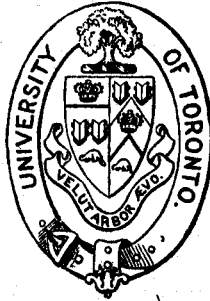


The UNIVERSITY OF TORONTO QUARTERLY



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THE

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TORONTO, MARCH, 1895.

No. 1.

THE REFORMATION.

BY WILLIAM DALE, M.A.

[Read before the Modern Language Club.]

IN studying the history of any great movement it is absolutely necessary to the proper understanding of it to grasp, first of all, its relation to kindred movements, in a word, its historical environment; otherwise we should inevitably be lost in a mere wilderness of details. This is all the more necessary in the case of the movement known as the Reformation, owing to the different interpretations put upon the phenomena connected therewith. Some, approaching it from the religious side, have regarded it as the substitution of one set of theological dogmas for another; others, viewing it from the philosophical standpoint, have regarded it as the overthrow of the scholastic system of philosophy and the introduction of a sounder method of reasoning; others again, looking to the political results, have regarded it as the substitution of the modern idea of the State for the mediæval idea: viz., the idea that the sovereignty of the State is constitutionally limited in place of being absolute, i.e., that the individual has rights against the State; as the beginning, in other words, of the doctrine of the rights of man and of individual freedom.

How this movement was each and all of these combined, is what I wish to attempt to show in the brief time allotted to me. The task is not rendered easier by the fact that there exists no text-book—in the classical sense of the term—in which the

period can be taken up and studied as a whole : the only means by which the history of a period or great movement can be properly mastered. Indeed, from the last classical historian in the fourth century, we find in the literature of Europe no text-book until we reach the *Inferno* and the *De Monarchia* of Dante, both of which are based upon and in turn express the two all-embracing ideas of the Middle Ages. But Dante, while forming a good introduction to the Age of the Reformation, requires to be supplemented for the Reformation itself by Erasmus, More, Machiavelli, Guicciardini, Luther himself and Sarpi.

The history of Europe, or, more properly, of Western civilization, consists in the development and preservation of free institutions, and in the endeavor to bring about a condition of affairs in which every individual should have a fair share in the benefits of such institutions. It is this fact which differentiates Western from Eastern civilization as a whole : the progressive from the stationary in history : and it is the collision of these two principles—a collision marked in history by the Persian wars in Greece, the Punic wars in Roman history, the Crusades in the Middle Ages, the Turkish Question in modern times and constituting what is called the Eastern Question—which forms one leading feature of European history. And European travellers in Asia tell us that the religious and social differences in Europe to-day, irreconcilable as they appear to us to be, sink into insignificance in face of the vast problems presented by the continent of Asia.

Now the history of Europe, viewed by itself, is divisible into three distinct portions, not marked off, it is true, from each other by any particular date or event, but each portion distinguished by a great predominating influence. The first period of European history is that marked by the name of Greece ; the history of Europe, viz., before the influence of Rome was felt ; a period in which was created that charm of Hellas which has been so potent at various critical epochs of our history. The second period of European history is that marked by the name of Rome ; a period extending from the second century B.C. to the sixteenth century A.D., a long period of 1,700 years, during which the history of Rome was the history of Europe. The history of the various civilized nations of antiquity one after the other merged

in the history of Rome, and out of the history of Rome that of the chief European nations has arisen. (And I would like hereto whisper, what is almost a dangerous secret in this University yet, viz., that the history of Rome is not only the great central fact of European history, but that out of the 2,700 years during which the history of our civilization can be traced with some degree of certainty, 1,700 belong to the history of Rome, i.e., to that central portion during which the influence of Rome was the predominating influence, and, hence, it seems to follow that, if you would understand any portion of European history, you must understand and know the history of Rome.) The third period of European history is that marked by the name Teutonic, or German, i.e., the period since the beginning of the sixteenth century, the modern period in the midst of which we are living. In this period the predominating influence has been Teutonic—what that influence chiefly consists in I may point out a little later.

The history of civilization is the history of a struggle of influences, first between Greek and Roman and then between Roman and Teutonic. The history of Europe is written in the Greek, the Latin and the Teutonic languages, and is the record of the achievements of the Greek, the Latin and the Teutonic peoples for the most part. And the view which I take of the Reformation is shortly this, that it represents the revolt, the successful revolt of the Teutonic peoples, Scandinavians, Germans and Saxons, from the rule and influence of Rome. What that means in its entirety I should not dare to tell you or attempt, except in the barest sketch, to tell you here. But it may explain to you why I had the presumption to accept your President's kind invitation to read this paper to this Association. The Reformation, in the view I take of it, is the last act, not in Roman History, but in the History of Rome as the predominant force in Western civilization; it was the overthrow of that Empire, with the history of whose foundation and development I have more or less to do in another place. The greatest historical writer of modern times has written "The Decline and Fall of the Roman Empire" and concludes his work A.D. 1453. Gibbon's great work was finished in 1788. Not many historical works have stood the test of the criticism of the last hundred years: Gibbon's main positions are still solid, but Rome, so far as she has fallen at all, fell only in the sixteenth

century, if at all; and the Roman Empire only ceased in Europe in the year 1806 A.D. So that you see the history of Rome is a very modern thing after all.

All roads—historical roads—whether you begin in the remotest times and travel forward, or begin in the most recent times and travel backwards, lead you to Rome—the Eternal City—the *milliarium aureum* in the field of historical research. In attempting, then, to give you some idea of that vast series of phenomena known as the Reformation, or revolt of the Teutonic peoples from Rome, I can only indicate in the briefest way the various lines of study which must be followed up and developed in order to understand the history of the sixteenth century. And first let me touch upon that subject which lies at the root of the whole matter, viz., the growth and development of the Roman power, and the main elements of which that power consisted.

With the development of the Roman Republic into the Roman Empire, we are all of us familiar: how that Empire was the civilized world for at least five centuries; but we forget sometimes that that Empire was but a fringe of countries around the shores of the Mediterranean and that, in the dark background, behind the great rivers which formed the boundaries of the Empire on the North and East—the Rhine, the Danube and the Euphrates—roved countless hordes of fierce barbarians ready to break into and overwhelm the civilized parts of the world. The burden of sustaining the work of civilization was more than Rome could endure, and the Western Empire was broken up and divided amongst Teutonic conquerors, A.D. 476. But before this event took place the central fact of Roman history had taken place. The Roman Empire had been Christianised. Roman and Christian had become convertible terms. And it is one of the strangest phenomena in history to listen to the complaints of Roman Senators that Christianity had destroyed Rome. In a sense it was true. The old empire was founded on Paganism, on militarism and on slavery. Christianity, i.e., the principles of Christianity, were the death knell of all three; but in sounding the death knell of the old system of things, Rome inherited the name, the ideas and the prestige which had become inextricably associated with her name in the minds of the men of Europe.

Two circumstances contributed more than any others to draw this prestige to the head of the church in Rome, (1) the removal of the seat of Empire from Rome to Constantinople, thus removing the only rival which the church had at the beginning to fear, and how real that fear was, and how fortunate for Europe that removal was, may be seen by comparing to-day Eastern Europe with Western Europe; and (2) the conversion of the Teutonic peoples to Christianity by the missionaries of Rome. Deserted by what she thought at first her natural protector, she turned to the Gentiles and among them found consolation for her loss. The barbarians who sacked Rome, and conquered and plundered the Empire in the fifth century, were Christians in very large numbers, hence, the complaint that the Christians were the allies of the enemies of Rome. How the sway of Rome over the minds of men grew and increased as her military power waned, is a long and intensely interesting story. How she restored in the person of Charlemagne, the Roman Military Empire, Roman in name but German in reality, I must leave history to tell. But the restoration of the Roman Empire in the year A.D. 800, in the person of a German king, is too important an event for our purpose to pass over lightly. If there is any sense in the division of European history into Ancient and Modern, and if any one event is to mark the end of one and the beginning of the other, then the coronation of Charlemagne by the Pope, Leo III., in Rome on Christmas day 800, is that event. In old Rome, State and Church had been one; henceforth they are two and generally antagonistic powers. That coronation symbolised the union of the Roman and the Teuton, in the blending or collision of which the history of Europe was henceforth to consist. It was under the dominion of the two ideas here symbolised, the universal State with the Emperor at its head, the universal Church with the Pope at its head—both powers co-ordinate and both equally of divine origin in the belief of the time, a belief originating from the blending of Christianity with the idea of Universal Empire derived from Pagan Rome—that mediæval civilization grew and to some extent prospered. The Reformation was the revolt against the tyranny in which the practical application of these two ideas to the affairs of common life resulted. The establishment of a Teuton king as Roman

Emperor saved the civilization of the West. The futile attempts of the Emperors to realize what was only an idea, the political union namely of Germany and Italy, was the salvation of Teutonic freedom on the continent. It led inevitably to the mortal strife between the two co-ordinate powers, State and Church, and ended, as you know, in the victory of the Church in the great quarrel on the question of investitures. From this struggle, which lasted roughly for two centuries, 1050-1250, dates the culmination of the power of the Papacy. From this struggle dates the fear and hatred with which henceforward the German people regarded the tyranny of Rome. From this struggle dates the rise and influence of the free cities of Germany. When Henry IV. was excommunicated by the Church and deserted by his knights, the citizens of Worms and Liege remained faithful to their allegiance. To resist the encroachments of Italians soon became the test of Teutonic freedom. From this struggle dates the beginnings of Italian literature. The year of Dante's birth, 1265, is the year of the destruction at Benevento of the power of the house of Suabia by Charles of Anjou. The awful spectacle of the two divine world powers in mortal conflict is the inspiration of Dante's poetry. That victory of the Pope and the French destroyed the Empire in Italy; but it began that connection of the Papacy with France which led to the great western schism, and to that secularization of the Church which lasted on for three centuries until the Council of Trent in the middle of the sixteenth century.

I do not think in a general sketch of this sort it is necessary to say more on the growth of those powers, in the revolt from which the Reformation consisted. The mortal conflict for two centuries of the Church and the Empire partially exhausted the powers of both: henceforth their life is a life of exhaustion, and during the three centuries of exhaustion, dating from 1265, those forces gradually grew up which were to overthrow the influence of both. What those forces were I now proceed to mention briefly. Note, however, first of all the great forces which controlled Europe.

(1) The Church, with the Pope at its head, with Europe mapped out into Provinces, dioceses, and parishes; an organised system descending directly from the old Empire, and, if we

are to believe the almost unanimous opinion of European literature for two centuries, managed after much the same fashion as Roman Proconsuls, and Roman merchants, and Roman Publicani had managed the Provinces in the days long past.

(2) The Feudal system, with the Emperor at its head, and based upon the old rigorous system of Roman law; a system as severe and as oppressive as that based upon the Canon Law. You may imagine if you can the condition of the people between these two, the upper and the lower, mill stones.

(3) The scholastic system of philosophy, which in its rigorously logical deductions, once its premises were granted, is the exact counterpart in the intellectual world of the contemporary, spiritual, and temporal theories.

This threefold system is the theory of society, spiritual, temporal, intellectual, which the middle ages developed and under which it lived, so long as its triple tyranny was tolerable, and which has so often, in the distracted centuries which have since followed, challenged the admiration of sensitive minds. Again let me call your attention to the supporters, or rather, perhaps, victims of this threefold sovereignty—the people. It was they who ultimately suffered, it was they who ultimately revolted when reform became impossible. Now consider the elements growing up in opposition to these ruling forces. And first and foremost I place the growth of the free cities, which, with the growth of trade and commerce, after the era of the crusade, sprang into existence all over Western Europe and commenced that long struggle against Feudalism, which fostered and kept alive the almost extinguished sparks of freedom. This subject of city life in the middle ages is only beginning to attract the attention of historical writers, and offers a wide and varied field of original research. In the free cities we have the first line of the advancing army of progress. In the second line we have the people who have no walled towns within which to defy their oppressors, and no wealth with which to buy them off. They have left behind them the state of slavery, and now, encouraged by the examples of the cities, they find their serfdom becoming intolerable. All through the fourteenth and fifteenth centuries the forces of opposition are marshalled against the oppression of Church and State, and the cry for Reform is becoming louder and louder. What is the meaning, the historical sig-

nificance of the Waldenses in Italy, of the Mystics in Germany, of Wycliffe and the Lollards in England, of the Hussites in Bohemia? What is the meaning, the historical significance of Wat Tyler revolts in England, of the Jacqueries in France, of the Bundschuh in Germany? What is the meaning, the historical significance of the Council of Constance in 1415, of Basel in 1427, and, finally, when all too late, of Trent in 1546?

To understand the great struggle between Emperor and Pope in the 11th and 12th centuries is comparatively simple, there being but two elements; but how are we to disentangle the complications and combinations of the various elements of strife—combinations which differed in different countries—in the fifteenth century. In the middle of that century the cause of Reform seemed hopeless. The Middle Ages had failed to produce an instrument which could break the bonds it had forged for itself. But read the history of the last half of the fifteenth century. Whence came the instruments which were to break through the triple coat of brass in which Europe was enclosed? Again I can merely mention the instruments of Reform and pass on. These were: (1) The Revival of Learning. (2) The Invention of Printing. (3) The Discovery of America. Ask yourselves the meaning of each of these events. What does *Litterae humaniores* mean? *Humanæ* letters. The Middle Ages had become for men inhuman(e). Can you point out a more pathetic illustration of Sophoclean irony in the pages of history than the encouragement which Popes and Cardinals gave to the revived study of Greek and Latin authors? Can you point out in the pages of history a subject of more significance for civilization than the difference of effect which the Revival of Letters produced upon the Roman mind, and upon the Teutonic mind? Why did the scholars of Italy become Pagan while the scholars of Germany and England became Protestant? If you want to understand some of the deeper questions involved in the Reformation, questions by no means settled yet, let me recommend to you a book by Mr. Seebohm, entitled "The Oxford Reformers." England, owing to her geographical position, has had a development all her own. Germany was the heart, the very centre, of the great struggle; the field on which the forces of the new and the old met in deadliest strife. By the end of the 15th century all the elements of a revolu-

tion are in existence; the instruments are all forged; the exactions of the church and the tyranny of the rules have reached their utmost limit; but Erasmus—the *homo pro se* (Ep. obs. Vir.)—published his edition of the Greek Testament in 1516. The train only requires lighting and Europe will be in a blaze from Scotland to Sicily. Into the story of the Indulgences, into the part played by the Elector of Saxony and Erasmus in the critical year 1520, into that stirring of the popular heart which cheered on Luther at every step he took, into the history of the Diet of Worms, January 28th, 1521, and the refusal of the Emperor to grant reform, I cannot enter. The issue of that Diet was to make the Reformation an accomplished fact, and, further, that it was to be not Reform but Revolution. What was the Reformation? I cannot tell. Time has not yet answered the question fully. But you may mark its steps through the last three centuries in the peasant war in Germany, in the revolt of the Netherlands from Spain, in the civil war and revolution in England, in the revolution in France, in the union of Germany and Italy in our own day. If you can tell the meaning of these events, you can tell the meaning of the Reformation.

Whatever evolutionists may say, mankind fight and always have fought for ideas. Since the twelfth century, at least, the progress of civilization has been the strife between two radically different theories of life: theories called by the antitheses religion and morality: ultramontaniam and positivism: spiritual and material: Hebraism and Hellenism: but which we here can better comprehend under the terms Catholic and Protestant. The one theory has for its ground principle, the authoritative will of God: the other has for its starting point the actual condition of mankind; the one seeks to organize society upon the basis of religion: the other employs religion as an instrument for the amelioration of mankind. Judicially speaking, it would be impossible to pronounce one theory true and the other false. But so it is: our civilization is the product of these two fundamentally irreconcilable theories of life. Perhaps it is best so, and in the future Hellenism may have to protest against Socialism as it has protested in the past against Catholicism.

I have not attempted to describe the Reformation era, the epoch-making sixteenth century: still less have I attempted to

describe the results of the Reformation which are written in the history of the last four centuries. To the principles of the Reformation are to be traced the reform within the Catholic Church herself: the growth of a new national life among Protestant nations at any rate, and of a spirit of international comity: the growth of modern literature and of national education: the growth and progress of scientific enquiry and of a spirit of toleration: above all, the general amelioration of the condition of the masses by the disappearance of the relics of feudalism. And to-day, notwithstanding many apparently untoward circumstances (which are the signs of a vigorous life), the outlook for the future is brighter than at any previous period in the history of civilization.

LA HARPE AND SAINTE-BEUVE.

BY MISS R. W. CHASE, '95.

[Read before the Modern Language Club.]

THERE is a very wide field involved in attempting to compare the two great critics La Harpe and Sainte-Beuve; and to give anything like a comprehensive survey of them in a short essay is a very difficult matter. Perhaps it would be better to start out with some idea of the relative places which the two men occupied in the history of French literature.

