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The History of Scientific Thought.

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THE earliest form of history is a chronicle of priests and kings with their attendant worshippers and warriors. The misty dream of god-descended heroes passes into the clear vision of the ordered march of Roman legions; the picturesque pageant of medieval bishops and barons vanishes in the smoke of Bosworth field; and the sound of Drake's guns, drumming the Spaniards up the Channel, melts into the strains of a Te Deum, sung in Notre Dame for another victory over Marlborough.

Then Clio discovers politics, and tells us of statesmen and of constitutions. Pericles and Cicero, Richelieu and Walpole, Magna Charta and the Petition of Right, the Declaration of Independence and the French Revolution (with appropriate footnotes on contemporary literature and art), are acclaimed as the proper study of mankind. The old idea of a Garden of Eden or a golden age of heroic kings in the past changes into the equally pathetic delusion of certain and continued progress in the future, necessarily linked with the growth of political democracy in the present.

So historians taught when our fathers were young. Then came Thorold Rogers and William Cunningham, who first saw the importance of economic history, while Maitland was putting new life into the chronicles of Law and Constitution by the study of records. Underlying the froth and glitter of politics and war, we were shown the deep and steady currents of economic change. Control of the trade routes of the ancient world, the rise of European prices due to the gold of Mexico and Peru, the coal of England burning into power in the pioneer factories of the world, were realised as more mighty than the beauty of Helen or the valour of Achilles, the will of Popes or the ambition of Kings, the genius of Napoleon or the lure of Reform Bills. And the believers in sudden Utopias, disillusioned by this time of political reform, hastened to become economic socialists.

But now men begin to ask how these resistless currents of economic change are started, and what determines the channels in which they flow. It is clear that our varying control over the resources of Nature is one factor involved. When bronze could be used instead of stone and flint, when fresh-forged iron

replaced the softer bronze, new industries appeared, and the efforts of men were perforce turned aside to develop and exploit them. The making of gunpowder pierced the knight's bright armour and levelled the baron's frowning walls, to spread abroad the King's peace and liberate the trade of towns. Tull's discoveries in the art of growing field-crops, and Bakewell's study of the methods of stock-breeding, gave food for the rapidly growing population, called into being by the energy of coal, converted in the factories built to meet the inventions of Watt and of Arkwright.

This harnessing of Nature's fiery steeds of power is one of the two functions of that ordered knowledge we call science, and, conversely, the material wants of man give one of the two motives from which pure as well as practical science springs. Geometry arose from the need for the repeated mensuration of land after the yearly flood of the Nile; astronomy began as the bye-play of Chaldean astrologers, seeking, by the dim light of the stars, to peer into the future and thus control the destinies of man; thermodynamics was developed to explain and improve the working of the steam-engine.

But another desire is also at work to generate science, and another function is fulfilled by science when born. Man does not live by bread alone. The longing of the soul for light, of the brain for knowledge, is a nobler if a rarer instinct than the craving of the body for food and shelter. The mystery of existence, the eternal riddle of the Sphinx, moves the mind of the philosopher, and, when he learns to humble his hopes and advance step by step on the slow road of observation and experiment, he becomes a man of science and gains an ever-increasing insight into the secrets of Nature.

So it is that history, to become a complete record of man's story, must take account of his intellectual as well as of his material achievement. Thus alone, when the history of thought is combined with that of action, can we watch in its fulness the great human drama, and write in worthy form a Universal History of the World.

Moreover, to do this as it should be done, we must call to our aid the transforming magic of literature. Our poets must not only sing of burning Sappho or the hills of Rome, of Ivry or of Waterloo, of fights for

freedom or of legal progress broadening down from precedent to precedent. They must tell us also of Newton and of Einstein; of the busy laboratory and the mountain observatory; of the spiral nebula whirling from its arms new stars into the dark abyss of space, and the hundred million years of organic evolution; of the lion-haunted dreams of early cave-men, the rise and fall of succeeding civilisations in the long history of the world, and the majestic march of modern knowledge—perhaps but starting on an illimitable progress towards the moral and material betterment of all mankind, perhaps doomed to check and dissolve once more amid the social and economic dangers of our great democratic experiment. There is romance enough in the story of the past, in the veiled mystery of the future, to give a theme worthy of Shakespeare or of Sophocles.

