3rd May, 1946.

CABINET.

SCIENTIFIC MAN-POWER.

MEMORANDUM BY THE LORD PRESIDENT OF THE COUNCIL.

As my colleagues will remember, I appointed in December 1945 a Committee, under the acting chairmanship of Sir Alan Barlow, with the following terms of reference:

"To consider the policies which should govern the use and development of our scientific man-power and resources during the next ten years.

"To submit an interim report on very broad lines at an early date so as to facilitate forward planning in those fields which are dependent upon the use of scientific man-power.

"At a later date to make recommendations as to the establishment of permanent machinery for carrying out surveys as to the best use of our scientific resources in the national interest."

This Committee have now fulfilled the first part of their terms of reference and I attach a copy of their report on Scientific Man-power problems. As will be seen from the summary of conclusions (paragraph 67 of the report), the Committee find that we are threatened with a very grave shortage of qualified scientists unless urgent steps are taken to double the output of science graduates from the Universities. They accordingly recommend that the Government should sponsor an ambitious University expansion programme at the earliest possible moment. I am in general agreement with the conclusions to which the Committee have come, as I attach the utmost importance to ensuring that the nation has available an adequate supply of qualified scientists. If we do not do so we cannot maintain, far less improve, our position in the world and our standard of life at home. I sincerely hope, therefore, that the Committee's recommendations will be accepted by the Cabinet.

I announced my intention to appoint the Committee in the House of Commons on the 29th November, 1945, and in answer to a Question in the House of Commons on the 14th February I undertook to give careful consideration to the question of publishing the report on Scientific Man-power when it became available. The Chairman of the Committee informs me that the report has been drafted with a view to publication if the Government decide to adopt such a course. In view of the very general interest which has been shown in the deliberations of the Committee, and the need to secure a wide acceptance among educational authorities in general and the Universities in particular of the case for an urgent expansion of the Universities, I think that the report should be published immediately.

I accordingly seek the approval of my colleagues:

(i) To publish the report forthwith.

(ii) To accompany its publication with a statement in the House of Commons to the effect that the Government are in general agreement with the conclusions of the Committee, which they recognise will involve a substantial liability on the Exchequer, and commend them to the immediate and serious consideration of the Universities with a view to the formulation of detailed proposals in consultation with the University Grants Committee.

The Chancellor of the Exchequer concurs in this Memorandum.

(Initialled) H. M.

Office of the Lord President of the Council, S.W. 1,
3rd May, 1946.
SCIENTIFIC MAN-POWER

REPORT OF A COMMITTEE APPOINTED BY
THE LORD PRESIDENT OF THE COUNCIL

Presented

LONDON
HIS MAJESTY'S STATIONERY OFFICE

Cmd.
CONSTITUTION OF THE COMMITTEE

SIR EDWARD V. APPLETON, G.B.E., K.C.B., F.R.S.
PROFESSOR P. M. S. BLACKETT, F.R.S.
MR. GEOFFREY CROWTHER.
SIR ALFRED EGERTON, F.R.S.
SIR GEORGE NELSON.
PROFESSOR S. ZUCKERMAN, C.B., F.R.S.
DR. C. P. SNOW, C.B.E., Scientific Assessor.
MR. M. T. FLETT, Secretary.
MR. E. J. C. DIXON } Assistant Secretaries.
MR. E. J. S. CLARKE 

CONTENTS

PREAMBLE ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... 1
I.—INTRODUCTION ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... 2-5

II.—THE IMMEDIATE PROBLEM—
(1) DEMOBILISATION ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... 6-8
(2) EMERGENCY ACCOMMODATION ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... 9

III.—THE LONGER TERM PROBLEM—
(1) SUPPLY AND DEMAND ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... 10-23
(2) DOUBLING THE OUTPUT OF SCIENTISTS ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... 24
(i) The Talent Available ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... 25-27
(ii) Comparison with other Countries ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... 28
(iii) The Relation between Science and other Faculties—
(a) Engineering and Technology ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... 29-34
(b) The Humanities ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... 35
(iv) The Capacity of the Universities to Expand—
(a) The Need for Money ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... 36
(b) Other Impediments to Expansion ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... 37-44
(c) The Problems of Individual Universities ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... 45-54

(3) THE QUALITY OF SCIENCE TEACHING ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... 55

(4) THE EFFECT OF OUR PROPOSALS—
(i) The Supply of Graduates during the ten years ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... 56-57
(ii) The Assessment of Priorities ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... 58-60
(iii) The Position after 1955 ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... 61-62

(5) THE IMPLEMENTATION OF OUR PROPOSALS ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... 63-66

IV.—SUMMARY OF CONCLUSIONS ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... 67
To the Rt. Hon. Herbert Morrison, M.P., The Lord President of the Council:

Sir,

PREAMBLE

1. We were appointed by you on the 9th December, 1945, to consider the policies which should govern the use and development of our scientific man-power and resources during the next ten years and to submit a report on very broad lines at an early date so as to facilitate forward planning in those fields which are dependent upon the use of scientific man-power. We now have the honour to submit the following report.

I.—INTRODUCTION

2. We do not think that it is necessary to preface our report by stating at length the case for developing our scientific resources. Never before has the importance of science been more widely recognised or so many hopes of future progress and welfare founded upon the scientist. By way of introduction, therefore, we confine ourselves to pointing out that least of all nations can Great Britain afford to neglect whatever benefits the scientists can confer upon her. If we are to maintain our position in the world and restore and improve our standard of living, we have no alternative but to strive for that scientific achievement without which our trade will wither, our Colonial Empire will remain undeveloped and our lives and freedom will be at the mercy of a potential aggressor.

3. The problem of scientific man-power during the next decade falls into two distinct parts. The immediate tasks are to bring back our qualified scientists to civil life from the Forces and from the innumerable civilian occupations in which they have been serving the Forces; to guide them into peace-time occupations according to the needs of reconstruction; and to make good the physical damage which war has inflicted on our Universities and research establishments. The longer term problem is to provide sufficient qualified scientists to meet the nation's requirements during the reconstruction period and thereafter. The two problems are distinct and we deal with them separately.

Definitions

4. We should explain here that for our purpose we define "qualified scientists" as persons holding degrees in the mathematical, physical, chemical and biological sciences, together with the small number of men and women who, without being university graduates, are members of recognised scientific institutions with a membership status that is accepted as the equivalent of a university degree in these subjects.
Similarly we define the "demand" or "requirement" for scientists as the number of qualified scientists who are wanted to fill recognised scientific posts. Finally we have for convenience used "leakage" to represent shortly those people with scientific qualifications who are not at any given time in employment in this country definitely scientific in character, and "wastage" to mean a reduction in the available number from "leakage" and other causes taken together. These last words are used in a purely statistical sense and carry with them no implication that we consider that all qualified scientists ought to walk narrowly within their own subject. On the contrary we believe that much benefit would result from the wider diffusion of scientific knowledge and scientific methods throughout all spheres of activity.

5. We are satisfied that the demand for scientists over the next few years will exceed the possible supply not only as a whole but separately in each major branch of science. Consequently we have not attempted to deal with the separate needs for each category of scientists. Indeed, to establish a reliable quantitative assessment of demand and supply for each scientific subject would involve a formidable statistical enquiry which, if attempted, would seriously have delayed the presentation of this report. Demand will no doubt exceed supply by different amounts in different subjects, but we think that the determination of the demand for each particular type of scientist may safely be left for later attention.

II.—THE IMMEDIATE PROBLEM

(1) DEMOBILISATION

6. In considering this question we have had the benefit of the advice of the Ministry of Labour and National Service and have obtained the views both of the Board of Trade and of the military authorities. The qualified scientist is clearly a key man and we are satisfied that applications for his release, whether from the Forces or from civilian war work, are being treated with consideration and expedition by the authorities concerned. Some delay is of course inevitable in tracing a particular man who may be serving in the Army overseas and there are occasions on which the military commander on the spot (with whom must rest the ultimate decision whether a serving soldier can be released under Class B) feels it essential to retain a man on grounds of military necessity. But we are satisfied that this power is not being exercised unreasonably.