Malherbe, Boileau, and La Harpe may be ranked together as the three representatives of the infancy, flourishing and decadence of the classical theory of literature in France, which overthrew the Pleiade in the 16th century, reached its prime in the 17th century, and in the 18th gradually declined, because, by strict adherence to its own rigid rules, it had robbed literature of all vitality, and had become reduced to a mere servile imitation of the great classical period. Having no life in itself it must necessarily have died out, even if the Revolution had not come to sweep away the last remnants of it.

In the works of La Harpe we see the last brilliant flashes of this movement, as a candle burns up brightly just before it goes out. All the rules, artifices, and conventionalities laid down by Boileau and his school of writers are rigidly adhered to, and one might say revelled in; the choicest, most elegant terms are used; smoothly flowing language delights our ear, while through the 18th century superficiality of thought and limited area of idea, beams out at us the impenetrable self-satisfaction so characteristic of that age, and so particularly characteristic of La Harpe.

The Revolution had come and gone, and old traditions had been, as Saintesbury puts it, "tumbled from their ancestral seats," before Sainte-Beuve appeared on the scene. It was only

one year after La Harpe died that he was born, but French literature and thought were already in a new era—that of the restless, dissatisfied 19th century,—rudely awakened by the shock of that great national convulsion from her peaceful but narcotic slumbers, and now sitting up and looking about her with keen enquiring eyes. It is the result of her investigations which we find in the works of Sainte-Beuve. All those revolutionary processes which had followed up the overthrow of old traditions culminate in the works of this great critic. In him we see the first great apostle of the new era, the era of broadening horizons, of investigation and of analysis. “Sainte-Beuve,” says Saintesbury, “is the first scientific and universal critic that the world has ever seen.”

In regard to the lives of these two men, I shall only be able to touch on a few facts.

La Harpe was born at Paris, in 1739, (Voltaire was just 35 years old then), and he died in the same city in 1803, at the age of 64, having spent most of his life there. The story of his life is a very unhappy one. He seems to have been beset by enemies from his youth up, but this was no doubt largely due to his overbearing disposition and personal ill-temper. He was naturally endowed with a great facility in producing, and a great aptitude for judging things, but along with this he had a most abnormal amount of self-esteem (he was a very small man), and an excessive irritability in matters of taste, which made him many enemies, and the numbers of these kept increasing through the course of his life. Happily for La Harpe, the good idea which he had of himself inspired him with the most utter contempt for the attacks of his adversaries, whose shafts, in consequence, fell from him with blunted points. If you wish to know the details of his life, which are very interesting, especially as a character-study, you will find a very spicy account of them in the French Encyclopædia in the library, and also among the works of Sainte-Beuve. I will only mention the fact that he was educated by charity, having been left an orphan at an early age, and that during the first years of his literary career he lived with Voltaire, who was a very father to him and treated him like a spoiled child. La Harpe's growing critical instinct and self-esteem often led him to correct Voltaire's plays according to his

own taste, and without the knowledge of that author. But Voltaire, proud of his *protégé*, would, when it was brought to his notice, invariably exclaim, "Le petit a droit, cela va mieux ainsi!" We shall see later how La Harpe repaid this kindness and almost fatherly pride. La Harpe tried his hand at poetry and journalism, but although he indeed made himself remarkable in the latter by his self-eulogies and his criticisms of others, he did not find his true vocation, until, in 1786, he opened at the *Lycée de la rue Saint Honoré* a course of lectures on literature. These lectures were afterwards printed, and form, together with Marmontel's *Elements de Littérature*, the chief source of information as to 18th century French literature criticism of a fashionable kind.

In 1804, one year after the death of La Harpe, and two years after the birth of Victor Hugo, Sainte-Beuve was born in Boulogne-sur-mer. His father held an office of some importance, and his mother was an Englishwoman. It was probably from her that he got his taste for the English descriptive and analytic poets, Cowper, Wordsworth and Shelley, whom he tried to imitate in his first poetic attempts. He began by studying medicine, but soon turned his attention to literature, and distinguished himself on the *Globe*. Like La Harpe, Sainte-Beuve first tried his hand at poetry, but the critic in him soon killed the poet, and he betook himself to that critical study of literature, foreign, classical and French, which made his reputation. The papers to which he chiefly contributed were the *Constitutionnel* and the *Moniteur*, and, during the middle of this century, his Monday articles of literary criticism were the chief recurring literary event of Europe. These studies were afterwards collected and published in sets, under the titles "*Critiques et Portraits Littéraires*," "*Portraits Contemporains*," "*Causeries du Lundi*," and "*Nouveaux Lundis*," the last series only finishing with his death in 1869, at the age of 65.

The dispositions of these two men were about as far removed as the two poles, and the general tone of their writings naturally shows the effects of their different temperaments.

La Harpe was sharp, haughty and domineering, and his inflated vanity coupled with his diminutive stature made him an object of mockery to his enemies, who had many nicknames for

him, such as "Bébé," "Harpula," "Psalterion," etc. He held one shoulder a little higher than the other, and there was a stiffness, boldness, and a kind of decision and certainty about his whole person, but never an air of complete and real authority. Le Brun quotes a satirical remark of Piron's about him :

" De La Harpe, a-t-on dit, l'impertinent visage
Appelle le soufflet"

And these words express exactly the general feeling of the public toward La Harpe. One cannot wonder at this feeling when one considers the disposition of the man. He was full of bitterness of spirit, and himself spared neither friend nor foe. Even Voltaire, to whose kindness we have alluded, and to whom La Harpe owed such a debt of gratitude, did not escape his sarcastic allusions. In his pitiless gazette, the *Mercur*, La Harpe states that the later tragedies of Voltaire, do not offer one remarkable scene. "Voltaire," he remarks, "should end up like Jean Leclerc, who, not ceasing to write in spite of his old age, corrected every day a proof which was afterwards thrown into the fire in his ante-chamber." One can hardly restrain a legitimate indignation on reading things like this. La Harpe seems to have been two different beings in one—a human being with natural affections, and a critic—and these two sides of his nature he never could unite. There were depths of kindness in him. Stories are told of kind actions which he performed, sometimes at great sacrifice to himself, but as soon as his critical instinct was aroused, it carried all before it,—bonds of friendship, ties of gratitude, all were forgotten. When someone reproached him once for the bitterness of his satires, he replied naïvely: "Je ne puis pas m'en empêcher, cela est plus forte que moi."

La Harpe had not the good nature not to take offence at moderate criticisms, or to close his eyes to the insults and spiteful proceedings which envy always opposes to success, and he was continually carrying on a thousand little wars, in the confusion of which his dignity as a man and as a writer received cruel and irreparable wounds. He had the courage of his opinions, however, as all true critics must have, and faced with dauntless intrepidity the mob of little authors whose literary conceits he attacked, posing as their judge and as their scourge ;

but at the same time his vanity was such that he aspired to the honor of being a restorer of taste and a model in his own works and his own poetical productions, and here he was quite insufficient. The feeling which he aroused in his contemporaries is very well expressed by Chénier when he says: "How has he not felt that he was rendering himself odious in disparaging without relaxation and without measure his rivals, even his masters, and that he was rendering himself not less ridiculous in prolonging for four volumes the interminable song of his own eternally exclusive praises. One sees by the example of La Harpe into what errors the frenzy of self-esteem can drag a man of merit, and of a very distinguished merit; for one owes justice even to those who were constantly unjust."

One turns with relief after such a picture as this to the smiling critic of the 19th century, who in 1864, gave this advice to a young man of his acquaintance: "Pour out into criticism, that rival and sister of your poesy, your sympathy, your effusions of feeling, and the purest of your substance; praise, help by your words these growing talents, which meet with so many difficulties at first; and begin to withdraw your aid from them only when they themselves withdraw from the right path, and fail in their promises; remain then moderate and reserved toward them." The generosity and broad sympathy of Sainte-Beuve is finely depicted in these words. Sainte-Beuve's great kindness of disposition, and his entire absence of literary vanity are two points in which he contrasts most strongly with La Harpe. It was characteristic of Sainte-Beuve that he always tried to discover the good points in a man, and if there were any, he would find them. After quoting some words in praise of La Harpe by Voltaire and by Chateaubriand, he says: "I like to quote here these grateful words and to oppose them to so many other mocking and disparaging remarks, because, in truth, in spite of many faults and fits of passion which give scope for ridicule, I believe I have perceived a depth of generosity in La Harpe, and I think that no one has been more cruelly exposed to the ferocity of those self-esteemes which his own, after all, spared so little."

The methods of these two men are, of course, as different as the 19th century is different from the 18th century, and a

comparison between them really involves a comparison between the 18th and 19th century methods of French literary criticism. Of course, this involves a good deal, and can only be attempted very superficially in an essay of this kind; so I shall be obliged to trust somewhat to the knowledge of this subject which most of those who listen already possess, or ought to possess.

The first difference which I noticed between La Harpe and Sainte-Beuve, on going into the library and looking over their works, was that those of La Harpe are contained in three volumes, while Sainte-Beuve's works fill sixty-one. But when I came to read an article from both on the same subject—a criticism of Racine—I found that La Harpe's article covered 119 big, two-column pages, while that of Sainte-Beuve was contained in 45 much smaller ones. So the difference in productiveness is not caused by the fact that La Harpe had not so much to say as Sainte-Beuve about what he did know. The explanation lies in the difference of mental area, characteristic of the two centuries. Sainte-Beuve lived in a time when the influence of foreign literature was widening men's minds and opening up new fields. He was broader in every way, and also deeper than La Harpe. He had more topics, and he had a wider, more sympathetic, and more analytic way of treating them. He was always wanting to learn, to probe, to investigate; his restless activity knew no bounds. To the same acquaintance whom we mentioned before as receiving advice from him, he said: "Que la fatigue n'aille à aucun moment vous saisir, ne vous croyez jamais arrivé."

How different the narrow, self-satisfaction of La Harpe, who is par excellence a man of the 18th century. In a great many ways he reminds one of Pope,—in his cold correctness, flowing style, and sure taste, his polish, his pedantry, and his artifices. Form came before idea in importance with him, he had cut and dried rules for what a sonnet, an epic, or a drama should be, and he criticised every writer by these rigid standards of authority. Sainte-Beuve, on the contrary, endeavored in criticising, to place before himself the object which the author himself had when he composed his work,—it is characteristic of Sainte-Beuve that he studied the author himself as well as his works. This is a 19th century characteristic. Again, La

Harpe's ignorance of the ancients is indeed singular in a Professor of ancient literature. He knows the Middle Ages but little better. This is only another mark of the superficiality with which the 18th century contented itself, that satisfaction with precedents and stated rules which was overturned and swept away in the great Revolution. There is no trace of it to be found in the works of our 19th century critic.

Sainte-Beuve is distinguished for his fineness of analysis, his psychological penetration, and his knowledge of men. In his essays he depicts the finest shades of feeling. Here one may see the effect of his medical and physiological studies, which taught him exact and precise observation, so that he learned to watch the action of temperament upon the mind. He is an exquisite painter of portraits; he studies his personages thoroughly, notes the least gestures and the lightest attitudes by which their individuality is betrayed, and brings them out in their true light by placing beside them figures which contrast with them. To me this portrait-painting seems to be the chief aim of Sainte-Beuve,—he seems to delight in making a psychological study of an author by means of his works; he occupies himself, moreover, less in *judging* than in *understanding*. There is none of the 17th century pedantry about Sainte-Beuve. Hear his remarks on the speech of Monime, in Racine's tragedy of *Mithridate*, where Monime was trying to strangle herself with her head-band, or, as Racine puts it, "to make a frightful bond of a sacred diadem." Sainte-Beuve says: "She apostrophizes this diadem in enchanting verses, which I will, indeed, guard myself against finding fault with; I will only note that in the anger and scorn with which she overwhelms '*ce fatal tissu*,' she dares not name it except in generous terms, and with 'exquisite insults.'"

La Harpe, on the other hand, admires such things as this, —they are a part, as it were, of his religion. With him everything must be dignified, elevated; one must use the choicest words, far removed from anything vulgar. He has none of Sainte-Beuve's analytic thought and subtle reasoning, he is neither curious nor studiously investigative, but his style is pure, lucid, and animated. He extends, he develops, and applies the principles of Voltaire, and without having any of the latter's

piquaney or unexpected turns, he has something of his easy and natural charm and elegance. Taste is the least incontestable quality of La Harpe.

It is only in criticising the classics that La Harpe is just. He is never so to his contemporaries. But in his reviews of the works of men who have gone before him, all his powers come out in full force. Of course, the value which he discovers in the works is relative: he measures everything according to the cut and dried rules of classic tradition,—but it is a real value. We cannot be sure that it is possible to be absolute in this kind of thing; we do not know what the 20th century may think of our tastes and opinions.

Perhaps the best way to give a clearer idea of the difference in the critical methods of these men would be to read one or two remarks by each on the same subject. After comparing the Roman and Greek tragedies of Racine with the original classics, much to the advantage of the latter, Sainte-Beuve says: "All this would lead us, if we ventured to do so, to conclude with Corneille that Racine had a much greater talent for poetry in general than for the theatre in particular." But in going on to speak of the Jewish plays, *Athalie* and *Esther*, he says: "Racine, in the Hebrew subjects, is quite differently at his ease than in the Greek and Roman subjects. . . . Nourished by sacred books, sharing the beliefs of the people of God, he keeps strictly to the Scripture narrative, and does not believe himself obliged to mix the authority of Aristotle to the action. . . . Yet, *there is a certain element in Judaism, secret, underlying, wholly oriental*, which it is important to seize and make prominent, under pain of being tame and unfaithful, even with an appearance of exactitude; *and this radical element Racine has not seized*. Let us begin with the architecture of the Temple in *Athalie*. Among the Hebrews everything was figurative, symbolical, and the importance of forms was connected with the spirit of the law. But at first I seek vainly in Racine for this marvellous temple, built by Solomon, all in marble, in cedar, covered with plates of gold, shining with cherubims and with palms; I am in the vestibule, and I do not see the famous bronze columns, eighteen cubits in height, I see neither the sea of brass, nor the twelve brazen oxen, nor the lions; I do not

discover in the tabernacle those cherubims of olive wood, ten cubits high, which envelop the ark with their wings. The scene takes place under a Greek peristyle, rather bare, and I feel myself already less disposed to admit the sacrifice of blood and the immolation by the sacred knife, than if the poet had transported me into that colossal temple where Solomon on the first day slew for peace-offerings 22,000 oxen and 100,000 sheep." Similar faults are found with the character and the conversation of the personages, and then Sainte-Beuve goes on to say: "In fine, *Athalie* is an imposing work as a whole, and magnificent in many places, but in it Racine has not penetrated the very essence of Hebraic oriental poetry, as he has of the religion."

Now, hear La Harpe, who thinks the plays of Racine much finer works of art than their classic originals, and who, with his limited knowledge of antiquity, and his superficial survey of things, cannot accuse Racine of failing to grasp a "*certain secret, underlying element in Judaism,*" which has wholly escaped his own mental vision. "The most extended and rich conception, in the simplest subject, and which appeared the most sterile: the unique merit of interesting for five acts with a priest and a child, without placing in operation any of the passions which are the ordinary resources of the dramatic art: without love, without episodes, without confidantes; the true imprint of manners and customs stamped upon each line (La Harpe had no great knowledge of these same manners and customs); the magnificence of an august and religious spectacle, which shows tragedy *in all the dignity which belongs to it* (note that phrase, it is characteristic); the *sublimity* of a style equally admirable in a pontiff, who speaks the language of the prophets, and in a child who speaks that of his age; the sustained beauty of a versification in which Racine has surpassed himself; a *dénoûment* in action which represents one of the greatest tableaux ever offered on the stage; it is these things which have placed *Athalie* in the highest rank of the productions of poetic genius, it is these things which have justified Boileau when, alone against the general opinion, and representing posterity, he said to his discouraged friend, '*Athalie* is your finest work.' "

I think from these two examples some illustration may be gathered of what I have said about the two men. It is the grandeur, the dignity and sublimity of *Athalie*, and its dramatic ingenuity which attract La Harpe. He does not think about the Temple as Sainte-Beuve does, simply because he has not studied antiquity to any great extent, though to be sure he was nominally a Professor of ancient literature. Sainte-Beuve always studied his subjects deeply and pushed his investigations as far as possible.

