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Classics and Science.

LORD MILNER, in his presidential address to the Classical Association on January 6, made a notable declaration of the unity of educational purpose of classical and scientific studies. He pointed out that to the mind which had received real enlightenment there could be no antagonism between these two great branches of human knowledge. "All modern science had its roots in the classics, and, on the other hand, no man imbued with the spirit of the great classical writers could be lacking in respect for science or fail to recognise its supreme importance to the progress of mankind." Lord Milner went on to say:—

"I wonder what Plato and Aristotle, could they reappear among men to-day, would say to an education that was purely linguistic, even if the literature with which it occupied itself was the best ever known. Looking with wondering eyes on the achievements of science which had transformed the world since their day and given to man command over physical forces such as they had never dreamed of, would they not be seized with an intense desire to probe these marvels to the bottom, to know all about their causes, the methods and the steps by which such great results had been attained? And what would they think of a man who, living in the midst of these achievements, took no interest in them except in so far as they affected his personal convenience and well-being, enabling him to satisfy his wants cheaply, to travel with rapidity and comfort, to communicate in a few minutes with the uttermost ends of the globe, to escape suffering, avert disease, and even postpone the advent of death, and who never felt impelled to go more deeply into the matter and to learn something of the inner nature of the mysterious forces the discovery of which was so rapidly transforming the life of men upon this earth? Any Greek philosopher revisiting the world to-day would condemn such a man as a misfit—a creature unsuited to its environment."

With this conception of the close relationship between classical learning and scientific discovery most scientific workers will be in cordial agreement. The common enemies of both are ignorance, sordid commercialism, and general public indifference to intellectual light, whether it comes from the past or the present. There was a time when this was not so clearly recognised as it is to-day, and when classical scholars placed followers of experimental science among the barbarians. Tradition, method, social distinctions and professional prospects were then all on the side of the classics of Greece and Rome, and the most capable pupils were directed to the study of them and discouraged from devoting attention to modern scientific studies. It was claimed that instruction in classical languages was particularly valuable in developing accuracy, training reasoning powers, improving the memory, and cultivating all the faculties necessary to make the best use of life in any field. Psychologists have, however, destroyed the educational concept upon which this claim is based, and it is no longer believed that the exercise of the mind on one kind of material improves the faculty to deal with other kinds. No subject can therefore be put forward as affording unique general training in mental faculties or powers.

We are glad that Lord Milner did not base his plea for classical studies upon the grounds of the mental discipline secured through concentration upon the letter, but dealt rather with the spirit manifested in the literature and culture of ancient Greece and Rome and its guidance for life to-day. Whatever may have been the true source of Greek thought and discussion, whether intuitive or acquired, our own intellectual culture is unquestionably of Greek origin. While Latin was first taught as a medium of expression, and for use in the needs of life, Greek was studied for the knowledge to be gained through it. We do not hesitate to pay tribute to the brilliant genius of Ionian philosophy, the careful work of Hippocrates and his school, and the richness of the Alexandrian epoch. In the teaching of the Ionian school it is possible to find, as Prof. Gomperz has pointed out, two of the corner-stones of modern chemistry—the existence of elements and the conception of a single fundamental or primordial matter as the source of material diversity. Advanced views relating to the shapes and motions of bodies in the solar system were held at a very early date in Greek

history (though they were afterwards superseded by childish ideas), and the first phase of the history of thought upon organic evolution began with early Greek philosophers in the seventh century before the opening of our era, while its effects on Christian theology and Arabic philosophy were felt for more than two thousand years. Acquaintance with these and other achievements of Greek genius should be part of the intellectual equipment of every educated man, and the science student can find even more to admire in that wonderful age than can the purely literary scholar.

While, however, we hold the philosophers of Greek antiquity in highest honour, it must be confessed that the whole of Greek natural knowledge has little bearing upon the principles, methods, and practice of modern science. Scarcely a scientific work of to-day contains a reference to contributions to the subject by Greek philosophers, and their guesses or observations may be said to be disregarded by scientific discoverers generally. While the mathematician esteems the achievement of Euclid and the investigations of Archimedes, and the physician finds much to admire in the works attributed to Hippocrates, the chemist and experimental biologist are disposed to regard Greek speculation on their respective subjects as fruitless. Indeed, from the point of view of practical chemistry, it would be more reasonable to study Arabic literature than Greek. The creative genius of the early Greeks is undoubted, but its results are negligible in comparison with the work of modern science.

The value of acquaintance with Greek learning is not in the material knowledge itself, but in the spirit which created it. The Greeks possessed to a high degree the spirit of scientific curiosity and the desire to find a natural explanation for the origin and existence of things which is the ground motive of progress in science. The aim of Greek thought was the unification of disconnected knowledge. This laid the foundation of synthetic science, but carried with it the tendency to reduce natural phenomena to a rigid geometrical or logical system. It is possible that the modern science student would be all the better if given a trend in the same direction, as experimental inquiry alone is apt to be narrow and must be specialised. Even neglecting this philosophical aspect of science, the early Greeks manifested supremely the characteristics of true apostles of science. Passionate regard for truth, disinterested research, imagination, acute reasoning, and creative intelligence were the essence of the Greek spirit, and they are elements of the unalterable germ-plasm which transmits the scientific temper throughout the ages. Because inspiration and constructive thought are necessary to the student of natural knowledge, the writings of Greek philosophers cannot be neglected by him without detriment to his intellectual equipment.