7. Release by nomination, of course, only affects scientists whose pre-war employers are anxious to secure their return or who, by some means, have established contact with their prospective employer. We have examined carefully whether anything can be done to improve the facilities for placing qualified scientists who have secured their release but have no appropriate job waiting for them. In this work the Appointments Department of the Ministry of Labour and National Service has a vital function to perform and we consider that, as its value depends fundamentally on the comprehensiveness of its scope, every possible means should be used to ensure that both individuals seeking an appointment and employers seeking scientific staff are aware of the facilities which it offers, and make full use of them. We have considered but have, with some hesitation, rejected the possibility of inviting the Ministry to make available at all demobilisation centres a pamphlet giving men coming out of the Forces comprehensive information about existing professional vacancies. Such a pamphlet could not in equity be restricted to professional vacancies and any attempt to make it cover all vacancies would almost certainly break down in this
period of acute and general man-power shortage. In any event we do not believe that by this time there is any large number of qualified scientists still in the Forces or that there is a significant number who on demobilisation have had to take employment in which their scientific qualifications are not adequately used.

8. We would here remark that the scientist in industry cannot work in isolation and is most fruitfully employed as a member of a balanced team of scientists, engineers, technical assistants and other ancillary staff. At the moment the shortage of man-power in these latter categories is almost as acute as the shortage of trained scientists. We appreciate the reasons that have led the Government to restrict the number of Class B releases to a comparatively small proportion of those under Class A, but we would urge the authorities responsible for Class B releases to consider sympathetically any cases in which it can be clearly shown that the work of a scientist is being held up by the lack of a particular experienced assistant.

(2) EMERGENCY ACCOMMODATION

9. For many years one of the chief burdens of the reports of the University Grants Committee has been the shortage of buildings. As long ago as 1936 the Committee stated that there was in the Universities a keen sense of dissatisfaction with the accommodation which they described. The war has led to a serious deterioration in the position and the need of Colleges that have suffered war damage is now desperate. For example, unless urgent measures are taken to remedy the situation, it is unlikely that the University College, London, will be able to accommodate as many as 20 per cent. of the students who wish to enter it in October 1946. We recommend, therefore, that everything possible should be done by the release of such university accommodation as is still requisitioned by the Government and by making available suitable emergency accommodation to meet the immediate needs of the Universities, particularly of those Colleges that have suffered war damage.

III.—THE LONGER TERM PROBLEM

(1) SUPPLY AND DEMAND

10. To arrive at our existing capital of qualified scientists we have had made an actuarial calculation based on the ascertained output of qualified scientists over a number of years and the recorded death rate for these years. In such a calculation a fundamental factor is the average active life of a scientist, the length of which can only be estimated after allowing not only for the easily assessable incidence of retirement on grounds of age and of death but for other forms of leakage from the profession as well. In the Civil Service the average professional life is 30 years, and we have used 30 years in making our calculation. As a result we arrive at a figure of 60,000 as the absolute maximum potential capital of qualified scientists in 1946.

11. But there can be little doubt that the young Civil Servant who has already chosen his profession is more likely to remain a Civil Servant than the student who has just passed his final examination in science is to remain in definite scientific employment. Moreover, in our calculations some allowance must be made for graduates who came from overseas and returned home after securing their degrees and also for people who only studied science in order to pursue other subjects, notably medicine.
12. We know that there were 45,000 scientists registered on the Ministry of Labour’s Central (Technical and Scientific) Register at the end of 1945, and our existing capital must therefore be somewhere between 45,000 and 60,000. The Ministry of Labour inform us that, to the best of their belief, the Register covers between 80 per cent. and 85 per cent. of working scientists, and, in all the circumstances, we have come to the conclusion that it is unlikely that the nation has at its disposal to-day a force of more than 55,000 qualified scientists.

13. The assessment of future demand is no less problematical. We have studied the available results of a number of recent enquiries, among them one carried out by the Industrial Research Committee of the Federation of British Industries on the probable demand for research and development workers in industry in the post-war years. As a result we have arrived at a figure of approximately 70,000 as the estimated minimum demand for scientific workers in this country and in the colonial service in 1950. Of this total roughly 30,000 represents teachers in the Universities and secondary schools.

14. We are conscious that too much reliance cannot be placed on this figure and there is, indeed, reason to believe that it represents an underestimate (perhaps a serious under-estimate) of the number of scientists whom the nation could usefully employ once peace-time industry gets into full production and science begins to build upon the many advances that it has made under the stress of war. We hope, indeed, that this is so, as we hold strongly that there is even now insufficient appreciation of the potentialities of well-directed scientific effort. But for the reasons which we set out below, we fear that it will prove to be beyond practical possibility to add even 15,000 qualified scientists to our existing capital within the next five years, and we have therefore thought it well that our estimate of future demand should be a cautious one.

15. It is only to the Universities that we can look for any substantial recruitment to the ranks of qualified scientists. The proportion that has come from other sources in the past is very small indeed and we do not favour any attempt to add a responsibility for producing a substantial number of pure scientists to the existing and prospective burdens of the Technical Colleges. Generally speaking, the university is an essential stage in a scientist’s education and in any event the Technical Colleges will be hard put to it to produce the number of technologists that are required to support and apply the work of the scientists.

16. Before the war the British Universities were turning out on the average some 2,500 scientists each year. The rate of output fell in the late 30’s but recovered during the war and the science faculties are now practically full. On the assumption that the faculties continued to be full but did not expand their output, they would turn out perhaps 12,500 scientists during the next five years.

17. The Universities have, however, already indicated that they are prepared to expand their output provided that the necessary finance is forthcoming. In May 1945 the University Grants Committee invited all Universities in Great Britain and the three University Colleges of Exeter, Nottingham and Southampton to formulate an estimate of the expansion in their student body which, ignoring financial considerations, they would contemplate when they had returned to normal conditions. The estimates
received by the University Grants Committee in reply to this enquiry show considerable divergencies among the Universities. Oxford and Cambridge, for instance, did not feel that they could expand their numbers at all above their pre-war level, while the English Civic Universities as a body thought that an expansion of the order of 85 per cent. might be possible within the first post-war decade. Taken as a whole, the replies of the Universities envisaged a potential increase in student population during this decade of approximately 45 per cent. over the pre-war strength. The figures given were not all sub-divided between the various faculties, but it is probable that, in view of the more elaborate equipment which it requires, science would not expand quite proportionately to the expansion in arts. Let us say that it would expand by about 40 per cent.

18. If we were to accept this estimate, we should come to the conclusion that, from a pre-war average annual output of 2,500 scientists, the Universities' estimates would yield by 1955 an output increased to 3,500 per annum.

19. The Universities were not asked to estimate the rate at which their expansion could be achieved, but for obvious reasons it is likely that, if things were left to run their course, the curve of expansion would rise very slowly in the first years of the decade. If, however, we can assume that the progression from 2,500 to 3,500 scientists per annum were made at a uniform rate and that in each year of the decade the number graduating would be 100 more than in the year before, the additional number of qualified scientists in 1950 would amount at most to 1,500.

20. Towards the 1950 requirement of 70,000 we have, therefore, on this basis a gross supply of 69,000 scientists. But so far no allowance has been made for wastage. Death and retirement will take its toll of our existing capital. We must assume that a proportion of trained scientists will go into other professions and we must also assume that a proportion of the annual output from the universities will be foreign students. We cannot pretend to have estimated the extent of this wastage accurately. Wastage during the war years was small but the circumstances were quite exceptional and a return to a more normal rate must be expected. It is not unreasonable to assume that the trained man-power available in 1950 would be less than 60,000, perhaps no more than 55,000.