I should like to read in closing one more selection from Sainte-Beuve's essay on Racine, which will give some idea of his exquisite touch and his subtile manner of dealing with a subject. "If one passes abruptly from the pictures of Rubens to those of M. Ingres, the great Flemish master, one sees at first in the French artist nothing but a rather uniform tone, a diffuse coloring of pale and soft light. But let one approach nearer and observe carefully; a thousand fine shades dawn under his eyes, a thousand scientific purposes come out from this deep and close texture, one can no longer take his eyes off it. It is the case with Racine when one comes to him after leaving Molière, or Shakespeare, he demands then more than ever to be regarded from a very close standpoint, and for a long time; thus alone one surprises the secrets of his manner; thus, in the atmosphere of the principal feeling which makes the background for each tragedy, one will see the different characters with their personal traits stand out and move about; thus, the differences of accentuation, fugitive and impalpable as they are, will become tenable, and will lend a kind of relative truthfulness to the language of each one; one will know with precision just to what point Racine is dramatic, and in what sense he is not." After reading this, one says to himself, with Bersier, that only one epoch, ours, could produce such a type, and that only one man, Sainte-Beuve, has been able to make of criticism an instrument so marvellously delicate. La Harpe, clever man and distinguished critic as he is, could write nothing like this.

BRIGHT AND GLADSTONE AS ORATORS.

BY J. LOVELL MURRAY, '95.

[Read before the Modern Language Club.]

ONLY a very inadequate idea of a man's oratorical power is to be derived from the reading of his speeches. Anything like a complete disquisition on such a question as this should only be attempted after the careful observation of an actual listener. And, as we have never had the good fortune to form part of an audience of either of these speakers, we have simply read some of their orations : and we have gathered the testimony of others as to their style and mode of delivery, and as to the effects produced on their respective audiences. From these two sources we have collected our ideas, which we attempt to combine and condense in this paper, necessarily brief, and so, in view of the largeness of the subject, necessarily incomplete.

In considering Gladstone's oratorical powers, we find that not one quality, but a combination of qualities have made him an all but complete success. His first qualification as an orator is his exquisitely sweet, clear, resonant voice—that "silver-trumpet voice," far-reaching but not harsh, and strong but not loud. His earnest, deep-flashing eyes, and his energy of action while speaking gave him additional power. His gift of utterance is simply phenomenal ; his wide range of vocabulary, and his "torrent-like fluency" have hardly ever been equalled. In December 1852, when the Chancellor of the Exchequer, Disraeli, brought in his budget, Gladstone spoke against it in a speech which displayed at once range of knowledge, accuracy of detail, and unquestioned genius for oratory, and which readily gave him a place among the first speakers of the day. Very soon afterwards, he was recognised as being foremost in the nation as orator, politician, financier, and statesman. His only really great speeches are on political questions ; and, strange to say, those showing the greatest genius are on subjects which are essentially heavy and

uninteresting, such as those of assets and liabilities. Certainly no other man of our century could make a really fascinating address out of a budget speech.

Gladstone was not so successful on the public platform as in the House of Commons. There he was completely at home. He was too fond of looking carefully all around a question, rather than of plunging at once into its very heart, to suit the ordinary audience. A restless public crowd found his thorough aptitude for details almost tedious. But on the floor of the House, he was a very Hercules of oratorical strength. It was in his budget speech of 1852 that he first showed those qualities in which, Justin McCarthy thinks, he is unequalled by any other orator of our time,—i.e. “the readiness which seems to require no preparation, but can marshal all its arguments as if by instinct at a given time, and the fluency which can pour out the most eloquent language as freely as though it were but the breath of his nostrils.” He could get up any time, and, if need be, any number of times in a night, and he was always ready, whether vehemence, or cool, syllogistic argument were called for; he could pour forth a stream of the most scathing sarcasm, or heap up a colossal pile of unanswerable facts, as occasion demanded. He simply could not but be eloquent. Somebody once said that Gladstone was the only man in the House who could speak in *italics*. Another feature of Gladstone’s oratory was, that although he would often get himself into a seriously involved sentence, yet no labyrinth of dependent clauses was so intricate that Gladstone could not work his way out creditably and speedily. Harley called one of his speeches a “circumgyration of incoherent words.” We can hardly conceive of such a speech from Gladstone, but we might properly call many of his speeches “circumgyrations of coherent words.” Gladstone’s orations were not flowery; in general, he did not excel in the imaginative. He was too much in downright earnest for that. But although not florid, he was, as we remarked before, exceedingly fluent. Indeed, he was too fluent at times. For his very fluency sometimes carried him away, at the great expense of proportion. And he was often redundant. It was one of the defects of the Peelite school of oratory, to which he belonged, to indulge in wordiness, and even at the height of his oratorical glory, this

defect was noticeable in Gladstone. But his fluent verbosity served him well on the repeated occasions on which violent denunciation was called for. He had not much of Bright's playful humor; but he abounded in that sarcastic, scornful rhetoric, which could always silence his opponents so effectually.

We cannot stop to speak of the massiveness of intellect, the tenaciousness of memory—especially for details—the marvelous power of adaptation, and the noble aspirations which characterized throughout this wonderful and versatile man, and which had such a direct and salutary effect on his oratorical efforts. But we must pass on to that other star of oratory whose light shines with more dazzling brilliancy if with less steadiness than Gladstone's—John Bright.

Thorold Rogers anticipates a high place for Bright's speeches in literary estimation. We do not judge this will ever be so. A good oration can never be a piece of good literature. When we read it and appreciate it, different faculties are called into play from those which are exercised when we form an estimate of a literary work. On reading over an oration, our imagination is drawn upon. We see a mass of people, ourselves in the midst, and an orator with gleaming eye and trumpet voice speaking the printed words before us: we fancy the magical effect that would be produced on an audience, and we silently cheer and clap our hands, or groan and hiss with the crowd. After all, then, it is more our ear than our eye that is exercised in the appreciation of an oration, even when we read it. Not its qualifications as a literary composition, but its qualifications as a composition intended to move an audience by forces not intended to be felt, directly, in the reading of it, determine its worth.

Gladstone spoke of Bright as "the man whom the House loves to hear." No wonder when Bright stood before the House with his robust appearance, his fine genial Saxon face, and his sparkling eye: and when he spoke with that clear, ringing voice of his which could reach 15,000 persons at one time, no wonder if every sound would be hushed to hear what one critic has called "the thrilling vibrations of Bright's noble eloquence, now penetrating in its pathos, now irresistible in its humor." His delivery was slow, manly, artless and uninterrupted, so that he gave his hearers time to think as he proceeded. His clear,

honest logic was not weakened by any over-haste, or any dropping of the voice. One great charm of his speaking was his remarkable ease. He never spoke beyond his strength. The only effort he put forth was the effort to restrain. He would not allow himself to give energetic expression to the intensity of his passionate sentiments. The same self-command put a check on the exhibition of his scorn, and on the play of his imagination. All these things were his servants, not his masters. This manly reserve could not but give loftiness to his speeches; and the serenity of himself amidst all the conflict of these faculties struggling for expression, only added intensity and strength. He always went direct to the heart of his subject, while Gladstone would take time to weigh and measure preliminary details; and he expressed himself so clearly, forcibly and vividly that all classes felt the power. It is refreshing, too, to see how eager Bright seemed to be to rush into his theme. The result of all this was extreme naturalness. There was no mannerism to jar, no hesitancy to interrupt; mind worked direct on mind, and the audience scarcely recognised the medium of speech.

In comparing Bright with Gladstone, we must take into consideration not only his different genius but his different education. Gladstone was a capital scholar, Bright was not a college man. But to their respective preparations in this regard, we shall refer later. Bright could speak well extempore—instance one of his speeches on the Crimean war; but his best efforts were carefully worked out. We might say that Bright *when prepared* was *great*; Gladstone was *always prepared and great*. As we should expect, Bright was singularly successful in the clear simple exposition of a subject, but he could not begin to cope with Gladstone in the almost miraculously lucid way in which the latter could explain the multifarious details of an intricate subject, such as, for example, those of a budget speech. He always had facts at hand, but he regarded them as subordinate. He grasped rather at eternal principles; he went at once to the primary root of things. But Bright was at a disadvantage on account of his inferior education, for while he was more uniform and symmetrical than Gladstone, he lacked in the comprehensiveness and variety which so distinguished the other, who had all the wealth of the classics at his disposal. But though his edu-

cation was circumscribed in some ways, his knowledge of English literature—and especially of Milton, Shakespeare, and the Bible—was very extensive. Based as it was on them, Bright's English style was accurate, as well as vigorous and beautiful, and was possessed of resources which fitted it for whatever subject was to be dealt with. His familiarity with this literature, particularly with the Bible, helped largely to give him that simplicity which was one of the greatest sources of his power. His language, which, though not more pure, was much more Saxon than Gladstone's, was made up largely of words of one syllable, and this contributed to give him a wider audience than Gladstone had. Bright's imagination was remarkable, his imagery was sublime: his passion for poetry could be seen throughout: and, in whatever respects he may have been inferior to Gladstone, he certainly surpassed him in fancy and vivacity. One writer has said "In that perfect blending of imagination, pathos, passion and the noblest ethical feeling, which gave to the great passages in Mr. Bright's great speeches their dignity and power, he stood apart and alone." Like Gladstone, he showed great skill in disentangling himself from the subordinate clauses of a long periodic sentence. In one oration, we came across one sentence of 163 and, after it, another of 158 words, without a single break in form or sense in either. His humor, a quality which Gladstone seriously lacked, was rich, genial and sparkling. It was never coarse nor splenetic, but essentially good-natured and playful. He used it to confuse rather than to wound his opponents. His comparison of Lord Beaconsfield to a quack at a country fair selling pills which were good against earthquakes, is an irresistible instance of his bubbling humor. But the prevailing character of Bright's oratory is his pathos. He could safely use this instrument, which few members of the House dared to employ, for he knew how to handle it. He had a heart as well as a brain, and the House would yield to his spell, when with passionate tenderness he would appeal to the conscience of men, and would touch the finest chords of the human heart. Before leaving our consideration of Bright, we cannot refrain from quoting what one biographer has said of him. "His diction is drawn exclusively from the pure wells of English undefiled. Milton and the Bible are his unceasing study. There was a time when it was rare to find him

without *Paradise Lost* in his hand or in his pocket. The use of Scripture imagery is a marked feature of his orations, and no imagery can be more appropriately employed to illustrate his views; for Mr. Bright, in all his grand efforts, rises far above the loaded, unwholesome atmosphere of party politics, into the purer air and brighter skies of patriotism and philanthropy. We may differ about his means or measures, but no one can differ about the aim, when he puts forth his strength to raise Ireland or India in the scale of civilization, to mitigate the evils of war, or to promote the spread of toleration and charity throughout the world."

These, then, are in brief some of the distinguishing qualities of these two eminent orators, each of whom is alone, of all the great speakers of the century, worthy to be compared to the other. The fact that they were great orators can not be disputed, for our criterion is ever ready. Was the audience moved? Did the people applaud? The House of Commons is still the most severe audience in the world. A man must be a great orator indeed to move that impassive assembly. But friends and foes alike had to rise from their seats and cheer to the very echo at some of the oratorical flights of these two men. The question will naturally be asked, "But which is the greater orator?" Justin McCarthy would say that the greatest orator is the one who has made the greatest speech; that no number of novels each as good as *Gil Blas* would make *Le Sage* the equal of *Cervantes*; that this is the only principle of criticism sanctioned by posterity. If that be our standard, Mr. Bright is certainly the greater orator, for some of his finest speeches are unequalled by any of Mr. Gladstone's. But if we measure by the aggregate of oratorical powers possessed by each of these two men we must at once relegate Mr. Gladstone to the foremost rank; for, as one of Mr. Gladstone's biographers has said, "Probably no one, past or present, had in combination so many gifts of voice, manner, fluency, argument, style, reason and passion as Mr. Gladstone." We know that neither Pitt nor Fox was the master of oratory that Gladstone was. Burke was a greater political essayist than orator, and Chatham was a greater actor than orator; Canning with all his polished rhetoric was commonplace; Macaulay was not a true orator; Bright was not sustained in his efforts. So,

judged from this standpoint, Mr. Gladstone never had an equal in the British Parliament : and, possibly, Mr. Bright's claim to second place is indisputable. For, though Lord Beaconsfield and others have excelled in certain particulars, we dare maintain that in the aggregate of characteristics which combine to make the great orator, Gladstone and Bright stand supreme : and of these two men we may say that Gladstone was a genius, while Bright had only a very high order of talent.

But in another and more important regard, Bright and Gladstone occupy a unique position amongst political orators. That is in their loftiness of character, their high ideals, their purity of motive and their devotion to truth. Some one said of Bright : " He seems alive only to the truth, which is the central quality of his speeches, and the very soul of his eloquence." The same could be said with scarcely less accuracy of Gladstone. They were both intensely earnest, and their words always appealed to the higher natures of their hearers. They both aimed at truth, at the amelioration of the poorer classes, at the sweeping away of existing wrongs. They loved all men, especially Englishmen. Their audiences felt that not voices but men were speaking—men the purity of whose very souls they could read as they spoke ; and supporters and opponents alike would be made stronger and better men by listening to the words of these eminently Christian orators. Their career as public men is over. Mr. Gladstone has retired from public life. Mr. Bright is dead. But they have left behind, as a safe precedent for succeeding statesmen and orators, two long, consistent, energetic lives—lives lived not for themselves, but for England, for truth and for God.

HOW FAR DID CÆSAR FULFIL THE POLITICAL NEEDS OF HIS TIMES?

BY R. ORLANDO JOLLIFFE, '97.

[Read before the Classical Association, January 29th, 1895.]

"If there is one lesson," says Mr. Froude, "which history plainly teaches, it is this; that free nations cannot govern subject provinces. If they are unable or unwilling to admit their dependencies to share their own constitution, the constitution itself will fall in pieces from mere incompetence for its duties."

This was precisely the case at Rome. The career of conquest on which the city had entered with the first Punic war had been continued and unbroken. In a short time, from mistress of Italy, she had become mistress of the world. And so rapidly had this change occurred that sufficient time had not been granted for the corresponding change in Roman character that was essential for the wise government of the empire which the fortune of the city had, as it were, thrust upon her. The peculiar system which was organized for the government of the provinces led to the downfall of the republic itself. The power of the governor was practically unlimited. His investment with the Imperium made him far more powerful than the city magistrates, for there the duality of office acted as a restraining influence, while he was unimpeachable during his term of office. If, after his return, any charge were laid against him, a wise expenditure of provincial gold among the jurymen, who either had themselves committed similar offences, or intended to do so if ever they had the chance, gained him an acquittal. The natural result of this domestic republicanism and provincial despotism was the undermining of republican principles, for men who had once tasted the sweets of unlimited power, could not on their return bring themselves to the level of ordinary citizens. Later on we shall treat in greater detail of the evils of this provincial system.

The opinion has been held that, in spite of the degeneration, moral and economical, that was caused by this system, Caesar might still have preserved the old republican constitution, and by wise reforms have promoted political advancement and freedom, such as have taken place in England. But it must be remembered that political advancement in England has been based upon freedom, whereas the basis of the Roman state was slavery: and no steady advance in freedom could occur until slavery was abolished. On the contrary we agree with Mr. Merivale that the tendency of the Roman state was, from the first, towards monarchy. The critical times which necessitated the appointment of a dictator gave evidence that there was some obstruction in the working of the constitution, which rendered the appointment of a temporary sovereign an absolute necessity. And after the time of Sulla, the establishment of imperial sovereignty was only delayed by the nearly equal forces of the chiefs who were contending for the prize.

We shall now endeavor to give as briefly as possible some features of the development of the constitution, in order that we may perceive what abuses had been developed with that growth and what measures were needed to check them, and provide for a sounder and more efficient form of government.

In studying the history of Rome, we cannot fail to be struck with the greatness of the change that came over the character of that people. We shall show how this change was accomplished in a great measure, by the influence which the provincial system had upon them, later on.

The most characteristic qualities of the early Roman character were "*constantia et gravitas*." They were a nation of kings—kings over their own appetites, passions and inclinations. They were intensely, and above all, practical and moral, with little art, little philosophy and less poetry. Their freedom was not the freedom of license, but the freedom of self-restraint. From earliest childhood, they were schooled in absolute obedience. The father was, legally at least, absolute master of wife and children, even to the extent of life and death. Similarly, what the father was to the family, that the gods were to the nation. They regarded the gods as guardians of the state, to be obeyed implicitly. Their stern rationalism did not permit

them to clothe their gods in such fantastic forms as the poetical mind of the Greek gave to the deities he professed to worship, but inclined them to worship the spirit rather than the form; and it was this characteristic of their religion that led them to build temples and offer sacrifices to the highest human excellencies: to "Valor," to "Truth," to "Modesty," to "Concord."

It was out of this peculiar national character that the Roman constitution was developed, and it was precisely owing to this character that they were able to prosper under a constitution, which to modern experience would promise only the most hopeless confusion. The citizens, assembled in comitia, were the sovereign authority in the state, and they exercised their power immediately. They formed the only Court of Appeal, and without their sanction no citizen could lawfully be put to death. In them, too, lay the supreme power of legislation. As a check on precipitate resolutions, a single consul or tribune might interpose his veto. But the veto could only last a year and might be got rid of at the next election. The Senate had the privilege of preconsidering all measures to be submitted to the people, and of refusing to recommend them, if it wished, but the magistrate who consulted it was not legally bound to act on its advice.

