize the data we possess regarding the function and the relative importance of nucleus and cytoplasm respectively.

To-day I feel I shall have done some service if I have demonstrated the dominance of the nucleus and impressed you with the conviction that the future will see not merely a cellular but a nuclear pathology and physiology. From the *omne vivum ex vivo* to the *omne ovum ex ovo* and the *omnis cellula e cellula* of our predecessors we now reach the *omne chromosoma e chromasomate* of the modern student of development and see before us surely the conclusion *omne biophorum ex biophoro ejusdem generis.*

If this be the ultimate conclusion of the investigator it is at the same time the point from which chemist and physicist, anatomist and physiologist, pathologist and physician must start to develop harmoniously, each along his respective line, their various conceptions of vital processes, and, as the indications are that these biophores exist in the nucleus so it is that to the nucleus and its alterations each of

us, whatever his particular branch of biological science, must apply himself for the fullest, most intimate grasp of the succession of changes that take place in health as also in disease.

BILHARZIA HÆMATOBIUM.

Blood Fluke.

BY

HARRISON R. ROSS, M.D.,

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Bilharz, in the year 1851, while engaged in the study of the diseases of Egypt, discovered that the endemic hæmaturia of that country was due to the presence in certain veins of a trematode worm to which he gave the name of "Distoma Hæmatobium," afterwards better known as "Bilharzia Hæmatobium," after the discoverer.

This disease, while very prevalent in Egypt, Arabia, Mauritius, and certain parts of South Africa, is practically unknown in America—being only met with in imported cases. These have evidently been very rarely found up to the present time, as in my search through the literature of the subject I have succeeded in finding reports of only four or five, all of which were seen in the United States.

As I have at present two cases of Bilharzia under observation, the patients having been infected while on military service in South Africa, it has occurred to me that in view of the many Canadians and immigrants who, having served with the British forces during the late Boer War are now settled in Canada, the disease may be more often met with than formerly.

That a large number of the men were infected with this parasite during the campaign is beyond doubt, as pointed out by Hardy and Douglass in a very interesting article on the subject in the *Lancet*, of October, 1903. What information I have been able to glean seems fully to bear this out.

Hæmaturia,—the primary and practically the only symptom of the disease in the first few years of its course,—being one common to so many pathological conditions of the genito-urinary tract, there is at once suggested a wide range of possibilities. But if the fact can be elicited that the patient had resided in a country where the parasite is indigenous the possibility of Bilharzia would at once be suggested, and if confirmed by a microscopic examination of the urine a great deal of unnecessary and painful instrumentation might be avoided.

As there is very little to be found relative to this parasite in our text books, the subject being left to writers on Tropical Medicine, a short description of the worm and ova together with the accompanying plate may be of assistance in recognizing the latter under the microscope.

The worm is a soft white creature, differing in shape and size in the two sexes. The body of the male, about 12 mm. long by 1 mm. broad, is flat with the edges enfolding over the ventral surface forming a cylinder wherein the female is enclosed during congress.

The female is filiform in shape and longer than the male, measuring about 20 mm. and darker in colour.

The ovum, the most important feature for the purpose of diagnosis, is oval and measures about 0.16 mm. in length, though there is a considerable variation in size in those seen on any one slide under the microscope. They present a terminal or lateral spine, as the case may be,—which difference has not as yet been satisfactorily explained. While the spine is invariably at the end on the ova found in the urine, it is said that those found in the fæces present the lateral spine. In an article by Herbert Gunn in the *Journal of the American Medical Association*, Vol. XLVI, No. 14, he expressed the opinion that the lateral-spined ova are produced by a different species of worm.

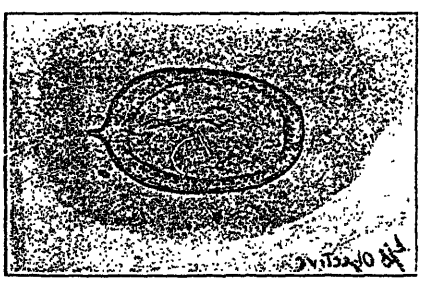
Apparently very little has been added to our knowledge of the habitat and life history of the worm since the investigation of Bilharz. In regard to the mode of infection, while it is generally admitted that the parasite gains entrance into the human body by being swallowed in infected food and water, it seems probable that it may directly infect the bladder and rectum through the external orifices while bathing. By whatever channel the worm gains entrance into the body it eventually finds its way into the veins of the portal circulation and urinary organs, principally in those surrounding the bladder and rectum, where they make for themselves in the walls of these viscera under the mucus lining, a smooth walled nidus communicating with the veins and which is in reality nothing but the altered blood vessel. The ova then force their way from the nest into these hollow viscera and appear in the urine and fæces, the sharp spines with which they are armed possibly assisting them in their migration through the intervening tissues. The parasite itself is never found in the excreta.

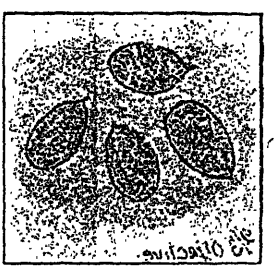
It would appear that, in the vast majority of cases of Bilharzia, the lesions caused by the parasite and the migrating ova must be very slight indeed, as little inconvenience is experienced by the host,—the only symptoms being the presence of some small clots of blood in the urine, the slight burning in the urethra on micturition.

In Natal a very large number of the male inhabitants harbour the parasite, but few are seriously inconvenienced. This applies particularly to the young boys of the country, who seem to be exceedingly susceptible, but, as a rule, on arriving at puberty they then throw off the disease.

Bilharzia may, however, give rise to the most intense suffering; incessant desire to micturate, dysentery, profuse hæmaturia and melæna being the principal symptoms. The patient loses weight and becomes anæmic and dull from loss of blood. In these severe cases the mucous membrane of the bladder will be found swollen and hyperæmic, with ecchymosed patches varying in size to that of a shilling and coated with a tough mucus or layer of grayish yellow exudation. When the intestines are involved the walls of the rectum show similar lesions, and dysentery, tenesmus and melæna set in.

Even in those mild cases in which the patient is not aware that he harbours the disease, the ova acting as foreign bodies in the bladder,





not uncommonly become encrusted with urinary salts and form the nucleus of small calculi which, as a rule, pass out through the urethra. It is remarkable, however, that in Egypt not only does this occur more frequently than in other countries where the parasite is indigenous, but the disease often leads to the formation of very large stones necessitating surgical measures for their removal.

The course of the disease is slow and insidious, often lasting many years before any serious symptoms develop, but eventually it may spread throughout the whole urinary tract and the ureters become occluded by the masses of ova and the infiltration of the walls.

The danger to life depends very much upon the severity of the infection, but is, as a rule, not serious, as in the great majority of cases the parasite dies within the host and recovery follows. Even, however, in slight infections it is the cause of a very distinct predisposition to intercurrent diseases.

The treatment of Bilharzia is unsatisfactory in the extreme, and while the symptoms may be relieved to some extent, nothing has as yet been found that will affect the parent worm and thus rid the patient of the disease, though a large number of drugs have been tried, among which are chiefly the urinary antiseptics as urotropine, benzoic acid, salol and methylene blue. Draughts containing male fern or turpentine seem to have been most used, but with indifferent success.

The condition of the bladder may be treated by irrigations containing one of the many mild antiseptics generally used for that purpose with a very fairly satisfactory but temporary result. The general health should receive attention and be kept up by good food and tonics—iron being indicated where there is a severe loss of blood.

Of the two cases I now have under observation the first came to me complaining of "passing blood in the urine, vague pains over the region of the kidneys, slight burning on micturition and increased frequency, loss of weight, and a general feeling of weakness and lassitude." His appearance was, however, good, temperature and pulse normal, mucous membranes good colour.

On his first visit to me I did not go into the history of the case, but merely inquired into the symptoms and made a three-beaker test of the urine, which showed the whole bulk to be distinctly blood-tinged, and in the third beaker a large quantity of blood clots, varying in size from a grain of rice to that of a pea, also a considerable quantity of deposit.

This specimen was handed to Dr. W. H. Delany, pathologist at Jeffery Hale's Hospital, who reported that it contained besides blood and vesical epithelium a great number of the ova of Bilharzia Hæmatobium.

Upon again seeing the patient I learned that in 1900 he went out to South Africa with one of the Canadian Contingents and served there for three years, being stationed for a good part of the time in Natal. Shortly after his discharge in 1903 he noticed for the first time an increased frequency in the desire to micturate, and occasionally the passage of a few small clots of blood at the end of the act. The presence of these clots gradually became more and more frequent until, at last, it occurred each time he voided urine.

During the first two years there were no further symptoms, but about a year ago the quantity of blood increased and he began to suffer from pain in the region of the kidneys and perineum, with a general feeling of weakness and lassitude. Recently he has at times been troubled with diarrhœa, and occasionally has noticed streaks of blood in the stools. As the nature of his employment necessitated a good

deal of heavy work and exposure, which seemed to aggravate all the symptoms, he was obliged to give it up.

Since the beginning of the trouble he has been under almost constant treatment for some one of the many troubles of which hæmaturia is a symptom, the actual condition never having been recognized.

The examination of the interior of the bladder, while not altogether satisfactory on account of the blood obscuring the view, reveals no marked changes in the mucosa beyond a general hyperæmia, nor could any changes be detected in the mucous membrane of the rectum.

My second case very well illustrates the fact that while a patient may have a considerable number of ova in the urine he does not necessarily suffer any inconvenience, even though the disease is of some years standing.

This man, after having served in South Africa for several years in the Constabulary, noticed on three or four occasions a very small clots of blood in his urine — and, although he had very often heard of "Red Water" and had actually known of several men in his company who had suffered from it, he did not seem to connect his own symptoms with the disease, as they were so slight and his general health perfect.

The ova in this case, while not so numerous as in the first, can be found without difficulty on every slide made from the deposit in the urine which contains also a considerable amount of pus and epithelium and a few red blood cells. Dr. Delany reports that in both cases the ova contained in the urine present the terminal spines, and that he has been unable to find any in the fæces notwithstanding the fact that one of the patients has symptoms of beginning trouble in the rectum.

The examination of the blood of these two patients, as is always the case in parasitic diseases, shows an increase in the number of Eosinophiles to seventeen per cent. and five per cent. respectively.

While in the past Bilharzia Hæmatobium has been looked upon in America rather as a medical curiosity than as one of the diseases we have to deal with, it appears to me, from what I can learn of the prevalence of the disease among the men who served in South Africa, that it may now be much more often met with,— as in all probability many of the ex-soldiers now scattered throughout the Dominion harbour the parasite, and sooner or later will present themselves for diagnosis and treatment.

I wish to add my sincere thanks to Dr. Delany for his valuable assistance, and particularly for the diagnosis in both these cases.

ADDRESS IN SURGERY.

Delivered at the Seventy-Fourth Annual Meeting of the British Medical Association.

BY

SIR VICTOR HORSLEY, F.R.C.S., F.R.S.

Late Chairman of the Representative Meeting of the British Medical Association; Surgeon to University College Hospital, and to the National Hospital for the Paralysed and Epileptic, Queen Square.

ON THE TECHNIQUE OF OPERATIONS ON THE CENTRAL NERVOUS SYSTEM.

In considering in what way I could best fulfil the extremely honourable and at the same time responsible duty of delivering the Address in Surgery on the occasion of such a meeting as this, it occurred to me that exactly twenty years had elapsed since I showed at the annual meeting of the Association at Brighton the first three patients upon whom I had operated at Queen Square Hospital for intracranial disease. Many of what were then regarded as special points in the technique of operations on the central nervous system are now, thanks to the work of surgeons in every part of the world, household words. The principles then advanced were chiefly based on experiments on animals. During the past twenty years further experimental research on animals and clinical observations on human beings have confirmed and extended the general soundness of the broad principles underlying the treatment then proposed.

I intend, therefore, to-night to analyse my cases at the National Hospital, Queen Square, and facts which we have gained therefrom since 1886, while from my experience at University College Hospital and in private practice, I shall only quote such cases as are unique, or particularly demonstrate certain points.

The considerable interval of time which has elapsed since the Brighton meeting has also permitted of such an accumulation of facts that important questions of diagnosis and prognosis, which were matters of much doubt in 1886, can now be more readily answered. In fact, the advance in technique of the surgical treatment of diseases of the brain and the spinal cord has been relatively less than the improvement in our knowledge of the seat and nature of the diseases for which surgical intervention is useful and necessary.

Correct diagnosis in diseases of the nervous system is still far to seek, and yet operative treatment in such a difficult field is often expected to yield as good results as the relatively easier and simpler work of curing herniæ or removing abdominal tumours.

It will soon appear of what immense importance it is to the community that the study of neurology should be pushed forward by every means in our power in order that the earliest commencement of a tumour of the brain should be determined as certainly as that of one nearer the surface of the body. The International Commission for the advance of this branch of science, which owes its inception to the great German anatomists, Professor Waldeyer and the late Professor His, will, it is hoped, have a co-ordinating and fostering influence on the work.