21. But a review of demand over five years is an inadequate basis for any recommendations regarding provision for the training of scientists where three years is the minimum period of university education, and it is therefore necessary to have regard to the movement of demand after 1950. In the absence of estimates, even of the provisional kind upon which our 1950 figures are based, we can only make the broadest assessment of the possibilities. We do know, however, that in education the effect of the raising of the school-leaving age by one year in 1947, the establishment of the County Colleges and the subsequent raising of the school age by a second year will result in a further steep increase in the demand for teachers with scientific qualifications. Between 1950 and 1955 an additional 15,000 teachers will be needed, the curve of demand flattening out after the latter year. In industry we estimate that the exceptional demands caused by the needs of recovery will have been determined by 1950 and that thereafter any expansion in demand will reflect mainly the increasing application of science. A steady but not exceptional rise in the employment of scientists in central and local government service is probable. Taking all the known factors into account we feel justified in assuming that by 1955 the demand for scientists will be not less than 90,000.
22. Towards this total demand we can set our present capital and the new scientists to come from the Universities between 1946 and the end of 1955, less the wastage over those years. On the assumption that the Universities expand according to the figures that they returned to the University Grants Committee and, neglecting the effect of conscription, we make an approximate calculation of our new capital as follows:

(a) Present capital ... ... ... ... 55,000
(b) Additions to capital ... ... ... ... 30,000

\[55,000 + 30,000 = 85,000\]

For wastage, in the absence of any better figure we may again assume that, in science as in the Civil Service, an average professional life lasts 80 years and make an allowance of, say, 3,000 for new science graduates who do not enter the scientific professions in this country. Hence:

(c) Reduction of present capital ... ... 18,000
(d) Loss from new capital ... ... ... ... 3,000

\[18,000 + 3,000 = 21,000\]

leaving us with—

(e) Net capital at 1955 ... 64,000

23. Thus against the 1955 estimated demand of 90,000 we could not expect more than 64,000 under present plans. In the face of these figures, we consider that, if national recovery and our material progress are not to be dangerously hampered by lack of trained scientific ability, the output of scientists must be raised very much above the level of the present University proposals. It is too early to attempt to estimate exactly what the output should be once the nation has settled down to peace-time conditions but we are satisfied that the immediate aim should be to double the present output, giving us roughly 5,000 newly qualified scientists per annum at the earliest possible moment.

(2) DOUBLING THE OUTPUT OF SCIENTISTS

24. An expansion in the output of qualified scientists involves problems that are to a great extent common to all faculties faced with a demand for a substantially increased output of graduates. It is hardly open to doubt that many faculties will find themselves in this position and, as we have no desire that science should receive exceptionally favourable treatment, we have, in the following paragraphs, spoken where it seemed to us appropriate, in terms of the development of the Universities as a whole.

(i) The Talent Available

25. We need to form an estimate of the proportion of the population that is inherently fitted to benefit from a university education. We attach very great importance to this question, as whatever happens, the quality of our university graduates must not be sacrificed to quantity. In few other fields are numbers of so little value compared to quality properly developed. Character, temperament and wider qualities of mind are, of course, as important as intellectual acuity and the test of fitness for the Universities is not intelligence alone. Moreover, before it enters the University, intelligence must be trained and the associated personal qualities matured to a standard that we would not wish to see lowered. (In para. 38 below we deal with the effect of this factor on the supply of qualified entrants to the Universities during the next few years.)

26. We have surveyed the results obtained in recent years on the distribution of intelligence, as measured by “intelligence tests,” among the
whole population and among samples of the members of certain Universities. We are encouraged to consider these results to be fairly reliable, especially in view of the wide experience gained during the war in their use by the Services. The following results are especially relevant to our enquiry:

(a) At present rather less than 2 per cent. of the population reach the Universities. About 5 per cent. of the whole population show, on test, an intelligence as great as the best half of the students, who amount to 1 per cent. of the population. We conclude, therefore, that only about one in five of the boys and girls, who have intelligence equal to that of the best half of the University students, actually reach the Universities. It cannot be assumed that all of these have the other innate capacities necessary to a university career. It must be allowed, indeed, that many boys and girls of high intelligence would not desire a university career; yet there is clearly an ample reserve of intelligence in the country to allow both a doubling of the University numbers and at the same time a raising of standards.

(b) The investigations also show clearly that the great majority of the intelligent persons, who do not reach the Universities, are ex-pupils of the elementary schools. If university education were open to all on the basis of measured intelligence alone, about 80 per cent. would be expected to come from those children who started their education in the public elementary school and only 20 per cent. from those whose education had been in independent schools. In fact, at the present time only about 40 per cent. of university entrants are ex-pupils of elementary schools, whereas 60 per cent. are from independent schools. Thus, among university entrants, elementary school pupils are only half those to be expected, and those from independent schools about three times as many as expected.

These figures, rough and incomplete as they are, do make clear that a high proportion of the reserve of potentially able students comes from families that are unable to afford the cost of higher education. If, therefore, it is not to be lost to the Universities, greatly increased financial assistance both at the secondary school and at the university level is essential.

27. We conclude, therefore, that there is available in our population a large reserve of innate intelligence and that, even allowing for the other factors, there are more potential graduates than we could hope to take into our universities by any degree of expansion practicable within the next ten years. This would still be true if the standard of intelligence at which the individual is regarded as suitable for a university education were materially higher than it is to-day.

(ii) Comparison with other countries

28. In considering the number of students who ought to proceed to a University, comparisons are often made with other countries. We would echo the warning of the University Grants Committee in their quinquennial report of 1936, and draw attention to the difficulty of ensuring that the institutions taken into account are of comparable status, that the students are studying similar subjects at comparable intellectual levels, and that statistics are obtained for the same year in the countries compared.

(*) The University data consist of the test of a sample of graduates of Scottish Universities carried out by Professor Godfrey Thomson and of a sample of Manchester undergraduates carried out by Dr. Leybourne-White. The Committee are deeply indebted to Dr. Leybourne-White for her ready and invaluable assistance in making these results available and to the Simon Fund for Research at the University of Manchester for making her research possible.
Nevertheless we agree with the Committee's conclusion that when liberal allowance for margins of error in the basis of comparison has been made, it did not look as though, in England at any rate, there was an unduly large provision of facilities for university education, unless, indeed, it be held that university education was being altogether overdone elsewhere. Judgment here is commonly influenced by accounts of graduate unemployment in Europe in the years following the financial crisis of 1931, but we are not disposed to think of the future in terms of recurrent unemployment crises whether of graduates or of workers generally. We attach importance therefore to the fact that such figures as have come to our notice suggest that, even if the student population in British Universities were doubled, we should still fall short of a number of European countries and certainly of the United States of America in the relative provision we have made for higher education.

(iii) The Relation between Science and other Faculties

(a) Engineering and Technology

29. In the figures that we have quoted we have made no estimates for the vitally important studies in engineering and related technologies which before the war accounted for roughly 40 per cent. as many university students as the pure science schools. The close relationship between pure science and the various branches of engineering cannot be over-emphasised, nor the fact, to which attention has been drawn in reports made both in this country and in the United States of America, that, whereas no one can doubt the value of our achievement in fundamental science during the war, we were not always so successful in those applications of science which lie in the field of engineering and technology. We have, therefore, read with interest the report presented to the Minister of Education by the Committee under the Chairmanship of Lord Eustace Percy which was appointed to consider the needs of Higher Technological Education in England and Wales and the respective contribution to be made thereto by Universities and Technical Colleges.

30. The Percy Committee, reporting in July 1945, drew a distinction between the functions of Universities and Technical Colleges. Industry, they said, must look mainly to the Universities for the training of scientists and mainly to the Technical Colleges for technical assistants and craftsmen. Both Universities and Colleges must share the responsibilities for educating the future senior administrators and technically qualified managers of industry. We are more particularly concerned here with the need for those whom the Percy Committee call engineer-scientists and development engineers. There must be a large increase in the number of these highly trained technologists capable of appreciating the latest progress in the research laboratories and applying the results to practical engineering or processes in industry. The solution offered by the Percy report is the development of full-time technological courses of university degree standard at a selected and limited number of Technical Colleges.

31. We cordially support this recommendation. Moreover, in view of the consideration that we give below to the problem of university expansion, we would also support Lord Eustace Percy's opinion, given in a Chairman's note attached to the report of his Committee, that the Government should treat the Colleges of Technology as a group and develop among them some major university institutions. Some, situated in University Cities, might become the Faculties of Technology of the neighbouring University after a period in which standards had been worked out with the University on the basis of mutual acceptance of each other's teaching. Others, geographically
remote from existing Universities, might qualify for independent university powers, and it will be seen from paragraph 52 below that we would welcome the establishment of new University Colleges of this sort.