Such, in its chief outlines, was the constitution and character of the Roman people, so long as they remained masters of Italy. But Fate had destined them for something higher than that. It has been often remarked that the true test of the individual or the nation is not adversity, but prosperity. The era of prosperity had now come for Rome, but when she was weighed in the balances, she was found wanting. Nevertheless, such was the strength of the early national character that it took nearly a century for it to be entirely disintegrated.

Over the conquered provinces, rich with the accumulated treasure of centuries, the energetic Roman business men at once spread. Their frugal education, their abhorrence of debt, led them to turn to account their extraordinary opportunities. But the very influence that these exerted either resulted in insatiable avarice, or by reaction, led to boundless extravagance. Gold seemed to be pouring in streams into the city. To the Senate as the administrator of the provinces, there fell of course the largest share. It had control of the public treasury, and from

its own ranks it appointed the governors for the provinces, so that the tendency of the state was now to plutocracy.

In such a time it was no wonder that a mania like the South Sea Bubble sprang up. Men believed as Dick Whittington did of London, that the provinces were paved with gold. The small landowners in their eager desire for wealth, sold out their holdings to the now enriched Senators and started off to seek their fortunes. To the large tracts of domain land which they had held, till at last they were beginning to regard their tenures as private property, the great families now united these small holdings so that Italy merged rapidly into "latifundia."

It did not take these large landowners long to discover that slave labor was much cheaper than the employment of free citizens, and perhaps the aversion of the latter class to servile toil, now that an easier path of life seemed open, contributed somewhat to the result. The many wars of conquest had caused such an overcrowding of the slave market and such numbers were brought into Italy that free labor was now no longer employed. Accordingly the unemployed free population that remained behind crowded into Rome. They had no occupation except politics and no property save their votes. As the quickest road to wealth lay now through political power, the elections became matters of annual bargains between a candidate and his supporters. And when he had wrung from the hard hands of the provincials enough to pay his election debts, to bribe the judges on his return, and last, but not least, to satisfy his own greed, the Roman noble would return to that ancient Paris, only to waste his substance with riotous living, and then to go through the same old round as before. Thus their former hardy and abstemious mode of life degenerated into grossness and sensuality.

Another influence that contributed in no small degree to the latter result, was the immigration of foreigners and especially Greeks to the city, which the extension of the state naturally caused. The influence of the growth of Hellenism in Rome can scarcely be over-rated. The conquest of Greece brought to Rome a taste for knowledge and culture; but the culture seldom passed beneath the surface, and knowledge bore but the same fruit as it had borne in Eden. They had believed in the gods

with simple piety; the Greeks introduced them to an Olympus of divinities which the practical Roman found that he must either abhor or deny to exist. The "Virtues" which he had been taught to reverence had no place among the graces of this new theology. Reverence these gods he could not, and it was easy to persuade him that they did not exist. Thus, while morality was assailed on the one side by extraordinary temptations, the religious sanction of it was undermined on the other.

Such was the state of Italy at the time of the Gracchi. Alone among the self-seeking politicians of the time they saw that these evils must be checked, or the days of the republic were numbered. The efforts of Tiberius Gracchus were directed chiefly against the extension of the "latifundia." Unfortunately he used unconstitutional means, and thus gave the aristocracy a chance to raise the cry against him, that he was subverting the republic. It was a cry always powerful at Rome, and on this occasion it did not fail to secure the usual result, the death of the man against whom it was directed. All his efforts had been practically in vain, for inside of two years the law was quietly repealed by the Senate.

Ten years later Caius Gracchus was elected tribune. With even more political sagacity than his brother, he saw that the true source of the commonwealth's disorders lay in the Senate, and with it he commenced his reform. His first act was to take all judicial functions from the Senate and bestow them on the Knights. This of course gained the latter body to his side, and now for the first time, having united them into a political party, he was all powerful. Besides the restoration of his brother's agrarian law, and a measure which was aimed at his brother's murderers, he introduced another, which, however ill-advised, was destined to exert a powerful influence on subsequent history. This was a law for the distribution of corn to the poor citizens. The effect of this measure was to increase still more the influx into the capital and thus to render the deadliest blow that had yet been aimed at the constitution. The privilege once granted was thenceforward claimed as a right, and the utmost that could be ventured on in later times was to limit the evil.

In spite of this socialistic measure, Caius Gracchus was not

so much of a demagogue as to think that the charity-fed mob could govern the world. He meditated, accordingly, the enfranchisement of the Italians, and, anticipating part of Cæsar's great work, he intended to scatter Roman colonies throughout the provinces, Carthage being one of the points he had selected. But the multitude found it far more agreeable to have their corn measured out to them from the public magazines under the shade of Roman porticoes, than to cultivate it for themselves in the sweat of their brow. And Gracchus had not, as Cæsar had, sufficient force behind him to command obedience. Moreover Carthage was still a name of terror. To restore Carthage, they said, was treason: and to divide their privileges with Samnites and Etruscans, and so water down the price of their votes, was little better. It was the same old cry as ever, and as ever that same old cry led to the inevitable result. Gracchus was slain by the very people for whom he had done so much.

Most of the occurrences in that long revolutionary period—that Roman “Reign of Terror” which lasted from 123, down to 49 B.C.—are closely connected with our present subject, for they are but successive stages in the national decay, and they show us to what a depth of degradation senatorial misrule at home and abroad had brought the commonwealth: but time forbids us to dwell upon them; and we can only mention one feature which exerted a powerful influence on later events, inasmuch as it finally paved the way to the establishment of the military monarchy. This was the change in the character of the army that was brought about by Marius.

Like every other self-made man, Marius was intensely practical, and his early military training led him to pay especial attention to the army. He saw that fewer men better trained and disciplined could be made more effective and more easily handled than the citizens in arms, called for the moment from their various occupations, to return to them when the occasion for their services was past. The only thing requisite was thorough organization. Accordingly he equipped his recruits at the public expense, and trained them with the strictest discipline. Standing armies, it is true, were prohibited in Italy, and every general was required to disband his legions on entering the sacred soil, but nevertheless the materials of these legions remained a dis-

inct order from the rest of the people, capable of instant combination, and in combination irresistible, save by opposing combinations of the same kind. The army thus became professional, and, as it looked more to the general for its rewards than to the state, it became an instrument in the general's hands. Henceforward, we find that nearly all the politicians are military leaders who depend for success upon the armed force behind them. And in this we see the inevitable result—civil war, so soon as two men who both wished the supreme power should come into collision.

The weakness of the Senatorial rule during the decennium of the Sullan restoration is well described by Mommsen: "No one of the movements, external or internal, which occurred during this period—neither the insurrection of Lepidus, nor the enterprises of the Spanish emigrants, nor the wars in Thrace and Macedonia, and in Asia Minor, nor the risings of the pirates and the slaves—constituted of itself a danger necessarily affecting the life-springs of the nation; and yet the state had in all these troubles well-nigh fought for its very existence. The reason was that the tasks were everywhere left unperformed, so long as they might still have been performed with ease; the neglect of the simplest precautionary measures produced the most dreadful mischiefs and misfortunes, and transformed dependent classes and impotent kings into antagonists on a footing of equality. The democracy and the servile insurrection were doubtless subdued; but, such as the victories were, the victor was neither inwardly elated, nor outwardly strengthened by them. It was no credit to Rome that the two best generals of the government party had, during a struggle of eight years, marked by more defeats than victories, failed to master the insurgent chief Sertorius, and that it was only the dagger of his friends that decided the war in their favor. As to the slaves, it was far less an honor to have conquered them than a disgrace to have been pitted against them in equal strife for years. Little more than a century had elapsed since the Hannibalic war; it must have brought a blush to the cheek of the honorable Roman, when he reflected on the fearfully rapid decline of the nation since that great age. Then the Italian slaves stood like a wall against Hannibal's veterans; now the Italian militia were scattered like

chaff before the bludgeons of their runaway serfs. Then every plain captain acted in case of need as general, and fought often without success, but always with honor; now it was difficult to find, among all the officers of rank, a leader of even ordinary efficiency. Then the government preferred to take the last farmer from the plow rather than forego the acquisition of Spain and Greece; now they were on the eve of again abandoning both regions long since acquired, that they might be able to defend themselves against the insurgent slaves at home. Spartacus, too, as well as Hannibal had traversed Italy with an army from the Po to the Sicilian straits, beaten both consuls, and threatened Rome with a blockade; the enterprise which it required the greatest general of antiquity to undertake against Rome in former days could be undertaken against the Rome of the present day by a daring captain of banditti. Was there any wonder that no fresh life sprang out of such victories over insurgents and robber chiefs?"

We have given in outline some of the features of the growth and development of Rome, and have endeavored to show how her foreign policy had resulted in such national deterioration as to render a change of constitution imperative. We shall now try to show how far Caesar remedied these faults and mistakes—in short, "how far he fulfilled the political needs of his times."

His conduct before the actual outbreak of the war indicates not only that he did not want war but even that he was anxious for peace. It was with this end in view that he offered to his rival the greatest concessions. He knew only too well the horrors which war could not fail to bring in its train. Accordingly, while the conflict lasted, and after his final victory, he everywhere displayed that magnanimity and self-restraint which in the midst of unlimited power is the sign of true greatness. He regarded conquest as only half of the victory, and he saw that the security of its duration lay only in the unconditional pardon of the vanquished. This moderation, well calculated even in its very semblance of excess, attained its object. The trembling anxiety of the propertied classes was in some measure allayed. This was certainly an incalculable gain for the future: the prevention of anarchy and the scarcely less dangerous alarm of

anarchy was the indispensable preliminary to the reorganization of the commonwealth.

This course he maintained in the general amnesty after his victory, and in the settlement of the state at large. It seems all the more incredible when we reflect that it did not convert the more incredible when we reflect that it did not convert enemies into friends, but rather turned friends into enemies. His Catalinarian adherents who wished the abolition of all debts and the institution of a general war against property, were indignant that murder and pillage remained in abeyance. The republicans on the other hand, blinded by a false idea of the duty they owed to the constitution, were not propitiated by his leniency. But like every genuine statesman, he served not the people for reward, not even for the reward of their love, but sacrificed the favor of his contemporaries for the blessing of posterity and above all for the permission to save and renew his nation. The era of tranquillity that, despite the fact that the reconciliation of the old parties was at best but an external one, was thus restored, gave him the opportunity of making the reforms he contemplated.

The decay of the judicial system caused by corruption and venality has already been touched upon. The measures which Caesar took for its reform did not and could not form a permanent cure for all its evils. Justice cannot be attained in a state whose basis is slavery, inasmuch as the right of proceeding against slaves lies, if not *de jure* at least *de facto*, in the hands of the master. And even in the numerous pleadings in charges against citizens that have come down to us, there is scarcely one that makes even a serious attempt to fix the crime in question. Cicero himself gives us an estimate of these proceedings: "Plura enim multo homines judicant odio aut amore aut cupiditate aut iracundia aut dolore aut latitia aut spe aut timore aut errore aut aliqua permotione mentis quam veritate aut præsripto aut juris norma aliqua aut iudicii formula aut legibus."

Caesar's main reforms were in the selection of the jury-men, and in the establishment of the Emperor as the final court of appeal, so that he founded that procedure of appeal to a higher court, which was to be so important for succeeding, and even for modern times.

Nor had the military system escaped the general decay. As in the Carthaginian system at the time of Hannibal, the governing class furnished the officers; plebeians and provincials the rank and file. The generals were for the most part independent of the home government, so that the army was no longer an instrument of the commonwealth. Under a good general it was capable of reaching military perfection; under a poor one, it sank into a disorganized and cowardly rabble. It was no wonder that mutinies were of frequent occurrence, or that provincial towns were plundered, when the generals themselves set the example. The degeneracy of the officers—a natural result of the luxurious indolence of the upper classes—is well pictured to us by Caesar himself in the description he gives of their conduct. When orders were given to march against Ariovistus, they wept, groaned and cursed. They rolled on the ground in anguish of spirit. They made their wills and some even applied for leave of absence. Another reason for the irregularity of the system was to be found in the defective pay of the soldiery, due not more to financial mismanagement at home, than to the venality and peculation of the generals abroad.

Caesar's main reform consisted merely in the establishment of a stricter form of discipline, and in a more energetic centralization of command. The latter step he effected by the appointment of adjutants (*legati legionis pro praetore*) and by the institution of a permanent military head in the person of the Imperator. Nor did he experience any great difficulty in regulating financial matters on account of the solid foundations which the magnitude of the empire and the exclusion of the system of credit supplied. The chief abuses had been due to the venality of the officials. These were now appointed by him, and as they remained under his personal supervision, better order soon prevailed.

There were two institutions, however, (both of which had originated with Caius Gracchus) which were the chief evils of the financial system—the distribution of corn, and the farming of direct taxes. From this time, the direct taxes were either treated as contributions in kind to be supplied directly to the state, or converted into fixed money payments, in which case

the collection of the amount was entrusted to the provinces themselves.

With regard to the distribution of corn, the fact could not be overlooked that a multitude of destitute burgesses were only protected from starvation by these largesses of food. The list of recipients had reached 320,000. This number was at once cut down to 150,000, and the latter number was fixed once for all as the maximum number of recipients. Thus what had been a political privilege was turned into a provision for the poor.

“ But the task of breaking up the old parties, and of furnishing the new commonwealth with an appropriate constitution, an efficient army, and well-ordered finances, difficult as it was, was not the most difficult part of Cæsar’s work. If the Italian nation were really to be regenerated, it required a re-organization which should shake Rome, Italy and the provinces to their very foundations.” Let us endeavor here also to delineate the old state of things, as well as the beginnings of a new and more tolerable time.

A capital naturally loses its municipal and national stamp more quickly than a subordinate community. This was especially the case with Rome. From all quarters of the empire men had flocked to this ancient Paris for speculation, for debauchery, for intrigue. In the houses of the rich, bands of slaves were accumulated in large numbers, and all the evils resulting from slave population were more conspicuous there than any place else. But there was another element, as bad, if not worse, than the slave population: the freedmen who had not yet attained the rights of citizens. They had all the vices of slaves without being beneath the eye of a master. The government not only did not do anything to counteract this corruption of the populace, but they even encouraged it for their own selfish ends. Indeed the distributions of grain formed an official invitation to everyone indisposed to work to take up his abode in the capital.

Unhappily the primary evils were the least capable of being eradicated. The abolition of slavery with all its train of national calamities was, of course, impossible. Nevertheless as far as he was able, Cæsar worked energetically at the lamentable and disgraceful state of affairs that he found there. The extensive build-

ing operations opened up to the proletariat an honorable source of gain. The great influx into the capital was checked by the limitation of the corn grants; and the ranks of the existing proletariat were thinned by a comprehensive system of transmarine colonization. In a few years more than 80,000 of these had been settled in the provinces.

We have already noticed the chief evils that were prevalent in Italy at large—the disappearance of the agricultural and the unnatural increase of the mercantile classes, resulting in the formation of the idle proletariat. Thus there arose a most fearful disproportion in wealth, so that the state became a commonwealth of millionaires and beggars. The full development of slavery crushed out the middle class entirely. It was this unequal distribution of wealth that was to a large extent responsible for the economic and moral disorganization of rich and poor, a disorganization that was outwardly different, but in reality the same.

With such an increase of wealth, luxury grew to boundless proportions, and moral and social degeneration could only be the result. It is a fearful picture this—of Italy under the oligarchy—but it is only an indication of the inevitable result of the unlimited ascendancy of capital wherever it occurs. The social laxity that prevailed was almost incredible. Even Cato, the model of old Roman virtue, had no hesitation in divorcing a wife at the request of a friend who wished to marry her, and afterwards, on the death of that friend, in marrying his own wife the second time.

Such evils were essentially irremediable, but skilful treatment might yet prevent for a time the spread of the mortification that must, sooner or later, result in national death; and this was what Cæsar tried to do. Measures against absentees from Italy, for the elevation of family life, for the curtailing of outrageous luxury, followed one another in quick succession. We have already mentioned the way in which he dealt with the financial crisis after his victory, but we may add here that Cæsar was the first who gave an insolvent debtor the right (a right on which our modern bankruptcy regulations are based) of formally ceding his estate to his creditors, and of beginning, though with diminished political rights, his financial existence over again.

How great and how just an improvement this was over the earlier law that made the insolvent debtor the slave of his creditor, it is unnecessary to mention. And he attempted moreover to impose a limit on the power of capital. For Italian money-dealing, the maximum amount that a man was allowed to put out at interest, was limited to half the value of his estate. If this regulation were successfully carried out, every capitalist would be compelled to become a landowner, and that class of usurers, who lived merely on their interest, would die out. The rate of interest in the provinces was also regulated, 12 per cent. being now the maximum.