But the twenty years of medical and surgical work which have passed have done more than improve our topographical knowledge of the probable seat of encephalic lesions, they have taught us from the operating theatre what previous generations had never learnt in the *post mortem* room—namely, a great deal of the vital pathology and true anatomical nature of brain disease. How often we see the nature, structure and treatment of cerebral tumours discussed on the basis of such growths as are seen at autopsies, that is, when they have reached such a maximal degree of development as to have caused death! *Post-mortem* records can never teach what the careful study of the living tumours exposed in an operation can demonstrate, since in almost every case the former condition is practically what we may term inoperable.

I must first briefly allude to the responsibility of the surgeon in the treatment of diseases of the central nervous system. As in all special branches of medicine and surgery which are in a process of evolution, it is not easy to assign credit or blame when the course of treatment pursued is respectively successful or unsuccessful; but so long as our powers of diagnosis remain as imperfect as they are so long will the vulgar error of regarding surgical treatment as a *dernier ressort* be committed. This question, namely, When should medicinal treatment be given up and operative treatment substituted? has been raised again and again and hotly discussed in connexion with many diseases, notably appendicitis.

In 1890, hoping to secure a more logical and definite pronouncement on this fundamental point at the International Medical Congress, I proposed that in cases of Jacksonian epilepsy and other syndromata which suggested the existence of gross organic disease of the brain, a definite probationary period of medicinal treatment should be agreed upon, and that an elementary case where no urgent symptoms like optic neuritis existed surgical treatment should be employed after thorough drug medication * had been energetically applied for about six or eight weeks and cure had not appreciably resulted. No conclusion, however, was arrived at.

*Practically such drug treatment means mass treatment with the iodides, combined or not with mercury.

Again, in 1893 I was unable to get an expression of opinion on this point, although Dr. Allan Starr, in his well-known work on "Brain Surgery," had also formulated the conclusion that the surgeon should be invited to consultation in the case after about three months' medical treatment had been unsuccessful. Although such a course is in general the practice at the Queen Square Hospital, this view of the situation unfortunately has not yet been discussed in the profession. Even in the present I have been asked to operate on a patient with a lateral tumour of the cerebellum who had been known to have optic neuritis for nine years, and last year I did operate on such a patient who had been known to have optic neuritis for thirteen years.

Assuming now that in a given case surgical treatment is considered advisable, the question immediately arises for what precise purpose is it to be employed, for all treatment, medical or surgical, is either palliative or curative. These two aspects of the matter require separate consideration.

Palliative Surgical Procedures.

It is a prominent characteristic of intracranial disease that (1) it is liable to produce optic neuritis, which customarily ends in total blindness; (2) it may concomitantly cause severe headache and vomiting, all of which symptoms are dependent upon pressure, and can be completely palliated or wholly removed by making a sufficiently free opening in the skull and dura mater.

The first of these, namely, optic neuritis, is a condition which, owing to its causing blindness, is of such vital importance to the interest of the patient, and so to the community, that it merits full attention. In 1886 its pathological causation was a matter of acute controversy, but we learnt by a very few years of operative surgical experience that, whatever other factors might be concomitant, the most important one in the production of optic neuritis was increase of the intracranial tension, and thus it happened that our earliest experience was the strikingly rapid subsidence of the optic neuritis when the skull and dura were opened. Therefore it is now possible to dogmatize on this question, and to say that in no case of optic neuritis (not of course of toxæmic or anæmic origin) should the process be allowed to continue after it has once been diagnosed, and that if blindness results therefrom the responsibility is very heavy on any one who fails to advise such a simple proceeding as opening the dura mater. The gravity of this responsibility does not seem to be generally recognized, and it is owing to this as well as to the backward state of neurological diagnosis that melancholy cases such as the following occur. A. B., lady, married, developed symptoms of cerebral tumour with acute optic neuritis, and was told by a neurologist

that nothing could be done surgically. Subsequently, and after some treatment with the iodides, the neuritis subsided into complete atrophy and blindness, while the cerebral lesion gradually retrogressed. When the patient came under my observation in the spring of this year, her physical condition was apparently perfectly normal except the permanent loss of sight. This calamity would have been wholly avoided by operating to relieve the optic neuritis, even if nothing further had been attempted to deal with the lesion itself.

As regards the procedure to be adopted, my own experience is that although in rare instances the neuritis may begin to subside after even the first stage of only opening the skull, it is, as a rule, necessary to make a free opening in the dura mater to effect this purpose. One reservation must be made, that in cases where the tumour directly involves the optic tract, the specially delicate anatomical structure of the optic tract may negative the attaining of this otherwise invariable result.

In predicting what will be the condition of vision after surgical treatment of the optic neuritis, everything depends upon the care with which the ophthalmoscopic appearances of the disc are interpreted. Yellowish-white stippling, patches of exudation, or opal white atrophic changes, especially when associated with macular figures, all indicate that the secondary changes in the disc are likely to be permanent, and, therefore in proportion to their development so the vision will be impaired whereas when the loss of vision has been dependent simply on the swelling of the disc, then not only is the sight saved but largely improved. For some further discussion of this most important point from the point of view of the ophthalmologist, I would refer to Mr. Leslie Paton's recent analysis of the Queen Square cases which contains many of the results of my operations.

One more point must be mentioned in connexion with optic neuritis, because although of more importance in diagnosis than technical procedure I find it is of the utmost value in indicating to the surgeon on which side he should operate. I refer to the localizing value of the incidence of the optic neuritis. Varying statements have been made on this subject from time to time, namely, that (a) the optic neuritis begins on the side of the lesion, (b) that it begins on the side opposite to the lesion, (c) that sometimes one thing happens and sometimes the other according to the position of the lesion in the skull, for example, whether above or below the tentorium and acording to the nature of the lesion. I wish to lay down the position drawn from an examination of my own cases of intracranial tumour that the optic neuritis commences on the side of the lesion. I am quite aware that true exceptions may yet be found to this rule, but I would point out that some of the exceptions hitherto described have not been real, that in any given case it is not a

question merely of the number of dioptres of swelling of the disc, but it is also a matter of the anatomical changes in the disc, and finally that by the time the patient comes under observation the disc on the side of the lesion may be actually subsiding into decadent conditions at a time when the opposite disc is rising into its maximal swelling.

To sum up, then, during the past twenty years we have learnt that although the old procedure of de Wecker of incising the swollen sheath of the optic nerve in the orbit is of no avail, we can with certainty avert blindness by opening the subdural space early in cases of intracranial disease. [Preferably in the basal temporal region of the right side, that is, assuming that no attempt is made to attack the disease itself.]

Curative Surgical Procedure.

If the operation is undertaken for the purpose of effecting a cure we have to consider (1) what is the nature of the disease, (2) what loss or aberration of nerve function it causes, (3) whether if the lesion be wholly extirpated there will be a recovery from the disorder of function, and (4) whether any loss which may have been present before operation will be made permanent by the necessary extirpation of particular regions of the brain.

On points like the last it is evident that we cannot give a satisfactory opinion until we know precisely first what parts of the central nervous system alone contain the representation of movements or the record of sensation, and consequently of what parts does destruction entail permanent loss of function. In other words, we require to learn from the cerebral physiologist under what circumstances and to what extent can we get compensation of function when various parts of the cerebrum and cerebellum are destroyed.

1. *As Regards the Cerebrum.*—Apparently from the clinical records we can generalize thus far, that special motor functions cannot be restored if the whole of their cortical representation be removed. The same thing is probably also true of the special senses, and certainly is true of the hemianopic representation of sight. Succinctly stated, this amounts to the generalization that compensation is not possible after the destruction of middle level centres. The higher sensory representations and *a fortiori* the intellectual functions are, on the contrary, not permanently abrogated by the destruction of any part of the cerebral hemisphere. The net conclusion, however, must be that as little injury as possible should be done, and no more removed than is absolutely necessary.*

*It being always understod that this does not apply to the skull but only to the nerve structures. The opening in the skull must always be free to allow of a proper survey of the brain.

2. *As Regards the Cerebellum.*—This question of compensatory power is of notable scientific interest when studied in the cerebrum, which is so clearly an assemblage of different nerve centres (in fact we might almost say organs), but it is no less interesting in the study of a homogeneous structure like the cerebellum, and has assumed a particular importance in the present subject because of Professor Frazier's proposal to extirpate the lateral lobe of the cerebellum in preference to pushing it aside by displacement for the purpose of reaching deep-seated tumours. My own experience is against such extirpations for convenience. In fact, I regard them as an unnecessary multilation, though quite admitting that in the process of removing a large tumour in that region the cerebellum is considerably bruised when so pushed aside. I ought to add that although I have removed a considerable number of lateral recess cerebellar growths, I have never found it necessary to do more than compress the cerebellum aside (see Fig. 4, Plate 4).

As to whether there is loss of function from such displacement involving bruising of the cerebellum, I have followed up the longest surviving case that I could find in the Queen Square series, namely, one of cerebellar tumour and cyst combined, which I operated on eleven years ago, when the patient was a boy of 14. He is now a healthy young man of 25. In this case the tumour was a large one, situated in the right lateral lobe of the cerebellum, which was consequently markedly compressed, and probably the dentate nucleus of that side was also affected. The only indication of loss of physiological function that he now presents is a slight unsteadiness of the hand when he is particularly fatigued, as for instance after a long bicycle ride. There is distinctly a plus tension of the normal cerebro-spinal fluid. As far as the cerebellum is concerned, whether this remarkable recovery is due to restoration of function of the bruised portions or compensation from the uninjured part cannot yet be determined with certainty (I believe the former), but the conclusion I would draw is that we should preserve as much as possible of every portion of the encephlon which is not absolutely shown to be diseased.

At any rate cases either cerebral or cerebellar dealt with on these lines show a remarkable power of recovery of function.

Consideration of the Details of Operative Procedure.

Perhaps the most convenient way of continuing this review of the technique and procedure of encephalic operations will be by taking the essential steps of such operations *seriatim*, and virtually it will be found that the fundamental purpose of every detail is the prevention of shock

and the maintenance of the physiological integrity of the nervous system.

(*a*) Previous Preparation.

The general preparation of the patient by dieting, enemata, etc., is the same as for all operations. In a few instances I have found calcium chloride of probable service in cases where oozing from the bone or superficial tissues was to be expected, as in cases of penetrating endotheliomata of the skull.

The head and cavities in relation to it having been thoroughly disinfected for two or more days with sublimate and carbolic acid, the patient is placed on the table in such a position that, while the head is elevated to diminish the pressure in the venous sinuses, the shoulders are also slightly raised, so that the glottic respiration is not interfered with. If the operation is to be on the cerebellum the patient is placed on his side, with the uppermost arm drawn downwards. By these simple means complete access can be gained for any operation on the encephalon without subjecting the patient to constraint which affects both the circulation and the respiration. This question of posture of the head is no mere matter of convenience to the operator, it is an extremely serious one to the patient for the satisfactory performance of the operation, and is only to be secured by having a suitable head-rest, such as the fork rest of Professor Frazier or the one I use.

(*b*) Anaesthesia.

The all-important question of anæsthesia must next be considered. My own experience is confined to general anæsthesia, for I have never yet employed the intraspinal injection of cocaine or stovaine.

Since the use of an anæsthetic agent should, I think, extend beyond the production of analgesia, and include among other purposes the convenience of influencing the blood pressure at will, intraspinal anæsthesia is of too limited applicability because control of the intensity of narcosis is lost. Moreover, in man, cases the psychical effect produced by the preparations for an operation upon a patient suffering from a lesion of the central nervous system might be unfavourable unless consciousness were abolished. However, after the very remarkable results of Morton and others, this question must be regarded as quite an open one and may indeed help to decide the best means of avoiding shock in this department of surgery.

In 1886 I suggested, in view of the remarkable power that morphine possesses of contracting the cerebral vessels, that it was better to use a

combined anæsthesia of morphine with chloroform, a combination which many years before was largely advocated in general surgery. Unfortunately the adverse effects which morphine produces on the alimentary canal have always proved a bar to its common use. As regards the central nervous system also it has a disadvantageous action on the respiratory centre, and since the energy of this is already lowered by the shock of the operation I gave up the combined anæsthesia and have employed pure chloroform only for many years.

Of the general anæsthetic substances at our disposal, therefore, there are at the present time two for practical discussion, namely, ether and chloroform.

Of these two, numerous experiments on animals in 1883-5 proved to me the striking disadvantages of ether, in spite of its greater safety, which it owes to its far lower physiological toxicity on nerve tissues. Apart from this specific difference the most important contrast between the two substances is due to their respective effects on the blood circulation. Ether directly causes, besides a rise of the blood pressure, a notable increase of the blood venosity, and therefore much additional and troublesome hæmorrhage. In its later effects—that is, on recovery—it causes excitement, as well as in many cases notable headache and, of course, vomiting.

