

NATURE

No. 3905 SATURDAY, SEPTEMBER 2, 1944 Vol. 154

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SCIENTIFIC AND INDUSTRIAL RESEARCH.—II

WE have already noted that one of the first problems in the development of an adequate strategy of research is the re-examination of our whole educational system with respect to the provision of adequately trained and broadly educated workers for scientific research, and the balancing of the immense needs for technical and scientific training by competent education in the liberal arts and humane studies. This involves not merely an adequate supply of competent investigators, but also of those capable of directing research effectively, as well as of the laboratory technicians necessary for the efficient use of the fully trained research worker. Again, since both the support of research in the first instance, and the utilization of its results afterwards, involve some understanding by the community generally of the value and significance of scientific research, we are concerned also with the general education of the community and not merely with education at the university level.

This point has not yet been as fully appreciated by scientific workers as is desirable, despite the attention which has been focused on education in general by the Government White Paper on Educational Reconstruction, the debates leading up to the new Education Act, and the recent series of reports such as the McNair Report on Teachers and Youth Leaders, the Norwood Report on Curriculum and Examinations in Secondary Schools and the still more recent Fleming Report on the Public Schools and the General Educational System. This neglect is the more important as the attention given to scientific and technical training in the Government's own White Paper and the Norwood Report, to say the least, can scarcely be regarded as adequate. To some extent this has been corrected in the Statements issued by Nuffield College on "Industry and Education" and on "Problems of Scientific and Industrial Research", the latter of which reiterates that the foundations for a sound and scientifically minded industry must be laid in the schools by good grounding in mathematics and in the principles and methods of science, coupled with a thorough mastery of the English language and a broad cultural approach to all subjects. "We live in a world in which science lies at the very roots of community, and a mastery of scientific thinking grows more and more indispensable for the successful practice of the arts of life. The culture of the modern age, if it is to have any meaning, must be deeply imbued with scientific ways of thought."

Strong support for this point of view can be found in the report of the Chemistry Education Advisory Board on the Education and Training of Chemists, and in the report of the Federation of British Industries Committee on Industry and Education, but it is one that will demand the sustained support of scientific workers if it is to be achieved in practice. None the less, it is to the universities that we may well direct our attention in the first instance. Their place in the strategy of research, as the main source

Editorial and Publishing Offices

MACMILLAN & CO., LTD.,

ST. MARTIN'S STREET, LONDON, W.C.2.

Telephone Number: Whitehall 8831

Telegrams: Phusis Lesquare London

Advertisements should be addressed to

T. G. Scott & Son, Ltd., Talbot House, 9 Arundel Street, London, W.C.2

Telephone: Temple Bar 1942

The annual subscription rate is £4 10 0, payable in advance, Inland or Abroad.

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of supply, both direct and indirect, of the type of personnel required, is unique and unchallengeable. It is this position that must be considered before we consider the further question of their place in, or relation to, whatever organization of research may be desirable to implement our strategy.

Attention has been directed to the universities as a source of supply for the research workers required in industry and elsewhere in several reports. While in most of these papers and reports the short-range and long-range problems are clearly distinguished, the more fundamental problems involved have seldom been discussed. The universities are social institutions, just as research from one point of view is a social process, and any scheme of university expansion with its concomitant calls for larger endowment must make plain to the ordinary citizen what social purposes such expansion will serve. That presupposes a re-examination of the fundamental questions of the functions of the universities and their place in the society of to-day. As Rashdell has pointed out, new needs must be met by new machinery. University institutions must undergo perpetual modification in the future, as they have undergone perpetual modification in the past.

But Rashdell's further observation in this connexion is worth noting. "It is well," he adds, "in this as in wider fields of social, political and religious organisations, as far as possible to preserve historical continuity." That observation is worth remembering for the help that attention to such historical continuity may give in developing a social philosophy. A false philosophy, as Dr. Conant recently noted, was one of the reasons for the triumph of Nazism in Germany; and the University Grants Committee in its last quinquennial report recognized the special responsibilities of British universities in this field in view of the suppression in European universities of independent thought and critical discussion. The late Prof. J. L. Stocks was even more explicit. "What is wanted," he wrote in an essay "On the Need for a Social Philosophy", "is a philosophic discipline, encouraging and promoting the careful exposition and discussion of the pre-suppositions of social organisation on every side. No such discipline exists in this country at present. Our generation is not being given in these matters the tools necessary for coming to a sound critical judgment, and . . . philosophy alone has the power to give them those tools. When men do not know the faith by which they live, they will be apt inadvertently to betray it."

