

SCIENCE

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SCIENCE AND CULTURE.*

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

It is with peculiar pleasure that I stand before this new department of Natural Science Instruction, and I deem it a great honor that you have asked me to preside over its deliberations. It is an important sign of the times that such a department as this should have been organized by the scientific men of the country. It is significant of a broader view of the work of scientific men that we find so many here to-day to take part in the first meeting of a department which has for its object the discussion of questions pertaining to the teaching of science. I am assured that the movement which culminates in our gathering to-day is timely, and that it is but the visible expression of the feeling which has been steadily growing among scientific workers that the time is near at hand for a restatement as to the place of science in the education of a man. I congratulate you that you are among those who are to take part in this movement, and I trust that great good will result from your efforts.

With your permission, I wish now to bring before you, at the opening of this department, a few suggestions which may serve to give direction to your work.

It is not so long ago but that many of us have personal knowledge of the insignifi-

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cant place accorded to natural science in the schools from the primary grades to the college. Afterwards there came a period of conflict between the advocates of science, on the one hand, and of the old culture-studies, on the other. In the controversy much was said which should have remained unsaid, and many arguments were brought forward which have long since been abandoned by both sides.

Thus, in urging the introduction of science into the schools, much was said regarding its usefulness, as in farming, in manufacturing and in commerce. The usefulness of science in everyday life was brought forward as one of the strongest arguments for its introduction in the course of study in school and college. This was so emphasized as to lead some to hold forth the money-getting value of science as contrasted with the culture-value of the older studies. Thus there arose in the popular mind the notion that while science is more 'practical,' and while it may fit a man to earn a livelihood, it is lacking in culture-value. The notion has been fostered by the fact that in the building of technical schools science has been given a large place. In fact, these schools are very commonly called scientific schools and colleges. When the educational world, during the latter half of the present century, saw the rise of engineering and mechanical schools, in which chemistry and physics were given great prominence; of agricultural colleges, in which botany, zoology and chemistry occupied the greater part of the student's time; of schools of horticulture, schools of dairying, sugar schools, etc., in all of which one or more of the great modern sciences occupy prominent place, what wonder that science seemed to be merely a servant to minister to man's material interests! What wonder, too, that some men, dazzled and bewildered by the splendid achievements of science in many fields of

human industry, became materialistic and set up science as their educational goddess! In this period we heard much of the 'new education,' and too often by this term was meant little more than is included in mere trade schools. The 'new education,' while ostensibly an education in which science replaced the language and literature of the older curriculum, very commonly included merely such sciences as were of immediate use in a particular industry, and too often only those portions of these selected sciences which were most directly 'practical.' To make the matter worse, the graduates of schools with such a curriculum were called Bachelors of Science. What wonder that some men looked askance at scientific courses of study! What wonder that college men, who had been accustomed to think of the culture-value rather than the money-value of the studies in the college curriculum should hold aloof from close association with such science!

Against such merely utilitarian views as to the place of science there have been strong protests during all this period of educational unrest, but these have been little heeded. Gradually, however, with the increased introduction of science-study in the schools and colleges, doubts have arisen as to the soundness of the utilitarian view. The question is often asked whether science is 'useful' merely in the lower sense of contributing to man's material advancement. Our thoughtful students and teachers are asking whether science may not be pursued with profit by those who will not 'apply' it in some industrial pursuit. May a man profitably give prolonged attention to chemistry who does not propose to be a manufacturing chemist, an assayer or a maker of drugs? Is it a profitable use of the time of the college student to give years of study to the lower forms of vegetation, unless he hopes to become the botanist of some experiment station, or

expert bacteriologist of a cheese factory or brewery? In other words is there a culture-value in these studies? May a man profitably pursue science for its culture-value, as one pursues the classics, literature, history and mathematics? Is a man made a better man, not merely a more efficient money-making machine, by the study of science? These questions are now being asked by teachers and students, and it is to help answer these that this department has been organized.

The making of a man to-day is a complex undertaking. Life is too short and knowledge too vast for us to think of furnishing a man with mere knowledge. No man can hope to master all knowledge. No man can hope to master all the details involved in the life of the community in which he lives, much less those of the civilized world. In the making of a man in primitive communities, little more was necessary than skill in hunting and fighting, with a few arts, all of which could be easily acquired by a few years of practice under the guidance of his elders. To-day in the making of a man we must develop the almost primitive child, with his limited horizon of knowledge and philosophy, into an alert, quick, accurate being, able to comprehend and classify the multitudes of facts, and to grasp and solve the many problems with which modern life is filled. We realize to-day that in making a man we must train him. We can no longer hope to acquaint him with all facts, but we may prepare him to classify and arrange them. And here perhaps is the best test of good training, of what we call culture; it is the ability to accurately classify. That culture is best which so prepares a man that whatever fact presents itself to him he will be able to arrange it accurately with reference to others. This ability to classify facts is of far more importance than the mere acquaintance with facts, however extended the latter may be.