Ether I regard, therefore as inadmissable as an anæsthetic in operations on the central nervous system; but in saying this I must not be thought to be criticizing my colleagues, especially American surgeons, who have accomplished most brilliant results under ether narcosis.

Chloroform, *per contra*, causes a fall of blood pressure with relatively less blood venosity—although this is by no means absent, as will be seen below. It therefore does not aggravate the bleeding, nor embarrass the respiration by causing bronchorrhœa.

By its more essentially paralysing action on nerve centres it causes practically no after excitement and but moderate headache. It is probably as frequently followed by obstinate sickness, but this depends on many other correlative factors, and primarily on the dose used (vide infra). Chloroform, however, as already stated, is more dangerous. It kills by paralysis of the respiratory centre as often or more often than by paralysis of the heart.

Moreover, all cases of increased intercranical tension (as is now well recognized) are liable to die at any moment from sudden paralysis of the respiratory centre. How often one sees this accident in cases of intracranial tumour which are only at the very last transferred for surgical treatment! Two or three instances will suffice.

Case I.—Boy, aged 17. National Hospital, Queen Square. Admitted with all symptoms of localized cerebral tumour. Prepared for operation. On morning of day of operation suddenly fell back "dead" in bed. Respiration stopped, heart beat continued. Failure to restore respiratory centre. Post-mortem examination: Small encapsulated tumour of the leg area.

Case II.—Woman, aged 42. University College Hospital. Admitted with symptoms of cerebellar tumour. Operation advised. Patient decided to have same done at home. Two hours before leaving hospital suddenly collapsed. Respiration stopped, heart beat continued. Failure to restore respiratory centre. *Post-mortem* examination: Tumour of interior of lateral lobe of cerebellum.

Case III.—Woman, aged 38. Private practice. "Tumour of brain" had been diagnosed nine years before. Admitted into nursing home with symptoms of lateral recess cerebellar tumour. Prepared for operation. Twenty-four hours before operation attack of cerebral vomiting, followed by sudden arrest of respiration. Heart beat continued. Artificial respiration combined with opening of the skull failed to restore respiratory centre. *Post-mortem,* lateral recess cerebellar tumour.

In the literature of the early days of cerebral surgery may be found instances of death on the operation table I have no doubt that these were due to failure of the respiratory centre, owing to a dose of chloroform having been given which, though perhaps not necessarily lethal in an ordinary case, was fully so to a patient whose bulb was hampered by previous tumour pressure. Chloroform, therefore, must be used with caution in the surgery of the nervous system, to avoid giving a dose which might bring about fatal arrest of the respiratory centre.

The immediate problem is how to regulate the dosage of chloroform, and let me say, in passing, that the whole of my consideration of this question is applicable to all operations, and not only those on the central nervous system. Yet, curiously enough, because the early efforts of Snow, Clover, and others to obtain the administration of such drug in known quantities were not entirely successful, the present haphazard and dangerous method of unknown dosage became customary and universal.

At the original suggestion of Dr. Waller I obtained, on July 10th, 1901, from the Council of our Association the appointment of a Research Committee to secure data for the administration of choloform in known doses commencing with its precise quantitive determination. The results so far obtained have already proved of notable value.

The committee have found that less than 2 per cent. of chloroform vapour in the atmosphere breathed by a patient is enough to produce deep

narcosis and that a much smaller dose is required to maintain unconsciousness to pain. Various apparatuses have been devised to give known percentages of chloroform. Of these I have worked practically entirely with Mr. Vernon Harcourt's.

Much has been written on the subject of chloroform administration, but I must state categorically what I believe to be the most profitable way in which it can be used in operations on the nervous system, and how its disadvantages can be mitigated or avoided.

If the mask of the inhaler be made to fit by wet aseptic towels, the amount of the dose given will be under complete control. With the dose commencing at 0.5 per cent., and rising in one to two minutes to 2 per cent., the patient ought to be ready for operation after five to eight minutes. If the initial narcosis be complete no adverse event——for example, vomiting—will occur. If it be incomplete when the operation is commenced various drawbacks will appear. This is, of course, well recognized as a general principle by anæsthetists, but is so salient a point as to deserve repetition.

I desire now to refer to the use of chloroform during the operation, and, first, as regards its use as an anæsthetic or pain-preventing agent.

I venture to repeat what I constantly stated in the chloroform discussions of the last three years, that having now, by means of the Harcourt or other regulator, the power of giving known doses, we ought to arrange the narcosis strictly according to the nerve excitations it is intended to drown, and so avoid contributing to the patient's discomfort by giving unneccessary quantities of the drug.

As a rule the amount of 2 per cent. is given for about five minutes before the incision of the skin and reflection of the flap which constitutes the maximal pain period of the operation. This completed, the dose can be lowered by pushing the tap back and the bone be removed at 1 per cent. As the dura is a sensitive membrane supplied by the fifth cranial nerve the dose should be somewhat raised just previous to its incision to prevent reflex starts or movements on the part of the patient.

As soon as the dura is opened the encephalon can be dealt with without causing any pain except if the course of the fillet or one of the peripheral sensory cranial nerves be accidentally irritated. Consequently all this part of the operationis done under less than 0.5 per cent. of chloroform in the air respired, an amount which of course is far below that required in the induction stage. Indeed in many cases (the edges of the wound being as usual thoroughly protected by gauze) the chloroform can be entirely shut off, the longest period that I have been able to do this for being twenty minutes. This, however, was a case of a cerebellar

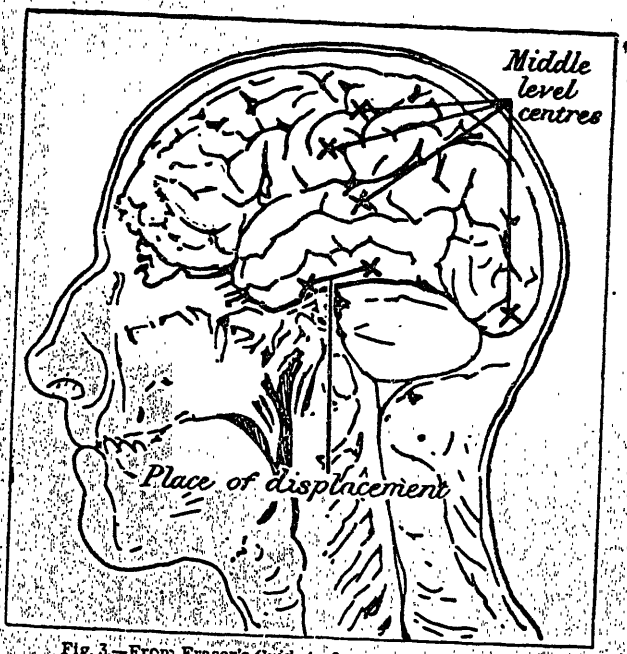


Fig. 3.—From Fraser's *Guide to Operations on the Brain.*

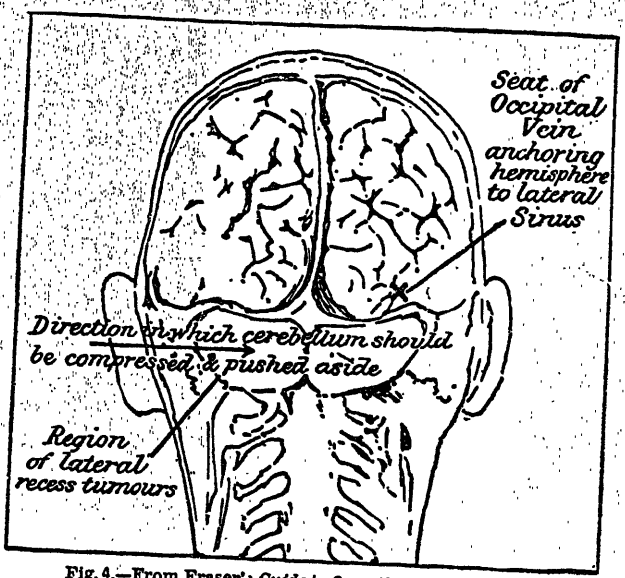


Fig. 4.—From Fraser's *Guide to Operations on the Brain.*

tumour in a child, and I have never been able in the adult to exceed twelve or fifteen minutes before the return of the reflexes of the limbs necessitated the renewed administration of the drug. After the encephalic lesion is dealt with the percentage always should be raised to about 0.7 or even 1 per cent. to provide for the insertion of the sutures in the skin, as naturally that is a strong pathic stimulus. Finally this percentage is continued to the commencement of the dressing to prevent the accident of vomiting occurring before the protecting rubber bib can be applied.

(c) Maintenance of the Body Temperature.

One of the depressant physiological effects of the general anæsthetic requires consideration, and that is the remarkable influence which Dr. Horatio Wood and Dr. Hare have done so much to elucidate—namely, a high degree of power to lower the temperature of the body, and therewith emphasize the shock of the operation.

This is of course characteristic of all narcotic substances (*cf.* Chloral, Lauder Brunton). Ether, for example, in a very short time will, as Dr. Hare has shown, lower the temperature of the body two degrees Fahrenheit. For this reason I think that all operating rooms should be at a temperature of not less than 75° F., and that the operating table should be provided with a suitable hot water bed.

While, however, cooling due to the anæsthesia can thus be readily combated, my experimental work of the last twenty years on both the carnivora and monkeys has convinced me that to maintain the physiological energy of the central nervous system and prevent shock thereto it is necessary during all operative procedures on the skull and its cavity to prevent cooling by radiation from the brain exposed in the wound. The wound, therefore, should be constantly irrigated, usually with a solution of sublimate of 1 in 10,000 strength, or with saline. These lotions are put into the irrigator at a temperature of 115° for the reason to be detailed directly, and the flow is regulated at will by an assistant.

While, therefore, a follower of Professor Cheever and others, in thinking that much shock can be prevented by artificially maintaining the general temperature of the body, I consider we must also preclude local cooling.

The use of the hot irrigation fluid, however, is not only to prevent cooling of the nerve centres; it also has another purpose—namely, the arrest of capillary and arterial hæmorrhage. I, therefore, take up the question now of hæmorrhage; and it is, of course, only necessary to speak on this occasion of the hæmorrhage from the central nervous system

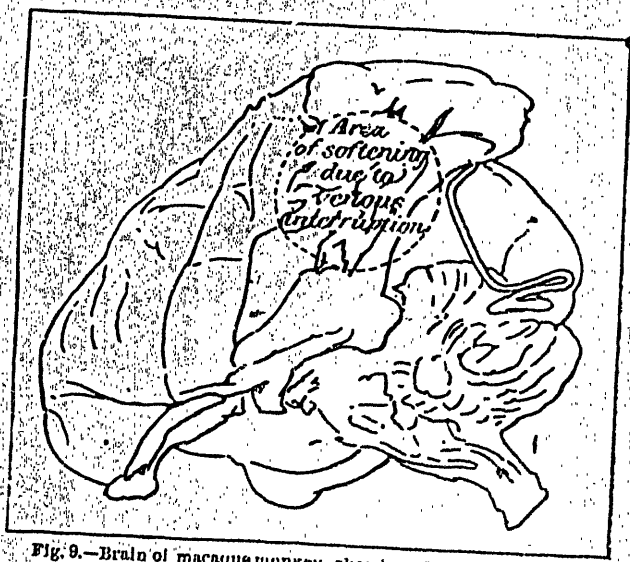


Fig. 9.—Brain of macaque monkey, showing effect of vein ligature for displacement of hemisphere.

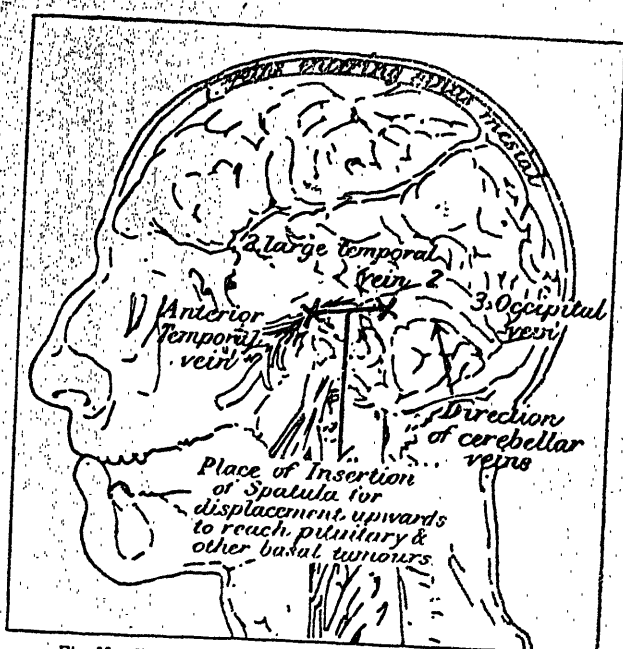


Fig. 10.—From Fraser's *Guide to Operations on the Brain.*

itself—unavoidable hæmorrhage met with in dealing with the nerve tissues.