In the attempt to restate the functions of the universities in the modern world, too little regard has been paid to the experience of the past. That can afford a surer guide to our grand strategy than preoccupation with the minor tactics required to deal with some transient if embarrassingly urgent problem. There could in fact be no finer starting point for the reconsideration of the place of the universities in the society of to-day than Rashdell's study of the medieval universities from which we have already quoted. "The two most essential functions which a true university has to perform and which all universities have more or less discharged amid the widest

possible variety of system and method and organisation . . . are to make possible the life of study, whether for a few years or during a whole career, and to bring together during that period, face to face in living intercourse, teacher and teacher, teacher and student, student and student." Thus Rashdell has crystallized three of the four principles which guided the Association of University Teachers in its approach to university problems as set forth in the report on university developments: the pursuit of knowledge, not controlled or dominated by any private or corporate interest; the dissemination of knowledge and culture; and the communal aspect—universities are schools of communal living, in which the development of students as individuals and their development as social beings are equally important.

Those three principles are more or less explicit in the great bulk of the reports and books or papers that have discussed the problems of university development, whether in regard to research or teaching, in recent years. The fourth principle, that universities are a part of society, both materially and intellectually, and bear a direct responsibility, and must therefore study the application of organized knowledge to practical problems, and train men and women for particular tasks finds almost equally general acceptance.

It is of special interest, to the scientific worker, to note how well these ideas are brought out by Dr. F. R. Leavis in his sketch for an "English School" in "Education and the University". This plea for a liberal or humane school at first appears to be remote from their own concern, but Dr. Leavis has crystallized his objective in words which show unmistakably its relevance. Strongly contesting subjective views, he visualizes a university as a focus of humane consciousness where intelligence, bringing to bear a mature sense of values, applies itself to the problems of civilization. That is the reason for his plea for a school of the humanities. He aims at producing minds that will approach the problems of modern civilization with an understanding of their origins, a maturity of outlook, and a sense of human possibilities, difficult of achievement, that traditional cultures bear witness to and that it would be disastrous to lose sight of for good.

Whatever view we may take of the functions of the universities or of their place in our strategy of research, we cannot ignore their inherent possibilities of leadership. Just as in the field of thought a university stands for adventure, so in regard to society the university plays its greatest part as a stabilizing factor. Sir Walter Raleigh pointed out that a university must be perpetually alert to discard superseded methods and to detect the importance and significance of new studies and new ways of approach, encouraging adventure and giving to each a place in the long line of pioneers who are pushing forward the boundaries and claiming new provinces. While serving as a repository of the reasoning of the ablest minds attracted to it, the university must continue its vital function of checking the dangerous extremes to which all institutions with power are subject, and above all at this time those extreme

tendencies of modern civilization shown in the modern State and in the tyranny of opinion.

But if it is not part of the duty of a university to inculcate any particular philosophy of life, it is, as the University Grants Committee recognized, most assuredly an essential part of its work to assist its students to formulate adequate philosophies of life for themselves. Only so can the universities make their great contribution to meet the danger to which Prof. Stocks directs attention; and there is here a very important practical point to be considered in relation to demands for increasing the range of technological studies at the universities. In a passage that deserves to be noted particularly in regard to the extra-mural activities of the universities and their part in adult education, Rashdell, after a warning not to lose or lower the ideal of the university as the place *par excellence* for professed and properly trained students, not for amateurs or dilettantes or even for the most serious of leisure hour students; for the highest intellectual cultivation, and not merely for elementary instruction or useful knowledge; for the advancement of science, and not merely for its conservation or diffusion; continues with the plea that it is the place "where different branches of knowledge are brought into contact and harmonious combination with one another, and where education and research advance side by side".