In addition to these efforts to check the ascendancy of capital, he endeavored to restore as far as possible the old agriculture. One-third of all farm laborers had now to be free men. By this measure, brigandage was checked, and a new source of gain opened to the proletariat. In his distribution of small holdings, his regulation that owners should not be allowed to alienate their land till after twenty years, was a happy medium between the full bestowal of the right of alienation, (which would speedily have brought the land back into the hands of the capitalists) and the permanent restrictions on free trade, imposed by Gracchus and Sulla, both equally in vain.

It is almost a hopeless task to give any brief yet adequate idea of the terrible condition of the provincials at this time. They were the victims of every kind of oppression. Violent outrages, murders, rapes, with or without the sanction of law, were matters of almost daily occurrence. Yet terrible as these things were, they did not press so heavily upon the community at large, as did the financial exactions of the governors and tax-collectors. Ordinary taxes became far more oppressive from the inequality of their distribution and the outrageous system of farming them, than from their high amount. They had, moreover, to submit to the quartering of soldiers in their houses, and Cicero himself says that a town might as well be stormed by an enemy as have a Roman army come to take up its winter quarters there. Grain was taken from them with little or no compensation in order to feed the idle mob of the capital. Their temples were robbed, their art galleries plundered, and every sacred and social tie mercilessly disregarded.

The havoc, however, that was committed by Roman capitalists was still more terrible and still less subject to control than this official misgovernment. They had gained a monopoly of all business, and they used it with great effect. The same evils of capital which we have described as flourishing in Italy, flourished in the provinces, but in a still more marked degree. Cases even occurred of money being lent to urban communities at 4 per cent. per month. "Any one," says Mommsen, "who desires to fathom the depths to which man can sink in the criminal infliction, and the no less criminal endurance of all conceivable injustice, may gather from the records of this period the wrongs which Romans could perpetrate and provincials suffer. Even the statesmen of Rome frankly conceded that the Roman name was unutterably odious throughout all Greece and Asia, and when the burgesses of the Pontic Heraclea, on one occasion, put to death the whole body of Roman tax-collectors, the only regret was that such things did not occur oftener."

The system of administration was thoroughly remodelled. As we have remarked, the governors had been despots: they now became the well-disciplined servants of a stern master, who, from the unity and life tenure of his power sustained a more natural and tolerable relation to the subjects, than those numerous, annually-changing, petty tyrants. The superintendence of the administration of justice remained in the hands of the governor, but he was now surrounded by a staff, not of his own creation but of the Emperor's appointment. For any mismanagement he had now to answer at the bar of a just and unrelenting monarch. The regulation of the public burdens, and of taxation, the extension of exemptions from tribute, and the complete setting aside of middle men in the collection of the taxes were most beneficial reforms in favor of the provincials.

On the other hand the direct suppression of the ascendancy of Roman capital would have required means more dangerous than the evil itself. But every act that violated the comprehensive monetary reforms which had been instituted was severely punished. A more radical cure for the evil was only to be found in the reviving prosperity of the provincials under the new administration.

Despite the almost incredible magnitude of Cæsar's reforms

of existing abuses, nevertheless that was not the main matter in his provincial reform. The old view of the provinces had been that they were the country estates of the Roman people, and they were employed and worked out as such. This view had now, owing to Caesar's reorganization of them, passed away. The provinces as such were gradually to disappear, in order to prepare for the renovated Italo-Hellenic nation a new home of whose several components no one part existed merely for itself, but all for each, and each for all. The new existence in this renovated home, the fresher, broader, grander national life, was of itself to overbear the sorrows and wrongs of the nation for which there was no help in the old Italy. The emigration to the provinces had been for some time preparing the way for the extension. But now everywhere from the Rhine to the Nile and from the Euphrates to the Pillars of Hercules, the new Imperator had scattered Roman colonies. By this means Italian municipal freedom was carried into the provinces. These communities were on an equal footing with the Italians, and so rapid had been their spread, in Gaul especially, that it now formed a province, solely composed of Roman burgesses, while others promised to become the same in time. With this extension of citizenship and national life, there disappeared the great practical distinction that separated Italy from the provinces. The reforms in national law, the establishment of religious toleration and of a national system of currency and the reform in the calendar were only further aids towards their amalgamation in one Empire.

The rule of the urban community of Rome over the Mediterranean world was at an end, and in its stead came a new state whose first act was to atone for the two greatest outrages which that urban community had ever perpetrated. While the destruction of the two greatest marts of commerce in the Roman dominions marked the turning point at which the government degenerated into political tyrannizing over and financial exaction from the subject lands, the prompt and brilliant restoration of Carthage and Corinth marked the foundation of a new great commonwealth which was to train up the whole Mediterranean world to national and political equality and to union in a genuine state.

Such are the faintest outlines of part of the work at which

Cæsar labored. Little was finished, much was begun. His rule lasted for five years and a half, out of which he spent only fifteen months in Italy. Yet in those fifteen months he regulated the destinies of the world, from the establishment of the boundary line between civilization and barbarism down to the paving of the streets of Rome. He had laid only the foundations of a grand building on which posterity has been building ever since, and on which it will continue to build to all time. Truly, as he himself used to say, he had lived long enough. Thus he worked and created, as never any mortal did before or after him; and as a worker and creator he still, after the lapse of nearly two thousand years, lives in the memory of the nations, the first and the unique—Imperator Cæsar.

EARLY GREEK LYRICS.

MISS J. A. STREET, '95.

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THE *epic* was for long the only poetry, artistic in form, which the Greeks possessed. Till the close of the eighth century, it held a solitary supremacy, and the secret of the spell which it exerted was in the charm of the past, in the magic of a flowing narrative which carried the listeners into an ideal region of heroic life. But gradually a change came. Hellenic life became fuller of experiences and efforts which stimulated the thoughts of the individual, interesting him in the present, and giving him new tasks, new objects of ambition, new possibilities of enjoyment. Then it was that, like two streams from a common fountain-head, the *elegy* and *ode* of the Greeks flowed out of the Homeric poetry. Both these preserve some characteristics of epic poetry together with the new elements which they embody. Chief of these new elements was a distinct expression of the personal feelings of the individual, of the manners of private life, of the complainings of disappointed love and the mourning of bereaved affection. Whatever the theme, there breathed in all elegiac poetry a characteristic spirit of melancholy—that gentle melancholy in which the flashes of a reckless, fleeting gaiety are so natural and so winning. But there is another mood of feeling, as truly natural, which requires a more splendid vehicle of expression, and demands an utterance too rapid, too peremptory to be compatible with the capacity of the elegy. In thankfulness for national deliverance, in exaltation at national victory, the *ode* had its first rise. Ages before that marvellous instrument of music, the Greek language, was ready for the touch of a Sappho or Pindar, the venerable Hebrew of the patriarchs had been wrought up to the pitch of sublimity in the triumph songs of Moses and Deborah. Besides the second song of Moses, his departing hymn, we need not point out the many noble, if less impetuous effusions of praise and thanksgiving with which the book of Psalms is filled. The

force and coloring indeed may vary according to the age, or the differing temper of a Moses, a Deborah, or a David; but in every age so long as Israel was truly Israel, the Hebrew muse was simple and sublime, in her birth and development essentially lyric, bursting forth with a ruggedness of address, a divinity of enthusiasm, which might have failed in producing a result of moral harmony, had not her feet been planted on the Rock of Ages and her lips touched with fire from the altar of the Lord. The character of the Greek lyric muse was very different. With that awfulness of import, that terror and weakness which distinguish the songs and singers of Israel, she had little sympathy or correspondence. All the elder poetry of Greece breathes a spirit of undoubting obedience to the popular or Olympian polytheism, and over all its literature, the spirit of Beauty, that aboriginal genius of Greece, poured continually its sunshiny hue, imparting elegance of form and rhythm of motion. To this spirit as to an imperial sovereign the whole poetry of Greece was subject. It was a veritable presence, a power of light and life and harmony, raising the low, illumining the obscure, repressing the extravagant, and infusing throughout a unity of its own creation. Not in the poetry only, but in all the arts and spectacles of Greece, the same influence of proportion and completeness operated; it was the same spirit which raised a Parthenon instead of a Pyramid, that produced a Pindar instead of a David.

The fact that Greek lyric poetry was composed with a view to being sung to the lyre, accounts largely for its immediate subjection to the laws of beauty and proportion. The pauses and intonations required by the ear in the musical accompaniments must have affected the structure of the words so accompanied. Even when the poet indulged in effusions not designed for any public occasion or actual singing, he was governed by the rules which belonged in general to that class of composition. Nor must we forget the intimate combination of the choric dance with music.* It is certain that the verse, the air and the measure or motion were all three influencing principles in the conception and formal con-

* Every one who was present at the performance of the *Antigone* will understand this statement, remembering how the singing and movement of those who took part in the chorus lent grace and meaning to the words themselves; and the chorus in the Attic drama was but the lingering on of the lyric poetry of which we are treating, after it had ceased to survive as a separate branch of literature.

struction of every one of Pindar's immortal hymns. In the mind of the Greeks, the muses were sisters, and the arts all related.

In lyric poetry, the poetry of strophes and stanzas, the Æolians and Dorians took the lead, and the paths which they marked out in this domain were so different that we may treat them as two distinct species. The poets and poetesses of the Aegean Islands cultivated a rapid and effusive style, polishing their passionate stanzas so exquisitely that they well deserve the name of "charms." The Dorian poets, inspired by a graver and more sustained imagination, composed long and complex odes for the celebration of gods and heroes. The Æolian chanted his own joys and sorrows to the lyre or flute; the Dorian trained a chorus who gave utterance to his celebration of the gods in dance and song. The energies which the Dorians turned to war, statecraft and social economy were restrained by the Æolians within the sphere of individual emotions ready to burst forth volcanically. It was at Sparta, that Melic dance and Melic music received their development; not through Spartans themselves however, but through foreigners who were in most cases invited thither and treated with conspicuous honor. Sparta then, instead of banishing strangers and despising culture as in later times, appears at this early period to have been a centre to which was attracted much of the best poetical talent of the day. In the ranks of her own warrior-citizens, where individuality was constantly suppressed, conspicuous talent could hardly be looked for; consequently, men of genius from other parts of the world found ready welcome there and were naturally eager to avail themselves of compliment from so powerful a state. Among these, Terpander, Tyrtaeus and Alcman were distinguished names. Their poetry, devoted to state interests, is embodied in hymns sung before the altar; *proscodia* or processional songs accompanied by flutes, as the chorus marched to the temple; the hymns especially dedicated to Apollo and Dionysus and technically called *paean* and *dithyramb*; and the *hyporcheme* which was always accompanied by dancing and originally formed part of the cult of Phœbus. All these poems were performed by men and boys, but there were special compositions for maidens called *parthenia*. Such was the character

of the Dorian or choral lyric, inspired always by grave or solemn occasions, dealing always with the divine, or the human that was almost divine.

The school of Æolian poetry, on the contrary, was all passion and sympathy and individual feeling. Nowhere in any age of Greek history did the love of physical beauty, the sensibility to radiant scenes of nature, the consuming power of personal feeling assume such grand proportions and receive so illustrious an expression as they did in Lesbos at the beginning of the seventh century. The customs of the Æolians permitted more social and domestic freedom than was common in Greece. Æolian women went into society, were highly educated and accustomed to express their sentiments to an extent unknown in history,—until modern times! All the elegances and luxuries of life which the climate and the rich valleys of Lesbos could supply were at their disposal. They studied the arts of beauty, formed clubs for the cultivation of poetry and music, and sought to refine metrical forms and diction. Sappho's Lesbian school might be likened to Margaret Fuller's classes in bygone New England days, except that, in addition to all that the American gave her pupils, the Greek poetess undertook to give instruction in the most difficult music, the most complex metres and the most profound religious rites. Hence, the voluptuousness of Æolian poetry is not like that of Persian or Arabic art. It is Greek in its self-restraint, proportion, tact. In the poems of Sappho, all is so rhythmically ordered that supreme art lends solemnity to the expression of unmitigated passion. In nothing has the world suffered greater literary loss, than in the loss of Sappho's poetry. Among the ancients she enjoyed a unique renown. She was called "The Poetess," as Homer was called "The Poet." Plato, in the *Phædrus*, mentioned her as the tenth muse. "Violet-crowned, pure, sweetly-smiling Sappho" is the tribute of her contemporary, Alcaeus. Her every word has a peculiar and unmistakable grace. Adequately to translate Sappho was beyond the power of even Catullus. We cannot approach even so near as we can to Pindar, who stands aloof and is inaccessible to modern touch. Her imagery, her music, her passion and truth, were all transcendent, and after reading

what exists of her, we never can think of the other poets who preceded and were coeval with her, without applying to them her own beautiful stanza :—

“The stars that round the beauteous moon
Attendant wait, cast into shade
Their ineffectual lustres, soon
As she in full-orb'd majesty arrayed,
Her silver radiance pours
Upon this world of ours.”

The lyrical rapture which marks her verse depends a great deal on the versification, on that Sapphic rhythm, than which it seems impossible to conceive one more suited to express passions, impetuous yet languishing, where the closing strain marks not victory but exhaustion. This striking fragment illustrates my meaning :—

“The moon is down ;
And I've watched the dying
Of the Pleiades ;
'Tis the midnight of night,
The hour glides by,
Yet alone I am sighing ”

That last line—*ἐγὼ δὲ μόνα καθεύδω*—is like the toll of a bell, mourning the dreariness of a forgotten tryst on which the moon and stars look down.

As all the Æolic woman is in the Sapphic strophe, so all the Æolic man is in the Alcaic stanza. Not many of Alcaeus' poems remain; his great work is the stanza that bears his name and symbolizes “through trial to triumph.” Of the poetry that does survive there is hardly a scrap of which we may not detect a close imitation by Horace. There is a remarkable dignity in the Latin Alcaic, and nowhere in his attempt to Latinize the metre and spirit of the Greek lyre, did Horace succeed so well as in the Alcaic ode. There is considerable likeness between the two poets. Both Horace and Alcaeus wrote poetry more polished than profound, more graceful than intense. In Sappho and Catullus, on the other hand, we meet with richer and more ardent natures, endowed with keener sensibilities. They do not lose themselves in the shallows of “Stoic-Epicurean acceptance,” but simply and exquisitely apprehend the facts of

human life. Where Horace talks of *Orcus* and the *Urn*, Catullus sings :

Soles occidere et redire possunt :
Nobis cum semel occidit brevis lux
Nox est perpetua una dormienda

Suns may set to rise again ; but once our little lamp of life goes out, there's naught but an endless night of sleep.

The contrast between the polished sententiousness of the one, and the passionate outcry of the other marks well the difference between the two classes of poets. One fragment of Alcaeus' poetry is of especial interest as showing a trait in the domestic life of the Greeks of this time. Alcaeus and his brothers had been banished from Lesbos for their opposition to the tyrant Pittacus, and one brother, Antimenidas, entered the service of Nebuchadnezzar, king of Babylon. Of the polished Greek citizen's adventures in the wars against the Jews and Egyptians, known to us through the Old Testament, we get a curious glimpse in a poem which Alcaeus addressed to his brother on his return home :—

“ From the ends of the earth thou art come
Back to thy home ;
The ivory hilt of thy blade,
With gold is embossed and inlaid ;
Since for Babylon's host a great deed
Thou didst work in their need,
Slaying a warrior, an athlete of might,
Royal, whose height
Lacked of five cubits, but one span.—
A terrible man ! ”

We can fancy with what delight and curiosity Alcaeus, who was an amateur of armor, examined this sword-handle, wrought with lotus flowers, or, perhaps, with patterns of crocodiles, monkeys and lions.

Before speaking of Dorian poetry and its productions at length, we must mention the Sicilian poet, Stesichorus, a contemporary of the Lesbian lyrists. Quintilian says of him that he sustained the weight of epic poetry on the lyre : that is to say, while the form of his poetry was undoubtedly that of choral Melic, the subjects were those of epical mythology. We hear of no other poet employing his epico-lyrical style and we have great

reason to bewail that no considerable specimen of his work has come down to us. Possibly Scott's "Marmion" might illustrate the spirit of such a union. But Stesichorus' inventive genius was not exhausted in developing the choral system and adding the *epode* to the Greek chorus. He also wrote pastorals and romances. His love tales from real life were an anticipation of the novel of to-day, and in his endeavor to create an idyllic form of literature he was far ahead of his age; yet, with all his genius, he was not thoroughly successful. His pastorals and romances were abandoned by his successors and his epical lyrics were lost in the tragic drama.

Passing over Ibycus and Arion, whose names are tangled in myth and fable, and whom we know through the scantiest fragments, we come to Anacreon, the poet of courtly festivity. Anacreon never sets one thinking; his hold of the reader is momentary, like a strain of music, or the fragrance of a rose, gaining no abode in the imagination. It does not seem as if the poet were sad or gay to please his audience, but to amuse himself. Repeat the most festive ode of Horace and it will touch more sources of sentiment than the most serious song of Anacreon, who rarely strikes a strain of hope or fear, moves no passion and excites no reflection.