(*d*) HAEMORRHAGES.

The first general principle is the recognition of the fact, originally established by Cohnheim's researches, that as few vessels as possible should be obstructed; and, again, experiments on animals show that in encephalic surgery this principle must be followed as closely in the case of the veins as in the case of arteries. For instance, in the monkey (Fig. 9, Plate 4), as well as in man, the blocking of the large temporo-sphenoidal vein (Fig. 10) and the most anterior external occipital vein produces softening of the posterior part of the hemisphere. In pursuance of this principle, where it is necessary to remove large portions of the brain, the branches of vessels to be divided should be severed as far as possible from the trunk. A few points in detail must now be discussed according to the nature of the vessel.

Arteries.—From time to time it has been proposed to tie the main arteries—for example, the carotid, with the view of producing a large control of the blood flow from the cerebral arteries. But a thorough consideration of the cases in which this has had to be done by reason of operative necessities has convinced me that it is a measure to be avoided as far as it possibly can be. For instance, when ligature of the carotid has been found necessary in the case where a portion of the hemisphere has been partly displaced and compressed to gain access to a basal tumour, etc., serious and even fatal secondary œdema and softening has proved the adverse influence of this proceeding. On the whole, I cannot suggest anything better than the original plan of tying all the arteries around the lesion before extirpating it; and inasmuch as all arterial supply of the encephalon is necessarily from below upwards, it is better to commence the excision of a lesion by beginning the incision in the brain below, and carrying it upwards and towards the mesial plane.

Arterioles and Capillaries.—Although it is necessary that every bleeding artery should be secured by ligature—and on this point one cannot too strongly emphasize the dictum of von Bergmann,[2] that it is very unsafe to trust to tampon pressure—it is remarkably easy to arrest capillary oozing and arteriole oozing from the brain by the simple means of hot irrigation. The most accurate work on this subject to my knowledge is that of the late Dr. Milne Murray,[3] who from his experiments came to the following conclusion, which I prefer to quote in his own words: "It is certain that water from 70° F. to 103° or 105° F. will invariably dilate blood vessels and promote the flow from open ones, but it is equally certain that water of temperatures from 110° F. to 120° F.

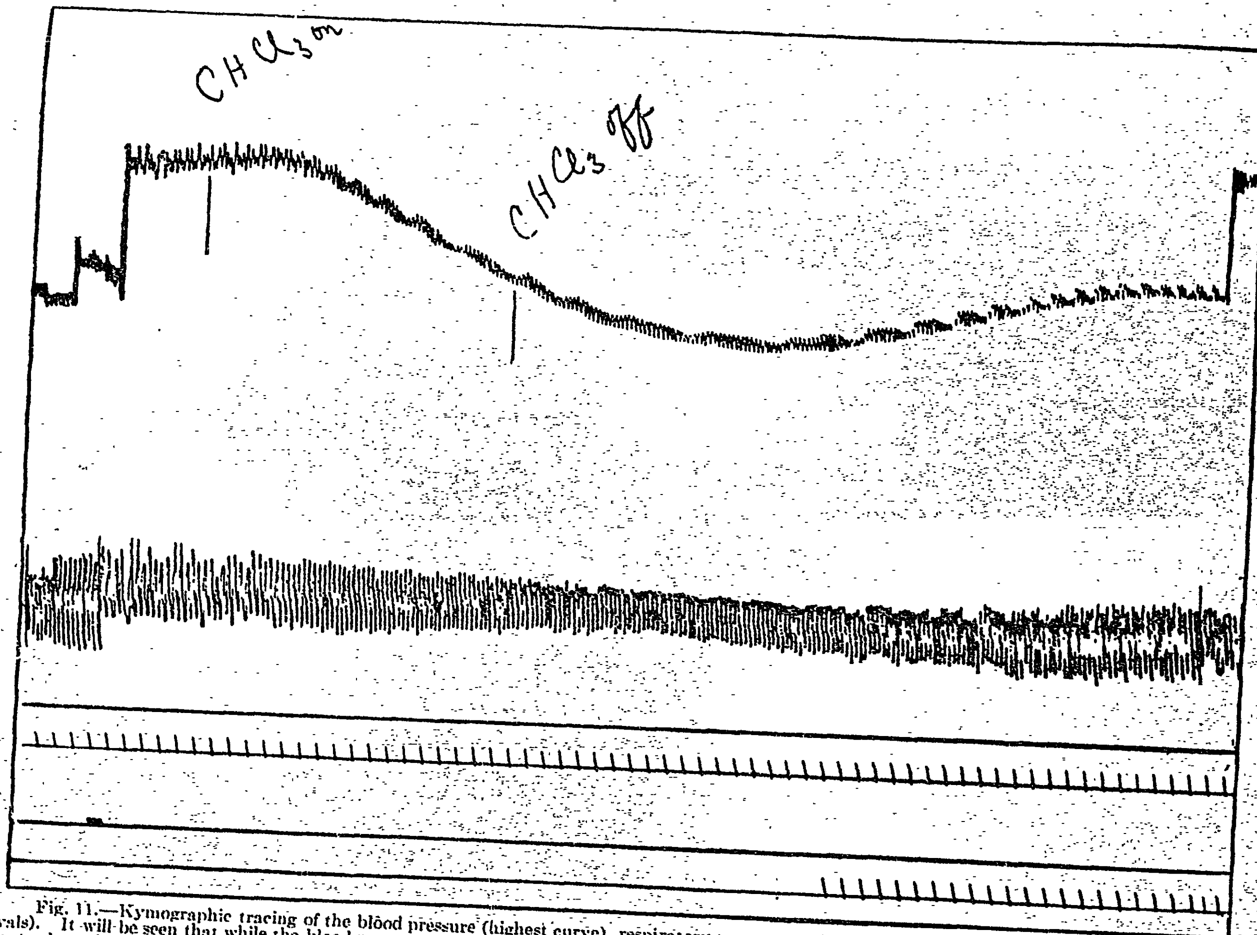


Fig. 11.—Kymographic tracing of the blood pressure (highest curve), respiratory movements (second line), and time marker (two seconds intervals). It will be seen that while the blood pressure was at its highest (the animal, a dog, being then under ether), chloroform vapour was given instead at the point marked "$CHCl_3$ on." Within twelve seconds the pressure began to fall, and continued to do so for about a minute, the fall continuing after the chloroform was shut off at "$CHCl_3$ off." Note also the effect of Chloroform in gradually diminishing the expiratory function of the respiratory centre (Hughlings Jackson, Laborde), thus leading to blood venosity. (See paragraph, page 608.)

will have just the opposite effect." Theoretically what we require is that the irrigation fluid shall at the moment of contact with the nerve tissues contract the small vessels and at the same time not cause any heat coagulation of the cut surface of the brain. In my opinion, therefore, the temperature of the fluid should not exceed 115°F.—that is, about 46° C.—but it is equally certain that it must not fall below 110°F. or 43.5° C. If a large irrigator be used it is practically an easy thing to keep the fluid at the desired temperature on account of its mass, and it is gratifying, especially in a cerebellar wound, to see the oozing gradually cease during the steady flow from the irrigator "hose" pipe.

Before leaving the question of hæmorrhage from the arterial system I must refer to the use of chloroform in this particular. As will be seen in the accompanying kymograph tracing (Fig. 11), one of the most striking features of the physiological action of chloroform on the mammalian is that it soon (10 to 20 seconds) causes a marked fall in blood pressure. Consequently when a lesion is about to be extirpated, and there is reason to expect considerable oozing, or when the brain is obviously turgid with congestion, I always ask that the chloroform percentage should be raised for, say, a quarter to half a minute to 1 or 2 per cent. This at once induces a convenient, proportionate, and, of course, temporary anæmia.

The consideration of capillary oozing and hæmorrhage brings us logically to the question of bleeding from the venous system, because capillary oozing is so dependent on the venous pressure. The same steps, therefore, which diminish the latter will also reduce the former.

Veins.—All bleeding from the veins and sinuses in bone can be immediately and absolutely certainly arrested by plugging with wax if the periosteum round the hole is completely removed. No difficulty, therefore, should ever arise from hæmorrhage from this cause. It is otherwise with wounds of the sinuses and Pacchionian bodies and venous lakes in the dura mater. The bleeding from these, however, no matter how severe, is immediately controlled by pressure with the point of an instrument, while the opening is closed by a fine lateral suture on a round needle in the usual way. The principal veins if necessary are, of course, ligatured like arteries by passing a round needle beneath them, and there only remains, therefore, for consideration the control and arrest of venous oozing.

Control of Venous and Capillary Oozing by the Use of Oxygen.

Venous bleeding as just stated, commonly occurs in association with capillary oozing, and is often very troublesome in spinal as well as in intracranial operations, especially those at the base of the skull.

This can be rapidly controlled by a simple manœuvre, namely, the inhalation of oxygen. It is not necessary here, nor have I the opportunity or time to discuss why during the administration of chloroform there is gradually induced a moderate degree of asphyxia which has the effect of raising the venous pressure. The fact is plain, and consequently all that has to be done to lower the venous pressure and stop the oozing is to get rid of the asphyxial condition. Though it is impossible to promptly improve the action of the respiratory centre itself directly or the respiratory movements of the patient and so lower the venous pressure, it is easy to raise the percentage of oxygen in the anæsthetic atmosphere breathed, by directing a stream of the gas through the air inlet of the Harcourt regulator, and so quickly abolish any asphyxia.*

It is interesting to see how rapidly the bleeding stops as the colour of the oozing blood changes from dark purple to a bright scarlet. I frequently, therefore, during operation, especially towards the end, request the anæsthetist to turn on the oxygen for this purpose as well as for the elimination of shock (vide inf.). It of course must not be forgotten that as the gas is delivered through the Harcourt tap at a pressure somewhat greater than the patient's own respiratory current passing through the chloroform bottle, the in-draught of chloroform air (and therefore the total percentage of chloroform) is somewhat diminished, but this is of no practical consequence, especially at that stage of the operation.

Shock.

I now come to the analysis of the Queen Square cases, and shall endeavour as far as possible to thereby throw light on the actual cause of death occurring within the first twenty-four to forty-eight hours after the operation—that is, from what is termed "shock."

The question is one of profound interest, for since shock or sepsis are practically the only causes of death which can be provided against, the answer to it lies at the root of successful prognosis as well as of further improvement in surgical technique.

A few prefatory words are necessary as to what is meant by "shock." I quite agree with Crile, who has done so much to elucidate this all-important question, that we should discriminate between shock and collapse; and that while collapse is a temporary accident, in which the patient's nerve centres are capable of being revived by ordinary clinical means, shock, on the other hand, is a post-operative condition, which deepens after the operation for a variable period, and which if it ter-

* I may here add that Bayliss and Starling found in their experiments on animals that warming the respired air diminishes the effects of operative shock. This can easily be done by passing the oxygen through a hot coil.

minutes fatally, destroys life, as a rule, within twenty-four hours. It is this dangerous phenomenon which we must now discuss.

From observation of the condition of patients after all kinds of operations it is evident that the phenomena of dangerous shock differ according to the part of the body operated upon, according to the condition of the patient before the operation, the concurrence of accidental hæmorrhage, etc. The alteration of the intracranial tension which is produced by opening the skull, of itself necessarily causes shock after encephalic operations in a manner which is somewhat different from that caused by other operations. Therefore I think its treatment must also be different. The nervous system is responsible for the maintenance of the respiration, the maintenance and control of the temperature of the body. Hence the only way in which we can adequately examine into the subject is by systematic discussion of these several points.

Fortunately the clinical investigation of the first—the alteration of the intracranical tension—has been rendered more easy by reason of the procedures adopted during the last thirteen years. In 1893, at the discussion in the Section of Surgery of this Association at Newcastle,[4] I pointed out that the early statistics of intracranial operations showed that the majority of deaths occurred from a severe degree of shock which could be in great part avoided by dividing the operation into two stages, the interval between them being about five days.*

The first stage consisted of the opening of the skull, the second of opening the dura mater and removal of the lesion. On the same occasion I drew attention to the fact that although at the second stage the dura mater was opened, the removal of the tumour was often attended by relatively little shock. Subsequent experience has fully confirmed these statements, and shown that it is in fact the opening of the skull which causes most general depression of nerve energy and most alteration in the circulation.

Method of Opening the Skull.

I cannot spend time on the various mechanical devices for opening the skull, but as much of the shock depends on the way in which this is effected, I must allude to the principles which I believe govern the opening of the cranio-neural tube at any point. Of these the first is that as far as possible the bone should be divided with as little vertically applied force as possible, and removed with the least possible pressure on

* The advantage of systematic two-stage operations only properly applies in my opinion to encephalic cases, although I have used it in emergency in a spinal operation,—Cf. also Brodnitz, *Verhandlungen der deutschen Gesellschaft für Chirurgie*, 1905, p. 219.

the brain and dura beneath. After a long experience of saws, circular or straight, and trephines driven by electromotors, I find that the foregoing principle can be most quickly and readily fulfilled by first removing a trephine disc, then marking with a large saw the area to be removed, and finally cutting away the bone with large bone forceps, all traction being directed outwards. The ill effects of vertical pressure or force are particularly seen when the opening of the skull has been done osteoplastically with the use of the mallet and chisel, and as in very many cases it is not advisable to preserve the bony wall of the skull the chisel need be but rarely used.

