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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE[1]

THE INTELLECTUAL WORKER

IN an address delivered in New York on December 1, 1925, at the annual meeting of the American Society of Mechanical Engineers, Secretary Hoover deplored the backward state of research in pure science in this country and made an earnest plea for greater financial encouragement of that important form of intellectual activity.

It is unfortunately true [he said] that we can claim no such rank in pure science research as that which we enjoy in the field of industrial research. . . . A list of the awards of the Nobel prizes to men of various nationalities reveals the small proportion of first minds that we support. . . . We have in recent years developed our industrial research upon a scale hitherto unparalleled in history. We have an increase in some ten years from one hundred to over five hundred laboratories engaged upon research for applications of known scientific fact and law. These results have been magnificent. But all these applied science laboratories are dependent upon the raw material which flows from the laboratories and men engaged in pure science, and the industrial investigators are the first to demand more support to pure science. . . . The sudden growth of industrial laboratories has in itself endangered pure science research by drafting the personnel of pure science into their ranks, depleting at the same time not only our fundamental research staff, but also our university faculties, and thus to some degree drying the stream of creative men at the source. Compared with other expenditures of far less importance to human welfare, the amount of money annually devoted in the United States to the aid of investigators and investigation is absurdly small. It is less than one tenth what we spend for cosmetics.

Secretary Hoover might well have extended his criticism and comparisons, had the occasion been appropriate, to other fields than that commonly designated by the term science. The fields of history, economics, political science, jurisprudence and philosophy, in all of which the accepted principles of scientific method more or less apply, show an equal paucity of work of high and fundamental character. The average dissertation which is accepted by American universities in history, economics or political science as a part of the requirements for the degree of doctor of philosophy is often appreciably below

[1] Papers presented at a general session of the association at Kansas City, on December 31, organized under the auspices of the committee of one hundred on scientific research.

the average in quality of the theses presented for higher degrees in Europe, and the study of jurisprudence, as distinct from the technical study leading to the practice of law, may fairly be described as in a deplorable state. We have, in short, a general problem of the recognition and encouragement of intellectual work and the intellectual worker quite distinct from that of the recognition or encouragement of practice and the practitioner, and Secretary Hoover's observations on the needs of pure science research apply with equal force to intellectual work in general.

It is not easy to define with entire precision an intellectual worker. We have, it is to be hoped, passed the time when a hard-and-fast distinction could be attempted between work of the hands and work of the brain as forms of human effort separated by an impassable gulf. The elements of a definition at least, however, may be found in the more or less obvious distinction to be recognized between work which, while by no means dispensing with intelligence or education, is seen to consist mainly in the routine expenditure of physical effort or time, and work in which physical effort or time is incidental to the demonstration of intellectual ability and training. To work of the former class we commonly apply quantitative standards in determining such practical matters as compensation or the value of the product, whereas in appraising work of the latter class we commonly take account primarily of the intellectual quality of the performance. A factory operative, for example, needs a certain intellectual equipment to tend a machine or assist in this or that process, but the intellectual equipment is small, it tends to diminish as mechanical processes become automatic, and the reward of performance is based upon the time spent or the quantity of product turned out. The locomotive engineer requires a higher degree of mind and education than most factory operatives or coal miners need possess, but in his case, too, the necessary training is easily acquired, and the other qualities that count most are limited to suitable physique, experience in performing a few simple and routine operations, acquaintance with a small body of formal regulations, and steady nerves. The time and physical effort expended by an editor or a university professor, on the other hand, in the performance of his routine duties is purely incidental, a sort of unavoidable recognition of the obligations of time and space, and what counts is his intellectual fitness for his task. No editor is paid on the basis of the amount of copy he turns out, or the time and physical effort spent in scanning exchanges or wielding the blue pencil, and no professor's salary is scaled by the number of hours spent in the lecture-room or laboratory or the number of students whose work he supervises. The basis of remuneration in each case is the assumed intellectual ability of the worker to do his particular job.

An application of this element of definition to the problem of determining who are and who are not entitled to be classed as intellectual workers gives us a number of groups, in some of which the intellectual character of the occupation is obvious, while in others the factors of time or practical performance seem almost equally important with that of intellectual ability, and still others are on the border line. The research workers in pure science may be taken as a type of those intellectual workers with whom neither time spent, nor product turned out, nor routine duties performed determine their status or their compensation. With them may perhaps be grouped the administrators of business, the heads of educational or scientific institutions, and writers in various lines. Most professions, on the other hand, show an inseparable union of practice and intellectual content, both of which enter into the calculation in determining the worker's compensation. The intellectual equipment, in ability and training, of the engineer, for instance, is exacting and tends to become more so, but the possession of the equipment is commonly shown in material performance of many and diverse kinds, and it is for the performance, with the presupposed ability to do what is done, that payment is commonly made.

