TECHNICAL EDUCATION

Note by the Lord Privy Seal, the Secretary of State for Scotland and the Minister of Education

The attached draft White Paper on Technical Education has been prepared in accordance with the conclusions reached by the Cabinet at their meeting on 4th January (C.M.,(56) 2nd Conclusions, Minute 6). It has been approved, subject to certain amendments which have now been made, by a Committee consisting of the Lord Privy Seal, the Minister of Education, the Minister of Labour, the Financial Secretary to the Treasury and the Joint Parliamentary Under-Secretary of State for Scotland.

2. We invite our colleagues to approve the White Paper for very early publication.

R.A.B.
J.S.
D.E.

15th February, 1956.
TECHNICAL EDUCATION

Presented to Parliament by the Minister of Education and the Secretary of State for Scotland by Command of Her Majesty February 1956
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TECHNICAL EDUCATION
White Paper by the Minister of Education and the Secretary of State for Scotland

DEFINITIONS

Most of those who pass through the system of technical education and make their careers in manufacturing industry are divided into three categories: technologists, technicians and craftsmen. For the purposes of this Paper these are defined broadly as follows:

Technologists

A technologist has the qualifications and experience required for membership of a professional institution. Most university graduates in engineering and other applied sciences, and a good proportion of holders of Higher National Diplomas or Certificates or similar qualifications, become technologists.

A technologist has studied the fundamental principles of his chosen technology and should be able to use his knowledge and experience to initiate practical developments. He is expected to accept a high degree of responsibility and in many cases to push forward the boundaries of knowledge in his own particular field.

Technicians

A technician is qualified by specialist technical education and practical training to work under the general direction of a technologist. Consequently, he will require a good knowledge of mathematics and science related to his own speciality. Examples of technicians in the factory are assistant designers and junior ranks of management on the shop floor.

Craftsmen

Craftsmen represent the skilled labour of manufacturing industry and account for more than one-third of its manpower. With the growing complexity of machines and the introduction of new materials it becomes all the more necessary for them to appreciate not only the how but also the why of the work they do.

The following are the principal qualifications associated with the three categories defined above:

University Degrees

A university honours degree is usually accepted for complete or partial exemption from the examinations of professional institutions. Some colleges of technology are affiliated to universities under arrangements which enable an internal degree to be obtained after a course at the college. More widely spread courses are held in major colleges for students intending to take external degrees of London University.

Technical College Diplomas

Certain technical colleges award their own diplomas or associateships at the end of courses at technological level, most of which are full-time.
National Diplomas and Certificates

National Diplomas and Certificates are awarded jointly by the Ministry of Education or the Scottish Education Department and the professional institutions concerned. There are two grades: Ordinary and Higher.

The Ordinary National Diploma is awarded to successful students who have taken a full-time course for two years from a minimum age of sixteen. The Higher National Diploma is awarded after a three years' full-time course starting at a minimum age of eighteen. Higher National Diplomas are usually recognised for exemption from certain examinations of professional institutions.

The Ordinary National Certificate is obtained by successful students at the end of a part-time course lasting three years from the age of sixteen, and the Higher National Certificate after two years' further study. It is common for students who have gained the Higher National Certificate to pursue their studies to a level which provides complete exemption from the examinations of professional institutions.

Certificates of the City and Guilds of London Institute

Final and Full Technological Certificates are awarded at the end of part-time courses of four or five years from the age of sixteen upwards. In craft subjects they represent the highest standards of skilled craftsmanship. Intermediate Certificates are awarded on the result of examination after a two year course. The Institute also holds examinations at technician level. These are broadly scientific in scope and in certain subjects are of a standard approximating to that required for a technologist.

Certificates of Regional Examining Unions

In England and Wales there are four Regional Examining Unions which work in close co-operation with the City and Guilds of London Institute and hold examinations of a similar level at the Intermediate stage and higher stages. Students then proceed to the final examination of the City and Guilds of London Institute.

Other Professional and Trade Certificates

In addition to the above qualifications awarded by examining bodies there are many certificates awarded on examination by professional and trade organisations.

INTRODUCTION

The Prime Minister, speaking at Bradford on 18th January, referred to the world-wide scientific revolution. He said: "The prizes will not go to the countries with the largest population. Those with the best systems of education will win. Science and technical skill give a dozen men the power to do as much as thousands did fifty years ago. Our scientists are doing brilliant work. But if we are to make full use of what we are learning, we shall need many more scientists, engineers and technicians. I am determined that this shortage shall be made good."

2. The figures given later in this Paper show how greatly the British system of scientific and technical education has expanded since before the war. Between 1938 and 1955 the number of university students in science and technology has doubled and since the Education Acts of 1944 and 1945, more schools and technical colleges have been built, more teachers have been recruited and more interest has been shown in education by parents and employers than in any corresponding period in our history.
3. But this is nothing like enough. From the U.S.A., Russia and Western Europe comes the challenge to look to our system of technical education to see whether it bears comparison with what is being done abroad. Such comparisons cannot be made accurately because standards and systems of education vary so much, but it is clear enough that all these countries are making an immense effort to train more scientific and technical manpower and that we are in danger of being left behind. A note about recent developments in the U.S.A., Russia and Western Europe is given in Appendix A.

4. But we do not need the spur of foreign examples. Our own circumstances show clearly enough the policies which we must pursue. Our aims are to strengthen the foundations of our economy, to improve the standards of living of our people, and to discharge effectively our manifold responsibilities overseas. Our success in each case will turn largely on our ability to secure a steady increase in industrial output, in productive investment, and in exports of goods and services of the highest quality at competitive prices. One industry after another is being compelled to follow its competitor, supplier or customer in modernising its techniques, knowing that unless new materials are discovered and new methods applied, British industry may fall behind in the race. The pace of change is quickening, and with it both the need and the demand for technical education.

5. The demand will be no less urgent from the less developed countries overseas, whom it is our duty and our interest to help win for themselves a higher standard of life. This can be done in two ways: there must be more places in our universities and technical colleges for overseas students, and more British experts must be available to work or teach abroad.