Prof. D. W. Bronk pointed out in his paper on the discovery and interpretation of biological phenomena in the symposium on the "Organisation, Direction and Support of Research" arranged by the American Philosophical Society last November that the departmentalism of science has tended to become more restrictive and the boundaries of teaching departments have insensibly created artificial barriers to the free range of inquiry. Questions as to the barriers we have erected around disciplines and departments must be frankly faced in considering the replanning and reorganization of the universities to meet post-war needs. Nowhere will more fundamental thinking be required than at this point and nowhere more than here will the universities need, as has been well said, "official window cleaners whose chief function is perpetually to open windows and let in air—the colder the better".

But there is more involved here than decisions as to how far to retain some of these compartments for administrative convenience or the clear thinking about the impediments they offer to effect research and the limitations they impose on the character of the training we give our future investigators. As already indicated, we have to define the relation of technology to university studies. Technological studies have significance not only in regard to the survival of the nation and the needs of individuals, but also to the advancement and the unity of knowledge itself. In fact, technological requirements are an important factor enforcing the consideration of a new synthesis of scientific effort. Nevertheless, we are, as Mr. P. R. Morris rightly said in a recent lecture to the Royal Society of Arts, "in danger of forgetting, and the present haphazard organization of courses

and studies encourages us to continue to forget, that the differentiation of knowledge into faculties and subjects can easily be regarded as a division of knowledge itself. There is here a fundamental question of principle of the highest importance and also a practical problem of systematisation and organisation".

That fundamental question has to be considered both from the point of view of the universities themselves and from that of their relations with the technical colleges and the place of the latter in the educational system. It is not the only principle which should determine whether or not the technical colleges should be developed into institutions of university rank but independent of the universities, but it is an important factor bearing on our decision. Almost a generation ago, Prof. Arthur Smithells argued powerfully that the isolation of professional or technological studies and their cultivation in separate institutions was fraught with serious dangers and disadvantages, and advocated the embodiment of professional and technical studies in our universities, and for the reason that a wider outlook would be thereby promoted. The Committee on Post-War University Education of the British Association, in its recent report though without reasons given, supports this view and considers that the development of technical colleges into institutions of university rank, but independent of the universities, should not be encouraged. Rather, British colleges carrying out technological work of university standard should be associated with their regional university, as the Imperial College of Science and Technology in London, the Royal Technical College in Glasgow and the College of Technology in Manchester.

From this view Sir Alfred Egerton dissents. He considers it highly important that there should be in Great Britain an institution such as the Imperial College, somewhat similar to the Massachusetts Institute of Technology; there should be one in the south of England, one in the north and one in Scotland, closely associated with the universities, with strong post-graduate schools and providing undergraduate teaching. There have been other powerful pleas for such institutes from the research point of view. But it is important that there should be no confusion with other proposals to advance certain university colleges to full university rank, which is a possibility also contemplated by the British Association Committee. Such proposals obviously are related primarily to the quantitative aspects of university expansion—the size of our university population and the size and number of the universities to cater for it.

These questions have been raised already, notably by Sir Ernest Simon in his pamphlet on the development of British Universities, and by the Association of University Teachers in the report already mentioned, where tentatively it is suggested that a university in Great Britain should range in size from 2,000 to 5,000 students, with residential accommodation for a large number of students. On this basis a national policy would first aim at building up the smaller universities to the optimum size and sub-

sequently at transforming some at least of the university colleges into true independent universities to provide the balance of whatever accommodation may be required to meet the needs of the university population at which it is decided to aim. Some approximate figure must clearly be adopted as target if any real plans for university expansion are to be formulated. That estimate will depend in part only on the demands for research workers and for teachers, for it must be related to the general question of university finance and the distribution of what increased grants may be available, not merely for expansion but also for improving the conditions and standards in existing departments. In fact, until we have attempted to formulate some reasonable estimate as to the student population at which we should aim, whether the pre-war standard of about 50,000, with better selection and higher standards, a twenty per cent increase, the fifty per cent increase suggested by the Association of University Teachers, or a hundred per cent increase, we can scarcely decide on what increase in grants is desirable, and this is a notable omission in the report of the British Association Committee.

