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A "Tour de Force."

THERE are three fundamental subjects in education—the history of our race, the world around us, and the conditions of health, happiness, and effective work. They correspond to Le Play's "famille, lieu, travail"; to the biologist's "Organism, Environment, Function." Fundamental they certainly are, but it is generally admitted that most men know little about any of them and understand less. We are perhaps deplorably slow to learn, but we are also very badly taught. Especially in regard to the history of mankind it is difficult to forgive our teachers, for we spent so long over it (the other fundamentals were for the "modern" side) and we know that we were not unappetised. Yet for bread we got stones. We find the same disappointment among most of our fellows, the disappointment of half-educated men who know their deficiencies. There are well-known ways of making the study of history grip—the use of graphs and charts, the biographical approach, with its calendar of great men, the emotional and dramatic methods so vividly illustrated by Dr. Hayward, and so on; but they seem rarely to be tested in schools or colleges, and widespread ignorance of a supreme subject prevails. We except, of course, those who are by birth historically minded, who learn in spite of bad methods or the absence of any; though even those who know many historical facts seem often like

students who are familiar with fossils, but unaware of the æonic pulse and progress of life.

These bitter reflections are prompted, of course, by Mr. Wells's "Outline of History,"¹ which convinces us of sin. For here we find what, in spite of its imperfections, is of the nature of a revelation—a sketch of the continuous movement from the nebula that became the earth to the League of Nations, a suggestion of the sweep and surge of civilisation, not in one corner, but all the world over, an attempt to focus attention on the things that have counted in the past and are living on, around us and in us, to-day. We use such words as "sketch," "suggestion," and "attempt," not in any disparaging way, but because no single man could offer anything else. The book is called "The Outline." There are probably big omissions, unconscious misinterpretations, mistaken accentuations, and so forth, but the point is that Mr. Wells has shown his day and generation the sort of history of the world that every educated man should have as a possession in his mind. It is a fine thing to have achieved what has hitherto been called impossible. We recall two books of many years ago—Haeckel's "Natural History of Creation" and Krause's "Werden und Vergehen"—which traced the cosmic genesis from nebula to consolidated earth, and the organic evolution from Protists to Man, and did this in a vividly picturesque way. They may not have been quite so fine as we thought they were, but, errors and omissions excepted, they were fine books.

Mr. Wells's "Outline" is another such big gift to education. Perhaps it will be a still bigger gift when someone writes another like it from a different point of view. For out of the mouth of two or more witnesses there is some chance of the truth being stated. But, as the author says, the book is an "experimental contribution to a great and urgently necessary educational reformation, which must ultimately restore universal history, revised, corrected, and brought up to date, to its proper place and use as the backbone of a general education. We say 'restore,' because all the great cultures of the world hitherto, Judaism and Christianity in the Bible, Islam in the Koran, have used some sort of cosmogony and world-history as a basis. It may indeed be argued that without such a basis any really binding culture of men is inconceivable. Without it we are a chaos." We would also quote the striking sentence which expresses Mr. Wells's appreciation of what a

¹ "The Outline of History: Being a Plain History of Life and Mankind." By H. G. Wells. Revised and corrected edition. Pp. xx+652. (London: Cassell and Co., Ltd., 1920.) Price 21s. net.

living conception of world-history may mean: "A sense of history as the common adventure of all mankind is as necessary for peace within as it is for peace between the nations." Yet we go on fumbling with educational methods, if such they may be called, which we know do not grip.

As is noted in the Introduction, it is usual to say that the time-table of instruction is full up, and that the idea of learning world-history is preposterous.

"If an Englishman, for example, has found the history of England quite enough for his powers of assimilation, then it seems hopeless to expect his sons and daughters to master universal history, if that is to consist of the history of England, *plus* the history of France, *plus* the history of Russia, and so on. To which the only possible answer is that universal history is at once something more and something less than the aggregate of the national histories to which we are accustomed, that it must be approached in a different spirit and dealt with in a different manner. This book seeks to justify that answer. It has been written primarily to show that *history as one whole* is amenable to a more broad and comprehensive handling than is the history of special nations and periods, a broader handling that will bring it within the normal limitations of time and energy set to the reading and education of an ordinary citizen. . . . History is no exception amongst the sciences; as the gaps fill in, the outline simplifies; as the outlook broadens, the clustering multitude of details dissolves into general laws."

We are forced to add that there would be no difficulty about the time for instruction if the methods employed were psychologically sound, if the suggestions of "historical associations" and clear-headed enthusiasts were put into practice. It is certain, for instance, that the purely intellectual presentation usually slips off the child's mind like water off a duck's back, and that it ought to. Moreover, in higher classes what is wanted is not history *plus* history, but a discipline in the way of reading history of such a kind that it will be natural to continue learning. What we so often do not get are centres of crystallisation—a less static metaphor than it used to seem.