6. We face, then, an intense and rising demand for scientific manpower and by no means only for men and women with the highest qualifications. Every technologist relies on technicians and craftsmen to translate his plans into products. It would be a great mistake to increase the output of technologists without adequately supporting them at the lower levels from which in any event many of them are drawn. Much therefore depends on strengthening the base of the pyramid of technical education by improving the education in the schools and raising the numbers of school-leavers who are able and willing to take successfully the courses offered at technical colleges.

7. Here the prospects are good. The romance of science is catching on as can be seen even in the toy shops. Every year parents and children are taking a greater interest in technical education. More boys and girls are staying on at school after the statutory leaving age; more are taking science and more are continuing their education after school; and more are succeeding in the courses on which they have embarked. These are welcome signs that the base of the pyramid is growing stronger. It will also grow larger, since the age-groups from which Industry and the technical colleges are now recruiting are the smallest for a hundred years. Soon the figures will climb upwards. Last year the number of 18 year olds in Britain was 642,000; in ten years' time it will be about 850,000.

8. Technical education must not be too narrowly vocational or too confined to one skill or trade. Swift change is the characteristic of our age, so that a main purpose of the technical education of the future must be to teach boys and girls to be adaptable. Versatility has been the aim of a classical education; technical studies should lead to a similar versatility and should, therefore, be firmly grounded on the fundamentals of mathematics and science. It is much easier to adopt new ideas and new techniques when the principles on which they are based are already familiar.
9. The range of technical education goes far beyond the study of materials and mechanics. Accountancy, costing, salesmanship, commercial skills of all kinds, including foreign languages, are equally important to a great trading nation. Full employment brings new problems which are more likely to be soluble the wider is the understanding of how our economy works. Such subjects as economics, business management, wage systems and human relations must now be given more prominence.

10. In a sense, all technical progress rests upon the common foundation of language, and more attention will have to be given to the teaching of good plain English, the use of which saves time and money and avoids trouble. Without it bridges are hard to build over the gulfs that separate experts in different specialised subjects not only from the general public but from one another.

11. A place must always be found in technical studies for liberal education. The time available often limits what can be done in the way of introducing into the curriculum subjects such as history, literature and the arts, but in any event a wide treatment of scientific and technical subjects is essential if students who are to occupy responsible positions in industry are to emerge from their education with a broad outlook. We cannot afford either to fall behind in technical accomplishments or to neglect spiritual and human values.

12. Against this background the Government have reviewed the system of technical education in Great Britain. They are resolved that it shall fully match the needs of modern industry and offer to every boy and girl the chance of seizing the opportunities which scientific progress is opening before them. This White Paper, having described the progress made during the last ten years and the plans already in hand, announces proposals by the Government for a new major advance.

CHAPTER I

ENGLAND AND WALES

TECHNICAL EDUCATION TO-DAY

The school background

13. Plans for technical education must take account of progress in the schools. A varied pattern of secondary education is being developed. The aim is to help each boy and girl to go as far as their ability and perseverance will take them. For this purpose the organisation and interest of the work at the top of secondary schools are vitally important, for at fifteen children are free to leave school.

14. There are three main types of secondary school: grammar, technical and modern. They take about 20 per cent., 5 per cent., and 75 per cent. of an age-group respectively. The proportions vary from one area to another to meet local circumstances and preferences. Combinations of two of these types constitute "bilateral" schools, and some local education authorities are experimenting with comprehensive schools, which aim to give children under one roof the opportunity of all three types of secondary education at standards not inferior to those prevailing in separate schools.

15. Recent developments in the schools promise well for the future of technical education. In the grammar schools the pendulum is swinging towards science. Of boys who stay on into the sixth forms of maintained
grammar schools about 60 per cent, now take science as their main subject.
In the direct grant grammar schools the figure is about 50 per cent. and
in the public schools it is over 40 per cent. In many schools to-day the
proportion of science sixth formers is so high that a further increase in
their number will depend on an increase in the size of the sixth form as a
whole. At the same time more thought needs to be given to the possibility
of reducing early specialisation and of forging stronger links between the
sciences and the arts.

16. It must also be said that some grammar schools and public schools
still think too much in terms of white-collar jobs for their pupils. They
fail fully to imagine the cornucopia of the scientific revolution and to picture
to themselves the opportunities which a changing and expanding British
industry can offer to their pupils during the next fifty years. If talent is
not to be wasted, more boys and girls must stay on at school till they are
eighteen and aim at studying science or technology at either a university
or a technical college providing advanced courses.

17. Secondary technical schools, which provide a general secondary education
with an increasing technical bias in the later years of the course, have
an important part to play in areas where suitable courses are not already
available in grammar schools. Proportionately, indeed, secondary technical
schools have the best record of any kind of school in sending their pupils
on to success in technical colleges.

18. Too many of these schools still select at thirteen a second layer of
ability and put their children through a two or three year course, often in the
premises of a technical college. This must be remedied. The secondary
technical school of to-morrow should select at eleven from children of
grammar school calibre and have buildings of its own and a staff which
combines academic quality and industrial experience. Schools of this kind
can build up strong sixth forms which will provide candidates for universities
and for advanced courses at technical colleges.

19. Many secondary technical schools are gradually being transformed in
this way and others are being built. Experience has already shown that these
schools can establish a reputation which will be attractive to the ablest
children of eleven and their parents. The pupils in these schools will look
upon a career in industry as their natural goal whether it be reached direct
or through a university.

20. Though the grammar and technical schools take, broadly speaking, the
most able quarter of the boys and girls from primary schools there is sub-
tantial talent in the secondary modern schools. For example, in 1952–53 out
of 2,700 winners of the Higher National Certificate of Mechanical Engineer-
ing, 23 per cent, had been to modern schools. Boys and girls in modern
schools are beginning to take the General Certificate of Education (Ordinary
level) at sixteen, and some transfer to the sixth form of a grammar school
and go on to a university.