32. We are glad to observe the great importance which the Percy Committee attach to the provision of post-graduate research courses as an essential feature of these Colleges and to the facilities for inter-change of advanced research students and staffs between them and the Universities. Indeed, we would welcome any arrangements between existing Universities and the selected Technical Colleges which would tend to establish a basis of mutual esteem and to raise the currency of high technological qualifications to full university degree standard.

33. But the measures recommended by the Percy Committee for Technical Colleges will not absolve the Universities from their responsibility for training a high proportion of the nation's first-class technologists. We think, indeed, that the Universities should aim, by the provision of courses in the engineering sciences and full facilities for post-graduate research, to attract into technology a greatly increased number of students of outstanding ability. Certainly the expansion in the numbers of technological students at the Universities should not be less than that which we recommend in the case of pure science. In the course of their expansion and development we believe that both the Universities and the selected Colleges will have to provide training for such qualifications as chemical engineer and engineer-physicist, in addition to such existing schools as engineering and mechanical sciences.

34. Finally, in order to provide technologists of the highest possible quality, we think that urgent consideration should be given to the development of two or three Institutes of Technology, preferably in University Cities, whose aim should be to provide graduate and post-graduate courses and to conduct research of a standard at least equal to that demanded of candidates for doctorate degrees in the Universities.

(b) The Humanities

35. It is not within our province to consider the future demand for graduates in the humanities, languages and the fine arts and we are not qualified to do so. We have been informed, however, that here too there exists a need for a very substantial increase in the available supply of trained ability, and if this should prove to be the case it would be a matter of great satisfaction to us. For we attach very great importance to the atmosphere of an association of men and women which takes all knowledge as its province and in which all branches of learning flourish in harmony. Such an atmosphere has a great part to play in completing any student's education and preventing him from becoming a narrow and cloistered specialist. In particular would we deprecate any attempt to meet the increased demand for scientists and technologists at the expense of students of other subjects (even if, as is unlikely, the Universities could be persuaded to make such an attempt) or to give any preference to science students over arts students in such matters as military service.

(iv) The Capacity of the Universities to Expand

(a) The Need for Money

36. The great bulk of the money required for university development must come from the Exchequer and we are satisfied that, more than any other single factor, the Universities' response to any call for expansion will depend upon a wise and generous financial policy towards them on the part
Nevertheless we agree with the Committee's conclusion that when liberal allowance for margins of error in the basis of comparison has been made, it did not look as though, in England at any rate, there was an unduly large provision of facilities for university education, unless, indeed, it be held that university education was being altogether overdone elsewhere. Judgment here is commonly influenced by accounts of graduate unemployment in Europe in the years following the financial crisis of 1931, but we are not disposed to think of the future in terms of recurrent unemployment crises whether of graduates or of workers generally. We attach importance therefore to the fact that such figures as have come to our notice suggest that, even if the student population in British Universities were doubled, we should still fall short of a number of European countries and certainly of the United States of America in the relative provision we have made for higher education.

(iii) The Relation between Science and other Faculties

(a) Engineering and Technology

29. In the figures that we have quoted we have made no estimates for the vitally important studies in engineering and related technologies which before the war accounted for roughly 40 per cent. as many university students as the pure science schools. The close relationship between pure science and the various branches of engineering cannot be over-emphasised, nor the fact, to which attention has been drawn in reports made both in this country and in the United States of America, that, whereas no one can doubt the value of our achievement in fundamental science during the war, we were not always so successful in those applications of science which lie in the field of engineering and technology. We have, therefore, read with interest the report presented to the Minister of Education by the Committee under the Chairmanship of Lord Eustace Percy which was appointed to consider the needs of Higher Technological Education in England and Wales and the respective contribution to be made thereto by Universities and Technical Colleges.

30. The Percy Committee, reporting in July 1945, drew a distinction between the functions of Universities and Technical Colleges. Industry, they said, must look mainly to the Universities for the training of scientists and mainly to the Technical Colleges for technical assistants and craftsmen. Both Universities and Colleges must share the responsibilities for educating the future senior administrators and technically qualified managers of industry. We are more particularly concerned here with the need for those whom the Percy Committee call engineer-scientists and development engineers. There must be a large increase in the number of these highly trained technologists capable of appreciating the latest progress in the research laboratories and applying the results to practical engineering or processes in industry. The solution offered by the Percy report is the development of full-time technological courses of university degree standard at a selected and limited number of Technical Colleges.

31. We cordially support this recommendation. Moreover, in view of the consideration that we give below to the problem of university expansion, we would also support Lord Eustace Percy's opinion, given in a Chairman's note attached to the report of his Committee, that the Government should treat the Colleges of Technology as a group and develop among them some major university institutions. Some, situated in University Cities, might become the Faculties of Technology of the neighbouring University after a period in which standards had been worked out with the University on the basis of mutual acceptance of each other's teaching. Others, geographically
remote from existing Universities, might qualify for independent university powers, and it will be seen from paragraph 52 below that we would welcome the establishment of new University Colleges of this sort.

32. We are glad to observe the great importance which the Percy Committee attach to the provision of post-graduate research courses as an essential feature of these Colleges and to the facilities for interchange of advanced research students and staffs between them and the Universities. Indeed, we would welcome any arrangements between existing Universities and the selected Technical Colleges which would tend to establish a basis of mutual esteem and to raise the currency of high technological qualifications to full university degree standard.

33. But the measures recommended by the Percy Committee for Technical Colleges will not absolve the Universities from their responsibility for training a high proportion of the nation's first-class technologists. We think, indeed, that the Universities should aim, by the provision of courses in the engineering sciences and full facilities for post-graduate research, to attract into technology a greatly increased number of students of outstanding ability. Certainly the expansion in the numbers of technological students at the Universities should not be less than that which we recommend in the case of pure science. In the course of their expansion and development we believe that both the Universities and the selected Colleges will have to provide training for such qualifications as chemical engineer and engineer-physicist, in addition to such existing schools as engineering and mechanical sciences.

34. Finally, in order to provide technologists of the highest possible quality, we think that urgent consideration should be given to the development of two or three Institutes of Technology, preferably in University Cities, whose aim should be to provide graduate and post-graduate courses and to conduct research of a standard at least equal to that demanded of candidates for doctorate degrees in the Universities.

(b) The Humanities

35. It is not within our province to consider the future demand for graduates in the humanities, languages and the fine arts and we are not qualified to do so. We have been informed, however, that here too there exists a need for a very substantial increase in the available supply of trained ability, and if this should prove to be the case it would be a matter of great satisfaction to us. For we attach very great importance to the atmosphere of an association of men and women which takes all knowledge as its province and in which all branches of learning flourish in harmony. Such an atmosphere has a great part to play in completing any student's education and preventing him from becoming a narrow and cloistered specialist. In particular would we deprecate any attempt to meet the increased demand for scientists and technologists at the expense of students of other subjects (even if, as is unlikely, the Universities could be persuaded to make such an attempt) or to give any preference to science students over arts students in such matters as military service.

(iv) The Capacity of the Universities to Expand

(a) The Need for Money

36. The great bulk of the money required for university development must come from the Exchequer and we are satisfied that, more than any other single factor, the Universities' response to any call for expansion will depend upon a wise and generous financial policy towards them on the part
of the Government. We have been most forcibly impressed by the effect of monetary uncertainties upon the development of our Universities. Their whole atmosphere is impregnated by a conception of financial stringency caused not only by current lack of funds but by the fear that at some future date their income from benefactors, and mainly of course from the Exchequer may suddenly diminish, leaving their governing bodies without funds to meet their inescapable commitments. In 1938, British Universities received about £3 millions in grants from the Exchequer and from local authorities. Too much stress cannot be laid on the comparison, but it is pertinent to point out that in the same year American Universities, serving a population some three times as large, received from public funds no less than £32 millions. We were glad to note that for the financial year 1946-47 the University grants have been increased from £5-65 millions to £9-45 millions and that in announcing this increase in the House of Commons on the 22nd February, 1946, the Chancellor of the Exchequer said that, in order to encourage Universities to plan future developments over a term of years, he had told the University Grants Committee that he should be prepared, if good cause were shown, to ask Parliament to vote even larger capital sums. We hope that it will be possible for the Government to persuade the Universities that in future they will be able to rely upon adequate and continuing assistance from the Exchequer towards any project for which, in the Chancellor's words, good cause is shown.