Alteration of Intracranial Tension.

(*a*) *Influence of Region of Skull Opened.*

Having thus briefly dealt with the methods of opening the skull, I pass to the next practical question—the influence of the region opened. This introduces a very important point which was first raised by Duret some thirty years ago, and has attracted the attention of most surgeons who have more especially operated on the cerebellum. It is obvious that inasmuch as the nerve centres of organic representation are situated in the posterior fossa of the skull, opening this region might theoretically be expected to cause more shock symptoms than the opening of other parts. No statistics can give a dogmatic explanation of this or any other clinical matter, and in fact every case forming the material for our present statistical analysis in which death occurred from shock after the first stage (six of the total number of cases) was complicated by the pressure of the lesion being only partly diminished, while in two instances there was, in addition, persistent hæmorrhagic oozing; but on taking all the cases together they give the following result, which is sufficiently demonstrative:

		Proportionate Ratio.
"Motor area"	1	death in 27 operations
Parietal and post-parietal regions	1	" 19 "
Frontal region	1	" 13 "
Temporal region	1	" 12 "
Cerebellar region	1	" 10 "

If, therefore, a line be drawn from the frontal eminences to the occipital protuberance, it is obvious that more shock results from operations below that line than from above, and also as we proceed from the frontal to the cerebellar pole of the encephalon.

Duret's conclusion was that pressure applied to the frontal regions specially produced lethal effect by direct transmission to the medulla.

along an axis parallel to such a line, and I shall show how such mechanical effects can, as far as possible, be avoided during operations on the basal parts of the brain.

(*b*) Production of von Bergmann's Oedema Cerebri.

The surgery of the central nervous system has been enriched by many contributions that have been made to it by von Bergmann, but on no point more particularly than that of the causation and frequency of œdema of the nerve tissues. (see especially his *Kopfverletzungen*, and, later, *Die chirurgische Behandlung der Hirnkrankheiten*, 1889, p. 118, *et seq.*) The readiness with which the cerebrum and cerebellum become œdematous is remarkable, but the circumstances under which it happens are not at all easy to understand, and the facts of a large series of cases do not fall into line with von Bergmann's generalization—namely, that œdema necessarily occurs whenever the skull is freely opened. Thus, after the second stage of an extirpation in which the skull has been very freely opened and a tumour removed, there may be only a very moderate degree of œdema of the hemisphere operated upon, which, like all traumatic œdema of the brain, arrives at its maximum in three of four days, and disappears without any complication. On the other hand, when the skull has been freely opened in the first stage and the dura mater left intact, if the pressure of the growth is considerable, that may be accentuated by the development of a markedly œdematous condition around the focus of pressure. It is, of course, quite comprehensible that this is owing to the fact that a slight relative increase of tension may unfavourably affect the walls of the cerebral blood vessels, which are still under compression, and bring about a Cohnheim effect. That this does occasionally occur is proved by the very rare phenomenon of transudation of the red blood corpuscles into the œdematous tissue, of which the following is an example, and as it is unique in my experience I quote it here:

The patient, a lady of 52 years of age, had had symptoms of cerebellar tumour for several years, and a varying degree of optic neuritis had been known to exist for more than two years. The case being referred to me, I opened the cerebellar region, and finding extreme tension, decided to relieve it by a small opening in the dura. This revealed a thin-walled simple cyst, which I punctured and removed. After a preliminary stage (three to four hours) of moderate shock, the patient gradually developed remarkable symptoms of deepening coma, Cheyne Stokes respiration, and a rising temperature. These symptoms terminated fatally in thirty-six hours from the operation. *Post-mortem* examination showed that the cyst was completely removed, and that

death had resulted from œdema, with punctiform extravasations, of the medulla and cerebellum.

Probably this unusual occurrence was partly determined by a moderate degree of arterial sclerosis which was also present, but had not the complication of œdema occurred no case could have been more satisfactory.

This question of œdema is in our experience clearly associated with the further question of unrelieved pressure, and this brings us to the all-important question of success in diagnosis and the much-discussed procedure which is called an exploratory operation. The statistics of Queen Square Hospital throw a good deal of light on this subject, and show that the former condition, namely unrelieved pressure, is a matter of great practical importance in respect of ordinary palliative operations performed to abolish optic neuritis and relieve the headache, in short, to the procedure to which Professor Cushing has recently given the name of "decompression" operations. I will take this point now. Thus, of 13 cases which died of shock after the second stage, in 7 by reason of failure of topographical diagnosis, the pressure was not relieved directly over the seat of the lesions, whereas in 6 cases in which a tumour of the brain was diagnosed and correctly localized, but in which removal was not attempted owing to the size of the growth and other reasons, no patient died.

A comparison of this kind is sufficient, I think, to warrant the statement that the risk of an operation for decompression is greater if the opening for the relief of pressure is not made directly over the lesion. Precisely the same point is borne out with even greater distinctness by the figures showing the relative risk of operating with and without a correct diagnosis. Thus, of 79 cases in which a correct diagnosis was made and the tumour successfully removed, 7 cases died of shock—a little over 8 per cent.; whereas in 16 cases of tumour which were incorrectly diagnosed and consequently not removed, 6 cases died from shock—approximately 37 per cent. It is, perhaps, worth while adding that practically in all these latter cases the tumour was a glioma or gliomatous sarcoma—that is to say, a diffuse growth the diagnosis of which is always the most obscure, and at the same time a form of neoplasm in which circulatory changes and œdema is always liable to occur.

I think that these data enable us to form a more or less correct estimate of the risk of an exploratory operation in cases of doubtful diagnosis.

Treatment of Shock.

As I have suggested above, the treatment must be arranged according to the symptoms which threaten life, and those may be grouped accord-

ing as they affect (1) the respiration, (2) the circulation, (3) the body temperature.

Depression, or aberration of special nerve functions—for example, motion, sensation, etc.—need not be a source of anxiety, as, if the centres of organic life are restored, recovery of the others will certainly follow in proportion to the extent to which their representation has been preserved.

1. *Respiration.*—The embarrassment of the respiratory centre in a stage of shock shows itself in increasing degrees of severity as follows: (*a*) shallowness of the respiratory movement, (*b*) periodicity and grouping of the respiratory movements, (*c*) typical Cheyne Stokes respiration These changes are best dealt with by inhalations of oxygen until the effect of nutrient enemata (*vid. inf.*) begins to make itself felt, but it is above all in depression of the respiratory centre that strychnine is of use in combating shock. In speaking thus favourably of strychnine I nevertheless agree with the elaborate and useful work of Dr. Crile on this subject, and believe that in many cases strychnine is used too empirically, too freely, or with undue reliance to its powers, and that in repeated doses it has a depressant action on the circulation. As a stimulant of the bulbo-spinal centres strychnine is of course unrivalled, when any marked alteration in the rhythm of the respiratory centres shows itself, a small dose should be given hypodermically, but for the above-mentioned reasons it does not seem advisable to give such a drug beforehand, as is sometimes done either immediately previous to the operation or at the end thereof, with the idea of anticipating difficulties resulting from shock. It is also not to be forgotten that the usual functional depression of the respiratory and the cardiac centres which immediately precede chloroform vomiting is particularly marked in these operations, and often causes unnecessary alarm.

2. *Circulation.*—In considering the depression of the circulation by shock, we must again express our indebtedness to Crile for having shown that this part of the subject is not merely a question of the central or cardiac maintenance of the blood pressure, but to a large extent the lack of influence of the vasomotor system. I think the beneficial effects of pressure on the surface of the body can be obtained by bandaging the limbs with cotton-wool. It remains, therefore, to consider what drug treatment is to be resorted to. As regards cardiac stimulation, that has always seemed to me to be a clinical error. The heart does not require accelerating as a rule, but it does require feeding. Undoubtedly repeated enemata (every two hours) of four ounces of beef-tea in which is dissolved Brand's essence or pancreatized milk is the readiest means of beginning to follow this line. If time presses, a very small dose of

atropine is useful, and in cases of peripheral vasomotor paralysis digitalis is also useful, but its use must be at once stopped if there is any acceleration of the pulse. It is, I believe, of universal experience that, compared to the foregoing drugs, alcohol is not worth mentioning, and as it has very definite depressant after-effects, I think its use is to be avoided. A small quantity of strong coffee gives all the psychic stimulation of alcohol without its depressant effects; and even if it be vomited within a few minutes, benefit results.

3. *Body Temperature.*—In a large majorty of cases the body temperature is somewhat lowered, but in certain instances, notably in children, one of the shock effects of operation is the losing of heat control and consequently the temperature, instead of falling, rises from the moment the patient is returned to bed. This rise may in a child become hyperpyretically dangerous, but can, of course, be, as a rule, like all neurotic pyrexia, controlled by cold sponging the upper limbs.

In leaving the question of shock I desire to once more assert that the main principle of operating on the central nervous system should be the avoidance and prevention of all conditions which lead to shock—namely, cooling and mechanical disturbance of the central nervous system. In respect of the necessity of producing less disturbance or chance of pressure upon the brain beneath, Mr. Spencer found in my laboratory that even slight pressure on the surface of the hemisphere materially affects, in accordance with the principles of Duret, the activity and regular function of the respiratory centre. So, too, in the second stage all the necessary instrumental procedures must be effected with as little pressure upon the brain and nerve tissues as possible. Sponging, for instance, should be avoided unless absolutely requisite; and, indeed, the practice of hot irrigation renders it very unnecessary. In particular, during the separation and extraction of an encapsulated tumour—such as a large fibroma every attempt ought to be made to exert a leverage or traction, so that the direction of the force is always outwards.

These principles underlying the avoidance of shock having been fully discussed, we may turn to the question of septic infection.

On Sepsis.

So far I have said nothing about the second possible cause of death, namely, septic infection. Few things are more interesting in a review of general surgery as compared to the special branches of the subject than to see how essentially different in varying conditions is the incidence of sepsis. It had always been recognized, and long before Lord Lister's immortal discovery of antisepsis explained why, that the cavities

of the body presented special risks in this particular. Nowadays, when many surgeons can show an unbroken record of successful operations for the radical cure of hernia or for appendicitis in the cold stage, I believe it is not completely realized how very different should be our estimate of the proclivity of the central nervous system to invasion by septic micro-organisms and the extremely feeble degree of its resisting powers. A survey of the literature of the last ten years proves this most distinctly, numbers of cases of sepsis arising in the practice of the most careful operators even for such simple conditions as a benign isolated fibroma compressing the spinal cord. The records of Queen Square Hospital of the past twenty years are somewhat vitiated by accidental infections traceable to causes unconnected with the special region of the wound. Thus of the 17 cases in which death directly resulted from sepsis, one was due to the condition of the scalp before the operation, another to infection from the mouth, and two if not three from imperfect sterilization of the ligatures. Of the remainder, the infection in a very large majority obviously orginated during the after-treatment of the case, while the external wound was still open at the drainage spot, especially when such openings and avenues of infection had been kept open by tampons and plugs. Personally I believe that the present-day precautions are sufficient at the time of operation, especially if the irrigation fluid used be a weak antiseptic lotion, that for the subsequent dressings it is essential to use an antiseptic (I have only complete confidence in a mercury salt), and that so long as the cerebro-spinal fluid continues to escape the most vigorous disinfection of the skin and frequent changing of the dressings must be carried out, for not only so long as the cerebro-spinal fluid is flowing is there great danger of septic invasion, but the difficulty of closing a drainage sinus is increased the longer the cerebro-spinal fluid passes through it.

In summary, I feel inclined to reassert the view expressed in 1886 that the less drainage is employed the better, and consequently that every effort should be made to close the skin wound as early as possible.

Displacement of the Brain.