21. With facts such as these in mind modern schools are being encouraged
to develop courses for their older pupils which stir their interest in the
careers ahead of them, and act, as it were, as bridges between school and
further education. These courses attract each year more children to stay on
after fifteen in spite of the high earnings in juvenile employment. Boys and
girls who stay on at school arrive at a technical college much better fitted
to profit by their first course and much more likely to have the basic
knowledge necessary to proceed to higher levels. It is also a great saving
to the colleges not to have to teach their young students what they ought
to have learned at school.
22. Secondary education will improve as the supply and qualifications of teachers improve. Upon these teachers and their colleagues in the primary schools will largely depend the success of the technical colleges. Too often in the past, the colleges have been thought of as mainly concerned with giving a second chance to those who missed or were deprived of opportunities at school. The stronger the schools become, the more confidently will the technical colleges be able to set their standards high.

Youth Employment Service

23. All these developments make it important for young people to be well informed about the new opportunities opened up by technological advance. An important part in this task is played by the Youth Employment Service which is provided by education authorities, or in some areas by the Ministry of Labour, all under the general direction of the Central Youth Employment Executive of the Ministry of Labour and National Service. This service, which has been greatly developed since the war, is in a very good position, in the talks on careers that it arranges in schools and in its individual advisory work, to make known the range of openings available and to advise on the ways and means by which training for the various occupations can be obtained; in many cases the service may do the most good by influencing the youngster and his parents in the direction of continuing full-time education rather than seeking immediate employment.

Technical colleges to-day

24. Technical colleges are concerned with an unlimited range of technology. Beside the wide field covered by mechanical, electrical, civil, aeronautical and chemical engineering, there are, for example, courses in architecture and building, textiles, mining, plastics and many forms of applied physics and chemistry. Indeed, students from almost every industry can be found in some technical college.

25. In England and Wales there are about 500 technical or commercial establishments varying from large colleges of technology, mostly in London and the County Borough, to small technical institutes.* Nearly all are maintained by local education authorities. Though some students attend as a condition of their employment, for example, because they are apprentices, most of them are volunteers. Some 80 per cent. of the work is vocational and most of it is part-time. The fees charged are very low, representing on an average no more than one-fifth of the cost of the course.

26. There has never been any uniform pattern of technical education throughout the country. Over the last sixty years or so technical colleges have grown up on response to local demand, their siting being largely dictated by the location of industry. A remarkable variety of studies has been organised, from preliminary courses for boys and girls of fifteen to post-graduate work. Courses at every level are often found in the same technical college. Some of the staff are full-time, many are part-time. Some courses are held in the day, more in the evening. Two things common to most colleges are that they were full soon after they opened and have been bursting at the seams ever since.

27. Since 1945, as a result of vigorous efforts by local education authorities and industry, more has been done to expand technical education than in any corresponding period. But with demand always running ahead of supply

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* There are in addition colleges of art, adult education centres and some 9,000 evening institutes which include a substantial number of students attending for vocational purposes.
the results achieved have not been appreciated as they deserve. Table I shows the growth of the numbers of students at establishments of further education since the war. The figures for 1938 are also shown for comparison.

**TABLE I**

**NUMBER OF STUDENTS IN GRANT-AIDED ESTABLISHMENTS OF FURTHER EDUCATION**

<table>
<thead>
<tr>
<th></th>
<th>England and Wales</th>
<th>1937-38</th>
<th>1946-47</th>
<th>1954-55 Provisional</th>
</tr>
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<tbody>
<tr>
<td>Full-time</td>
<td></td>
<td>20</td>
<td>45</td>
<td>64</td>
</tr>
<tr>
<td>Part-time day</td>
<td></td>
<td>89</td>
<td>200</td>
<td>402</td>
</tr>
<tr>
<td>Evening only (estimated)</td>
<td></td>
<td>1,094</td>
<td>1,166</td>
<td>1,575</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>1,203</td>
<td>1,411</td>
<td>2,041</td>
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</tbody>
</table>

28. The diagrams and tables below illustrate the part which the technical colleges and other establishments of further education now play in the educational system of England and Wales. They show the percentage of the population aged fifteen to twenty, year by year, who are at school or at universities, training colleges for teachers, colleges of technology, commerce or art, or evening institutes.

**TABLE II**

**BOYS**

<table>
<thead>
<tr>
<th>Age</th>
<th>Schools</th>
<th>Universities</th>
<th>Teacher Training Colleges</th>
<th>Technical, Commercial and Art Colleges and Evening Institutes</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Full-time</td>
<td>Part-time Day</td>
</tr>
<tr>
<td>20</td>
<td>4-5</td>
<td>0-5</td>
<td>0-9</td>
<td>5-8</td>
<td>8-1</td>
</tr>
<tr>
<td>19</td>
<td>2-9</td>
<td>0-1</td>
<td>0-9</td>
<td>8-3</td>
<td>10-2</td>
</tr>
<tr>
<td>18</td>
<td>1-3</td>
<td>0-1</td>
<td>1-1</td>
<td>11-6</td>
<td>12-8</td>
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<td>0-6</td>
<td></td>
<td>1-2</td>
<td>19-3</td>
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<td>1-4</td>
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<td></td>
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<td>15-3</td>
<td>25-4</td>
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</table>

**TABLE III**

**GIRLS**

<table>
<thead>
<tr>
<th>Age</th>
<th>Schools</th>
<th>Universities</th>
<th>Teacher Training Colleges</th>
<th>Technical, Commercial and Art Colleges and Evening Institutes</th>
<th>Total</th>
</tr>
</thead>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Full-time</td>
<td>Part-time Day</td>
</tr>
<tr>
<td>20</td>
<td>1-6</td>
<td>1-6</td>
<td>1-6</td>
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<td>0-5</td>
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<td>32-9</td>
<td></td>
<td></td>
<td>2-7</td>
<td>4-7</td>
</tr>
</tbody>
</table>
29. The British system of technical education is probably more flexible than any other. For example, in most other countries it is very unusual for anyone leaving school before the age of eighteen to be able to embark on a career leading to the highest technological qualifications. The following paragraphs illustrate the routes by which in England and Wales a student may reach the various goals.

