THOMAS HENRY HUXLEY

THE ADVANCE OF SCIENCE IN THE LAST HALF-CENTURY

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Recent industrial progress

The most obvious and the most distinctive features of the History of Civilisation, during the last fifty years, is the wonderful increase of industrial production by the application of machinery, the improvement of old technical processes and the invention of new ones, accompanied by an even more remarkable development of old and new means of locomotion and intercommunication. By this rapid and vast multiplication of the commodities and conveniences of existence, the general standard of comfort has been raised, the ravages of pestilence and famine have been checked, and the natural obstacles, which time and space offer to mutual intercourse, have been reduced in a manner, and to an extent, unknown

to former ages. The diminution or removal of local ignorance and prejudice, the creation of common interests among the most widely separated peoples, and the strengthening of the forces of the organisation of the commonwealth against those of political or social anarchy, thus effected, have exerted an influence on the present and future fortunes of mankind the full significance of which may be divined, but cannot, as yet, be estimated at its full value.

caused by the increase of physical science

This revolution—for it is nothing less—in the political and social aspects of modern civilisation has been preceded, accompanied, and in great measure caused, by a less obvious, but no less marvellous, increase of natural knowledge, and especially of that part of it which is known as Physical Science, in consequence of the application of scientific method to the investigation of the phenomena of the material world. Not that the growth of physical science is an exclusive prerogative of the Victorian age. Its present strength and volume merely indicate the highest level of a stream which took its rise, alongside of the primal founts of Philosophy, Literature, and Art, in ancient Greece; and, after being dammed up for a thousand years, once more began to flow three centuries ago.

Greek and mediæval science.

It may be doubted if even-handed justice, as free from fulsome panegyric as from captious depreciation, has ever yet been dealt out to the sages of antiquity who, for eight centuries, from the time of Thales to that of Galen, toiled at the foundations of physical science. But, without entering into the discussion of that large question, it

is certain that the labors of these early workers in the field of natural knowledge were brought to a standstill by the decay and disruption of the Roman Empire, the consequent disorganisation of society, and the diversion of men's thoughts from sublunary matters to the problems of the supernatural world suggested by Christian dogma in the Middle Ages. And, notwithstanding sporadic attempts to recall men to the investigation of nature, here and there, it was not until the fifteenth and sixteenth centuries that physical science made a new start, founding itself, at first, altogether upon that which had been done by the Greeks. Indeed, it must be admitted that the men of the Renaissance, though standing on the shoulders of the old philosophers, were a long time before they saw as much as their forerunners had done.

The first serious attempts to carry further the unfinished work of Archimedes, Hipparchus, and Ptolemy, of Aristotle and of Galen, naturally enough arose among the astronomers and the physicians. For the imperious necessity of seeking some remedy for the physical ills of life had insured the preservation of more or less of the wisdom of Hippocrates and his successors, and, by a happy conjunction of circumstances, the Jewish and the Arabian physicians and philosophers escaped many of the influences which, at that time, blighted natural knowledge in the Christian world. On the other hand, the superstitious hopes and fears which afforded countenance to astrology and to alchemy also sheltered astronomy and the germs of chemistry. Whether for this, or for some better reason, the founders of the schools of the Middle Ages included

astronomy, along with geometry, arithmetic, and music, as one of the four branches of advanced education; and, in this respect, it is only just to them to observe that they were far in advance of those who sit in their seats. The school men considered no one to be properly educated unless he were acquainted with, at any rate, one branch of physical science. We have not, even yet, reached that stage of enlightenment.

Further advance after Renaissance.

In the early decades of the seventeenth century, the men of the Renaissance could show that they had already put out to good interest the treasure bequeathed to them by the Greeks. They had produced the astronomical system of Copernicus, with Kepler's great additions; the astronomical discoveries and the physical investigations of Galileo; the mechanics of Stevinus and the 'De Magnete' of Gilbert; the anatomy of the great French and Italian schools and the physiology of Harvey. In Italy, which had succeeded Greece in the hegemony of the scientific world, the Accademia dei Lyncei and sundry other such associations for the investigation of nature, the models of all subsequent academies and scientific societies, had been founded, while the literary skill and biting wit of Galileo had made the great scientific questions of the day not only intelligible, but attractive, to the general public.

Francis Bacon.

In our own country, Francis Bacon, had essayed to sum up the past of physical science, and to indicate the path which it must follow if its great destinies were to be fulfilled. And though the attempt was just such a magnificent failure as might have been

expected from a man of great endowments, who was so singularly devoid of scientific insight that he could not understand the value of the work already achieved by the true instaurators of physical science; yet the majestic eloquence and the fervid vaticinations of one who was conspicuous alike by the greatness of his rise and the depth of his fall, drew the attention of all the world to the 'new birth of Time.'

The defect of his method.

But it is not easy to discover satisfactory evidence that the 'Novum Organum' had any direct beneficial influence on the advancement of natural knowledge. No delusion is greater than the notion that method and industry can make up for lack of motherwit, either in science or in practical life; and it is strange that, with his knowledge of mankind, Bacon should have dreamed that his, or any other, 'via inveniendi scientias' would 'level men's wits' and leave little scope for that inborn capacity which is called genius. As a matter of fact, Bacon's 'via' has proved hopelessly impracticable; while the 'anticipation of nature' by the invention of hypotheses based on incomplete inductions, which he specially condemns, has proved itself to be a most efficient, indeed an indispensable, instrument of scientific progress. Finally, that transcendental alchemy—the superinducement of new forms on matter—which Bacon declares to be the supreme aim of science, has been wholly ignored by those who have created the physical knowledge of the present day.

Even the eloquent advocacy of the Chancellor brought no unmixed good to physical science. It was natural enough