This vision of science as the uniting link between the intellectual and the practical efforts of man, the worthy subject of history and of literature—a vision hitherto seen by few—is at length becoming clear to many. Darwin fluttered some ecclesiastical doves; but now for thirty years a cumulative series of striking discoveries has awakened the imagination of all educated men. Röntgen's X-rays, the sub-atomic electron of Thomson, the radioactive disintegration of matter revealed by Rutherford, are paralleled on the biological side by the tracing of the source of malaria, the detection of vitamins, and the application of Mendel's researches to the breeding of new varieties of cereal crops. The War enforced the lesson. Victory was impossible without the aid of the physicist, the chemist, the biologist, and the engineer; and peace cannot bring prosperity and contentment until the electrician has led power about the land, and the economist taught us how best to use and distribute its products.

We see, therefore, a great quickening of interest, not only in contemporary science and its possible applications, but also in the story of scientific development in the past and in the lives of those who have made it. We need but turn over the pages of *NATURE* for the last few years to see what a change has taken place. Book after book has recently appeared dealing with some aspect of this wide subject, and *NATURE* itself has helped, both by notices in its editorial columns and by such serial publications as the *Calendars of Scientific and Industrial Pioneers* and the abstracts of *Early Science at the Royal Society*.

The universities and schools also are showing more interest in this aspect of science. Mr. R. T. Gunther, led by a chance finding of a collection of apparatus "locked up in a dark cupboard in Christchurch, all smothered with the dust of ages," is publishing a series

of studies of early science at Oxford, and Dr. and Mrs. Singer carried on notable research there on the history of science, especially on the biological and medical side, before they moved to London, where a University course of study in the history, principles, and methods of science, leading to an M.Sc. degree, has been established. Sir Clifford Allbutt gives occasional lectures at Cambridge on the history of medicine, and Sir Arthur Shipley on the development of biology.

In schools, nearly all boys now learn some science, and, both for those who are specialising in it and for those whose main intellectual interests lie in other fields of thought, it is well to gain some knowledge of the course of its growth, even to read some of its classical writings. The reports of the yearly conferences of schoolmasters show an increasing appreciation of the advantages of this mode of treatment.

Education is searching for a way of presenting the new humanism. When the works of the writers of Greece were rediscovered at the Renaissance, they were welcomed, not only as history and literature, but also as containing philosophy and science far in advance of anything then known to the modern world. It was natural and right that school studies should be founded on classics, and a classical education was then, and until recent times, the best available. It survived its usefulness, and the inevitable reaction brought into prominence a somewhat academic treatment of mathematics, and a rather inhuman and too odoriferous science. Such studies could not give a complete education, and a tendency to emphasise once more the benefits of classics became manifest.

Science, however, has now reached heights and depths far beyond those that could be touched by the Greeks, and philosophy in the light of science has assimilated the best part of Greek thought and passed on. History and archæology trace the rise and fall of five or more civilisations, in which that known to Herodotus and Livy is but the last before our own, and possess a wealth of records in which a student may learn the delight of research at first hand. The literature of Europe in the last three hundred years can show masterpieces not unworthy of ancient times, and the Gothic cathedral is as noble a building as the Athenian temple.

It is essential to train modern youth to understand and appreciate modern action and modern thought, and a modern humanism is now possible which views classical learning in its right place in a greater whole. In that humanism the history of scientific thought fills a worthy place, and, with a more intensive study of some science itself, may give that open mind and spirit of reverent inquiry into truth which is the essence of scientific method, and the best object of a liberal education.