It will be recognized, of course, that closer co-operation between the universities, particularly in regard to the development of schools of research and teaching, the elimination of redundancy, and the planning to cover existing gaps may offer some possibilities of economy to offset some of the increase. But whatever the target number we select, we must have regard, first to the principles already adumbrated; second, to the danger of opening the doors too wide and not retaining first-class staff owing to competition; and third, to the capacity of society to utilize the students when qualified. On the second point it may be observed here that the question of status and standards among the university staffs is of first-class importance. Quality must come before quantity and there must at least be that much relation between the financial rewards in a university career, whether of teaching or research, and those elsewhere, to ensure that a due proportion of the ablest minds of each succeeding generation are attracted to such careers. Accordingly no policy of university expansion which neglects to bring such matters as staff salaries and grading, superannuation, and the like, more into keeping with conditions in industry will achieve its purpose. Beyond this, if a university is a free and graded association of free men and women united in a corporate organization to study apart and develop truth, no limits can be set to the institutional forms its activities may take or to the spheres of conduct in which it may fruitfully intervene, other than those which in practice mere prudence will dictate to avoid the unwise diffusion of resources.

The third point requires somewhat fuller consideration. Mannheim has directed attention to the dangers which arise when there are more persons on the intellectual labour market than society as it is requires for carrying out its intellectual work. It is, of course, true that one of the reasons for expanding the universities of Great Britain is that at present industry is making insufficient use of scientific know-

ledge because it does not employ in the right positions a sufficient number of those trained to use such knowledge. It is also true that the demand for such workers has increased and that progressive firms already anticipate a difficulty in finding sufficient recruits of the requisite calibre unless the university schools of research are expanded. None the less, the warning which Mannheim gives of the effect of oversupply on society in the lost social value of the intellectual professions and the belittling by public opinion of cultural and intellectual activity is not one to be disregarded if we hope to plan for a new society and to preserve the essential elements of freedom and culture; and that warning is powerfully enforced by experience in Germany.

What, then, in short should be our basic strategy with regard to the universities and research? First, we must look to them for the supply of the research workers required in all branches of science and for industry, for government institutions and departments, and for fundamental research at the universities themselves. Second, we must look to them ultimately for the supply of leaders in all walks of society competent to apply scientific knowledge to the service of industry or of the nation as a whole. Thirdly, we must look to them to play a vital part in that work of adult education through which alone we can hope for a society in which policies and plans based on scientifically ascertained facts can be assured of reasoned and general support. Finally, these teaching functions must be in balance with the equally vital function of research of extending the bounds of knowledge.

That last task must be considered more fully in connexion with the actual organization of research. It is sufficient to note here that teaching must be in vital touch with research, and that we may have to consider more carefully to what extent the two functions can be combined in the same staff. That there must be the vital contact is not denied, nor the value to the research worker himself of attempting to expound to others the significance of the field in which he is working. What we are concerned with is raising the standard of teaching and with giving to the really great teacher with a genuine talent for exposition and for inspiring others the full scope and encouragement that he deserves. Such teachers are not necessarily great investigators also, and one reason for the inadequate appreciation of science is certainly the failure of scientific workers themselves to accord fitting status and prestige to the great expositor in their ranks. We would do well, as Sir J. J. Thomson urged, to pay far greater regard in our appointments to teaching posts, whether of professors or lectureships, to the powers of the candidates to present a subject in a clear and attractive way.

These relations will demand especial consideration with regard to the social sciences, where university study has important contributions to offer in clarifying the issues involved in many social and economic problems to-day, both in regard to methods and assumptions, and the problem of values and moral issues. Never was it more important that the univer-

sities should be places where thought and disinterested inquiry are pursued on the highest level, and where the best minds of each generation are trained for intellectual achievement. Teaching and research alike in the universities must be pursued in a spirit entirely free from bias, prejudice or preconceived ideas.