With these general considerations before us, there remains the discussion of particular procedures. One of the most important of these is displacement of the brain, which must be resorted to to reach tumours at the base. I mean displacement of the lobes or regions. My first attention to this subject was drawn by being requested in 1889 to operate on a tumour pressing on the front of the optic chiasma, and for this purpose I raised the frontal lobe, but found that the tumour was really a cystic adeno-sarcoma of the pituitary gland, and was inoperable. To

facilitate the elevation of the frontal lobe some of the veins entering the longitudinal sinus therefrom were ligatured. On the death of the patient some years later I found that there was some considerable softening of part of the frontal lobe in the area drained by these veins, and not directly implicated by the tumour. This and subsequent evidence referred to above led me to the following conclusions which I have repeatedly made use of and found of service, especially in 10 cases of operation on the pituitary body. The cerebral hemisphere is anchored by emissary veins to the dura mater at various points (see Figs. 10 and 3, Plate 4), (1) in the mesial plane, that is, to the longitudinal sinus; (2) laterally, chiefly by the temporo-sphenoidal vein to the lateral sinus opposite the asterion; (3) to a less degree by the external occipital vein, and (4) by the anterior temporo-spenoidal vein, both of which last are small vessels, but being almost terminal require to be respected (see Fig. 9, Plate 4). The hemisphere can be readily compressed upwards by inserting a flat spatula cautiously beneath it (see Figs. 10 and 3, Plate 4) and between the veins just described. The next question, of course, is What happens to the hemisphere compressed? This entirely depends on the mode of compression. If the compression is, as it should be, gradual, the soft nerve tissues soon mould, with very little internal derangement; but it is easy to produce, with too much and too rapid application of pressure, laceration of and ecchymotic oozing between the fibres of the corona radiata. Such compression contusions of the basal portions of the hemisphere are relatively unimportant, because they relate to portions of the cortex of which the function is either readily compensated when lost or of very wide representation. The inspection of the deep parts of the skull by displacement of portions of the brain entails trouble to the assistant, because it is certainly disadvantageous to move the retractor when once properly in position. So far I have spoken of the cerebrum. I think that precisely the same principles should prevail in the case of the cerebellum.

With this procedure properly applied to the temporal lobe it is remarkable how much can be seen and correctly examined. With a good illumination the crura cerebri, the circle of Willis, the pituitary body and internal carotid, the second and third nerves come into view. I have in two cases after removal of a pituitary tumour inspected the base of the brain further by means of a small rhinoscopic mirror placed in the sella turcica; and it is very easy by continued but gentle pressure with a copper spatula, or with a spatula of suitable size, and with a strong headlight, to inspect the lateral region of the cerebellum and medulla oblongata with the issuing nerves (See Figs. 3 and 4, Plate 4). For these reasons I venture to take exception to the step of removing

portions and lobes of the encephalon if these impede the approach to the lesion.

The Ventricles.

In this connexion, namely, procedures necessary for the examination of the deeper portions of the brain, a few moments must be devoted to the matter of exploration of the ventricles.

Considering that for 1,400 years (as we know historically) the lateral ventricles were looked upon as the most important part of the brain, inasmuch as the animal spirits, or, as we should now say, nerve energy, originated therein, it is not surprising to find that special danger was supposed to attend their opening or surgical interference. Undoubtedly their continued drainage exposes the patient to the particular risk of sepsis, but apart from this there is no reason why they should not be freely dealt with like other parts of the brain, opened and portions of their wall removed as the case may require, provided that one precaution is taken, namely, that blood is prevented from flowing into the ventricular cavity. This, of course, may be obviated at the time of operation by a simple plug, and when the removal of the lesion is completed a temporary tampon is left in for twenty-four hours, by which time all the oozing vessels are thrombosed. I may, perhaps, on this question draw attention again to my paper of 1893, because the case therein referred to of death by intraventricular filling was an instance of persistent oozing gradually forcing its way through the softened roof of the unopened ventricle.

Procedures in the Treatment of Malignant Disease of the Encephalon.

The analysis of the Queen Square cases also brings out in very strong relief the fact that where the technique of intracranial operations fails most is the treatment of malignant disease. This, therefore, will fitly form the last chapter of our considerations. All tumours which, growing from the meninges, penetrate the brain, or which are encapsulated, such as fibromata, myxomata, can all be excised with a good permanent result (see Figs. 15 and 16, Plate 4). The comparison between simple and malignant disease is well shown in the accompanying table of 55 tumours, cases in which the patients' histories have been followed up to date.

Queen Square Cases. Recurrence Table of 55 Tumours.

Glioma ..... 19 Sarcoma 4	23	Recurrence within 2 years, 20.	
Endothelioma.....	8	1 recurrence 3 years later; died of valvular heart disease. 7 alive well, longest 5 years.	

Tuberculosis	4	2 died within three months of tuberculous meningitis. 2 alive well, longest 7 years.
Gumma	8	No recurrence.
Fibroma	4	No recurrence.
Cysts	5	No recurrence.
Adenoma	Pituitary 3	1 recurrence.
Adeno-sarcoma		

But unfortunately a considerable proportion of cases of cerebral tumour are essentially malignant, and by reason of their diffusing through the nerve tissues are very difficult to deal with so as to produce a complete and radical cure. These are the gliomata or glio-sarcomata. One elementary point of difficulty arises from the fact that they not infrequently reach a considerable size before they produce sufficient symptoms to render a topographical diagnosis accurately possible. Further, pathological anatomy does not yet tell us how to classify these growths, or how to determine what is their exact point of origin, consequently it is very difficult to systematically attack their growing focus or plan correctly the complete extirpation of the infected tissues. Further, the regions of the brain surrounding the tumour are commonly œdematous, and this introduces a fresh difficulty—namely, to decide between the infiltration of the brain tissue with neoplastic growth and with simple œdema respectively. The Queen Square series of cases in the foregoing table show that recurrence of malignant disease was observed in no less than 20 out of 23 instances. I have on several occasions attempted, with but partial success, to obtain by extirpating such recurrences the same striking result as Bramann in his classical case, but undoubtedly the treatment of this class of disease will not be surgically satisfactory until the diagnosis is so far improved as to make it possible to remove the growth entirely with certainty in the first instance. I may quote a couple of cases illustrative of this:

Case I.—P. This patient, a man aged 62, sent to me by Dr. Sellers, of Preston, presented all the classical symptoms of a localized tumour of the right ascending frontal gyrus, namely, Jacksonian epilepsy, hand aura, slight hemiparesis, atopognosis, etc., and optic neuritis limited to the upper nasal quadrant of the right disc. At the operation a small tumour, 5 cm. in length, was found, which commenced in the substance of the cortex and was spreading diffusely from that focus. Microscopically it proved to be a highly malignant glioma. The patient remains in good health.

Case II.—F. In this case the patient, a boy aged 8, presented fulminating symptoms of cerebellar tumour, intense optic neuritis, inability to stand, repeated cerebellar fits, marked nystagmus and localizing pressure symptoms enabling a diagnosis of right cerebellar lateral lobe lesion.

A glioma of about 8 cm. long axis was removed from this situation. The patient is in perfect health nearly four years after operation, and shows no symptoms of loss of cerebellar function, although the removal of the growth necessitated considerable contusion of the cerebellar hemisphere.

These cases make it clear that the successful treatment of glioma resolves itself into a question of early diagnosis: In this respect it seems to fall into line with the corresponding malignant tumours, for example, sarcomata of muscle and other soft vascular organs and tissues.

Effect of Directly Exposing but not Removing Gliomata.

In 1890, that is, sixteen years ago, my attention was drawn to the remarkable progress of a case of glioma of the cerebrum which was referred to me by Dr. Buzzard for operation on the understanding that the operation should not be completed if the hemiplegia should be increased or made permanent. The tumour was found at the point diagnosed, but it was so large that obviously its extirpation would have been followed by some permanent paralysis. The wound was therefore closed and the patient made a good recovery. Two and a half years later he accidently infected himself with erysipelas and died in another hospital. At the *post-mortem* examination it was found that the tumour had disappeared, leaving a cicatricial and degeneration cyst. Since then I have operated on 10 cases of similar nature, but not always defining the tumour itself. In all, however, classical symptoms were present, namely, double optic neuritis, headache, vomiting, and varying motor and sensory pareses, together with severe intracranial tension and bulging of the brain through the opening of the dura.

I may quote the two most recent of these cases: The first, a boy, admitted into University College Hospital, with left hemiplegia and Jacksonian epilepsy, optic neuritis, stupor and vomiting. At operation I found that at least the middle third of the cerebral hemisphere, principally the leg area, was involved in a dark red diffuse growth. Regarding it as inoperable I closed the wound, hoping that the tumour would undergo retrogression in accordance with the previous cases. This duly happened and the boy is growing, is bright and intelligent. Examined July 10th, 1906, two and three-quarter years since the operation, he seems to be normally healthy, except that there is a considerable degree of spastic hemiparesis of the left leg, and to a less degree of the arm. Occasionally he has cortical twitching of the left leg.

The second of these two cases is that of a medical practitioner, whom I saw in October, 1902, with all the symptoms of a rapidly-growing malignant tumour of the left lateral lobe of the cerebellum. As this

was apparently confirmed when I opened the skull and dura by the extreme turgescence and deep red colour of the cerebellum, I closed the wound considering that the original intention of palliation of the headache and neuritis was the only possible treatment. His recovery was however, so complete that in a few months he returned to his practice, which he has been carrying on ever since. Cases of this kind are clearly comparable to those which Dr. Glynn has published[3] of subacute encephalitis and internal hydrocephalus simulating cerebral tumours. It is however, of course, difficult to determine the parallelism between his series of cases and mine, as only in one was an operation performed—namely, by Mr. Thomas—but in that instance the relief of the cerebro-spinal fluid was followed by complete recovery.

I venture to think that we are justified in making the following general deduction on the question of the surgical treatment of malignant disease of the encephalon: (1) That operation should be resorted to as early as possible; (2) the tumour should be, if possible, freely exposed and examined and extirpated with surrounding tissue; (3) that if it cannot be removed without undue interference with important or essential structures there remains some possibility of the tumour undergoing retrogression in a certain number of cases.

Conclusion.

In bringing this discussion of but one set of cases to a close some explanation is, I think, due from me why I did not follow the customary course of accumulating the records of as many cases as possible from the literature and basing my deductions on that basis.

My reason is that the massing together of cases treated by different surgeons under different conditions of operative technique with different clinical histories has always seemed to me an unscientific proceeding.

The errors of clinical observation are so numerous that to arrive at correct conclusions we ought to exclude variations of condition as much as possible.

I have only now the very agreeable duty of rendering an acknowledgement of my sense of indebtedness to Dr. Grainger Stewart, the Pathologist to the National Hospital (Queen Square), who has with indefatigable industry worked out the clinical records of the cases on which this address is based.

References.

[1] Waller, *Brain*, vol. xix, p. 569, 1896.
[2] *Die chirurgische Behandlung der Hirnkrankheiten*, 1889, p. 116.
[3] *Transactions of the Obstetrical Society*, 1885-6, p. 53.
[4] British Medical Journal, December 23rd, 1893.
[5] Ibid, April 22nd, 1905.

AUTOMOBILE FRACTURE OF RADIUS.

BY

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Possibly, at the outset, one ought to explain the exact meaning of the appellation which is set down as the title of this communication. It is a name which belongs to the development of the automobile industry, and comes to us from France. A synonymous term, sometimes used is that of "Chauffeur's fracture."

Being on the look-out for the lesion from reading, but never having heard before of a case in Montreal, I fancied the condition might be equally unfamiliar to the members of the society, and, therefore, of sufficient interest to bring before them.

The patient was seen July 18, 1905, immediately after the accident, the mechanism of which was as described below. He thought he had sprained his wrist. Having reason to suspect a fracture on account of the fact that tenderness was localized a little above the joint-line, I had a skiagraph taken, which showed the fracture as seen in the accompanying tracing. There was not the least deformity, such as one gets in a Colles fracture. The result has been excellent under fixation, early massage and movements.

This fracture has been studied of late mainly by French surgeons, France being the home of the auto. Lucas-Championnière read a *mémoire* on the matter in the spring of 1904, and describes the mechanism of the fracture as follows:

"To start an automobile, the crank is turned several times until an explosion is produced. Now, it not infrequently occurs that, as the handle is being turned, a premature explosion takes place, the consequence of which is a sudden reversion of the rotation of the handle,—a sort of snap-back. Usually, the chauffeur lets go in time; but, if not, then the hand is carried with the handle violently backwards from right to left. The resulting damage may be anything from a sprain or a simple fissured fracture up to a total separation of the epiphysis, or even a tearing out of the joint leaving the skin intact. The larger the machine the more violent is the recoil."

The French put forward two theories to explain the mode of action. M. Dragon, who in 1902 showed six cases of this fracture, attributed it to the shock of the handle upon the heel of the hand, like a fall upon the outstretched palm — exactly as in Colles fracture. Lucas-Championnière thinks otherwise; there is no such shock, he maintains,

* Read before the Montreal Medical Society, ——, 1905.

because the chauffeur has tight hold of the handle, and does not drop it; there is simply a turning back of the hand upon the forearm, a hyperextension of the wrist; as a result of which, the palmar ligaments exert a pull upon the lower end of the radius, and in this way break it a little above the articular surface.

In the present case you will see that it is only a triangular portion of the styloid process that is broken off; and I conceive this to be due to a combination of hyperextension and ulnar deflection, a hyperextension occurring while the hand was in ulnar deflection. When one turns a crank, the hand naturally assumes the position of ulnar deflection in order to gain power. This combined position would place strain not only on the palmar but also on the internal lateral ligaments; and it may be easily understood how the latter may pull off the triangle of bone from the styloid process, just as in Potts' fracture, the internal lateral ligaments pull off the tip of the internal malleolus.