(b) Other Impediments to Expansion

37. We have inquired into the reasons why the Universities have not found it possible to budget for an expansion during the next decade greater than that shown in their returns to the University Grants Committee. These reasons and our comments upon them may be briefly summarised as follows:—

The Supply of Students

38. While it is agreed that a large proportion of the population is inherently capable of benefiting from a university education, some University authorities doubt whether during the next ten years a sufficient proportion of this talent will have been trained to the point at which it can enter the University without causing a serious deterioration in the Universities' intellectual standards.

This fear is understandable. The recent Education Acts will not result immediately in a substantial increase in the number of young people completing their secondary education and it might be argued that the rather higher proportion of weaker students to be found in Scottish Universities before the war reflected the fact that, under pre-1944 conditions, Scotland with her much larger proportionate university population was already beginning to "scrape the pot" for suitable material. We do not accept this explanation of the situation in Scotland before the war but even if we did it must be remembered that England has a long way to go before her university population is proportionately equal to Scotland's. Moreover, for the next two or three years the Universities are likely to be besieged by prospective students returning from the forces; a very considerable proportion of fully-trained young persons is still being lost to the Universities through a variety of reasons, mainly economic, and the new Education Acts will not take long to show their effects. While, therefore, it is conceivable that somewhere about 1949 there might be some difficulty in filling a greatly increased number of University places, we think this is unlikely. We are quite satisfied that, if such a dearth should occur, it would be of brief duration, provided always that sufficient financial assistance is forthcoming to ensure
that able students are not prevented from going to the University by lack of means.

**Buildings**

39. The available University buildings are inadequate even to accommodate properly the existing student population. The shortage of building labour and materials prevents the Universities from embarking immediately on any substantial building programmes. The position is further complicated for Universities like Glasgow and Liverpool which are in the middle of large towns and can, therefore, only build new accommodation near their main sites by destroying houses and other buildings.

We recognise the inadequacy of existing university buildings and the importance in present circumstances of not adopting any means of remedying it that would accentuate the housing shortage. But even on the most material grounds, universities are as essential to the nation's prosperity as factories, and their claims upon building resources ought to receive the same priority. Some Universities are already finding it possible to increase their accommodation by running up one-storey buildings of light factory type which serve admirably for laboratories or lecture rooms or even hostels and whose construction is economical of labour. The possibility of using neighbouring country houses or vacated military camps as temporary annexes to Universities might be explored with advantage and as the building position improves, we would hope that, within two or at most three years, the Universities will be able to embark on a substantial programme of permanent building.

Meanwhile, in the present educational emergency much could be done to increase the size of the student body, if staffs and students were prepared to accept a measure of temporary inconvenience. In some cases an increase could, we think, be achieved by extending the shift system so as to make full use of those periods during which lecture rooms and laboratories are not at present in use.

**Staff**

40. The Universities are experiencing an acute shortage of suitable teachers. In some sciences such as physics and chemistry, in which the output of graduates has continued at a high rate during the war, there are probably sufficient qualified men available to teach increased numbers of students, but in other sciences (and incidentally in the arts faculties) the University authorities may feel that it is premature to expand the student body until more teachers have been trained.

We are not convinced that, if the Universities started a vigorous recruiting campaign, an adequate supply of science teachers of sufficient calibre would not be forthcoming. From the evidence that we have heard, we believe that in scientific subjects there is considerable first class material available and that the reason why it is not, generally speaking, flowing towards the Universities is partly the attraction offered by the Government's new Scientific Service but also, ignorance of the university careers that are open to scientists of good academic attainments and, in some instances, inadequate salaries offered by the Universities.

41. In this connection we make the following recommendations:—

(a) The Universities should be invited to make a comprehensive survey of their staff requirements in the light of the expansion to be aimed at.

(b) All university vacancies should be notified as a matter of routine to the Appointments Department of the Ministry of Labour and National Service which in this respect can fulfil a particularly
valuable function in making the vacancies known to prospective applicants.

(c) The Universities should consider whether it would not be possible for an increased proportion of their staff to be taken direct into the lecturer grade. Before the war the majority of university teachers entered their profession at about the age of 24 and were quite content to start as assistant lecturers. Many of the applicants for university posts now available, however, are between 28 and 30, and a large number of them are married men with families. Moreover, there are many whose pay and allowance during their period of military service were worth upwards of £1,000 per annum.

42. We would emphasise, however, that we are opposed to any attempt to increase the student population by adding substantial additional teaching responsibility to the individual members of a faculty. Generally speaking, indeed, the load on the teachers of science is already too great and their opportunity for research far too small. In our opinion it is essential that the average teacher should have more and not less opportunity for his own research than he has had in the past. As an emergency measure it may in some cases be justifiable to increase the amount of teaching done by an individual in order to obtain the maximum number of new graduates as soon as possible, but we hope that such instances will be few. Indeed, as will be seen from paragraph 55 below, we consider that any increase in the student body should be accompanied by a somewhat greater proportionate increase in the number of teachers. Even on this basis, however, we believe that in the science faculties, at least, a vigorous drive for new teachers would meet with a very considerable measure of success.

Colonial and Overseas Students

43. Looking at the problem from the narrow national point of view, it must be remembered that whereas the British Universities rightly regard it as a duty to take a proportion of students from the Commonwealth and from foreign countries, in present circumstances every student enrolled from overseas excludes a student from the United Kingdom. There is, moreover, strong evidence that foreign students are more anxious than ever before to come to this country to obtain their degrees and for post-graduate study, and the Foreign Office are gravely concerned about the proportion of applications which have to be refused.

We believe that the national interest demands that we should accept into our Universities as many as possible of these overseas students, but we cannot accept that they must necessarily be accommodated at the expense of our own. The obvious solution is to enlarge the Universities until they can take all students who wish to enter them and are capable of profiting from the education they provide.

44. To sum up, while there are formidable obstacles to the expansion of the Universities in the immediate future, we do not think that, once the urgency and the importance of the nation's need for more graduates is widely appreciated, and provided that the Universities' financial misgivings can be removed, they need necessarily prove insuperable.

(c) The Problems of Individual Universities

45. While it is possible to make certain wide generalisations that are broadly applicable to British Universities as a whole, any effective programme of expansion must take account of the individual problems facing each separate University. The following table shows how differently
the various groups of Universities responded to the idea of expansion when it was put to them by the University Grants Committee.

<table>
<thead>
<tr>
<th></th>
<th>Maximum No. of Students in first post-war Decade.</th>
<th>Percentage Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of Students</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1938-39</td>
<td></td>
</tr>
<tr>
<td>Oxford and Cambridge</td>
<td>11,000</td>
<td>11,000</td>
</tr>
<tr>
<td>London</td>
<td>7,500(2)</td>
<td>11,500(2)</td>
</tr>
<tr>
<td>English Civic Universities</td>
<td>12,700</td>
<td>23,700</td>
</tr>
<tr>
<td>University of Wales</td>
<td>2,800</td>
<td>4,200</td>
</tr>
<tr>
<td>Scottish Universities</td>
<td>9,500</td>
<td>12,600</td>
</tr>
<tr>
<td></td>
<td>43,500</td>
<td>63,000</td>
</tr>
</tbody>
</table>

We have not attempted to examine in detail the particular needs of individual Universities, but we would like to record the following provisional views on this question for the consideration of whatever body becomes responsible for the expansion programme.