The first two tasks, however, must be related quantitatively to some reasonable estimate of the needs of society for university graduates, first in the immediate post-war period, but finally to the long-term needs. That relation should be sufficiently flexible to minimize any over-training likely to hamper transfer or adjustment as the needs of society shift slightly from one field or branch of science. Clearly such flexibility must be had in mind in considering afresh the content of university curricula. Clearly also such quantitative relations involve a much fuller study of the structure of society and of the technique of social adjustment, for which provision also must be made in the organization set up to implement our strategy. Furthermore, limitation of the numbers of students entering the universities presupposes, as the British Association Committee emphasizes in its report, much more care in selection. When the number of places is limited, there can be no longer room except for those possessing the appropriate qualities of ability and character, though originality and creative needs should be our first concern here.

Qualitatively, all these four tasks alike involve loyalty to the conception of the university as a place where teaching and research are linked inseparably, set forth so consistently by Rashdell and by so many of those who have since touched this theme, but by none better than by Haldane: "A place of research, where the new and necessary knowledge is to be developed; a place of training where the exponents of that knowledge—the men who are to seek authority—are to be nurtured, and receive their spiritual baptism. Such a university cannot be dependent in its spirit. It cannot live and thrive under the domination either of the Government or the Church. Freedom and development are the breath of its nostrils, and it can recognize no authority, except that which rests on the right of Truth to command obedience".

Whatever the magnitude or directions which university expansion may take, those ideals must be served, and such service will assuredly demand all the inspiration and vision that the universities' greatest traditions of independent and fearless inquiry and faithful service can supply. In a memorable passage Rashdell described the service the University of Paris rendered in checking in France the dangerous tendencies of the Inquisition in Spain.

"The political position of Paris gave its university a place in the political and ecclesiastical world which no other university has ever occupied . . . a body of educated men, protected by the sanctity of their order against the hand of secular justice, possessing the right of public meeting, of free debate, and of access to the throne. The tendency of a body so situated to become a great organ of public opinion,

a channel through which the Court might address itself to the nation, and the voice of the nation reach the Court, was strengthened by the deliberate policy of the House of Valois".

The point which Rashdell here makes that at a particular crisis in the history of Europe the universities performed the function which is discharged at the present time by the Press, the platform or even by the polling-booths is of wider significance than as illustrating that Rashdell was fully aware of the social functions of the universities. It is even more explicitly shown in his reference to the University of Oxford: "It was not as a great semi-ecclesiastical corporation but as a centre of speculative thought and of religious life, that Oxford contributed to the making of English history. It was through her influence upon the religious life of England that the University of Oxford did at one supreme moment open a new page in the history of England and of the civilized world."

No one can ponder such passages without glimpsing something of the possibilities if the universities recognize the opportunities which confront them and face the task of reconstruction and development in a like spirit. There is need for fundamental thinking, for close analysis and wise organization and marshalling of resources, which however much they are augmented are bound to be limited. But creative thought and wise administration alike will be most fruitful as in loyalty to these ideals and traditions of the past the universities seek to discover the new forms and opportunities of service which are opening before them, and to grasp them surely in ever more active and intimate co-operation with the whole community upon which in part their own spiritual and intellectual effectiveness in enriching the national life depends.

THE APPRECIATION OF SCENERY

The Beauties of Scenery

A Geographical Survey. By Dr. Vaughan Cornish. Pp. 128+16 plates. (London: Frederick Muller, Ltd., 1943.) 6s. net.

THE scientific study of scenery, which owed so much to Sir Archibald Geikie, Lord Avebury, and later to J. E. Marr, has benefited greatly in recent years from the writings of Dr. Vaughan Cornish. He has not only devoted himself to the problems of the preservation of scenery and to the related question of national parks, but has sought also for a new approach to the appreciation of scenery. He has endeavoured to develop an analytic study of beauty in scenery, and in this new book he has sought to provide a manual on this subject, which he hopes may be useful as a basis "for education in scenic amenity in preparation for the re-planning of town and country".

His approach to the scenery of an area is influenced by his geological and geographical interests. Indeed it is certain that any real understanding of scenery must have a geological basis (especially if geology is taken to include physical geography). It may readily be admitted that many have a warm appreciation of the beauties of scenery without such a geological basis; but it can be claimed that some knowledge