The important practical point in connection with these automobile fractures is that they ordinarily cause no deformity; and particularly none resembling that of Colles' fracture, from which they are to be definitely distinguished. It is important therefore to remember that they may easily be overlooked, and be taken for a sprain.

In Colles's fracture the weight of the body drives the diaphysis of the radius into the epiphysis, and there is nearly always impaction. In chauffeur's fracture nothing of the kind! The fracture is by tearing—*par arrachement*—as the French say; naturally there is no impaction; and, as a matter of fact, usually no deformity of any kind.

The lesion is therefore a comparatively benign one. Moderate fixation, with early massage and passive movements give nearly always a good result.

Appended is a short bibliography:

Rev. de Chirurgie (Paris), vol. 29, p. 881.
Rev. de Chirurgie (Paris), vol. 30, pp. 162-163.
Lünd. Boston Med. & Surg. Jour., 1904, pp. 481-3.
Hitchings. J. A. M. A., Jan. 13, 1906.
Ghillini. Zeit. f. Orthop. Chir., 1904, xiii, pp. 759-64.

The seventh annual convention of the British Columbia Medical Association was held on August 1st and 2nd, at New Westminster. Dr. George E. Drew, of that city, presided. We notice the names of Dr. B. D. Gillies of Vancouver, and Dr. Hermann Robertson, Victoria, among the contributors, in a very varied and useful programme.

THE

Montreal Medical Journal.

A Monthly Record of the Progress of Medical and Surgical Science.

Remittances advertisements or business communications are to be addressed to the Montreal Medical Journal Co., Box 273; all others to the Managing Editor, 216 Peel Street, Montreal. All communications intended for insertion in this Journal are received with the understanding that they are contributed exclusively to this Journal. A limited number of reprints of articles will be furnished to authors at cost price, if a request to that effect accompany the manuscript.

VOL. XXXV. SEPTEMBER, 1906. No. 9

THE POWERS OF MEDICAL COUNCILS.

Of late many indignant protests have come from the columns, editorial and otherwise, of the press, regarding the action of the discipline committee of a certain medical council which recommended that a physician be deprived of his right to practice because he had advertised a cure for *la grippe*. Apart from the fact that the newspapers object to any restrictions upon the rights of an individual to advertise, there fall one or two observations to be made upon the case.

When a physician finds a new remedy, if he is wise he remembers that the best man may err, and he expects that the virtues of it will be tried and thoroughly tested; if it be a real remedy, we venture to say that never yet has it failed because of a wider trial than one man can give it. We venture to say further that his priority of discovery will never be denied to him, since the fact of its publication to the profession is in black and white. If the remedy be no remedy, then it fails as it de-

serves, but the physician has at least the consolation of having tried, and only one who has never made a mistake or never failed will deny him the honour that is due to him for his efforts. But should a physician discover a remedy and keep it for the purpose of personal gain, so that the poor throughout the world are unable to have the benefit of it for the lack of a dollar, he becomes a merchant. There is nothing to be said against the merchant because he does not give away his wares broadcast, for it is a rule of trade that an article is worth its equivalent in money and is not given up until the equivalent or properly secured promise of it is assured. Therefore, let the physician become a merchant in name as well as in fact; the medical council says only this: "Be a merchant or whatever else you like, a member of our profession you no longer shall be." The profession granted him his position as a member of it; under proper evidence of this abuse of it, it seems to us but reasonable that it shall have the right to take it away. The medical profession does not take away from him the right to breathe or eat, but it does take away the right to be called one of themselves.

When a physician, so-called, promises to cure a disease, he puts himself upon a level with a rain-maker or a fortune teller, or any other such humbug, because he undertakes what he cannot be sure of performing; as with the rain-maker and the fortune teller, in a general way, the greater the promises, the less the actual performance. If a man declares he can cure a disease, he is either so ignorant of the limitations of his own powers as to be incompetent, or he is a liar; to declare his readiness to use his best ability and efforts to cure a disease is within the limits of a physician, and a sensible public has for years been ready to accept the services of the medical profession on this basis.

It might be useful to point to a specific instance. If the discoverer of diphtheria antitoxin had up to the present moment kept secret that wonderful remedy, how many children now alive, would have died because their parents had not the necessary dollars to purchase their lives. Should a cure for cancer be discovered, and kept for the personal gain of the discoverer, how many afflicted poor could curse with their last breath, such a niggard spirit! How many hundreds in Montreal this very day, have received what attention physicians can give them, without payment? Many! If then, the profession or their representatives declare that this is a well recognised part of the physicians work, a gift of time and labour that every physician must pay, then physicians must pay it or cease to have the rights of their profession, just as a householder must pay rent or leave his house. In this matter, the profession must be the judge, and the profession is the best judge, because the

public does not look at these matters in the same light. We leave other professions and all trades to rule their own households, and we ask leave to rule our own.

THE BRITISH MEDICAL ASSOCIATION.

We extend our hearty congratulations to our colleagues of Toronto upon the completion of their arduous work of the past year in preparation for the meeting just held, and on its culmination in a very successful and important session of that great body. The details involved in such a large undertaking are innumerable, and yet, with a neglect of any of these details, the penalty would be great; we, of Canada, have not often an opportunity of entertaining the British Medical Association, and on the rare occasions on which that privilege is ours, we cannot but feel that our country expects us to uphold her reputation before many visitors, some of whom gather their first impressions of Canada from this very source. We can take the position, temporarily, of outsiders, to commend the diligence and the hospitality of our brethren in Toronto, and to offer a tribute of appreciation to Dr. F. N. G. Starr, the secretary, who has proved so painstaking and so successful a secretary, the labour for many months has for him been incessant and arduous, and it is but right that the sacrifices of much strength, and even health in the service of the association should be acknowledged with gratitude.

The material contributed by Canadians, to the meetings and discussions has been found adequate, we trust; the many valuable contributions made by our visitors from Great Britain and the United States we have enjoyed and shall profit by, and we extend them our thanks, and our earnest hopes that they have been repaid, in some degree, for the outlay of their time and work.

Reviews and Notices of Books.

CARR'S PEDIATRICS. The Practice of Pediatrics by Eminent Authorities. Edited by WALTER LESTER CARR, M.D., Consulting Physician to the French Hospital; Visiting Physician to the Infants' and Children's Hospital, New York. In one very handsome octavo volume of 1014 pages, with 199 engravings and 32 full page plates in colors and monochrome. Cloth, $6.00, *net*; leather, $7.00,

net; half morocco, $8.00, *net*. Lea Brothers & Co., publishers, Philadelphia and New York, 1906.

This large volume is compiled under the editorship of Dr. W. L. Carr, from the contributions of fourteen clinicians of the United States and England; these are Abt, Bovaird, Crandall, Dade, Davis, Jennings, McCarthy, Nicoll, Poynton (London), Riviere (London), Ruhräh, Southworth, Tuttle and Yale.

It is difficult to point out in a short review the particular points that one notes as worthy of mention, for these are many. The book is a kind of treatise on general medicine adapted to the diseases of children, and this is no dispraise, because care has evidently been taken to make it a thorough book of reference for the practitioner with a view of laying stress only upon these ailments met with in children. There is commendable terseness throughout, as is, indeed, necessary when one considers the huge amount of ground covered; a certain degree of dogmatic assertion varying with the personality of the individual writer is to be found, as might be expected; and as the book is really a practitioner's book, this is a desirable thing; equally good is it, that debate upon questions is, as far as possible, avoided.

Section I is upon Diseases and Injuries of the New Born. Section II upon the Development, Growth and Hygiene. Section III upon Infant Feeding, takes up, for example, maternal feeding, weaning, cow's milk, substitute infant feeding, and feeding after the first year, and it must be said that these are dealt with in a thoroughly practical way. Speaking for himself, the reviewer has found here some good, new information, and many old facts stated in a readily assimilable form. Diseases of the Alimentary Tract, and Diseases of Nutrition follow. The infections diseases are dealt with at considerable length, are well illustrated, and, we think, quite adequately treated. At times, it is true, there are points upon which one may differ with the author, but in general these are points of fair combat. Dr. Poynton is admirable in the modesty with which he keeps in the background his beliefs on the causation of rheumatism, and has written a very good series of articles upon the heart. With reference to paracentesis of the pericardium, is it not time that writers began to discountenance its use? The reviewer has never seen a thoroughly successful puncture made, is afraid to attempt it himself, and knows of many other physicians who think with him. Why not relegate it finally to the surgeon and advocate the open operation or none at all? Returning to the subject in hand, Dr. Ruhräh deals with the blood, lymphatics and

glands; Dr. McCarthy with the difficult field of the nervous system, where he has many successful illustrations; Dr. Dade's chapter on skin diseases follows. From a first somewhat hurried perusal, the book pleases much, and can be strongly recommended.

SECOND ANNUAL REPORT OF THE PHIPPS INSTITUTE FOR THE STUDY, TREATMENT AND PREVENTION OF TUBERCULOSIS. February 1, 1904 to February 1, 1905.

A volume of 450 pages contains this report, and it is a notably painstaking record of medical work, from many different standpoints. Nearly a thousand new cases were admitted to the dispensary, and nearly two hundred to the hospital during the year. In the first part, reporting the work for the year, careful statistical tables tell regarding all the patients exactly what happened, when it happened and how often; this is followed by an autopsy report of the 143 cases done during the year. Special reports on laryngological and neurological work follow. There is a short article on The Mental Attitude in Phthisis, in which the writer gives as his experience that the phthisic hopefulness is rare.

A long and full study of the kidneys in tuberculosis follows, in which it is shown that tubercles occurred in the kidneys in 58 per cent. of the cases; parenchymatous nephritis was most commonly found, although clinically albumen was not the rule, nor was œdema. The writer's view is that the most safe clinical signs are casts and tubercle bacilli in the urine. The heart and the liver are next dealt with, and a report on pneumothorax which occurred with a frequency of 9 per cent. in the autopsies. Dr. Ravenel reports on Maragliano's serum, hopefully, but not enthusiastically, and does not give an opinion upon the value of Marmorck's serum, the preparation and application of which he describes. Pearson writes at considerable length on the Immunization of Animals against tuberculosis, and the Appendix contains *fac-similes* of the forms, charts, rules, etc., in use in the Institute.

This is more than a report; it is a book of reference, and contains a great deal of scientific fact about tuberculosis in a thoroughly available form.

INDEX CATALOGUE OF THE LIBRARY OF THE SURGEON-GENERAL U. S. ARMY. Washington: Government Printing Office, 1906.

The present volume, the eleventh of the second series, contains nearly nine hundred pages, covering titles from Mo to Nyström. The volume contains over 8,000 author-titles, and we notice that the library now contains 155,202 volumes, and over a quarter of a million pamphlets.

PROGRESSIVE MEDICINE, Vol. II, June, 1906. Edited by HOBART AMORY HARE, M.D., Professor of Therapeutics and Materia Medica in the Jefferson Medical College of Philadelphia. Octavo, 368 pages, 31 illustrations. Per annum, in four cloth-bound volumes, $9.00; in paper binding, $6.00; carriage paid to any address. Lea Brothers & Co., publishers, Philadelphia and New York.

The present volume of Progressive Medicine opens with a good article on Hernia, by W. B. Coley, which contains an account of the year's advances. E. M. Foote, M.D., follows with an article on Surgery of the Abdomen, excluding hernia; an extremely interesting lot of material is aggregated here, upon a great variety of subjects.

The section of Gynæcology is by J. G. Clark, and carcinoma of the uterus is discussed at some length, with a plea for early recognition and the widest possible removal. Dr. Alfred Stengel writes upon the blood, the spleen, thyroid gland and lymphatics, and allied subjects. Diabetes, Gout, Hæmophilia and Hodgkin's disease are also treated. Dr. E. Jackson contributes the section on Ophthalmology. The volume is quite equal to its useful predecessors.

INTERNATIONAL CLINICS. Edited by A. O. J. KELLY, A.M., M.D., Philadelphia, U.S.A. Vol. II, Sixteenth Series, 1906. Philadelphia and London: J. B. Lippincott Company.

The present volume maintains the high standard set in this publication; it consists of twenty-five articles upon various subjects, which are mostly written with a view to a concise presentation of treatment. The illustrations of Rodman's article on tumours of the breast are very good, as are also those upon perineal repair in the article by Dorland. Some good X-rays of fractures are also presented. That these articles are particularized does not reflect upon those not mentioned, for, taken all through, they form a most interesting and instructive series.

PHLEBITIS AND THROMBOSIS. The Hunterian lectures, 1906. By WARRINGTON HAWARD, F.R.C.S., Eng., Consulting surgeon to St. George's Hospital, London. Bailliere, Tindall and Cox, London, 1906. Canadian agents, J. A. Carveth & Co., Toronto. Price, $1.50.