The part-time route

30. A boy of fifteen can go to a technical institute for a part-time junior course of one year which will improve his general education and help him to start at sixteen on an industrial apprenticeship or a commercial training. At that stage, joined by others who have left school at sixteen or seventeen, he will embark on a senior course of two or three years. Some of these will be craft courses leading to qualifications prescribed by industry, the examinations mostly being conducted by the City and Guilds of London Institute and Regional Examining Unions closely associated with it.

31. Parallel to the craft courses, or following them, come courses aimed at intermediate qualifications of technician level such as the Ordinary National Certificate, certain certificates of the City and Guilds of London Institute, and certain qualifications of industrial bodies.

32. At eighteen or nineteen the advanced stage begins. Until comparatively recently only a handful of students straight from school have been entering technical colleges at this point. Most part-time students at technical colleges have left school not later than sixteen and have worked their passage, many by study on one day a week and often one or more evenings as well, and many by evening work only, towards professional qualifications in engineering and other subjects. Advanced part-time courses last from two to four years and lead for most students to a Higher National Certificate, a London University degree, or some other recognised examination. Professional qualifications can be achieved after further study and practical experience in industry, so that the qualified technologist emerges at the age of 23–25.

33. In recent years a growing number of short post-graduate courses has been provided for the benefit of scientists and technologists employed in industry who wish to bring themselves up to date with the latest developments. In 1954 some 900 such courses were organised.

The full-time route

34. Full-time courses have also been organised in many of the major colleges. Those for the Ordinary National Diploma provide preliminary training suitable for entry into industry at eighteen as a student apprentice. These have not developed to any great extent because the majority of boys and girls who wish to remain in full-time education until they are eighteen prefer to stay at school.

35. The courses for the Higher National Diploma, being full-time are much more broadly based than those for the Higher National Certificate. They have a wider scientific content and normally include subjects of a liberal nature. Moreover, they often cover the full academic requirements for exemption from the examinations of professional bodies, whereas holders of the Higher National Certificate must spend an additional year or two on extra subjects, for example, works organisation and administration, and in some cases further specialised technical study.

36. In addition, a number of the major colleges provide full-time courses leading to graduate and post-graduate qualifications. These have hitherto represented the highest qualifications available to students in technical colleges.
National Colleges

37. Some industries, although important to the national economy, are too small to justify provision for advanced technical studies at more than one centre for each industry. This fact led the Ministry of Education soon after the war to arrange with six industries—foundry; horology and scientific instrument making; rubber; leather; food; and heating, ventilation and refrigeration engineering—to provide a national college for each of them. Selected students are sent full-time by the constituent firms, many of whom pay the students' wages during the course, the length of which varies from one to two years. The governing bodies, which are mainly representative of the industries concerned, are independent. The colleges are financed jointly by the Ministry and by industry, which has been generous towards them in both finance and gifts of equipment.

38. The College of Aeronautics at Cranfield differs in its origin and constitution from the other national colleges. It was established by the Government following the Fedden Report, and the Ministry of Education became responsible for the administration. The studies are post-graduate, and the governing body includes representatives of the Commonwealth and Services as well as industry.

Regional Planning

39. It was clear as far back as 1925 that the growth of technical colleges was leading to unnecessary duplication of courses in the highly industrialised regions. This was particularly true in Yorkshire where, on the advice of the then Board of Education, a Regional Advisory Council, representative of both educational and industrial interests, was established. Here and in other areas where other types of co-ordinating machinery were established much successful planning was done. In post-war conditions co-ordination was clearly still more desirable and in 1947, nine Regional Advisory Councils were set up to cover the whole of England. In Wales this function was entrusted to the Welsh Joint Education Committee. The Regional Advisory Councils serve two main purposes: (i) to bring education and industry together to find out the needs of young workers and advise on the provision required, and (ii) to secure reasonable economy of provision. Associated with these Councils are Regional Academic Boards for ensuring close co-operation between the universities and technical colleges in the provision of advanced courses. At the centre a National Advisory Council on Education for Industry and Commerce, which is largely representative of the regions, advises the Minister on national policy.

40. Much has been done by these bodies to establish good relations between industry and the colleges and to stimulate sound development. They must clearly play an even greater part in the future if courses, especially advanced courses, are to be organised on a strong and efficient basis and if adequate facilities are to be provided with reasonable economy in buildings and teaching staff.

Wales

41. Before the war the provision for technical education in Wales was, by comparison with that in England, somewhat meagre. This was a reflection of the traditional interest in grammar school education, seen mainly as a passport to the liberal professions, and of the fact that, in the past, Welsh industry, which was largely restricted to coal-mining, quarrying, iron, steel and tinplate, offered opportunities to relatively small numbers for skilled employment and high qualifications. Even so, the number of young Welshmen who availed themselves of these opportunities was insufficient for the
country’s needs—they preferred to be trained as teachers, clergymen, administrators, lawyers and doctors, to work in Wales and elsewhere, while the small Welsh demand for skilled engineers and technicians was, to some extent, met from other parts of the United Kingdom.

42. The industrial situation has changed considerably during the last generation. The character of the old-established industries has been transformed and many new industries have settled in Wales. The coal-mining and metallurgical industries are now more highly mechanised and the new factories, like their counterparts in the rest of the United Kingdom, depend on skilled craftsmen, mechanical, electrical, production and chemical engineers, on draughtsmen and scientists for their maintenance and development. Such a change is equivalent to a new industrial revolution in the life of the Principality, and as such, it constitutes a challenge to established ways, particularly in educational outlook and provisions. Young workers entering Welsh industry at fifteen to-day need opportunities for training as craftsmen as never before. Welsh grammar school pupils are wanted in industries that did not exist when their fathers were boys. Consequently more students must be attracted into advanced courses in technical institutes and colleges and into degree courses in applied science at the University of Wales if the youth of Wales is to equip itself for leadership in the economic life of the Principality.

43. The continuing growth in technical education in recent years is the measure of the country’s response to this challenge. Since the war full-time students at establishments of further education in Wales have increased from 1,500 to 2,500, part-time day students from 8,500 to 21,000 and evening students from 73,000 to 115,000.

44. During the same period seventeen new colleges have been completed or put under construction, while sixteen others have been extended.