There are nine books in "The Outline of History"—The Making of our World; The Making of Man; The Dawn of History; Judea, Greece, and India; The Rise and Collapse of the Roman Empire; Christianity and Islam; The Great Mongol Empires of the Land Ways and the New Empires of the Sea Ways; The Age of the Great Powers; and then a prospect—The Next Stage in

History. It was said of Buffon that he took all Nature for his province and was not embarrassed; but Mr. Wells has an even wider reach. It seems almost superhuman—to be so well done; but the author tells us frankly: "There is not a chapter that has not been examined by some more competent person than himself and very carefully revised. He has particularly to thank his friends Sir E. Ray Lankester, Sir H. H. Johnston, Prof. Gilbert Murray, and Mr. Ernest Barker for much counsel." There is a long list of authorities who have helped in various ways to keep the book true to the facts (their footnotes are illuminating); and he has been fortunate in securing in Mr. J. F. Horrabin a skilful illustrator who has put brains into his drawings.

It need scarcely be said that "The Outline" is a *personal* document—materials had to be selected, much had to be left out; prominence is given to some figures, others are in the background; the relative significance of various movements had to be judged, and all this has been obviously influenced by the author's philosophy. The difference here between Mr. Wells and other historians is that he is so clearly aware of the relativity of his work. There is another way, of course, in which the book is personal: it is written in good style—clear, picturesque, and incisive—and it expresses throughout the serious purpose of improving things by understanding them. Another personal characteristic, familiar to readers of Mr. Wells's books, is the courage of his convictions.

The First Book gives in very brief compass an account of the genesis of the earth and the evolution of organisms. There are a few points that puzzle us, such as an indication that the breastbone of Pterodactyls had no keel, but the sketch is masterly. The Second Book deals with the ascent of man, his Primate ancestry, the extinct Neanderthal offshoot, the first true men and their thoughts, the differentiation into races, with their various languages. The Third Book pictures the dawn of history, the primitive Aryan life, the first civilisations, the early traders and travellers, the beginning of writing, the emergence of priests, and the establishment of classes and castes. The treatment is a fine illustration of the art of leaving out what obscures the main issues and of the reward that comes to a man of science who has insisted on seeing things clearly. It is of great educational value to have this vivid and accurate picture of the rock whence we were hewn and the pit whence we were digged.

What dominates the Fourth Book is the idea

that by the beginning of the third century B.C. there had already arisen in the Western civilisation of the Old World the great structural ideas (1) of communicable and verifiable knowledge, as contrasted with priest-guarded mysteries; (2) of one universal God of Righteousness, whose temple is the whole world; and (3) of a world polity of which Alexander the Great became the symbol. "The rest of the history of mankind is very largely the history of these three ideas of science, of a universal righteousness, and of a human commonweal." The Fifth Book gives an account of the rise and collapse of the Roman Empire—an account which seems to us to betray bias. It was a very unsound political system. "The clue to all its failure lies in the absence of any free mental activity and any organisation for the increase, development, and application of knowledge." It was "a colossally ignorant and unimaginative Empire." When the smash came "there was one thing that did not perish, but grew, and that was the tradition of the world-empire of Rome and of the supremacy of the Cæsars." The Great War "mowed down no fewer than four Cæsars" who insisted on keeping up the evil tradition. We do not hear much of Roman Law from Mr. Wells, but he frankly confesses that he "contemplates the law and lawyers of to-day with a temperamental lack of appreciation."

The Sixth Book is chiefly concerned with Christianity and its idea of the Kingdom of God, and with Islam with its broad idea of human brotherhood under God. It is admitted that the founder of Islam "had to tack on to his assertion of the supremacy of God an assertion that Muhammad was in especial his prophet, a queer little lapse into proprietorship, a touchingly baseless claim for the copyright of an idea which, as a matter of fact, he had picked up from the Jews and Christians about him." Regarding Christianity, the author quotes with approval a sentence from Dean Inge's "Outspoken Essays": "St. Paul understood what most Christians never realise, namely, that the Gospel of Christ is not a religion, but religion itself in its most universal and deepest significance." Thereafter follows a passage which will interest many, in which Mr. Wells declares that there is no antagonism between science and religion. What he says seems to us to suggest rather that there is no antagonism between science and *morals*. "The psychologist can now stand beside the preacher and assure us that there is no reasoned peace of heart, no balance and no safety in the soul, until

a man in losing his life has found it, and has schooled and disciplined his interests and will beyond greeds, rivalries, fears, instincts, and narrow affections." And then he goes on to say, all too elliptically: "The history of our race and personal religious experience run so closely parallel as to seem to a modern observer almost the same thing; both tell of a being at first scattered and blind and utterly confused, feeling its way slowly to the serenity and salvation of an ordered and coherent purpose. That in the simplest is the outline of history; whether one have a religious purpose or disavow a religious purpose altogether, the lines of the outline remain the same."

In the Seventh Book the Age of the Land Ways is illustrated by the great empire of Jengis Khan and his successors, very sympathetically sketched ("the blood in our veins was brewed on the steppes as well as on the ploughlands"). Land ways give place to sea ways and Western civilisation has its renaissance ("Europe begins to Think for Itself," "Paper Liberated the Human Mind," "the expansion of human horizons," "intimations of a new and profounder social justice"). The Eighth Book is devoted to the Age of the Great Powers.