The three lectures delivered before the Royal College of Surgeons by Mr. Haward form a most interesting resumé of our knowledge of these conditions; without there being anything distinctly new, there is a concise, yet ample discusson of the causes and form of thrombosis, with good

reference to the literature of the day and much material of interest drawn from post-mortem sources. Pulmonary embolism and thrombosis form a section of interest, and the lecture closes with some useful remarks upon the treatment of thrombophlebitis. The references given in foot notes are copious and indicate the thoroughness with which Mr. Haward has pursued his subject.

Medical News.

THE ROYAL VICTORIA HOSPITAL.

Monthly report for July:—Patients admitted during month, 286; patients discharged during month, 289; patients died during month, 11. Admittances—medical, 87; surgical, 120; ophthalmological, 23; gynæcological, 35; laryngological, 21. Out-Door Department—medical, 877; surgical, 650; nose and throat, 370; eye and ear, 252; diseases of women, 102.

The following Montreal physicians and surgeons contributed papers at the British Medical Association meeting at Toronto:—Dr. Ridley MacKenzie, Dr. C. L. A. Reed, Dr. J. C. Cameron, Dr. D. J. Evans, Dr. H. L. Reddy, Dr. Wm. Gardner, Dr. J. R. Goodall, Dr. J. W. Stirling, Dr. W. G. M. Byers, Dr. A. D. Blackader, Dr. L. Gilday, Professor Adami, Dr. Klotz, Dr. J. Ballah, Prof. Wesley Mills, Dr. W. S. Morrow, Dr. Burgess, Dr. Geo. Armstrong and Dr. Francis J. Shepherd.

The New Brunswick Medical Society at the annual meeting in Fredericton elected the following officers for the ensuing year:—President, Dr. Stewart Skinner, St. John; Vice-Presidents—Dr. Bridges, Fredericton; Dr. Main, Edmunston; Secretary—Dr. Day, St. John; Treasurer—Dr. Melvin, St. John; Corresponding Secretary—Dr. Nugent, Briggs Corner; Trustees—Drs. Deacon, Milltown; Purdy, Moncton; McNally, Fredericton.

The officers of the Northern Alberta Medical Association for the ensuing year are: Hon. president, Dr. Braithwaite; president, Dr. Whitelaw; first vice-president, Dr. Green; second vice-president, Dr. Harwood; secretary, Dr. Dunn; committee, Drs. W. D. Smith, Ternan and May.

A Medical Association has been formed of physicians of the County of Nicolet, of which Dr. H. Veilleux, Ste. Gertrude, is president, and Dr. L. S. Giroux, Gentilly, secretary.

The three days meeting of the American Orthopædic Association was held at Toronto on August 20, 21 and 22, preceding the meeting of the British Medical Association.

Dr. G. W. Ross, formerly of Toronto, now of London, England, has been admitted to the Membership of the Royal College of Physicians.

The fifty-third annual meeting of the Nova Scotia Medical Association was held early in July at Lunenburg.

Dr. C. Stephen Davis, of Walpris Bay, New Zealand, was one of the visitors from a distance to the British Medical Association.

Dr. Vanderlip, lately of the Toronto Home for Incurables, has begun practice in Newfoundland.

Dr. W. K. Colbeck is retiring from practice at Grand Valley, Ont.

Dr. Geo. E. Wilson, of Palmerston, Ont., was married early in July to Miss Bessie Pearson.

Dr. R. J. Crawford, of Winnipeg, who has practised at Winnipeg for fourteen years, is leaving the profession of medicine to enter industrial life.

Dr. Ault, of Calgary, was married on August 15, to Miss Ada Gentles, of Kincardine, Ont.

Dr. L. A. Moreau, was married on August 14, to Miss Aline Trudeau, at St. Johns, Que.

Dr. Daniel Day-Smith was married on August 15, to Miss Avesa Raycroft, of Hamilton, Ont.

Dr. Walter G. Thompson, of Hamilton, was married at Toronto, on June 30th, to Miss Edith McArthur.

Dr. S. Hanford McKee of Dorchester Street, was married on August 19th, to Miss Shirley Cowan of Gananoque, Ont.

Dr. G. A. Woodruff, Nesbitt, Man., was married on June 27th to Miss Lottie McCurdy, of Nesbitt.

Dr. Charles MacDonald, of St. Stephen, N.B., formerly of Milltown, N.B., died suddenly on July 17th. He graduated from McGill University a few years ago, and was in his 29th year. He was married, and recently was in charge of the hospital at Eagle Lake, Maine.

Dr. Ezra Bemiss, formerly of Welland County, Ont., died on July 11th, in Newark, N.J., of heart disease. He studied at Toronto University, and graduated from a New York college.

Dr. W. A. McIntosh, a graduate of Toronto University, died on July 18th at Toronto, in his 29th year. He had practised in Deer Creek, Minnesota, and had recently suffered from blood poisoning.

Dr. J. W. Slavin, Drillia, died on the 11th of July, at the age of 71 years.

Dr. Emmett Hughes, of Ottawa, died on July 2nd, of peritonitis.

Retrospect of Current Literature.

OBSTETRICS.

UNDER THE CHARGE OF J. C. CAMERON AND D. J. EVANS.

ZWIEFEL, P. "Die subkutane Symphysiotomie." *Zeit. für Gyn*, No. 26, 1906.

The development of operations having the object of increasing the pelvic capacity has made considerable advance recently. In this connection may be mentioned the pubiotomy operation of Gigli, and its improvement under the name of "hebotomie" by Döderlein, who does away with the large incisions, practically doing the operation by the subcutaneous method. The development of hæmatoma after subcutaneous section of the pubic bone in cases of pelvic contraction, has led the author to study the question as to their origin. The usual explanation is that the hæmorrhage is the result of wounding of the cavernous body of the clitoris. The author has had occasion to make a free incision in two of his cases, in order to ascertain where the hæmorrhage had origin: in both he found the internal pubic artery which lies on the inner side of the pubic bone behind the crura clitoridis divided. On the anterior and posterior surface of the pubic bone anastomoses of the obturator artery form a net work which must be injured in the course of sawing through the bone. He states that in no case of fifty-one symphysiotomies which he has performed had a hæmatoma formed, in spite of the fact that the corpora cavernosa were frequently torn through or punctured. He points out that the internal pubic artery can be pushed out of the way if the periosteum is lifted, before the saw is passed behind the bone.

He suggests in this article that the symphysis be opened by sawing through the interosseous cartilage, previously making a nick or incision on the dorsal surface, which, being convex, may otherwise cause the saw to slip to one side. Briefly, the author's method consists in an

incision at the superior border of the symphysis in the middle line. The finger is passed down through this incision, pushing the tissue out of the road, and the posterior wall of the interosseus cartilage nicked by means of a knife. A curved needle is then inserted above the sheath of the clitoris close under the symphysis and guided upwards to the superior border of the bone, where the saw is connected with it, and the needle withdrawn. During this procedure the urethra may be held to one side by means of a catheter. Three or four movements of the saw are sufficient to cut through the cartilage. As a rule, after separation of the symphysis spontaneous delivery is awaited. The advantage claimed by the author for this method of operation is the avoidance of arterial vessels and its freedom from hæmorrhage.

He reports in detail three cases of successful operation. The idea that the cartilage does not heal as well as bone is, he thinks, unlikely, from his experience. He then discusses the objections of Gigli and Henckel to opening the symphysis because it is a joint; and agrees with Stoeckel that this position is untenable, as there exists no synovial membranes or synovial fluid in connection with the so-called joint. In conclusion, he thinks that in the case of pubiotomy, the enlargement of the pelvic girdle, obtained thus by symphysiotomy, is permanent and subsequent births may occur spontaneously.

JARDINE, ROBERT, M.D. I.—"Eclampsia during Pregnancy; Death from Suppression of Urine; Extensive Infarction of both Kidneys." II.—"Eclampsia during and after Labour; Recovery after upwards of 200 Fits." *Jour. Obstet. and Gyn. Brit. Emp.*, July, 1906.

Two interesting and unusual cases of eclampsia are recorded by Dr. Jardine. The first, a VII-para, æt 36, seven months pregnant, was admitted to the Glasgow Maternity Hospital suffering from fits. The usual premonitory symptoms had been present the day before admission. Venesection and transfusion of 2 pints of saline, followed by washing out the stomach, administration oz. 2 of Epsom salts, colon irrigation and hot packs were immediately employed. Within a few hours reaction took place and the next day the patient passed 35 oz. of urine containing a small quantity of albumen and over 1½ per cent. of urea, though there were granular casts, but no blood present.

The next day she was delivered of a seven months fetus, presenting the breech. The after-coming head was gripped by the cervix and chloroform had to be given to get it through. Vomiting began shortly after delivery and persisted for some hours, and but very little urine was passed, this showing a very small quantity of albumen and 1¾ per cent. of urea.

The following day the patient had a fit, and no urine was excreted. The temperature was normal and the pulse varied from 100 to 120.

The next day the patient vomited a dark material, but took 32 ozs. of milk by mouth. Saline was infused and she was cupped and poulticed over the kidneys, and hot packs were employed. Croton oil acted freely on the bowels. The patient seemed bright. Temperature was 99, pulse 90.

The following day there was a slight jaundice. The mental condition was good and appetite was present. Pilocarpine hypodermically resulted in profuse sweating. About ½ oz. of urine was obtained by catheter; there was only a trace of albumen in it. The treatment was continued.

The next day the jaundice was most marked. The sweating was profuse, but no urine was secreted. The pulse was 80 to 90.

The following day the right kidney was cut down upon, the capsule stripped and the kidney was incised for a short distance. The patient stood the operation well, but during the day her pulse failed. She complained of abdominal pain, became very restless, but there were no convulsions. She died ten hours after the operation just about five and a half days after the commencement of the suppression of urine.

The general interest of the post-mortem is centred in the kidneys which were markedly abnormal. The liver presented moderate fatty changes. The kidneys were somewhat larger than normal, and were rather congested. A large portion of the cortex, over practically the whole surface of the organ and in between the pyramids was the seat of very profuse changes, apparently of the nature of infarction. "At all points there appears to be a layer of normal cortex next the medulla, but the outer parts of the cortex, forming from one to two thirds of the whole, are sharply demarcated from this by a zone of intense congestion with extravastation of blood." The infarcted tissue presented the usual dull, opaque, yellow appearance, with congested and hæmorrhagic margins. There was no thrombosis or endarteritis. Microscopically, the infarction was found of a fairly recent character. The condition of infarction is associated with widespread thrombosis, which was confined to the smaller blood vessels of the cortex. No embolisms were recognized. No micro-organisms were found in the necrosed tissues.

Dr. Jardine has recorded two other cases in which the conditions were almost the same. Both of them were associated with prolonged suppression of the urine without marked uræmic symptoms. He compares these with other cases of suppression of urine without this necrosed condition in the kidneys, in which the suppression was associated

with definite uræmic manifestations. He has no satisfactory theory to advance.

With regard to the second case, a IV-para, æt 30, at full term, the general interest centers in the large number of fits, a total of 207, 199 during the puerperium, and 8 before delivery. She was admitted after having had some 7 fits in the course of a day and a half. She was under the influence of alcohol, was dazed and stupid. Her pulse was 100, and her temperature was 99.5. The vertex presented, and the os uteri admitted one finger. The urine contained a cloud of albumen with some epithelial cells, but no casts. The usual treatment of saline transfusion and salts, with hot packs resulted in a good reaction. Two days after admission she passed 50 oz. of urine, the albumen having reduced in amount. Delivery occurred spontaneously, and twenty-four hours succeeeding it the patient passed 110 oz. of urine. Forty-eight hours after delivery, having previously complained of headache, she developed a fit, which was followed afterwards by two others. In spite of very active treatment, such as gr. ½ of morphia, followed in two hours by gr. ¼, which caused the respiration to fall to 10 per minute, the convulsions continued to occur every ten or fifteen minutes. The pulse and bladder acted freely, and the patient was twice bled, but the fits were not controlled. Lumbar puncture was next carried out but nothing was developed, the culture proving sterile. Later on in the same day lumbar puncture was again performed and gr. ½ of cocaine injected, which seemed to quiet the patient a little, but the fits had not diminished in frequency till eight hours later, when improvement set in. Feeding was carried out by means of a stomach tube and was confined to peptonized milk. Strychnine and brandy were used as was indicated. Urine was secreted in which the albumen was 2 per thousand (Esbach). The temperature for the first two or three days was elevated.

In all the case persisted for ten days. The fits were nearly all severe. The coma between them was not profound. The complete recovery which followed shows that there could not have been any brain lesion nor was the patient an epileptic.

In comment on the case the author refers to the energetic treatment, to the failure of the saline transfusion, and particularly of the morphia. With regard to the lumbar puncture and the injection of cocaine, while it seemed to soothe the patient and her recovery may have been due to it, he feels it is impossible to definitely hold this opinion. He believes that the extreme activity of the kidneys and the good condition of the heart were what carried her through. Good nursing, he thinks, largely contributed to the satisfactory result.

D. J. E.