The following translations from Leigh Hunt are typical of Anacreon's verse.

τὸ ῥόδον τὸ τῶν ἐρώτων.

"The rose, the flower of love,
Mingle with our quaffing :
The rose, the lovely leaved,
Round our brows be weaved,
Genially laughing.

"O the rose, the first of flowers,
Darling of the early bowers,
E'en the gods for thee have places :
Thee too, Cytherea's boy
Weaves about his locks for joy,
Dancing with the Graces "

παρὰ τὴν σκίην βάθυλλε.

" Here's the place to seat us, love !
A perfect arbor ! look above,
How the delicate sprays like hair,
Bend them to the breaths of air !

Listen, too! it is a rill
 Telling us its gentle will,
 Who that knows what luxury is
 Could go by a place like this?"

Living at the court of Hipparchus at the same time with Anacreon was Simonides, of Ceos, probably the most prolific and most generally popular of Greek lyric poets. Trained to music and poetry as a profession, his genius must also have received no small impulse from the political circumstances of his time. In his youth he was one of the brilliant literary circle at Hipparchus' court; in advanced life he enjoyed the personal friendship of Pausanias and Themistocles and celebrated their exploits; in extreme old age he found an honored retreat at the court of Syracuse. Simonides was proverbial for *σωφροσύνη*, temperance in one's own conduct, and moderation in one's opinions and views of human life. This spirit breathes through his poetry where sweetness and elaborate finish are combined with truest poetic conception and great power of expression. Among the *scolia*, or popular Greek songs which we possess, is this one of Simonides', which sums up the qualities that a Greek most desired:

"Of mortal joys, the first is health:
 The second gift is beauty's charm:
 The next to these is guileless wealth,
 Then, youth, if blest with friendship warm."

Again we notice the difference between Hebrew and Greek. Solomon when asked what he would take from the Lord as a gift, chose none of these, but wisdom that is better than rubies and to which all the things that may be desired are not to be compared. Another of these *scolia* illustrates their moral teaching. "Whoso betrayeth not a friend hath great honor among men and gods"; while the most splendid specimen we have in this order of composition is a fragment from Pindar, beginning:

"O soul, 'tis thine in season meet,
 To pluck of love the blossoms sweet,
 When hearts are young."

While speaking of these popular banquet catches that carry us back so freshly to the life of the Greeks, mention, at least, must be made of the children's songs about flowers, tortoises

and hobgoblins. That the Greeks cultivated the serenade is clear from a passage in the *Ecclesiazusae* of Aristophanes. Marriage festivals offered another occasion for lyric poetry; the *hymeneal* sung during the wedding ceremony, the *epithalamium* chanted at the house of the bridegroom, and many other species, have been defined by the grammarians. Unfortunately we possess nothing but the merest *débris* of any true Greek poem of this kind.

In the neatness and elegance of his epigrams Simonides stands unrivalled. These sepulchral epigrams stand with the odes of Pindar and the tragedies of Sophocles as the symbols of perfection in literature. Foremost among them are those on the men whose fame is so exalted in history; these simple words commemorate the Three Hundred of Thermopylae:—"O stranger, tell the Lacedæmonians, we lie here obeying their orders"—words grown so famous that it is only by sudden flashes that we can appreciate their greatness. Another marvel of simplicity is this:—

"Archedice, the daughter of King Hippias
Who in his time
Of all the potentates of Greece was prime,
This dust doth hide;
Daughter, wife, sister, mother unto kings she was,
Yet free from pride."

What Simonides possesses quite peculiar to his own genius is pathos,—the pathos of romance. This appears most remarkably in the fragment of a *threnos* which describes Danaë and her babe afloat upon the waves at night. Nothing could be more exquisite than the contrast between the fierce elements that rage around, and the fair sleeping child, watched by the young mother, so anxious, so helpless, and so forsaken. Its exceeding simplicity makes translation formidable, but some such rendering as this might convey an idea of its tenderness:

"The wind blew hard, the rough wave smote
In rage on Danaë's fragile boat;
Her cheeks all wet with tears and spray,
She clasp'd her Perseus as he lay.
And—'Oh! what woes! my babe,' she said,
'Are gath'ring round thy mother's head!
Thou sleep'st in peace the while, and I
May hear thee breathing audibly;

For the wild wave thou dost not care
 It shall not wet thy clust'ring hair !
 Beneath my purple robe reclin'd,
 Thou shalt not hear the roaring wind
 Alas ! my beauteous boy ! I know,
 If all this woe to thee were woe,
 Soon would'st thou raise thy little head,
 And try to catch what mother said.
 Nay, sleep my child, a slumber deep,
 Sleep, thou fierce sea, —my sorrows, sleep !”

Even this hasty summary of Greek lyric poetry would be incomplete without a glance at Pindar. Yet Pindar among his peers is solitary. So colossal, so much apart is he, that it is impossible to discuss him in this bird's-eye view of a period of literature. At the time of Pindar, poetry was sinking into mannerism. He, by the force of native originality gave it a wholly fresh direction, and coming last of the Dorian lyrists, taught posterity what manner of poem an ode should be. Frigid, austere and splendid : not genial like Simonides, not passionate like Sappho, not acrid like Archilochus ; rigid in moral firmness, the unique personality of Pindar is felt in every strophe of his odes. Here is seen the true grandeur and majesty of religious poetry, where the gods are always represented as the givers of victory, and success never attributed to mere human causes. Priestly is his tone and priestly his conception of frail humanity.

“ Things of a day, what are we and what are we not ! a shadow's dream is man.”

The words recall the Psalmist.

Remarkable, too, in the mystical creed of Pindar, is his definite belief in the future life, including a system of rewards and punishments:—

“ The souls of the profane
 Far from heaven removed below,
 Flit on earth in murderous pain
 'Neath the unyielding yoke of woe :
 While pious spirits tenanting the sky
 Chant praises to the mighty one on high.”

Like a trumpet-blast for immortality, and trampling under foot the glories of this world, this *threnos* of Pindar's reveals the gladness of the souls who have attained Elysium.

“ Shines for them the sun's warm glow
 When 'tis darkness here below :

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And the ground before their towers,
Meadow-land with purple flowers,
Teems with incense-bearing trees
Teems with fruit of golden sheen."

"On every side around
Pure happiness is found,
With all the blooming beauty of the world;
These fragrant smoke, upcurled
From altars where the blazing fire is dense
With perfumed frankincense,
Burned unto gods in heaven,
Through all the land is driven,
Making its pleasant places odorous
With scented gales and sweet airs amorous."

In Pindar, the lyric movement culminates. We have sketched the progress of Greek poetry from Homer to Pindar; through love song and popular ditty, through banquet verses and choral stanzas, through dirges for the dead and sepulchral epigrams, to the glorious hymns and victory odes of Pindar. Fortunately, the epic song of Homer and the complex ode of Pindar, the two extreme points of this long series, have been preserved to us to show the progress made during the intermediate stage. Of that intermediate stage and its mass of literature, only a few isolated fragments remain to let us form any judgment. Some faint echoes of Aeolian passion and beauty-worship, a few massive melodies from the Dorian choral lyric, a solemn dirge or two, and Pindar's odes, that is all we know, or can ever expect to know, of Greek lyric poetry. Already the Attic drama was in vogue. Before Pindar's career was closed, Aeschylus had passed away; Sophocles and Euripides were the rising masters of tragedy; and, with Pindar's death, the Greek lyric with its dance and its song, its spirit of worship and exaltation, had been merged into those lovely choruses that add grace and beauty to every Greek drama.

THE LIMITATIONS OF THE SENSES.

BY W. H. PIKE, M.A., PH.D.

[Read before the Natural Science Association.]

THE subject upon which I am going to speak is the "Limitations of our Senses," and perhaps I ought to explain in what way I, as a chemist, am interested in this question. In fact I have two purposes to serve in this explanation, first, I wish to say in few words what I am going to speak about, and, secondly, I wish, at the outset, to disarm the criticism which the title of my address will provoke from the biologists present. I fear they will ask what business has a chemist talking of senses, he is out of his sphere, his subject has nothing of sense belonging to it. Therefore I wish to explain in what way the subject is of interest to a chemist.

In the course of a study of chemistry, from beginning to end, our attention is occupied with the atomic theory. The whole of chemical phenomena are explained on the hypothesis that all matter, whether gaseous or liquid or solid, is composed of atoms. These atoms are supposed to be the limit of possible sub-division. The theory says that if we continually divide matter as we may divide a sheet of paper with scissors, we ultimately come to portions which are not farther divisible, the units of which matter consists. It thus becomes of interest to a chemist to ask how far in this direction it is possible to go—how far can we divide matter? What are the smallest portions we have any evidence concerning? What are, in fact, the limits of our senses?

The subject, then, which I am going to discuss, is the answer to the question: what are the smallest quantities of matter of any kind which we can taste, smell, see or feel? I am not going to consider why our senses are thus limited, or what is the mechanism of our senses—such matters belong to my friends, the Biologists—but I will confine myself to trying to give an account of the limits known at present and I think you will agree that we can go a most surprising distance in this direction.

I will commence with the sense of sight and select as the substance, the coal tar dye magenta. Every one who has ever handled this dye knows how very difficult it is to get rid of it; how it stains everything it comes in contact with; how, when used on that curious machine, the printograph, we can take copy after copy from the slab of gelatine and yet more remains. How small, then, is the least quantity of this substance we can see?

To test this I have arranged an experiment. I have here a measuring flask in which I have dissolved exactly one grain of magenta, and you see how intensely coloured the solution is. I have here a solution made by taking $\frac{1}{10}$ of a grain, and it, too, is deeply coloured. This solution I will pour into a cell which contains $\frac{1}{1000}$ of the solution in the flask and this will contain $\frac{1}{10000}$ of a grain, and put it into the electric lanthorn. You see that the disk which the lanthorn throws of this substance, is about 22 inches in diameter. Now we can certainly see colour on each square inch and our disk contains close upon 400 square inches, so that, we can see colour from $\frac{1}{400}$ of $\frac{1}{10000}$ of a grain—that is, $\frac{1}{4} \times \frac{1}{1000000}$. Perhaps we could even go still farther than this and say that about $\frac{1}{10000000}$ of a grain is visible. Now we know from chemistry that the atom of magenta is 361 times as heavy as the atom of hydrogen, so that our atom of hydrogen cannot be greater than $\frac{1}{361} \times \frac{1}{107}$ grains, or in decimals .000,000,000,3 grains.

Let us next pass to the senses of taste and smell, and I will subsequently come back to other instances of sight. Some years ago a paper was published in Germany giving the smallest weight of various chemicals which could be detected by taste, and two were especially selected as being able to excite the sensation of taste in very different ways and very powerfully: they were strychnine as an intense bitter, and saccharine as an intense sweet. The method employed was like that which I have used in the case of the dye. It was found that .000,008 grains of strychnine and .000,08 grains of saccharine could be easily detected. These values are certainly very small but our sense of taste, sensitive as it is, is after all but a poor coarse sense when compared with our sense of smell.

The experiments upon the sense of smell were made by evaporating a known weight of a strong smelling substance in a room of known dimensions, then making a series of observers

sniff through a glass tube passed into a hole in the door, and estimating the number of cubic inches of the polluted air which passed into their nostrils at each sniff. Each observer was required to say what it was he smelt, and thus the figure for each substance was obtained. The lowest value was obtained in the case of mercaptan which has an intense smell, not unlike concentrated essence of rotten eggs, and it was then found that .000,000,000,03 grains of mercaptan could be distinctly recognised. Now, amazing as this value seems at first sight, I do not think it is at all incredible when we remember what extraordinary powers of smell animals have, how a dog can perceive traces of his master's footsteps after hours have elapsed, how deer will suddenly stop at the track of a man more than 36 hours old, and not only perceive a strange smell, but at once recognize it as the smell of their enemy.

I must not lose sight of my object, namely, to find out how small our chemical atoms are, or at least to find out an upper limit for them. Now I know that this mercaptan has an atom 62 times as heavy as hydrogen, and, therefore, my atom of hydrogen, which is used as a standard in chemistry, cannot be greater than $\frac{1}{62}$ part of this quantity of mercaptan, for it must take at least one atom of the mercaptan to excite our sense of smell—that is to say .000,000,000,000,05 grains. It may be of interest to add the figure obtained with oil of roses, .000,000,08 grains. So that both the sense of taste and smell seem more sensitive to unpleasant than to pleasant sensations.

I will now take again a case of sight. The smallest wire which can be purchased is about $\frac{1}{1000}$ inch diameter, a magnified image of which I will project upon the screen. By the side of it is a human hair and a piece of spun glass. Now this magnified image shows the wire as a coarse bar, and yet it is so small that a single cubic inch of, say, copper would give us 20 $\frac{1}{10}$ miles of such wire. I think everyone will agree that we could easily see a wire $\frac{1}{10}$ of this size, and that we could see a piece of such wire as long as its breadth. I have then calculated what the weight of such a piece would be, and I find the weight would be .000,000,001,8 grains. Now the atom of copper is $62\frac{1}{2}$ times as heavy as the atom of hydrogen which must therefore be less than .000,000,000,03 grains.

Of all the metals perhaps gold admits of greatest extension. It can be beaten into thinner sheets than other metals, and it is also very easily deposited by such methods as electro-plating on other metals.

It is known that one grain of gold will gild two miles of thin silver wire, and it is easy to see the gold on each $\frac{1}{1000}$ of an inch of such wire under the microscope. The gold would weigh on such a portion .000,000,009 grains, and this quantity contains enough atoms to go all round the wire.

Still thinner than this is the gold which is used on gold lace. It has been estimated that it is only .000,000,8 inch thick—this estimate being based on the weight of gold which will give a certain surface of lace. Now, let us suppose that this thickness is made up of a number of round spheres like a layer of marbles. Each we will assume an atom. I have thus calculated the weight which such a sphere would have, and find it to be .000,000,000,000,001,3 grains. and the atom of gold is nearly 200 times as heavy as hydrogen which gives for the atom .000,000,000,000,000,07 grains. I could go on multiplying instances like this, for all sorts of thin films have been measured. Such for example as the thickness of soap bubbles just before they burst, such as the thickness of the film of silver on mirrors—and so on, but I will content myself with two more illustrations of small quantities and the method of detecting them.

The first is by making use of our power of sub-dividing a current of electricity and of the delicate instruments which may be used to detect it. If we have the current of electricity, say electro-plating an object, we know that if we pass it through two wires of equal size, side by side, that half of the current goes through each wire, and each half may be similarly sub-divided. If now we find the greatest sub-division of the original current of electricity depositing, say, 1 grain per second of copper in an electrotype bath, and which will yet make its presence evident to our sight by a suitable instrument as a galvanometer, we arrive at figures of the same order of magnitude as those from gold lace. For example the galvanometer in the chemical laboratory, by no means a very delicate instrument, will show a current which will deposit .000,000,000,000,6 grains of copper per second. Perhaps I can give you some idea of the meaning of

this figure by pointing to the fact that, although there are in a year 31,557,600 seconds, there will only be deposited by such a current the not very large weight of .000,018,93 grains per year. So that it would take 52,813 years to deposit one single grain.

The last illustration I quote of extreme sub-division of matter, is a case of wire-drawing by a somewhat curious method. You know that certain viscous liquids may be drawn into very thin strings or threads, such liquids for example as sealing wax, or molten glass, and if the liquid be much above the temperature of the air, as in the case of molten glass, these rods solidify and may be examined and measured. Now, the more quickly the threads are drawn out the thinner they become, and the greater the difference between the fusing temperature, the more quickly do they solidify. A very good instance of such sub-division is afforded by spun glass, such as most of us have seen made on a glass blower's wheel; another illustration of the same process is afforded by mineral wool, where the threads are produced by forcing a current of steam through molten slag, which is really a kind of glass.

A few years ago it occurred to Prof. C. V. Boys, an English Professor of Physics, who wanted to make a very thin and very hard fibre for an instrument, to try to draw quartz fibres for this purpose. He found that by the use of the oxyhydrogen blow-pipe he could certainly draw such fibres, but they were not thin enough. He therefore tried to draw them faster by making the laboratory boy run away with the end, and they became thinner, but not thin enough; at last he tried fastening a piece of quartz to the arrow of a cross-bow, and when the end was fused in the blow-pipe he touched it with another piece and fired off his arrow. He thus obtained a long fibre reaching from the arrow to the piece in his hand, which was so thin as to float for a long time in the air and quite invisible to the naked eye. He tried to measure the thinnest fibres he thus produced by drawing them across the stage of a powerful microscope. He found that he could trace the fibre from the arrow, or from the hand a certain distance, but towards the centre they gradually faded out of sight altogether, and the only way he could tell that the fibre was still there was by attaching a piece of postage stamp to the end he *could* see, and finding that he could pull the

postage stamp across the laboratory by the arrow. He measured the thickness of his fibre down to $\frac{1}{100000}$ inch and he guessed the portion in the centre to be not more than $\frac{1}{1000000}$ inch in diameter.