The case of the teacher, whatever his field or the grade of his work, offers an interesting illustration of an intellectual worker of composite status. No one will question that intellectual ability as well as intellectual training are necessities of a successful teacher, but it can not be said that the demands in those directions in American public schools are more than moderate, and the intellectual demands of most college and university teaching are far from high. What distinguishes teaching from other forms of intellectual work, however, is the fact that it tends everywhere to become, save in rare instances, a matter of routine in content as well as in method. Its gradations and compensation are almost everywhere determined by length of service rather than by intellectual ability. Where the tangible is magnified, the intangible tends to recede. It is unhappily possible, in most American colleges or universities, for a professor who has once taken the trouble to master the material of his courses, and who has learned by experience the routine which unfolds with the passing of the academic year, to continue indefinitely as a professor in good standing without adding materially to his knowledge or his intellectual power. What is

true of the college or university professor is still more true of the teacher in the secondary school.

It is not necessary, in other words, that intellectual work shall be of a high character in order to be classed as intellectual. All that is necessary is that the intellectual element in the work shall predominate over what is physical and routine. Tested by this standard the teacher, for example, is certainly an intellectual worker, but he is in most cases an intellectual worker of relatively low grade.

Close to the bottom of the scale, judged by the relative importance of the intellectual factor, we find the varied branches of the "white collar" fraternity who fill the clerical occupations. Salesmanship and accounting, the clerical side of a government civil service, and all the wide range of occupations which involve the keeping of records or giving form to written or printed material, are assuredly intellectual work, each with its special requirements of intellectual equipment. Into the same general category, and entitled to various ratings on the scale of importance, fall musicians and artists, playwrights and actors, reporters and advertising writers, architects, pilots and many classes of foremen or superintendents. The line of demarcation, if it is to be drawn at all, must apparently be drawn at individual or group occupations as determined roughly by the prevailing character of the work done. If the intellectual qualifications are slight and the work essentially routine, the worker may best be classified as a manual worker of a different, but not necessarily higher, grade than one who handles tools or machines. Where, on the other hand, the intellectual qualifications are more considerable, or where increased knowledge or ability, as distinct from mere continued performance, opens the way to weightier responsibility and increased compensation, the work may properly be regarded as intellectual notwithstanding its limited range. The admission of "white collar" workers to trade union organizations is perhaps to be regarded as a recognition of a composite status, either side of which may be emphasized without thereby ignoring the other.

The statistical data are unsatisfactory, but if so-called clerical occupations be included, the aggregate number of persons in the United States engaged in intellectual work of all kinds, on the basis of the census of 1920, would seem to be approximately one fifth of all persons classified by the census as "gainfully employed." Substantially the same proportions appear to hold for many European countries.

What, now, is the present economic status, and what are the apparent prospects, of intellectual work in this country? Reference has been made to compensation. It is true that man does not live by bread alone, but he can not well live without it, and for most practical purposes what the community pays for work of any kind, whether directly in wages, salaries or fees, or indirectly in the provision of facilities or opportunities, affords a pretty accurate indication of the esteem in which the work is held.

At this point generalizations based upon statistical averages must be used with caution. Intellectual work, leaving aside the clerical or other occupations which may perhaps be regarded as on the border line, appears to be too varied to admit of saying positively that it is as a whole either over or under paid. With such wide diversity as exists between the surgeon who receives a thousand dollars for a single operation, a lawyer who asks a thousand dollars for every day spent in court, or a popular author who is paid forty or fifty thousand dollars in royalties for a single book, and professors who scramble eagerly for chairs with a beggarly stipend of two thousand or less a year, the law of averages does not hold. It is safer to deal with specific groups.