45. These facts represent a real achievement in meeting the altered situation. The older establishments are also readjusting their work. For example, year by year more grammar schools are providing courses with a technical bias and the Welsh Joint Education Committee has correspondingly extended its examination arrangements to meet their needs and those of the technical institutes and colleges as well. It has also provided a forum for discussion and guidance to those local education authorities within whose areas the demands for advanced technical education have reached considerable dimensions.

46. This service has been a valuable one because the industrial pattern of Wales still differs from that of England. There have been far-reaching changes but Welsh undertakings, with one or two notable exceptions, are generally not so large nor so highly concentrated as their English counterparts, and the numbers of apprentices employed in separate establishments are comparatively small. Plans for advanced technical education in Wales must correspond with this situation. They must assume a readiness on the part of local education authorities and industry to co-operate if the best courses at the advanced level are to be provided for the technical experts of the future. Leaders of the educational and industrial life of the Principality must increasingly come to regard selected colleges as common possessions, to be developed to the highest level of academic efficiency in their own fields; uneconomic and wasteful proliferation of small advanced courses would provide only the second-rate, and would not be good enough as an educational support for modern industry.
CHAPTER II

THE ROLE OF THE UNIVERSITIES

47. In the education of technologists, the technical colleges are the partners of the universities. Their functions are complementary and although this Paper is not primarily concerned with the universities, it would be incomplete without some account of the role they play and of their recent development.

48. The contribution of the universities to both education and research in advanced technology as well as in pure science, is fundamental to our progress as a country. As explained below, the Government attach the greatest importance to the development of higher technology in the universities.

49. In some universities the technological studies are of a general nature: in others, they are more closely linked with the careers available in the region, such as the textile or chemical industries. Invariably, these studies are set against the broad background of fundamental science, and specialisation in technology is often not attempted until the post-graduate stage. Although many students work in factories in the vacations, at most universities they gain their first real experience of industry after graduation or after a period of post-graduate study or research.

50. The universities have greatly expanded since the war, and this expansion has been mainly on the scientific side. In 1946 the Committee on Scientific Manpower (Cmd. 6824) recommended that the university output of scientists and technologists should be doubled. The universities responded to this call and accepted a heavy degree of overcrowding to meet the pent up demand of those whose university careers had been interrupted or postponed owing to the war. The number of full-time university students of science and technology rose from 12,949 in 1938–39 to 27,659 in 1950–51, an increase of 121 per cent. While this peak was not wholly maintained when the ex-service demand fell off, the reduction in numbers was surprisingly small, and they are now rising again. In the current session full-time students of science and technology have reached a new peak of 29,013, 132 per cent. above the 1938–39 figure. They now represent 34½ per cent. of the university student population, as against 26 per cent. in 1938–39. The numbers obtaining first degrees in science and technology is now just over 6,000. Of these pure science accounts for 4,200, many of whom ultimately enter industry, and technology for about 1,850. There are, in addition, some 450 students who obtain diplomas in technology.

51. During the whole of the period since the war, buildings for teaching and research in science and technology have received high priority in the allocation of grants by the University Grants Committee towards capital expenditure by the universities.

52. Of £24½ million spent or committed since the war on major building schemes (£50,000 or more) from moneys at the free disposal of the University Grants Committee, £7½ million was allocated to buildings of interest to all faculties (halls of residence, student amenities, libraries, etc.) and £16½ million to buildings for teaching and research. Of this £16½ million, about 84 per cent. went to science in its various forms including technology and medicine. These figures do not include the special allocations for technology referred to below: nor do they include the extension of the Manchester College of Technology, costing about £1½ million, which has been financed by loans raised by the Corporation of Manchester.
53. The Government decided that a still further effort was needed to extend the supply of university trained technologists and in 1953 they announced their intention to undertake a massive expansion of the Imperial College of Science and Technology (University of London) to enable its student numbers to be increased from 1,650 to 3,000; they have already increased by about a quarter. This project will ultimately cost about £15 million. A further programme of development outside London was announced on the 7th December, 1954. This includes major developments at Glasgow, Manchester, Leeds and Birmingham; schemes on a fairly large scale at Cambridge and Sheffield; and specialised developments at other universities, financed in some cases by Treasury grant and in others by industry, at Edinburgh, Bristol, Newcastle upon Tyne, Nottingham, Southampton and Swansea. The developments at Glasgow and Manchester are based on the Colleges of Technology as well as on the universities. The capital grants required to finance these developments will amount to about £5 million and £1½ million for equipment. These grants have been supplemented on a considerable scale by benefactions from industry of both money and equipment.

54. Most of the building projects in the programme outlined in the previous paragraph are already under construction and all will have been started by 1957, the final year of the present university quinquennium, which began in 1952. The Universities are now formulating their plans for further developments to be put in hand during the quinquennium 1957–62. The university Grants Committee, who will consider these proposals, will then make recommendations to the Government during the present year.

CHAPTER III
THE PLAN FOR THE TECHNICAL COLLEGES OF ENGLAND AND WALES

55. Against the background described in Chapter II the Government have decided on a further expansion of technical colleges. For this purpose they propose to put in hand immediately a five-year programme of development related as closely as can be to the most urgent demands and the extent of available resources. The objectives during this period are to increase by about a half the output of students from advanced courses at technical colleges and, as part of a proportionate increase at the lower levels, to double the numbers released by their employers for part-time courses during the day. This will call for building to be started in the period 1956–61 to the value of about £70 million. When these objectives are secured, the Government will consider what further measures are needed. The details of the five-year plan are described below.

TECHNOLOGISTS

56. The mixture of earning and learning made possible by technical colleges continues to demonstrate its success. The students have proved their worth in practice and employers want more of them. The present annual output from advanced courses at technical colleges in England and Wales
(including roughly 1,000 who gain degrees in science and about 500 who gain degrees in technology) is about 9,500. The proportion of these who ultimately become technologists in the sense in which the term is used in this Paper (see page 1) is not precisely known, but is probably about one half. The Government now propose to raise the capacity of advanced courses at technical colleges as soon as possible from 9,500 to about 15,000.