**Oxford and Cambridge**

46. We regret that neither of the ancient Universities has found it possible to suggest any permanent expansion in its student body. We realise that any expansion would have to be of modest proportions if it was not to affect the character of Oxford and Cambridge, and we do not wish to suggest any measure which would destroy the residential character which is so essential to their educational system. Nevertheless, we feel that Oxford and Cambridge should regard it as a duty to make some contribution towards meeting the nation’s enlarged requirements and we think that the University authorities might be asked to give early reconsideration to the possibility of accepting a somewhat larger student body. It might, for instance, be possible to achieve this end by the enlargement of some of the smaller of the existing Colleges and the foundation of one or more new Colleges.

**London**

47. The problem here must be considered in terms of the circumstances of each separate College and the appropriate rates of expansion might be very different in different cases. If, however, there were any substantial expansion in the numbers enrolled in the University as a whole, serious administrative difficulties might arise that could only be solved by a policy of decentralisation. Possibilities that have been suggested to us are the upgrading of those of the constituent Colleges, viz., University and King’s, which already embrace many faculties, to major University status; the association of groups of colleges such as those at South Kensington with new foundations in complementary faculties and residential facilities to form a complete University institution; the expansion of University facilities in East and South London; and the separation of the external examining function from the internal teaching and research function. These matters are outside our competence, but clearly there is no reason why there should only be one University in London or why an area with a population of over 8,000,000 people should only have accommodation for less than 20,000 students within its boundaries.

(2) Excludes Medical schools and the Institute of Education totalling some 6,500 students in 1938-39.
48. It will be seen from paragraph 45 above that the English Civic Universities are themselves prepared, if adequate finance is forthcoming, to increase their student body by no less than 86 per cent. We consider that in some instances even this is an appreciable under-estimate of what could be done. We believe, for example, that the Sheffield region could ultimately support a University considerably larger than the 1,500 students who represent its expansion programme (although even this involves doubling the pre-war size of the University) and we believe that Universities like Liverpool and Leeds ought to aim at a student body of not less than 4,000.

49. But if the Civic Universities are to expand they must be assured of an adequate nucleus of real ability round which to build. Oxford, Cambridge and London have in the past exercised a quite disproportionate attraction on talented students.

50. This drawing power results from the high value that is placed upon the degrees of the older Universities and from the greater amenities and, to some people, from the greater social distinction that they offer to their members. It is reinforced by a scholarship system that gives students who leave home for their university education more money than those who attend their local Civic Universities, thus conferring at once a measure of financial independence and freedom to enter fully into university life upon the former but not upon the latter.

We believe that the present system, which tends to concentrate the major proportion of State and county scholars into three Universities, is fundamentally bad not only for the regional Universities, whose whole intellectual level suffers from the lack of a sufficient number of outstanding students, but also for the three Universities themselves. We cannot believe that either Oxford or Cambridge would wish to become almost entirely a "scholarship University" or would benefit from such a development.

51. There are few things more important than to find a solution to this problem. Clearly it will not be easy. The attractive power of the Civic Universities must be raised by their own effort. Among the needs of first importance are halls of residence and greater facilities for corporate life generally; indeed, it is scarcely possible to exaggerate the importance of these. The vigour of their teaching and the excellence of their research will have its effect, but the efforts of the Universities themselves must be supported by the State and consequently we recommend that the educational authorities should consider urgently means by which scholars might be distributed more equitably. Possible schemes which have been suggested to us are the allocation of an annual quota of State and county scholars to each University and the making of special grants to individual Universities for the endowment of scholarships and research scholarships. Special financial provision might also have to be made to enable the Civic Universities to obtain their share of the best teaching talent.

The English University Colleges

52. When all possible expansion has been achieved by the Universities there will still remain a large gap to be filled. The existing University Colleges of Nottingham, Southampton, Exeter, Hull and Leicester ought to be able to make a substantial contribution towards filling it. All of them are well situated to serve as university centres and each of them ought we think to aim at earning full university status at the earliest possible date. Moreover, there are several large centres of population in which new University Colleges could profitably be established.
The Scottish Universities

53. Here the possibility of expansion is considerably less, as the proportion of the total population which already receives a university education is much larger than that in England and Wales. We cannot, however, believe that even in Scotland we have yet approached the limit of what is either possible or desirable in the national interest.

New University Institutions

54. Finally we think that, while giving all possible facilities to the existing Universities and University Colleges to expand themselves, early consideration should be given to the foundation of at least one new University. We recognise that such a foundation must have time to develop and that, taking into account the difficulty of providing accommodation, its contribution to the need for graduates would probably be small for some years after its birth. But there is nothing sacrosanct about the present number of Universities in the Kingdom and we are attracted by the conception of bringing into existence at least one University which would give to the present generation the opportunity of leaving to posterity a monument of its culture. Moreover, there is some reason to believe that a number of able teachers from the existing Universities would welcome the opportunity of re-enacting in the twentieth century the exodus which is said to have led to the foundation of Peterhouse in the thirteenth. We also believe that such a proposal would receive warm support from informed opinion and the general body of the public.

(3) THE QUALITY OF SCIENCE TEACHING

55. So far we have concerned ourselves with the need to raise the number of qualified scientists. Quality is, however, at least as essential as quantity and the quality of a scientific training depends largely on the standard of the research work upon which it is based. Strong research schools are needed in all university science departments not only for the intrinsic value of the researches and their value to the teachers themselves but also for training the able students in methods of research. Three years of undergraduate study do not make a trained scientist; an additional two or three years' research is essential for a considerable proportion of science graduates. Hence we are of the opinion that the proper training of a first-rate research scientist, and also of the higher grades of teacher, cannot be accomplished in much less than the five or six years already accepted as necessary for the training of a doctor. We hold strongly, moreover, that as an essential part of any balanced expansion in the science faculties, there should be not only an expansion in the number of teachers somewhat larger proportionately than the expansion of the number of students, but an expansion in research schools for training purposes apart from the needs of the students, and an increase in the financial grants that are made specifically towards research by University staffs.

(4) THE EFFECT OF OUR PROPOSALS

(i) The Supply of Graduates during the next ten years

56. It will be seen from paragraphs 20 and 23 above that, even on the most optimistic view of present plans, we are likely to be several thousand scientists short of our requirement in 1950 and 1955. In considering what effect the acceptance of our recommendation, that the output of scientific graduates should be doubled at the earliest possible opportunity, may have upon this shortage, it is necessary to take into account the following factors:

(a) It takes at least three years to qualify for a university degree and a proportion of students must do a period of post-graduate work before
they can be considered properly qualified. Even, therefore, if it were possible to double the intake of the Universities in October 1946 there would be no substantial rise in the output of qualified graduates until 1949 at the earliest.

(b) It is too much to hope that the Universities will in fact be able to double their intake in 1946. There will be more than enough applicants for places but we very much doubt whether, even assuming that teachers are available, the Universities will be able to carry through such a formidable task of reorganisation in the few months available before the opening of the academic year. Moreover, while much can be done to solve the accommodation problems by recourse to temporary expedients, even the flimsiest building takes time to construct and the most suitable existing building, time to convert for university purposes.

(c) As far as recruitment to the Universities in the years succeeding 1946 is concerned we have set out above our reasons for thinking that this is the least serious of the problems which must be faced. We have, moreover, brought to the attention of the Government our view that, if the intellectual standard of graduates is not to suffer, it is desirable that science students should be allowed, if they wish and if there is room for them, to complete their full course and obtain their degrees before doing their period of military service. But military service must be done and, assuming that it lasts for a period of two years, it will mean that at any given time the equivalent of two years' output of graduates will be soldiers and not scientists.

57. If we take these factors into account, the only possible conclusion is that whatever is done to increase the output of science graduates, the nation will be seriously short of scientists in 1950 and that without heroic efforts it is unlikely that supply will have finally overtaken demand even five years later.

(ii) The Assessment of Priorities

58. This conclusion means that if we are to make the best use of our limited supply of scientists, some system of priorities must be established. We recommend that in the immediate period of reconstruction the order of preference should be:

1st. Teaching and Fundamental Research.
2nd. Civil Science, both Government and Industrial.

59. We have the following comments on this order of priority:

(a) Clearly the quickest way to remedy the shortage of scientists is to ensure that a sufficient number of qualified teachers is available and the sooner this can be done, the sooner the output of new graduates will reach the desired level.