In law and medicine, where professional solidarity is highly developed and a legal monopoly of practice is accorded by the state, custom and professional ethics may sanction a uniform scale of minimum charges for specified services, with higher fees based upon the reputation of the practitioner, or the money value involved in the case, or the real or supposed ability of the client to pay; but even here, in spite of the very large rewards obtained in a few instances and of utterly extravagant rewards occasionally demanded in others, the average annual earnings in the profession as a whole are probably less than those of certain skilled manual workers. Substantially similar conditions appear to obtain among architects and engineers, or the tendency at least is in that direction. The average annual earnings of clergymen and professors are notoriously low, not seldom lower than a decent standard of living requires, and many writers, artists, musicians and actors are unable, with long hours and hard work, to earn as much in a year as a metropolitan city pays to its firemen and policemen. Most learned books do not sell enough copies to much more than repay the costs of publication and distribution, and the royalties would hardly keep the learned author in jeans. Very few scientific journals are able to pay their contributors, and most of them could not exist at all without some form of subsidy.

Certain other conditions characteristic of the field as a whole invite comment and reflection. The exceptionally large rewards occasionally reaped by exceptionally gifted or peculiarly fortunate intellectual workers appear to have little, if any, effect in raising the rewards of the great mass of the less gifted or less fortunate. For the vast majority of intellectual workers the money reward is extremely small,

the lower levels being occupied by clergymen, reporters and space-writers for daily newspapers, and college or university teachers below the higher professorial grades. The increase in salaries or other regular forms of compensation during the past two decades appears to have been much less, both absolutely and proportionately, than the increase in wages accorded to both skilled and unskilled manual workers. If the cost of living, as determined by index figures or statistical averages, be taken as a standard, it is probably true that the economic position of the great majority of intellectual workers in this country is appreciably worse to-day than it was before the World War, and this notwithstanding an increase in national wealth which has made the United States the wonder of the world. An exception is perhaps to be found among public school teachers, whose salaries, at least in the larger city systems, have shown substantial gains over living costs.

Evidences of the disastrous effects of an absurdly low level of compensation for intellectual work are to be seen on every hand in the changing character of the intellectual personnel and of the work actually performed. It is not to our credit as a nation that the intellectual quality of the clergy and the university professoriate should be undergoing a progressive deterioration, that the lure of better-paid applied science should draw young men from the less well-paid work of research, or that the higher forms of creative or critical work in literature, history, economics or jurisprudence should languish because of limited opportunities for remunerative publication. No one, it is to be hoped, will be so foolish as to imagine that a mere increase in money reward, however considerable, would of itself be sufficient to better the situation, and there are doubtless a good many intellectual workers in routine occupations who are paid even now more than they are worth, but unless the material rewards of intellectual effort and accomplishment bear a more rational relation to the social value of the service than they do in the great majority of cases now, we have nothing to look forward to but a continuing decline in the quality of our national culture and increased popular contentment with an existence whose chief virtue is its mechanical efficiency.

The supreme test of the intellectual life of a community is the importance which it attaches to research and creative intellectual effort. Unless research, in whatever field it may be carried on, is held in high esteem, with adequate facilities for its maintenance and adequate rewards for the men and women who devote themselves to it, the development of applied science in all its forms will eventually be checked. Sooner or later, unless research continues, we shall reach the end of the things that are known, and then progress will cease. What is true of research is true of creative intellectual performance: it must be magnified or intellectual life will decline. What can be done to avert such a calamity, and to give to research and intellectual creation the place of honor which they ought to hold in our intellectual and social life? I venture to offer one or two practical suggestions.

The first is the cultivation of a more effective spirit of solidarity among intellectual workers as a whole. Within the ranks of certain professions, notably law and medicine and increasingly among the various classes of engineers, professional solidarity is already more or less highly developed, and the weight of professional standards and professional influence is likely to be thrown in support of individual members of the profession in their practice as well as in support of undertakings important for the profession as a whole. Something akin to a trade union movement has already shown itself among public school teachers, architects and civil servants in this country, and among journalists, lawyers' clerks, scientists and authors in Great Britain and a number of continental countries. Whether or not a trade union organization of intellectual workers is desirable or feasible is, of course, an open question. What is both desirable and feasible, however, is a wider recognition of unity of spirit and aim. Problems and methods differ with subject-matter, but the temper which supports and honors research in one field contributes, directly or indirectly, to its advancement in others. The physician is neither a chemist nor a physicist, but he is as independent upon the discoveries of the chemist or the physicist for the successful treatment of disease or injury as he is upon the manufacturer who prepares his remedies or the artisan who fashions his appliances. Nearly or remotely, what concerns one concerns all, and if the legitimate needs of any one class of intellectual workers were assured of active moral support in every other class, less complaint would be heard that the needs were not met.