"Tremendously as these phantoms, the Powers, rule our minds and lives to-day, they are, as this history shows clearly, things only of the last few centuries, a mere hour, an incidental phase, in the vast, deliberate history of our kind. They mark a phase of relapse, a backwater, as the rise of Machiavellian monarchy marks a backwater; they are part of the same eddy of faltering faith, in a process altogether greater and altogether different in general character, the process of the moral and intellectual reunion of mankind. For a time men have relapsed upon these national or imperial gods of theirs; it is but for a time. The idea of the world state, the universal kingdom of righteousness, of which every living soul shall be a citizen, was already in the world two thousand years ago, never more to leave it. Men know that it is present, even when they refuse to recognise it."

Glimpses of this same vision we find throughout the book; it is so dominant in Mr. Wells's mind that he has seen all history in the light of it. Whether it makes for good history we do not know; it has made for a fascinating book which it does one good to read. Its influence will be far-reaching.

To what prospect does his study of universal history lead Mr. Wells? The trend of human evolution points in the direction of internationalism—but beyond. "Our true nationality is mankind." Religion and education, closely interwoven influ-

ences, have been the chief synthetic forces throughout the great story of enlarging human co-operations: of the former we may look for a revival, of the latter a re-adjustment informed with science. As a necessary basis for world co-operation, as a preparation for a world league of men, there must be "a new telling and interpretation, a common interpretation, of history." And that this book will further. "There can be little question that the attainment of a federation of all humanity, together with a sufficient measure of social justice, to ensure health, education, and a rough equality of opportunity to most of the children born into the world, would mean such a release and increase of human energy as to open a new phase in human history." Mr. Wells looks forward to "the final achievement of world-wide political and social unity," which will be reached by and based on righteousness as well as science, "perhaps with long interludes of setback and disaster," but "it will mean no resting stage, nor even a breathing stage, before the development of a new struggle and of new and vaster efforts. Men will unify only to intensify the search for knowledge and power and live as ever for new occasions." Almost the ending of what we cannot but regard as a great book is a key sentence: "Life begins perpetually."

The Dioptrics of Huygens.

Œuvres Complètes de Christiaan Huygens. Tome Treizième. Dioptrique 1653; 1666; 1685-1692. Fascicule i., 1653; 1666. Pp. clxvii+432. Fascicule ii., 1685-1692. Pp. 434-905. (La Haye: Martinus Nijhoff, 1916.)

NEARLY ten years have elapsed since we reviewed the twelfth volume of this great work (NATURE, vol. lxxxiv., p. 491), of which vol. xiii., consisting of two parts of altogether nearly 1100 pages, only lately reached us, though dated 1916. It contains everything written by Huygens on geometrical optics, both what was incorporated in the "Dioptrica" published in his "Opuscula Posthuma" in 1703 and 1728, and various extracts from his manuscripts now printed for the first time.

Already in 1652 and 1653 Huygens had written a treatise on refraction and telescopes, divided into three books, and by the present editors called part i. In the next twelve years he occupied himself with the subject from time to time, as appears from his correspondence. In 1665 he resumed more systematically his researches on spherical aberration, and found results which seemed to him

so important that he wrote an essay (part ii.) on them. This was soon interrupted by his settling at Paris as a member of the Academy and a pensioner of Louis XIV., but within a year he had a copy made of all he had yet written on the subject, and this is still in existence. In 1668 Huygens tried to verify by experiments his theory of spherical aberration, by which he thought he would be able to compensate the aberration of the object glass by that of the eyepiece; but this led only to disappointment, and he perceived that it was colour-effects which prevented the realisation of his ideas. He next got the idea of forming the object-glass of two lenses, situated close to each other, an idea which was never incorporated in his MS.; and it was probably the uncertainty he felt about the value of his latest results which still made him put off the publication of his work. In 1672 he heard of Newton's discovery of the composition of white light, and after some hesitation he realised its fundamental importance for the problems of dioptrics, so that the results he had himself found had not the value he had supposed them to have, and they were therefore removed from his MS.

In the meantime the undulatory theory of light had arisen in the mind of Huygens, and he proposed to write a larger work dealing with the new theory and its applications, in which his MS. on dioptrics might find a place. But in 1677 he discovered the explanation of double refraction in Iceland spar, which he considered the finest confirmation of his new theory, and beside which all his earlier work on dioptrics appeared to be of secondary importance. He therefore decided to let this work be preceded by a treatise on the undulatory theory of light and its principal applications, without dealing with the theory of lenses and telescopes. This was the origin of the celebrated little book, "Traité de la lumière," which, though not published till 1690, had been practically completed in 1678. Finally, in 1684, Huygens resumed his researches on the magnifying power of telescopes and questions related thereto, and it was probably in the following year that he wrote nearly all that which in the present edition has been put together in part iii., on telescopes. In 1692 he wrote to Leibniz that he seemed to have finished with the subject, though everything was not yet written down. He then numbered the pages of his MS. in the order which he proposed to follow in the final redaction. This pagination was generally followed in the posthumous edition of 1703, but in this way parts written at very different epochs are mixed up together. The present editors therefore preferred to follow the chronological order, so that the gradual development of Huygens's ideas could