(*) In the academic year, 1946-47 in fact, the Universities may be so full of men returned from the Forces, that relatively few new entrants direct from school will find places. If this occurs, we consider that any boy who has to wait one or two years to enter a University should be permitted if he wishes to start his military service directly on leaving school, rather than, as we recommend in general, after his university course.

(*) This recommendation was confined to science students because they are the only students about whom we are qualified to speak. We must repeat, however, that we do not wish to claim any preferential treatment for the scientist.
Scientific advance must proceed simultaneously both in the basic and applied fields. During the war basic research had, perforce, to be severely limited, and its rapid rebuilding must be on the highest priority. Since we must look to the Universities for the major part of our basic science, a generous and immediate endowment of the research schools of the Universities in equipment, technical staff and general research facilities is essential. We have given defence research the lowest place in our order of preference, partly because of the great strides which it made under the impact of war and partly because the immediate needs of other branches of science seem clearly more pressing. But it must be remembered that we are in a period of revolution in the technique of armaments that will have the profoundest effect upon future strategy and tactics. Consequently, the defence services must maintain not only a nucleus of able scientists but also adequate development establishments if we are not to fall behind in that technical equipment upon which our place among the nations may depend.

The order of priority set out in paragraph 58 applies only to the period of reconstruction. It should be the business of the Government to keep it constantly under review so as to ensure that it is speedily revised should circumstances demand.

The means by which any system of man-power priorities is to be implemented in peacetime must be largely financial. It is true that, within the Government service, arrangements can be made to direct scientists to whatever work is currently of the greatest importance. But there will be competition between industry and universities and within industry itself, and the distribution of available scientific man-power will depend on the prospects which each competitor can hold out to the individual scientist. We do not suggest that, generally speaking, the Universities should attempt to pay their scientific workers salaries similar to those offered in industry, because to a large number of scientists, academic life has an appeal which cannot be assessed in terms of money. But university salary scales and the inducements which an academic career can offer must be considered with the competing attractions of industry in mind. Generally speaking, far too much of a Professor’s time is taken up in dealing with petty administrative questions and both the efficiency of departmental administration and the amenities of professional life could be greatly improved if scientists could be provided with the secretarial assistance and office machinery that the average business man regards as essential.

The Position after 1955

We are faced by the apparent dilemma that if the supply of scientists is to catch up the demand within, say, the next 15 years, the output of scientific graduates must be increased to not less than 5,000 per annum, but that if such an output continues indefinitely there may be a danger of substantial overproduction unless the demand continues to increase rapidly.

If the active life of the average scientist should prove to be in the neighbourhood of 30 years, an output of 5,000 science graduates per annum postulates an ultimate total force of 150,000, or over one and a half times the force which we consider will be required in 1955. The Universities may therefore have misgivings about attempting to provide accommodation and teaching staff sufficient to cater for 5,000 science graduates per annum. We think, however, that the dilemma is more apparent than real. In the first
place although the demand for scientists may not reach 150,000 for many years to come, there is reason to expect that for an indefinite period it will continue to expand for, apart from the increasing application of the physical and chemical sciences not only to research, but also to production in industry, there is a wide and expanding field for the application of the biological sciences.

Secondly, by 1955 a large proportion of the accommodation at present used by Universities will be fit only for demolition and need not be rebuilt if the demand for it has ceased to exist.

Finally, we hope and believe that scientific training will come to be in greater demand as a foundation of a general education. Hence we do not believe that, even if the demand for recruits to the scientific professions should at some future date, fall below the supply, it is likely that a reduction in the student body in science faculties would take place.

(5) THE IMPLEMENTATION OF OUR PROPOSALS

63. If it be accepted that we must double our output of scientific graduates, the magnitude of the task to be faced must be recognised. The following summary of the problems involved is by no means exhaustive:

(a) Each University and University College in the Kingdom must be invited to consider its position and form an assessment of the way in which it can best contribute to the expansion demanded.

(b) The needs of individual sciences must be assessed and related to the existing capacity of the Universities, to the demands of each other and to their associated technological services.

(c) It is probably not possible to assess statistically the demand for graduates in the humanities and other branches of learning. But the expansion of these faculties cannot be left entirely to trial and error if there is to be no danger of a growing "lack of balance" in the Universities.

(d) A university building programme will have to be drawn up that shall ensure that the accommodation problem is solved as quickly as possible and with the minimum interference with the demands of housing, school education and industry upon the available building resources.

(e) Every assistance must be given to the Universities in finding and attaching to themselves as teachers, sufficient men and women of proper calibre.

(f) Arrangements need to be made to ensure an adequate supply of the best students from the schools. The magnitude of the problem is great but it must be faced. If the best available talent is to reach the Universities, then financial assistance must be made available to the great majority of university students. With the increase in residential facilities in the Civic Universities the need will be all the greater.

(g) The many problems raised by the continuance of conscription must be tackled.

(h) The parallel needs of the special Technical Colleges must be met and a regional and national system developed for knitting together the Schools, the Technical Colleges, the Higher Technical Institutes, the Universities and Industry.

(i) Finally, this heavy programme will have to be financed very largely at the expense of the Exchequer. The cost will be large in relation to previous university expenditure, although not in relation to other Government educational or research expenditure. It clearly must
be borne largely by the Exchequer, although we hope that private benefactors, to whom the Universities have been so heavily indebted in the past, will continue to show their generosity towards the foundations in which they are personally interested and will not be led to think that the value of their gifts will be diminished or that the need for them has gone.

64. We must here record that we are unanimously opposed to any infringement of the cherished independence of the Universities, even if it could be justified on the ground that it would facilitate the execution of the expansion programme.

65. We do not, however, believe that the maintenance of the Universities' independence is in any way incompatible with the extension and improvement of the machinery for adjusting their policy to the needs of the country. Such a step will in any case become inevitable, if the tax-payer assumes the main financial burden of the expansion programme, and we have no reason for believing that the Universities themselves would not welcome it. For, although the informal Committee of Vice-Chancellors has served as a valuable organ for co-ordinating and formulating University policy, it has no permanent secretariat attached to it and there is some reason to believe that the Universities have found their development seriously handicapped by the lack of such material as the detailed and comprehensive statistics which the Government would have to compile and keep up to date to serve as the foundation of the expansion programme.

66. The chosen instrument for the maintenance of relations between the Government and the Universities in the past has been the University Grants Committee and we do not think that the expansion programme which we envisage calls for the replacement of that Committee by any new organ of Government. The Committee came into existence in 1919 under a Treasury Minute which appointed it—

"To enquire into the financial needs of University Education in the United Kingdom(1) and to advise the Government as to the application of any grants that may be made by Parliament towards meeting them."

Its growing importance can be judged from the fact that the grants for which it was responsible rose from £1 million in 1919-20 to £2.25 millions in 1936 and have in the current financial year increased to over 29 millions. We have no criticism to make of the admirable work which the University Grants Committee has done and is doing. Indeed, we think that the mutual confidence which rightly exists to-day between the Committee and the Universities will very greatly facilitate the execution of the expansion programme. But the State has perhaps been over-concerned lest there should be even a suggestion of interference with the independence of the Universities and, from the terms of reference quoted above, it is clear that the University Grants Committee was originally intended to be a somewhat passive body whose main function was to criticise proposals put forward by the Universities and which was not itself expected to make any attempt to suggest possible developments involving expenditure to University authorities. We gladly recognise that the Committee has not in fact been content to accept so passive a role but we think that circumstances demand that it should increasingly concern itself with positive University policy. It may be desirable for this purpose to revise its terms of reference and strengthen its machinery.

(1) Since the Government of Ireland Act, 1920, the University Grants Committee has restricted its activities to Universities in Great Britain.
IV.—SUMMARY OF CONCLUSIONS

67. The Immediate Problem

DEMOBILISATION

(1) We have enquired into the procedure for expediting the return of scientists to civil life; we believe that it is adequate to present needs and we have no improvements to recommend. (Paras. 6-7.)