In the second place, we can insist that the line be drawn—much more clearly than it is commonly drawn at present—between teaching and research in universities and special schools. Taken as a whole, the existing situation at this point is chaotic. Scholars who might add materially to the sum of knowledge if they were given a fair chance, and whose obvious place is in the laboratory or the library, are spending the larger part of their time and energy in teaching undergraduates; professors whose forte is teaching are going half-heartedly through the forms of research; courses of study ostensibly designed for graduate students are open also to undergraduates, often with the result of meeting the needs of neither class; and students whose mental development will

never pass beyond the assumed level of junior or senior year are encouraged to seek a doctorate in science or philosophy. It is time that such disorder were ended. Systematic teaching is not research, neither is it creative intellectual effort, and the type of mind that excels in the one is rarely found excelling in the other. It is not so much a question of higher or lower, as it is a question of difference, and a clear recognition of the difference by university faculties and governing boards would go a long way toward giving to American university life an intellectual character which it now too often lacks.

A final suggestion is drawn from the point stressed by Secretary Hoover in the address already referred to. We need a far more ample endowment of independent and unfettered intellectual work of every kind. We still lack an adequate provision of research laboratories and libraries, research professorships, fellowships and other foundations, and avenues of publication of the fruits of original and independent investigation or thought. We need these things, both within and without the university. The low level of intellectual interest which obtains in most American universities is not likely to be raised by increasing the endowments for undergraduate purposes. The level will be raised only by establishing pure learning upon a firm and ample basis, and conceding its primacy among all the things for which a university exists. There is equal need of independent foundations, dissociated from any university, national in scope and unhampered by ancestral or geographical obligations. We might have had the needed endowments long ago if intellectual workers, recognizing their solidarity, had unitedly asked for them; we can have them now whenever the workers are prepared to use them and ask for them with common voice.

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PROBLEMS OF A SCIENTIFIC INVESTIGATOR

AT no time in the history of civilized countries has there been so much time and money spent on scientific research as now. Governments are maintaining an army of men and women who are delving into every phase of our economic and social life, opening doors to new avenues of development and endeavor. Our great corporations are equipping laboratories and employing specialists to study the problems with which they are confronted and blaze the trails along which they can reasonably expect to press on to the accomplishment of greater things in increasing their winning capacity and in enlarging their fields of operation. Scientific societies are husbanding their resources that they may add to the world's knowledge and the world's power by turning their searchlights upon the clouds of superstition and ignorance that still hover about men. All this augurs well for the future; and if undue pressure is not brought to bear upon these research workers to make their results count in certain special directions and they are not unduly pressed for time, conclusions will be reached that will not only aid in the development of our national resources but will solve many of our social and economic problems and enhance the peace and happiness of the world.

The great publicity given recently to the exploiting of Tutankhamen's tomb in Egypt and the rifling of the dinosaur nests in the Gobi desert have awakened a general popular interest in archeological investigations to such an extent that nearly everybody in our part of the country is hunting for a buried city, a lost mine or a hidden treasure. To capitalize this awakened interest and secure therefrom results that shall be permanent and worthwhile is the task of the biologists and anthropologists of to-day. But to meet the popular demand for sensations and avoid wasting precious time, energy and money is no easy accomplishment in these days of Sunday sheets and sensational scientific exaggeration. Research workers are in great danger of giving this popular demand for something striking, something unusual, too much heed. It is a great temptation to shake one's plumage and cluck instead of sitting on the nest till the eggs are hatched, and we may be able to determine with some degree of accuracy the character of the offspring.

If we would dignify our profession and make permanent results the goal to be attained, we can not afford to fan the sensational flame. The modern craze for advertising is making us forget professional ethics and personal justice. A short time ago an investigator sent some rubbings of a few Hebrew inscriptions found on some lead crosses and swords near Tucson to a celebrated Hebrew scholar in one of our large educational institutions and asked for an interpretation of their significance. He received a courteous letter in reply, stating that he could translate nearly all the inscriptions and requesting that full information regarding the articles and full text of all Latin inscriptions and other symbols be sent him and that he be permitted to prepare a paper for some scientific society on the finds; but the letter contained no translations of Hebrew symbols. A few years ago an archeological worker spent an entire summer of great hardship in a remote region of northern Arizona and was fortunate enough to find several large cliff pueblos before unknown. A brief account appeared in the local papers. Forthwith an official archeologist made a hurried trip to the region,