May science help in such training as this? Can it contribute to culture? Must we still rely for culture upon the old studies only, or may we look to science for help? The answer to these inquiries should not be hard to give. In spite of the fact that science has been so badly treated, in spite of the fact that for so long its culture-value has been little esteemed, I venture to say that when properly presented it will stand second to no other subject.

In the first place, it must be clearly understood that nothing here said implies the substitution of the culture given by science-study for that given by the classics, literature, history, mathematics, etc. We cannot spare that culture from modern life. But we need in addition the special culture given by science. The culture given by science must be supplementary to, and not substituted for, the culture with which we have long been familiar.

Let the teacher of science make use of it as a means of culture for students. Let teachers set forth the culture-value of science study. Let us hear less in the schools of the practical value of science. Let us emphasize its vastly greater importance in the making of men. We are already familiar with some of the direct culture results; thus we know that through science-study quickness and accuracy of observation are developed, and both eye and hand are trained to be the ready servants of the alert mind. In the pursuit of the higher lines of science, the mind is trained to accurate generalization from secure data and to an indefinite suspension of judgment in the absence of sufficient evidence. The proper pursuit of science should develop a judicial state of mind toward all problems.

Indirectly the pursuit of science leads to a higher appreciation of Nature. As a man understands the meaning of the natural world his appreciation of its beauty and

grandeur is increased. He is then led to entertain broader views of Nature and to see more clearly the relations of part to part. Finally he is led to a proper appreciation of his place in nature; possibly he is humbled by the certainty of his individual insignificance in the vast organism, but he is strengthened by the equal certainty that in his race he is the inheritor of all that makes for progress and advancement.

Men of this department of Natural Science Instruction, shall we not make of science a help to higher culture, rather than an aid to more material success? Let us give it wings, so that it may carry our pupils above mere earthly things, and not doom it to do no more than turn our spindles, haul our goods and coin our money. While we rejoice in these material achievements of science, let us bear in mind that these are not of supreme importance. When we stand by the mighty Niagara we realize that it has an infinitely higher significance for man than the mere turning of wheels. Just as the solemn flood of water speaks to and stirs man's deeper thoughts, and makes him forget the wheel-turning power of the rushing torrent, so the profound contemplation of nature through enlightened and untrammelled science leads him away from sordid things up to the higher planes of thought and experience.

CHAS. E. BESSEY.

THE HUMANISTIC ELEMENT IN SCIENCE.*

THE time has happily passed when the rival supporters of literary studies on the one hand and of scientific studies on the other slept on their arms or engaged in open combat. Both sides were intent on victory, with no disposition to give quarter or to concede that the truth might not all be on one side. But when opponents have come to know each other better they not

infrequently abide by at least a tacit agreement to live as friends. We have now arrived at such a stage in educational history and practice. An occasional note of discord still comes from the few who refuse to be reconstructed; but the prominent figures in the old conflict are fast passing over to the majority, and the new generation is born with a more pacific spirit. The pursuits of peace are more liberalizing than the devastations of war. Hence the origin at first of a spirit of toleration, and then of equality and fraternity. It is now time to inquire about a common ancestry and community of aims and interests. The spirit of the times does not sanction narrow bigotry or unseemly dissension. Educational intolerance is now as much an anachronism as religious intolerance or martyrdom for conscience. It has come to be recognized that no one system of theology contains all the truth, and no one branch of human learning is the sole instrument of culture, nor does it possess the exclusive capacity of imparting power.

At the time of the revival of learning in the Middle Ages the apostles of the Renaissance, who introduced the study of classical literature, were called humanists. Hence humanism has often been called 'the culture derived from classical training.' But more broadly, humanism is a system of thought in which the human element or interest predominates. The humanities therefore include much more than classical language and literature. They stand for philology, poetry, rhetoric, grammar and archæology, as well as for the Greek and Roman classics. Philological studies, says G. P. Marsh, "were called *literæ humaniores*, the humanities, by way of opposition to the *literæ divinæ*, or divinity, the two studies, philology and theology, then completing the circle of scholastic knowledge, which, at the period of the introduction of the phrase, scarcely included any branch of

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