(2) The fullest possible use should be made of the facilities offered by the Appointments Department of the Ministry of Labour. (Para. 7.)

(3) Applications for the release of experienced assistants under Class B should be considered sympathetically where it can be shown that if release is not granted the work of a scientist will be held up. (Para. 8.)

EMERGENCY ACCOMMODATION

(4) Everything possible should be done to meet the immediate needs of Universities for accommodation, particularly the needs of those that have suffered war damage. (Para. 9.)

The Longer Term Problem

SUPPLY AND DEMAND

(5) Our estimate of the position in 1950 and 1955 may be summarised as follows:—

<table>
<thead>
<tr>
<th></th>
<th>1950</th>
<th>1955</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum requirement of Qualified Scientists</td>
<td>70,000</td>
<td>90,000</td>
</tr>
<tr>
<td>Maximum number likely to be available if expansion in the output of graduates is limited to that envisaged in the returns furnished by the Universities to the University Grants Committee</td>
<td>60,000</td>
<td>64,000</td>
</tr>
<tr>
<td>Deficit</td>
<td>10,000</td>
<td>26,000</td>
</tr>
</tbody>
</table>

(Paras. 10-22.)

(6) It is essential therefore that the output of scientific graduates should be increased very much above the level of expansion at present envisaged by the Universities; the immediate aim should be to double the present output giving us approximately 5,000 new scientists every year, at the earliest possible moment. (Para. 28.)

DOUBLING THE OUTPUT OF SCIENTISTS

THE TALENT AVAILABLE

(7) There is available in the population a large reserve of innate intelligence. Its size is such that, while recognising the need for other qualities also, we assume that there is available more suitable material than we could hope to take into our Universities by any degree of expansion practicable within the next ten years. But financial assistance must be forthcoming on a larger scale if much of the available talent is not to be lost to the Universities. (Paras. 25-27.)
COMPARISON WITH OTHER COUNTRIES

(8) Even if the total student population in British Universities were doubled, this country would still fall short of a number of European countries and the United States of America in the relative provision which it makes for higher education. (Para. 28.)

TECHNOLOGICAL EDUCATION

(9) (a) We support the recommendation of the Percy Committee on Higher Technological Education that there should be developed at a selected and limited number of Technical Colleges, full-time technological courses of University degree standard. (Paras. 29-30.)

(b) The status of these higher technological colleges and the bonds between them and the existing Universities (including facilities for post-graduate research) should be strengthened wherever possible so as to raise the currency of technological qualifications. (Para. 32.)

(c) The increased facilities to be offered by Technical Colleges does not relieve the Universities from their responsibility for training a high proportion of the nation’s first-class technologists; the expansion in the output of graduates should be not less proportionately in technology than in pure science. (Para. 33.)

(d) Urgent consideration should be given to the development, preferably in University Cities, of a few Institutes of Technology designed to maintain the highest possible standards of study and research. (Para. 34.)

THE HUMANITIES

(10) We hope to see a substantial expansion in the number of students studying the humanities; the humanities should not be sacrificed to the need for an increased output of scientists and technologists. (Para. 35.)

THE CAPACITY OF THE UNIVERSITIES TO EXPAND

Finance

(11) It is of great importance that the Universities should be assured that in future they will be able to rely on adequate and continuing assistance from the Exchequer towards any project for which good cause is shown. (Para. 36.)

Students of Requisite Standard

(12) We are reasonably sure that even in the next few years there will be no lack of trained students to fill the expanding universities. (Para. 38.)

Accommodation

(13) We make a number of proposals which might help to mitigate the university accommodation problem (para. 39); we attach great importance to the provision of halls of residence and other facilities for corporate life in the Civic Universities. (Para. 51.)
Teachers

(14) In science at least there is ground for believing that a vigorous drive for new university teachers would meet with a very considerable measure of success; we make certain detailed recommendations regarding the steps which the Universities might take to secure additional teachers. (Paras. 40-41.)

(15) To improve teaching efficiency, and to give individual teachers adequate time for their own research, any expansion in the number of students should be accompanied by a proportionately larger expansion in the number of teachers. (Para. 42.)

Overseas Students

(16) Everything possible should be done to meet the demand of students from the Commonwealth and from foreign countries for places in British Universities and to increase the size of the Universities to enable these students to be accepted without excluding students from this country. (Para. 43.)

THE PROBLEMS OF THE INDIVIDUAL UNIVERSITIES

Oxford and Cambridge

(17) The two ancient Universities should regard it as a duty to make a contribution towards meeting the nation's enlarged requirements for graduates; this might be possible by the enlargement of some of the smaller of the existing colleges or by the foundation of one or more new colleges. (Para. 46.)

London

(18) There is scope for an expansion in the student population of London University although such expansion may involve adopting a policy of decentralisation. (Para. 47.)

English Civic Universities and the University of Wales

(19) A really substantial expansion here depends to a considerable extent on the Universities concerned being able to compete with Oxford, Cambridge and London for the limited supply of talented students; to this end the Civic Universities must improve their amenities and the educational authorities should consider urgently a revision of the scholarship system. (Paras. 48-51.)

The University Colleges.

(20) The existing University Colleges can be substantially expanded and the possibility of founding new University Colleges in large centres of population should be considered. (Paras. 51 and 52.)

Scotland

(21) There is, we think, still scope for expansion in the size of the Scottish Universities. (Para. 53.)

A New University

(22) The possibility of bringing into existence at least one completely new University should be considered as soon as possible. (Para. 54)
THE QUALITY OF SCIENCE TEACHING

ACILITIES FOR RESEARCH
(23) This depends largely on the quality of research and every effort should therefore be made to ensure that adequate facilities for research are available for post-graduate students and for university staffs. (Para. 55.)

THE EFFECT OF OUR PROPOSALS

THE SUPPLY OF GRADUATES
(24) When all possible measures have been taken to expand the output of graduates the nation will certainly be seriously short of scientists in 1950 and is unlikely to have an adequate supply by 1955. (Paras. 56–57.)

THE ASSESSMENT OF PRIORITIES
(25) In the allocation of our limited supply of scientists during the reconstruction period the order of preference should be:
(i) Teaching and Fundamental Research;
(ii) Civil Science, both Government and Industrial;
(iii) Defence Science. (Para. 58.)

(26) It is important to maintain an adequate nucleus of able scientists working on the problems of defence. (Para. 59(c).)

(27) The order of priority set out in conclusion (25) should be kept under constant review by the Government. (Para. 59(d).)

(28) As one means of implementing this order of priority the attractions of an academic career should be improved. The provision of more secretarial assistance and office machinery for university teachers would not only contribute to this end but would materially increase the efficiency of the Universities. (Para. 60.)

THE POSITION AFTER 1955
(29) We do not think that the Universities need be deterred from expanding their facilities in order to produce 5,000 scientific graduates per annum by any fear that this will leave them with excessive staffs and accommodation once the demand for qualified scientists has levelled out. (Para. 61.)

THE IMPLEMENTATION OF OUR PROPOSALS
(30) We hope that an increase in Exchequer grants to the Universities will not result in a diminution in private benefactions. (Para. 68(i).)

(31) If our proposals are accepted by the Government, their implementation must not involve any infringement of the independence of the Universities; but we think that such independence is not inconsistent with a greater degree of co-ordination between university policy and the needs of the country than has existed in the past. (Paras. 64 and 65.)

(32) The Government's part in any expansion programme should, we consider, be the responsibility of the University Grants Committee which ought to be put in a position to concern itself more positively with university policy than it has done in the past. (Para. 66.)

68. In conclusion we would like to guard ourselves against an imputation to which we fear that our report may lay us open, namely that we are imbued
with a narrowly materialistic view of the functions of a University. We are well aware that the training of specialists is not the only or even the most important function of a University and we know that the Universities themselves will strive to ensure that every student can seek the full life within their precincts and that specialised knowledge is not bought at the expense of wisdom.

69. We wish to acknowledge most gratefully the invaluable help which we have received from our assessors and from our secretarial staff.

Signed on behalf of the Committee:

J. A. BARLOW, Chairman.

M. T. FLETT, Secretary.
13th April, 1946.