**Advanced full-time and sandwich courses**

57. As technologies grow more complex and the need for versatility increases, the strain of reaching these high qualifications by evening work or by studies on one or two days a week becomes more severe. There will be many, especially those who ambitions do not extend beyond the Higher National Certificate, who will wish or will be obliged by circumstances to continue to take part-time courses. But the Government believe that for the highest technological qualifications sandwich courses will become more and more appropriate. These are courses lasting four or five years and involving alternate periods, usually of three to six months, of theoretical education in a technical college and specially designed practical training in industry.

58. These advanced courses will suit the able worker who has already had experience in industry and should also attract an increasing number of boys and girls who, when they leave school at eighteen, feel the urge to start their careers as soon as possible.

59. The National Advisory Council on Education for Industry and Commerce under the chairmanship of Lieut.-General Sir Ronald Weeks has very recently submitted to the Minister of Education a report on sandwich courses. This report has been prepared after consultation with the Federation of British Industries, the National Union of Manufacturers, the Association of Chambers of Commerce, the Trades Union Congress and the associations of local education authorities and teachers, and all these bodies have expressed their general support for the proposals in it. It is reproduced as Appendix B to this Paper. The Government fully endorse this report. Sandwich courses have been or are being developed for the building, chemical, electrical, mechanical engineering, mining and railway industries and similar arrangements for other industries will be vigorously encouraged.

60. Sandwich courses at the highest level will, no doubt, be eligible for the new Award to be given by the National Council for Technological Awards under the chairmanship of Lord Hives. This Council has been set up on the recommendation of the National Advisory Council on Education for Industry and Commerce. At the moment, the only national qualification of sufficiently high level for many of the best students attending technical colleges is the London External Degree. This suffers from the disadvantages inherent in external control and is limited to a few technologies. It was therefore considered to be unsuitable as a permanent qualification for colleges of advanced technology. In the National Advisory Council's view the best way of overcoming the difficulty was to create a new qualification of high standing which would allow the colleges freedom to plan their own courses in consultation with industry and the professional bodies and to conduct their own examinations. The National Council for Technological Awards, which is an independent body, was recently established to create and administer this new qualification and to satisfy itself that conditions of teaching, and the syllabuses and examinations, are satisfactory. This is a vital task: the work of the Council will do much to determine the scope and quality of advanced technological studies in the next generation.
Aid to students

61. These developments must be backed by an adequate system of financial aid. For those already employed in industry Technical State Scholarships are available to help students of outstanding intellectual ability to pursue honours degree courses at universities or courses of equivalent standing elsewhere. Students proposing to attend courses leading to a Technological Award will, therefore, be eligible for Technical State Scholarships and the number will be raised as these courses develop.

62. In order to encourage boys and girls to enter these courses straight from school, the Government propose in future to allow ordinary State Scholarships awarded on the results of the General Certificate of Education Examination to be held not only for honours courses at universities, but also for courses leading to a Technological Award.

63. Local education authorities already have power to assist students at such courses and, in view of the academic level of these studies, authorities are being asked to give such assistance in the form of Major Awards, i.e., at rates equivalent to those paid to university students.

64. The Government are glad to note that many of the students now attending advanced sandwich courses are assisted generously by their employers. Enlightened firms pay the college fees and the students’ wages during studies, the latter at a rate which would be earned if the students were working in industry. This arrangement attracts students to the courses, stimulates their sense of loyalty to the firms and strengthens the firms’ ties with the colleges. This is a healthy development which the Government have encouraged by allowing the payment of fees to count as a business expense for income tax purposes, and they hope to see more firms adopting this practice.

Colleges of Advanced Technology

65. The Government consider that the bulk of full-time or sandwich courses should be carried on in colleges which concentrate on advanced courses of technological level.

66. Teachers capable of taking charge of such courses are scarce and the equipment they need is often expensive. Moreover, an advanced course in one technology often cannot be efficient unless allied technologies are studied to a similar level in the same college. The college must also be strong in the appropriate fundamental sciences. And opportunities for research are essential in order to promote fully effective co-operation between industry and the staff of the technical college.

67. In 1952 a special rate of 75 per cent. grant was introduced to foster the development of technical colleges in which a large proportion of the work would consist of advanced work and research in technology including courses in advanced technology at graduate and post-graduate levels.

68. The following twenty-four* colleges at present receive 75 per cent. grant for certain of their advanced work: —

- Birmingham College of Technology.
- Bradford Technical College.
- Brighton Technical College.

* The Manchester College of Technology, which has been receiving 75 per cent. grant, has now been granted a Royal Charter and will come under the aegis of the University Grants Committee. It is therefore not included in the list.
Huddersfield Technical College.
Leicester College of Technology and Commerce.
Liverpool College of Building.
London—
   Battersea Polytechnic.
   Lambeth, Brixton L.C.C. School of Building.
   Chelsea Polytechnic.
   Finsbury, Northampton Polytechnic.
   Islington, Northern Polytechnic
   St. Marylebone, The Polytechnic.
   City, Sir John Cass College.
   Southwark, Borough Polytechnic.
   Woolwich Polytechnic.
Middlesex, Acton Technical College.
Nottingham and District Technical College.
Salford, Royal Technical College.
Stoke-on-Trent, North Staffordshire Technical College.
Sunderland Technical College.
Warwickshire, Rugby College of Technology and Arts.

and in Wales:—
   Cardiff College of Technology and Commerce.
   Treforest, Glamorgan Technical College.

69. The Government now wish to see the proportion of advanced work at these colleges vigorously increased. The Minister of Education will discuss forthwith with the local education authorities concerned how this can be done within the framework of the building programme announced in this Paper. In addition there may be a few other colleges which, because of developments now in train or the movement of industry, may qualify for 75 per cent. grant.

70. The building up of colleges of advanced technology will not prevent the development elsewhere in suitable cases of advanced courses, particularly those of a part-time nature. Indeed, part-time advanced courses are already provided in some 150 local colleges conveniently placed for the students and part-time staff who work in industry. These courses make a vital contribution to the total output of technologists, especially by the Higher National Certificate route, and they will be expected to continue and develop as long as they are efficient and can attract enough students.