Now such figures as $\frac{1}{1000000}$ inch diameter convey nothing to us unless we compare them with things we are familiar with. Perhaps it will help to realize the meaning, when I say that a piece of quartz of 1 cubic inch, that is, about the size of a walnut, would give a fibre 20,095,300 miles long—or that an express train at 60 miles per hour, would have to run for $38\frac{1}{4}$ years without stopping to unwind the fibre if wound on a reel.

Now I have calculated what the weight of a piece of this fibre as long as its diameter must be, and I find it comes to the amazing value of .000,000,000,000,526 grains, and the atom of quartz is about 60 times as heavy as the atom of hydrogen, so that our atom of hydrogen cannot be greater than .000,000,000,000,000,008 grains. Indeed, it must be much less for we can hardly imagine a fibre composed of a single row of atoms.

It is I think clear from these figures that we shall never be able to see the atoms, we shall never be able to examine the atoms of different things reacting and grouping themselves to form new matter, and we can certainly never weigh them, except by some such indirect way as I have illustrated.

I think I ought to conclude by apologizing for the smallness of my subject, and to trust that I shall not be classified with Gratiano in "The Merchant of Venice" as one who "Speaks an infinite deal of nothing," or as one of those of whom Dryden says,

"But far more numerous was the herd of such,
Who think too *little* and who talk too much"

KINDRED PHENOMENA.

BY G. F. HULL, B.A.

[Read before the Mathematical and Physical Society.]

VERY often we hear it stated that light, heat, electricity, and magnetism are similar in nature. The reasons for this statement are not, we believe, well known. It will be the object of this paper to trace, through the more important stages, the development of these phenomena, to suggest how the impression of their similarity arose, and to show how the mists of doubt and ignorance were cleared away by the potent influence of great discoveries.

I wish, first, to give a very brief history of these phenomena. Of them the most common is that of light, and yet to the ancients very few of its laws were known. The most casual observer, however, could not have been unaware of the properties of shadows, while the appearance of the images of trees and clouds beneath the still surface of a stream must have been observed if not understood. We find that mirrors were known fifteen hundred years before our era, for they are mentioned in the Book of Exodus. The art of glass making was speedily followed by the invention of burning glasses which are spoken of by Aristophanes in 424 B.C. The sources of light are now recognized to be the sun, stars, and bodies undergoing combustion, but the ancients were in doubt as to whether a body became luminous by means of something emitted by it, or by means of something issuing from the eye of the spectator. Pythagoras (540-500, B.C.,) the author of some of the propositions of Euclid and the originator of a musical scale, held the first view, while Empedocles and Plato held the second view. Aristotle (350 B.C.) denied them both, and held that light was due to the presence of a *pellucid* or medium. His ideas along this line, if indeed we can understand them, were of a very hazy nature. To him, however, is due a partial explanation of the rainbow, viz: that it is caused by the reflection of the sun's rays from drops of water. The laws

of rectilinear propagation and of reflection were discovered by Plato's school, but the law of refraction was unknown for centuries later. Ptolemy (150 A.D.) drew up tables of values of the angles of incidence and refraction, but did not connect them by law. For fifteen hundred years these tables remained as Ptolemy left them—the material necessary for the statement of the law of refraction which, however, was unformed. Alhazen (1100 A.D.), an Arabian astronomer, studied the anatomy of the eye and optical deceptions, and produced the first complete treatise on optics. But no great development was possible until the law of refraction was at last discovered by Willibrod Snellius in 1621, and published a little later by Descartes, to whom the law is sometimes attributed. The last named scientist was a philosopher as well as a mathematician and consequently most of his work in optics consisted of speculations concerning the nature of light.

In 1666, Newton made the great discovery concerning the composition of white light, and ten years later Römer, the Danish astronomer, determined the velocity of light. These last three important discoveries placed optics on a satisfactory basis, and great progress was made before the close of the seventeenth century. About this time Huyghens advanced the theory that light is due to wave motion in the ether, a theory which has been perfected by Young and Fresnel of whom we shall speak later.

Turning for a moment to electricity we know that the ancients were acquainted with the power which amber, when rubbed, possessed of attracting light pieces of paper and cork. Thales (600 B.C.) distinctly mentions this property which was considered sufficiently mysterious to have a place in mythology. No use, however, was made of this property and no study seems to have been given to it until 1600 A.D., when Dr. Gilbert, an English scientist, discovered that many other substances, sulphur resin, glass, etc., possess the same or a like characteristic. To this property he gave the name of *electrification*. Gray, in 1729, found that electrification passed from one body to another, an experimental fact, which, though simple, was very important. In this connection I must mention Franklin, who gave the terms positive and negative to the two kinds of electrification, and, by means of a kite, showed that lightning is an electric discharge.

Current electricity was introduced about one hundred years ago. Galvani noticed that when a zinc and a copper bar were placed one in contact with the lumbar nerve of a frog and the other with the muscles of its leg, if the other ends were brought together there was a sudden convulsion of the limb. Volta, whose attention had been called to this phenomenon, explained it by stating that the two metals were at different *potentials*. Following up this idea he constructed the apparatus known as Volta's pile, the first instrument for the generation of an electric current. Electric batteries were then introduced, and the chemical and heat effects of the current were discovered and used for many purposes. Before dealing with the magnetic effects of the electric current, it might be well to mention that the property of the lodestone was known to the Chinese as early as 2000 B.C., and that they were probably acquainted with the magnetic needle about 1100 B.C. But no study seems to have been given to magnetism until the appearance of Dr. Gilbert's book, "De Magnete" in the year 1600.

The connection between electric and magnetic actions was not understood until Oersted, in 1820, discovered that when a magnetic needle was placed beneath a straight wire carrying a current, the needle was deflected. Ampère, whose name must ever be associated with electrodynamics, repeated this experiment, extended it to the action of currents upon currents, and placed the whole on a mathematical basis.

Probably the greatest name connected with the development of electricity is that of Faraday. One of his most important discoveries, made in 1831, was that when a magnet is moved towards or away from a coil of wire, there is a current generated in the coil. A more general statement of the law is that whenever there is any change in the number of lines of magnetic force traversing a closed circuit a momentary electrical current is produced in the circuit.

Oersted's and Ampère's discoveries proved that wherever an electric current existed there were magnetic actions. Faraday's discovery showed that whenever there was a change in magnetic force electric currents were produced in neighboring circuits. After this electric and magnetic actions were seen to be very closely related. Thus far nothing indicated that light,

heat and electricity were in any way related except that an electric current could produce heat and light and heat could produce an electric current. But these agencies can be transformed into one another as well as into chemical action, work, etc., which proves that they are all forms of energy. It is necessary, in order to identify light and electric action, to look behind these phenomena and ask the questions: "What is light?" "What is electric action?"

The first question was a troublesome one two hundred years ago. Newton tried to solve it and at last adopted the hypothesis that light was due to particles of matter shot out from the luminous source. This corpuscular theory, as it was called, obtained great weight in England on account of the name of its illustrious author. To such a degree had it been developed by Newton that for over a hundred years it held almost complete sway against careful critics.

But another theory, which owes its origin to many persons, had been gaining ground on the Continent. In 1690 Christian Huyghens published his "*Traité de la Lumière*," in which light was assumed to be due to undulations in a medium called the *ether*. Indeed, Newton himself accepted this theory for a time, but, on account of the difficulty of giving a satisfactory explanation of the law of rectilinear propagation and of the phenomenon of polarisation, he fell back upon his own. In England, Dr. Thomas Young (1773-1829) was led to the study of light from the study of sound. He was acquainted with the phenomenon of *beats*, and he asked himself if it would not be possible to arrive at an analogous result in the case of light. In other words, if light were due to a system of waves proceeding outwards from a source, would it not be possible to combine two systems in such a manner that the crest of one wave would coincide with the sinus of one of the other set of waves, thus producing no motion or darkness at that point. He devised an experiment giving an affirmative answer to this question. This experiment illustrating the principle of interference of light cannot easily be shown to an audience. The analogous experiments—the interference of sound waves and of waves on the surface of liquids—must serve as substitutes.

By means of these two tuning forks, one vibrating 256 and the other 260 times per second and sounding together, we are able

to distinguish four *beats* per second. Four times in a second, a condensation from one fork and a rarefaction from the other arrive together at the ear, and consequently at these times the ear experiences a minimum effect. Between each of these minimum effects the condensations from both or the rarefactions from both are simultaneous, and maximum effects are the result. The production of this increased loudness and partial silence by the superposition of two sets of waves is one method of showing interference of sound. More accurately, the term is used in acoustics when the waves of the different sets are of equal length and follow each other at an interval of half a wave-length. In this case total silence is the result.

For showing the interference of the waves on the surface of liquid we have here an open, shallow vessel containing mercury, and just touching its surface are the ends of two short wires which are attached to the lower prong of a horizontal tuning fork. When the fork is set in vibration, two sets of waves are caused to travel outwards from the sources of disturbance, and, at points on the surface whose distances from the sources differ by one, three, five, or any odd number of half wave-lengths, there should be no motion. These points should consequently lie on hyperbolas whose foci are the two sources of disturbance and whose equations are $r_1 - r_2 = (n + 1)\lambda/2$, where r_1, r_2 are distances from the two sources and $\lambda =$ the wave-length. By means of a mirror we cause the light from the electric lamp to be thrown on the surface of the mercury; from this it is reflected and, passing through a lens, falls upon a second mirror and is then thrown upon the screen. By adjusting the lens we get an image of the hyperbolas of the mercury, and when the fork is set in vibration the hyperbolas of rest are clearly seen. This property of producing points of rest in the region acted on by two disturbing forces is the characteristic of wave motion.

Young's experiment showing the interference of light will be easily understood by reference to Fig. 1. L is a small source of light, C a cardboard in which are two small holes, A and B, close together, S is a screen upon which the

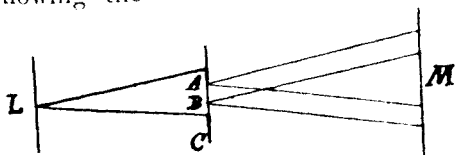


Fig. 1.

light is received. When monochromatic light was used, Young found that at M, the centre of the space which received light from both A and B, there was brightness, and at both sides dark and bright bands. These could be accounted for on the supposition that light was due to wave motion.

This experiment, as performed by Young, was probably faulty. At any rate, it was greatly improved upon by Fresnel (1788-1827), an eminent French scientist, who, during his short life, developed the theory to such a state of perfection, that it is accepted by all physicists to-day. He used two mirrors inclined at a small angle and thus obtained two images, close together, of a source of light. These two images take the place of the sources A and B in Young's experiment. He was able to measure the wave-lengths of light and found them to vary all the way from the $\frac{1}{40000}$ of an inch in the red to the $\frac{1}{60000}$ of an inch in the violet.

This principle of the interference of light leads at once to the conclusion that light is due to wave motion in a medium which we call the ether. The phenomena of double refraction and polarisation lead to the further conclusion that the vibrations constituting this wave motion cannot be in the direction of the propagation of the motion, as in sound, but must be in a plane at right angles to that direction. This is the essential part of the wave theory of light as built up by Fresnel.

Radiant heat has been found to obey the laws of light. The measurement of the wave-length in a manner similar to the above gives results between $\frac{1}{30000}$ and $\frac{1}{40000}$ of an inch.

We have not the time, had we the inclination, to describe the many theories which have been held concerning electricity. Let us then briefly notice the steps leading up to the opinions held to-day.

The first great departure from older notions was, I think, made by Faraday, when he laid down his views of electric action. To Faraday not the conductor but the medium outside played the important part in all electric phenomena. Formerly an electrified body was supposed to have something called electricity residing on its surface or within its volume which caused electric action, and a current of electricity was supposed to be the transference of this electricity along the wire. But the action of a current on a magnet at a distance and the induced action of one

current on another through a distance pointed to the conclusion that the medium plays an important part in the phenomena. Faraday pictured the medium about an electrified conductor as filled with lines of force, and to him they were not imaginary, but physical, lines. The properties of the medium along any of these lines, he considered differed from the properties of the medium along all other lines. This was due, he thought, to the straining or distortion of the medium about the conductor.

Among the many experimental facts which led him to this conclusion there is one I must mention. In 1845, Faraday discovered that the plane of polarisation of light can be rotated by a magnetic field. Let me briefly explain what is meant by polarised light. When the particles of ether vibrate in a certain definite manner the light is said to be polarised. When the vibration is in a circle about the direction of propagation we call it circularly polarised light, when in an ellipse it is elliptically polarised, and when in a straight line it is plane polarised. (According to the wave theory all vibrations are in planes perpendicular to the direction of propagation). Light which has passed through a plate of tourmaline or a Nicol prism is rendered plane polarised. Its characteristic may be determined by placing another plate of tourmaline or another Nicol in its path. When this second crystal is turned about the direction of propagation we find that, when a plane of symmetry of the second crystal is at right angles to the corresponding plane in the first crystal, the light is extinguished. At the ends of the hollow core of this large double electromagnet are two Nicol prisms capable of rotation about the axis of the magnet and between the two inside poles of the magnet is a bar of heavy glass. Allowing a beam of light from the lamp to pass through the instrument we see the small white spot on the screen. Turning the second Nicol, this white spot gradually decreases in brightness and at last disappears. The Nicols are now crossed. If the current which produces the electromagnet is now turned on, the spot of light immediately appears, but can be shut out again by turning the second Nicol through an angle a . This shows that the plane of polarisation of light has been turned through an angle a in its passage through the magnetic field. If the current is reversed, and therefore also the direction of the lines of magnetic force,

the plane of polarisation is turned through the same angle a but in the opposite direction. This experiment shows that the medium in the region of an electromagnet must be influenced by the creation of the current, and further that the medium which transmits light transmits also electromagnetic actions.

Experiments similar to this were performed by Kerr, in 1875 and 1878. In the first he found that a liquid dielectric, in the region of two metal plates at different potentials, becomes doubly refracting. In the second he discovered that the polished pole of an electromagnet rotates the plane of polarisation of incident polarised light.

The considerations which led Faraday to picture the medium about an electrified conductor as the seat of electric action, led James Clerk Maxwell, in 1865, to construct the electromagnetic theory of light—a theory in which light is considered as an electromagnetic disturbance. Faraday's lines of force became Maxwell's lines of displacement. The repulsion between two similar charges Q , of electricity—proportional to Q^2 —was expressed in terms of the elasticity of the medium. Hence F , the force between two equal charges Q at unit distance, would equal $e Q^2$, where e is the elasticity of the medium.

The attraction between two equal currents—proportional to the square of the current strength—was made to depend on the density of the medium and the square of the velocity of the ether vortices developed by the current; but the velocity of the ether vortices is proportional to the current strength; hence F the attraction between two equal currents at unit distance $= dC^2$ where d = the density of the medium. Letting F and F equal unity, we have $c/q = \sqrt{e/a} = v$, the velocity of propagation of a disturbance through an elastic medium. In other words the ratio of the electromagnetic to the electrostatic unit of quantity should be equal to the velocity of the electromagnetic disturbance. In 1868, Maxwell devised an experiment for finding this velocity by means of a comparison of the two units of quantity, and he found the result $v = 2.88 \times 10^{10}$ cms. per. sec. Other physicists by similar methods have attained values for v , the means of which gives $v = 3 \times 10^{10}$ cms. per. sec. Now this is the velocity of light in a vacuum. The anticipation of Maxwell that the velo-

city of an electromagnetic disturbance is the same as that of light seemed therefore to be borne out by his theory.

Maxwell also pointed out that, as a result of his theory, the refractive index of a substance should be universally proportional to the square root of its specific inductive capacity. Experimental determinations of these quantities showed that though this relation is not exact, there is a close connection between these two fundamental constants of light and electricity.

As was to be expected, Maxwell's work drew attention to the relations of light and electricity, but, though everywhere regarded as a splendid piece of mathematical analysis, as a physical treatise it received a more favorable reception on the Continent than in England and to the disgrace of English scientists the fruits of Maxwell's labors were reaped by a foreigner.

In the year 1879, the attention of Dr. Heinrich Hertz, at that time engaged upon electromagnetic researches at the Physical Institute in Berlin, was called to the following problem proposed by the Berlin Academy of Science :—"To establish experimentally any relation between electromagnetic forces and the dielectric polarisation of insulators." After numerous attempts and failures he succeeded, eight years later, in partly establishing this relation, and incidentally proved one of the assumptions of Maxwell's theory. Following up this line of work he succeeded, in the year 1888, in performing some remarkable experiments, in which he showed that electromagnetic actions are propagated in waves, that these waves can be reflected and refracted as in the case of light, and that the velocity of propagation of these waves, though it differs for different media, is approximately equal to that of light.