It is the human side of Greek thought and action that the science student should know, and the scientific facts themselves are ancillary to it as a means of training. Science as studied in most schools is a spiritless performance and has not that contact with human nature required to make it appeal to most pupils. Attention to the history of great scientific discoveries may perhaps tend to counteract the conception of science as a mere repository of facts and a vocational study. Greek philosophy can usefully take an important place in such a course, but consideration must be given to the most appropriate stage at which to introduce it. It is now generally agreed that there should be no specialisation of studies below the age of about sixteen years, so that up to this stage all students should have formed the same foundations of a general education, including both the literary and the scientific elements. If the preliminary training thus received in classics enabled an average pupil to read original Greek texts by sixteen years of age, the value of this attainment to the student who then proposes to devote himself mainly to science cannot be doubted. As, however, such proficiency is rare, it would appear that the case for the teaching of Greek or Latin holds chiefly for those who propose to continue the study to an advanced stage, and that for students who propose to specialise in other directions preliminary instruction which is necessarily truncated serves no very useful purpose.

A subject of study should be considered as an instrument of service—mentally, morally, and materially—as a working part of the machinery of life. If the preliminary training in classics cannot reach this stage of attainment for science students, then obviously it would be better to absorb the spirit of Greece through translations than to spend time at what must prove a vain study so far as reading original texts with intelligence is concerned. No student who proposes to devote himself to science could hope to render Aristotle into English in the style of the translation now being published by the Clarendon Press under the editorship of Mr. W. D. Ross, or of Sir Arthur Hort's translation of the "Enquiry into Plants" from the Greek of Theophrastus published in the Loeb Classical Library, to mention two instances only. Whatever may be urged as to the value of the study of the classics to science students must refer chiefly to the substance of the best works in these languages, and that can be gained from translations.

Acquaintance with the Greek spirit through such means is much needed in science teaching when the age is reached at which a student can appreciate the systematising aspects of science. Early interest in science comes through wonder and delight in the intrinsic beauty and charm of natural phenomena, and is followed by interest in the use of the forces of Nature by man. With adolescence comes the power of appreciating systems of theoretical completeness and unity, and it is then that attention may usefully be turned to the thoughts of Greek philosophers. Young pupils are very rarely impressed by unifying principles and philosophical speculations whether placed before them in Greek or their own language. Their work in science is thus almost necessarily limited to acquaintance with perceptual phenomena, and conceptual ideas make little appeal to them. Similarly in historical studies striking episodes and dramatic events are more easily intelligible to immature minds than the constitutional or other causes which produce them. Probably a grammatical generalisation is more readily understood than a principle derived from laboratory measurements, and on that account pupils who have been trained to apply scientific method to language may be better prepared to take up the study of science seriously than one in whose mind there is nothing but loose ends. Whether Greek and Latin are essentially the most suitable languages for promoting this sense of law and order, as well as facility in the art of expression, is a matter of opinion. There may on these grounds be a value in preliminary training in classics to students who propose to devote themselves mainly to scientific pursuits, but there is so much in Greek science and philosophy that cannot be understood without acquaintance with natural knowledge that an even stronger plea can be made for training in science for those who intend to give their chief attention to classical studies.

The Hormone Theory of Heredity.

Hormones and Heredity: A Discussion of the Evolution of Adaptations and the Evolution of Species. By Dr. J. T. Cunningham. Pp. xx + 246 + 3 plates. (London: Constable and Co., Ltd., 1921.) 24*s*.

IT would be no exaggeration to say that holes could be picked in any theory of heredity as yet put forward. The problem is one of great difficulty and complexity, and when we think of the enormous number of qualities or "factors" conveyed in the minute space of an ovum, or still more in a single sperm-cell, it seems at first sight impossible to believe that all these qualities are "represented," rather than that the presence of certain of them, which might be called "key-factors," imply the development of numerous others. But, however this may be, the thought suggests itself that perhaps the knowledge we possess of the nature of protoplasmic structure and function is not yet sufficiently advanced to warrant the statement of any theory professing to be adequate. We are, indeed, in some doubt even with respect to certain fundamental facts. As will have been clear to readers of the correspondence in these columns, in which Sir Archdall Reid and others have taken part, the actual meaning of many of the terms used is in dispute.

It may be of use to attempt to express in a few words the main question at issue without using language of uncertain connotation. Suppose, then, that an organism is exposed to a new set of external conditions. Some forces or influences acting upon it are changed, and the effects produced in the organism, which we call its "reactions," are not the same as before. These reactions are, of course, conditioned by the nature of the organism itself, and may or may not be of such a kind as to be of benefit to it in adjustment to the new state of affairs. If they are so, they are sometimes called "adaptations." But this term is apt to suggest to certain minds a species of directing agency, and is best avoided. In any case, the length of life of such an organism will be dependent on its response to the changed conditions. Those organisms with the longer life naturally leave more offspring, which will be more like their parents than like the offspring of parents which have responded less favourably to the change in environment. The first-mentioned offspring will, therefore, respond to this changed environment in the same way as did their parents, and probably some of them, owing to the random shuffling of the material of the germ-cells, more favourably.

It will be seen that we are not justified in speaking of such a case as one of "inheritance of acquired characters." If the response in question were continued in the offspring after the altered environment had returned to its original or some other state, an alteration in the "germ-plasm" might be supposed to have been produced. But some difficulty arises here in respect of cases in which it appears that a change may be persistent for a few generations and that then reversion to the original mode may occur. Are such cases to be regarded as changes brought about in the germ-plasm? We note how difficult investigation is made by the length of time needed for the tests. Many researches are in progress at the present time, and