71. There are those who argue that a college of advanced technology cannot be successfully administered within the framework of local government. The Government do not accept this. Local authorities take great pride in such colleges and often have been willing to find more money for them than the pressure on national resources has allowed them to spend. To remove them from local control against the wishes of the authorities could be justified neither by past experience nor by the hope of better results from a more central control. This statement is, however, subject to one qualification: the Government do rely on the local authorities to work
effectively together in planning the provision of courses and—just as important—in making it possible for students, whether they live in their own or another local authority's area, to attend courses which best suit their needs.

72. Colleges of advanced technology must also have the independence appropriate to the academic level of their work. Some local authorities have pointed the way by establishing strong governing bodies widely representative of industry and with power to spend within the heads of annual estimates approved by the authority. The Minister is taking steps in consultation with the local education authorities concerned to ensure the general adoption of this policy for all colleges of advanced technology. He also proposes to review the accommodation and equipment of each such college and to satisfy himself that the staff are adequately qualified and have appropriate freedom to plan their own courses.

73. Within the five-year programme of capital development announced in this Paper the colleges of advanced technology will be expected to make considerable progress in increasing their volume of advanced work, especially by means of full-time and sandwich courses, and in divesting themselves of work below the advanced level. They will be expected, too, to develop a substantial amount of research, particularly research sponsored by industry, and, where appropriate, to initiate post-graduate studies. They should also encourage their staff to undertake a reasonable amount of consulting work.

74. For all this to be done the scale of staffing will have to be more generous than it is in some cases at present. This must be faced, for these colleges are of crucial importance to the future of technological education in this country.

75. These and all other colleges engaged on advanced work will be expected to develop close contacts with the appropriate universities. This is done today both direct and through the Regional Academic Boards for Technical Education on which the universities, the local education authorities, the technical colleges and industry are represented. It seems probable that the resources of both universities and colleges could be co-ordinated to greater effect than is sometimes the case at present.

TECHNICIANS AND CRAFTSMEN

76. The conditions which demand an increase in technologists apply also to technicians. As many as five or six technicians may be required to every technologist. The Minister of Labour and National Service has already asked industry, through his National Joint Advisory Council, to consider future needs for technicians and craftsmen and how to meet them.

77. The traditional method of training technicians and craftsmen in this country is apprenticeship, of which the characteristic feature is that the apprentice receives practical training in employment for a period of years. Versatility and grasp of principles are indispensable for enabling those who are being trained today to keep up-to-date and play their part effectively in the conditions of the future. In view of this employers in most industries which have adopted apprenticeship schemes have agreed to release their apprentices for one day a week for attendance at technical classes where facilities exist.

78. Since the war there has been a great increase in the use made of such facilities, but there is certainly scope for more. Table IV shows the wide variations in the practice of day release in different industries.
<table>
<thead>
<tr>
<th>Industry</th>
<th>Boys</th>
<th>Girls</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimated numbers insured at</td>
<td>Estimated numbers insured at</td>
</tr>
<tr>
<td></td>
<td>end of May*</td>
<td>end of May*</td>
</tr>
<tr>
<td></td>
<td>Numbers released by employers</td>
<td>Numbers released by employers</td>
</tr>
<tr>
<td></td>
<td>during year</td>
<td>as per cent. of numbers insured</td>
</tr>
<tr>
<td></td>
<td>1954</td>
<td>1954</td>
</tr>
<tr>
<td>Engineering, Shipbuilding and</td>
<td>77,330</td>
<td>69,203</td>
</tr>
<tr>
<td>Electrical Goods</td>
<td>69,203</td>
<td>90</td>
</tr>
<tr>
<td>Mining and Quarrying</td>
<td>37,960</td>
<td>20,807</td>
</tr>
<tr>
<td>Public Administration and Defence</td>
<td>10,050</td>
<td>5,495</td>
</tr>
<tr>
<td>Building and Contracting</td>
<td>67,670</td>
<td>30,216</td>
</tr>
<tr>
<td>Chemicals and Allied Trades</td>
<td>8,140</td>
<td>3,220</td>
</tr>
<tr>
<td>Gas, Electricity and Water Supply</td>
<td>6,830</td>
<td>2,503</td>
</tr>
<tr>
<td>Paper and Printing</td>
<td>19,620</td>
<td>6,455</td>
</tr>
<tr>
<td>Professional Services</td>
<td>12,730</td>
<td>3,371</td>
</tr>
<tr>
<td>Transport and Communications</td>
<td>40,370</td>
<td>6,679</td>
</tr>
<tr>
<td>Metal Manufacture</td>
<td>16,230</td>
<td>2,516</td>
</tr>
<tr>
<td>Other Manufacturing Industries</td>
<td>6,150</td>
<td>896</td>
</tr>
<tr>
<td>Clothing</td>
<td>12,440</td>
<td>1,706</td>
</tr>
<tr>
<td>Food, Drink and Tobacco</td>
<td>21,580</td>
<td>2,450</td>
</tr>
<tr>
<td>Textiles</td>
<td>17,880</td>
<td>1,846</td>
</tr>
<tr>
<td>Precision Instruments, Jewellery, etc.</td>
<td>5,360</td>
<td>482</td>
</tr>
<tr>
<td>Manufacturers of Wood and Cork</td>
<td>20,260</td>
<td>1,184</td>
</tr>
<tr>
<td>Vehicles</td>
<td>48,980</td>
<td>2,916</td>
</tr>
<tr>
<td>Treatment of Non-Metallicous Mining Products other than coal</td>
<td>11,800</td>
<td>584</td>
</tr>
<tr>
<td>Distributive Trades</td>
<td>76,360</td>
<td>3,025</td>
</tr>
<tr>
<td>Leather, Leather Goods and Fur</td>
<td>2,340</td>
<td>95</td>
</tr>
<tr>
<td>Miscellaneous Services (including Entertainment)</td>
<td>19,060</td>
<td>503</td>
</tr>
<tr>
<td>Agriculture, Forestry and Fishing</td>
<td>46,610</td>
<td>574</td>
</tr>
<tr>
<td>Insurance, Banking and Finance</td>
<td>7,240</td>
<td>7</td>
</tr>
<tr>
<td>Metal Goods not elsewhere specified</td>
<td>17,410</td>
<td>163</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>610,400</strong></td>
<td><strong>166,896</strong></td>
</tr>
</tbody>
</table>

* Figures supplied by Ministry of Labour and National Service.
† Industries classified in accordance with the Standard Industrial Classification.
79. Technical education, essential as it is, is always regarded as an adjunct to, and not a substitute for, practical training on the job. Industry, therefore, must play the leading part in any increased output of craftsmen, but the Government will be ready to do its share in providing the additional facilities for technical education which may be required both to match any rise in numbers as well as to meet any call for more intensive technical education of apprentices.