A brief description of one of these experiments may here be given. When an electric discharge takes place between the discharge knobs of an induction coil or the coatings of a Leyden jar, that discharge is in general of an oscillatory character. In popular language this is explained by stating that there is a rush of electricity many times to and fro across the spark gap. The time of oscillation, which depends on the capacity and self-induction of the circuit, was calculated from theory by Lord Kelvin in 1853. Before the discharge takes place, according to Maxwell's

theory, the ether about the conductor is strained in a certain manner. The discharge breaks this state of strain, but as the discharge is oscillatory, there is imposed on the ether a series of positive and negative configurations. A set of waves then travels out from the spark gap and the wave length equals $V \times T$ where $V =$ the velocity of propagation of the disturbance and $T =$ the periodic time of the discharge. If these waves could be reflected from a plane surface we should have, as in the case of sound, stationary waves and the distance between two nodes or points of rest would be half a wave-length.

The manner in which Hertz operated was as follows:—Each of the poles of an induction coil was connected to a copper wire 30 cm. long, at the outer end of which was a square brass plate 40 cm. long and which terminated at the spark gap in a small brass sphere. (See Fig. 2). The electric oscillations were produced by the discharge of the induction coil across the gap; this part of the apparatus he called the *vibrator*. The instrument

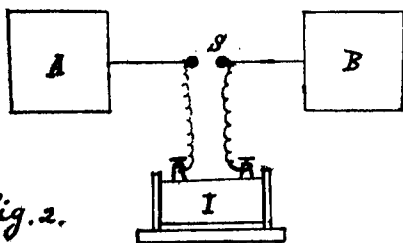


Fig. 2.

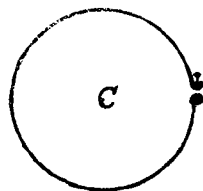
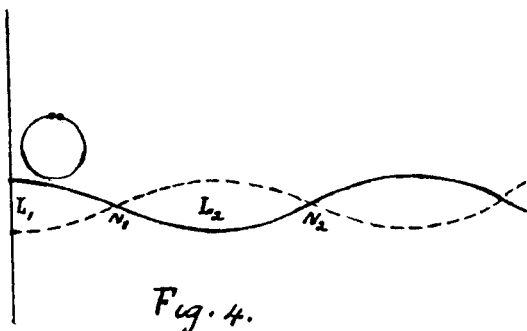


Fig. 3.

used for detecting these oscillations and called the *receiver* was simply a circular copper wire of 35 cm. radius and having an adjustable spark gap. (See Fig. 3). In order to obtain the best results the time of oscillation of the discharge in the receiver should equal that of the vibrator, hence the receiver may also be called the *resonator*. Let the plate A of the vibrator be directly above B so that the direction of the connecting wire is vertical. The plane of the receiver, with its spark gap at the highest point, we will suppose, is confined to the vertical plane through the spark gap S. When the discharge takes place at S, the stationary waves in the vicinity of a wall or metallic reflector are graphi-

cally represented by the curved lines of Fig 4. At L_1 there is sparking in the receiver; the effect decreases as the receiver is moved towards N_1 , becomes a minimum at N_1 , increases as the circle approaches L_2 and then decreases until a minimum effect is



produced at N_2 . This distance $L/2$ between the modes N_1, N_2 is half a wave-length. The time of oscillation may be calculated from the capacity and self-induction of the vibrator. The velocity of propagation of the waves is then known to be L/T . Hertz found the wave-length in this particular case to be about 4.6 metres and the periodic time to be 1.5×10^{-8} seconds. Hence, $V = 3.06 \times 10^{10}$ cm. per. sec., nearly, and this is approximately equal to the velocity of light. (In this description I have spoken of only one set of waves—in reality there are two sets. See Hertz "Ausbreitung der Electricischen Kraft," pp. 139-140; or the English translation by D. E. Jones, "Electric Waves," pp 129, 130).

As soon as Hertz discovered that the effect of an electric oscillation spreads out as a wave into space, he attempted to concentrate this action. In place of the plates and wires used in the vibrator in the experiment just described, he now used two brass cylinders 3 cm. in diameter and 13 cm. long, terminating at the spark gap in spheres of 2 cm. radius. These he placed in the focal line of a cylindrical, parabolic, mirror of zinc. The receiver consisted of two straight wires 5 cm. in diameter and 50 cm. long placed in the focus of a reflector similar to the first; two small wires led from these to a spark

gap behind the reflector. With this apparatus he observed that the electric action was confined to the optic axis of the mirror ; hence he was able to cause an *electric ray* to pass in any desired direction. Causing a ray to fall upon a plane metallic reflector, he found that the angle of reflection was equal to that of incidence. When the ray was made to fall upon a large prism of hard pitch it was found to be refracted, the index of refraction being about 1.69. Indeed Hertz was able to show, by means of this experiment, that rays of electric force follow the well-known laws of light, viz., rectilinear propagation, reflection, refraction, and polarisation. He is therefore led to say concerning these electric rays: "We may perhaps further designate them as electric rays of light of very great wave-length. To me, at least, the experiments described, seem eminently fitted to remove any doubt as to the identity of light, radiant heat, and electromagnetic wave-motion."

The wave-lengths of the electric radiations which he secured were several metres, while those of radiant heat and light are from 75×10^{-6} to 40×10^{-6} metres. The length of the electric wave however decreases with the capacity and self-induction of the discharge system ; in order that waves may be secured whose length is of the same order as those of light the circuit must have atomic dimensions. The suggestion therefore arises that light is a wave-motion due to electric discharges in the ultimate particles of matter. We may therefore regard light as an electric phenomenon and optics as a department of electricity.

HERMANN VON HELMHOLTZ.

W. N. MCLEOD, '95.

[Read before the Mathematical and Physical Society.]

THE works of von Helmholtz are so extensive that it will be possible for me to sketch briefly only a few of the main lines of his thought. Few men of his time have been more gifted; few men of science, certainly, have been granted a more universal and generous recognition of their powers.

In speaking of him some years ago, W. K. Clifford, the mathematician, said:—"In the first place he began by studying physiology, dissecting the eye and the ear, and finding out how they acted, and what was their precise constitution; but he found that it was impossible to study the proper action of the eye and the ear without studying also the nature of light and sound, which led him to the study of Physics. He had already become one of the most accomplished physiologists of this century, when he commenced the study of physics, and he is now one of the greatest physicists of this century. He then found it was impossible to study physics, without knowing mathematics; and accordingly he took to studying mathematics, and he is now one of the most accomplished mathematicians of this century."

Helmholtz, however, was more than physiologist, mathematician and physicist of the first rank; he was likewise a philosopher in the best sense of the word, and a writer whose style, considered from a literary standpoint, is remarkable for its clearness and beauty.

One of the main qualities which characterize the scientific work of Helmholtz, is a certain completeness and maturity; a completeness which was the natural product of clearness of thought, of deepest insight, and of extraordinary analytical power; a maturity which was the legitimate fruit of the long-continued preparation for his life-work.

He was born on the 31st of August, 1821, in Potsdam, where his father was Professor of Literature in the Gymnasium.

No remarkable events distinguished the earlier years of Helmholtz from those of the majority of clever youths. While a school-boy he developed a love for science, and when the class was reading Cicero or Virgil, he was often finding the paths of rays in a telescope, or developing optical theorems not usually met with in text-books. Neither at that time, nor for many years afterwards, was a living to be made out of physics, so, acting on the advice of his father, Helmholtz took up the study of medicine. He was the pupil of Johannes Müller, from whose laboratory came many of the most distinguished German physiologists of the last generation. He eventually became a military surgeon, which position he held until the year 1848. He attracted general attention in the year 1847, when he was 26 years of age, by publishing his essay on the Conservation of Energy.

About the same time in England, Joule had been busy making research on the same subject, and had published his theory of the mechanical equivalent of heat. For some time the best known scientific authorities in both countries rejected the theories of these men as fantastic speculation. Helmholtz was supported by his fellow student Du Bois Reymond and by the mathematician Karl Jacobi, who recognised the connection between the line of thought in the essay, and the principles investigated by Daniell, Bernouilli, d'Alembert, and other mathematicians of the last century, and soon the members of the then young Physical Society of Berlin accepted Helmholtz's results.

About the researches of Joule, Helmholtz knew but little. The study of medicine led to the problem of the nature of *vital force* and he convinced himself that if—as Stahl suggested—an animal had the power now of restraining and now of liberating the activity of mechanical forces it would be endowed with the power of perpetual motion. The essay contained the results of a critical investigation of the question, whether any relations existed between the various kinds of natural forces for perpetual motion to be possible. He began by an argument which practically amounts to the statement that science is limited to the search for a mechanical explanation of nature, and that, whatever the final result of the quest may be, it must be pushed as far as possible.

Assuming that the basis of a mechanical theory must

ultimately be the action of forces between material points, and, implicitly assuming the Newtonian laws of motion, the conclusion is reached that the law of the Conservation of Energy holds good, and holds good only, if the forces are central; that is, if they are attractions or repulsions, the magnitudes of which depend solely on the distances between the mutually reacting particles. This was followed by an appeal to experiment with the result, "that the law of the Conservation of Energy does not contradict any known fact in natural science, but in a great number of cases is, on the contrary, corroborated in a striking manner."

The essay was written for the benefit of Physiologists, but, as has been already intimated, the Physicists also took the doctrine. It is unnecessary to dwell upon the marvellous influence that these results have had on physical science during the last half century. The principle of the conservation of energy has long passed the debatable stage, and some of the greatest discoveries in all branches of modern physics have been deduced from it. This was only the third or fourth paper published by Helmholtz, but his remarkable abilities were now fully known.

His connection with the army was severed in 1848. For some time he was teacher of anatomy in the Art Academy of Berlin and assistant in the Anatomical Museum of that city. After this he was successively professor of physiology and general pathology at Königsberg, professor of anatomy and physiology at Bonn, and professor of physiology at Heidelberg.

In 1851 while at Königsberg he designed the ophthalmoscope and thus made it possible to diagnose the inmost recesses of the living eye—a discovery which shows the great importance to the physiologist and physician of a thorough knowledge of physical principles.

In 1852, he adopted and enlarged the theory of color-sensation, originally due to Young. It assumes that all the sensations of color are compounded out of three fundamental sensations, which are respectively a red, green, and violet or blue. Nearly, if not all the phenomena of color-blindness can be explained on the hypothesis that, in the case of persons so affected, the power of appreciating one or other of these sensations is wanting.

In 1856 was published the first section of his great work on *Physiological Optics*, a work which occupied his attention for ten

years, although he was busy also with other important problems during this time. It is, as he himself has said, a complete survey of the whole field of that science. In the first place he treated the eye as an optical instrument, traced the path of the rays through it, and discussed the mechanism by which it can be accommodated to distinct vision at different distances. To investigate the last point it was necessary to measure the images formed by reflection from the surfaces of the crystalline lens. For this purpose he invented a special instrument, the ophthalmometer, by which such measurements can be made on the living patient with great accuracy.

In an interesting course of popular lectures, published in 1868, and since translated by Dr. Atkinson, von Helmholtz insisted that, far from being, as was often supposed, a perfect organ, the eye has many optical defects; and that our unconsciousness of these is due, not so much to its perfection from the instrument-maker's point of view, as to the ease with which it adapts itself to different circumstances, and to the skill with which long practice enables us to interpret the messages it conveys to the brain.

The second section of the work was devoted to the sensation of sight. The theories of color and of intensity, the duration of the sensation of light, the phenomena of contrast and subjective appearances were all discussed with a fulness never before attained. The last part was devoted to such problems as our visual appreciation of three dimensions in space, and binocular vision. Perhaps the greatest work of Helmholtz is that on "Sensations of Tone," in which the conditions, under which our senses are trained, are illustrated in a yet clearer manner. The theories advanced were novel, but, though some points are still open to dispute, they have as a whole been generally accepted.

It contained his discovery of the physical basis of the sensations which affect us when listening to consonant and dissonant musical intervals respectively. If two notes, which differ but little from unison, are produced together, throbbing alternations in the intensity of the sound are heard as beats. If the interval is gradually increased, the beats become quicker, till at last they can no longer be distinguished separately. According to von Helmholtz, however, they produce the effect of dissonance.

“The nerves of hearing,” he says, “feel these rapid beats as rough and unpleasant, because every intermittent excitement of any nervous apparatus affects it more powerfully than one that lasts unaltered. Consonance is a continuous, dissonance an intermittent sensation of tone.” The disagreeable effect depends in part upon the number of beats, in part upon the interval between the notes which produce them, being greatest when the rapidity of the beats is neither very large nor very small, and when the interval between the two notes is not great. In applying this theory it is necessary to take into account not only the beats between the two fundamental notes, but also those due to two series of secondary sounds, by which they may be accompanied. The presence or absence of these—the so-called upper harmonic partials—depends upon the way in which the note has been obtained. They produce the differences of quality which distinguish one musical instrument from another.

It was hardly to be expected that differences of opinion would not arise as to some of the points discussed in two works, so wide in their scope, and so novel in their methods, as the treatises on the Sensations of Tone and on Physiological Optics. Koenig, the celebrated instrument maker, has demonstrated the existence of beats, which, in the case of compound sounds, could be explained as due to the upper partials, but as they are produced when the notes are as pure as it is possible to make them, they do not appear to be accounted for by the original theory. Another writer (Voigt Wiedemann’s *Annalen*, 1890) who has recently examined the matter, concludes that both the combination tones of von Helmholtz, and the beat tones of Koenig, can theoretically be produced, and that one system or the other will tend to predominate according to circumstances. Several other points of considerable interest have been raised, but those who, on one ground or another, have objected to the views of von Helmholtz have not been entirely in accord among themselves.

In these investigations on the eye and ear, on light and sound, Helmholtz was at his most characteristic work, but he has also made great scientific achievements as a mathematician. In the year 1871, when fifty years of age, he definitely abandoned physiology for the field of labor with which his name will ever be primarily associated, and he was appointed Professor

of Natural Philosophy in the University of Berlin. In his relations to the undergraduates, he was found to be cold and distant by some; but these were, for the most part, of a class to whom he could have imparted little. On the other hand he was ever quick to recognize latent powers, and alert to rouse those who possessed them into activity.

He was deeply interested in the electro-magnetic theory of light, and developed it in a form which is even more general than that adopted by Clerk Maxwell; but while Helmholtz indicated possibilities, Maxwell assumed all that was necessary to explain the facts. The great work of Heinrich Hertz, who was a student in Helmholtz's laboratory, was developed from a problem in electrodynamics given by the latter as a theme for a prize essay in physics.

The first of Helmholtz's researches that was clearly free from all physiological origin motive or suggestion, was the important monograph upon the hydrodynamical equations which express vortex motion. It formed the starting point of his remarkable series of studies of fluid motion.

In his numerous papers on thermodynamics he reduced to an intelligible and systematic form the labors and intricate investigations of several independent theorists, so as to compare them with each other and with experiment.

Many other subjects were investigated by him, such as electro-dynamics, stereoscopic vision, galvanic polarisation, the theory of anomalous dispersion, the origin and meaning of geometrical axioms, the mechanical conditions governing the movements of the atmosphere, the production of waves, etc.

His career as director in this important University laboratory drew to a close, with the establishment of the Imperial Institute for Physical and Technical Research, to the presidency of which he was called in 1888, where he devoted the few remaining years of his life to the further pursuance of his investigations.

He had already reached the pinnacle of renown. All honors—scientific, academic, national, royal and imperial—which the world had to bestow, had been showered upon him. In 1877, he was rector of the University of Berlin; in 1883, the Emperor William I. bestowed upon him hereditary nobility; in 1891, the celebration of his seventieth birthday was the occa-

sion of international scientific applause and gratulation. Much uncompleted work appears to have been interrupted by Helmholtz's sudden death, among other things the completion of the new edition of the Handbook of Physiological Optics, and a compendious treatise on Mathematical Physics. This latter book, which is to include the development of optical theory along lines already indicated by the work of Maxwell and of Hertz, will, it is reported, be brought to completion by Dr. Arthur König.

In 1893, Helmholtz undertook for the first time a journey to America, upon which trip he was accompanied by Mrs. von Helmholtz and by four assistants from the Reichsanstalt. The party visited Chicago, and Helmholtz attended the sittings of the chamber of delegates of the International Congress of Electricians, of which body he had been elected honorary president. He took an active part in the deliberations of the chamber, to whose service he brought his fundamental knowledge of the subjects under consideration, and likewise a wide experience from the sittings of previous congresses.

This was his last important public appearance. On the return voyage it was his misfortune to fall down the companion-way of the ship, sustaining injuries from which, at his age, the most serious consequences were to be feared. Scarcely had he made complete recovery when the two paralytic shocks occurred which caused his death at noonday on September 8th, 1894. Thus passed from earth, at the age of seventy-three years, the first physicist of our time.