80. The terms of apprenticeship and education should be adjusted to suit changing needs. For example, it is undesirable that rigid apprenticeship age limits should prevent the completion of a pre-apprenticeship full-time course where this is found to provide a useful preparation for a young person who intends to become a skilled craftsman but who would not finish the course until after his sixteenth birthday. At the other end, the withdrawal of the privilege of day release at the age of eighteen, which sometimes occurs in the middle of an educational year, discourages both students and colleges.

Wastage

81. Serious wastage occurs at present in courses for technicians and craftsmen. In many courses only one-quarter of those who start reach and succeed in the examination which comes at the end of it.

82. Most of the wastage takes place at the age of about sixteen. The main reasons for it are reliance on evening classes, the need to work overtime, being away on a job, shift work, travelling difficulties, ill-health, a change to another job, home conditions which make study there impossible, or lack of encouragement from the employer. Some of these are irremediable, but the present rate of wastage can be reduced by greater understanding on the part of parents and employers, by better selection and especially by the substitution of part-time day for evening classes.

83. It is not always easy to judge whether a boy or girl of fifteen or sixteen will be able to make a success of a particular course and it is human to err on the side of generosity. Young people want to feel that they can go far. But it is a mistaken kindness to admit them to courses for which their ability is clearly inadequate. The temptation to do this is less where there is a system of easy transfer upwards from one grade of course to another.

84. Experience shows that wastage from part-time day courses, especially the large majority which are attended as part of a formal apprenticeship training, is much less than from evening classes. The local education authorities and industry will therefore be urged to enable more and more boys and girls to study during the day instead of in the evening. At technician level it may well be advantageous to provide some of these day-time classes in the shape of sandwich courses as recommended in the report at Appendix B to this Paper.

85. Table IV shows the number of boys and girls under eighteen released by their employers during the day in 1953–54. In that year the number of students of all ages released during the day was 326,000. In 1954–55 this number rose to 355,000. The Government's aim now is to see this last figure doubled.

Refresher courses

86. As industrial techniques develop it will be important to provide opportunities for workers in mid-career to bring themselves up to date. Training in new skills will remain the responsibility of industry, but it will be for the technical colleges to provide short courses designed to explain the principles involved.
87. Girls are a match for boys at school. They do at least as well in the selection at eleven plus and in most secondary school examinations. But once they leave school far fewer girls continue their education. The only exception is that twice as many girls as boys take full-time courses in further education between the ages of fifteen and eighteen, but the numbers involved are very small. The picture is quite different for part-time courses, for which four times as many boys as girls are released. Among girls of eighteen only one in five pursues any form of education. How unsatisfactory these figures are can be seen against the fact that half the girls and women in the country between the ages of fifteen and thirty-five are “gainfully occupied”. Hundreds of thousands of these young women are not making the best use of their talents because they stopped their education when they left school.

88. A great many girls do not see the point of further education once they have got a job. Their hopes are naturally bent on marriage and they fear perhaps—that by aiming at a certificate they may miss a husband.

89. Employers, finding that many girls marry early and give up their jobs, often think it not worth while to help the girls who come to them from school to continue their education. We find, for example, that only one girl in twenty-five in the distributive trades, which employ over a quarter of the girls in work, is released for a day-time course. In short, so many girls leave school with the idea that whatever job they take they are only filling in time till they get married that the demand for their further education is very much smaller than it ought to be.

90. A change of outlook is needed, not because more girls and women should be persuaded to go out to work, but because further education will enable the great number who do earn their living to qualify for better jobs and to gain the maximum pleasure and profit from their work; and, contrary to old-fashioned ideas, such further education is not wasted if a girl marries and exchanges a career outside the home for one within it. Far more often than not the knowledge and experience that comes from studying for a better job helps her to build her own family on foundations of common interests and understanding.

91. Apart from teaching, the most popular courses with girls cover such subjects as nursing, commercial and secretarial work, commercial and industrial design, art, the needle trades, catering, cookery and domestic subjects. Fair numbers are taking courses in scientific subjects, but there is no doubt many more could take up science and would find openings for most successful careers. The problem is how to increase the number of girls asking for science courses, and the weakness here is in the secondary schools, where there is a shortage of teachers of mathematics and science more pronounced than in boys’ schools. The best point to attack this problem must be in the girls’ grammar schools where the Head could influence more girls, who have decided to take up teaching, to choose science or mathematics as their special subject. Only small numbers of girls at present decide to study science or mathematics at the universities or training colleges. It is in the national interest that more should be encouraged to do so.

92. We do not know the precise extent of the reserve of talent among our young people, which waits to be developed by further education; but it is safe to say that it is greater among the girls than the boys. As, however, the ambition to marry will very rightly continue to be uppermost in the thoughts
of girls, progress in recruiting more girls and women for courses in technical colleges depends on their recognition that further education will help and not hinder the prospects of a happy married life.

THE PROGRAMME OF CAPITAL DEVELOPMENT

93. The building programme for technical colleges for 1956–57 is planned to reach about £9 million. Though this is £2 million larger than the 1955–56 programme and nearly £4 million larger than the 1954–55 programme, it is a good deal less than local education authorities have asked for. The Government propose to step the programme up. The rate of the increase will be decided from time to time, [in the light of economic circumstances and progress with the programme], but the general intention is to start £70 million worth of work within a period of five years, i.e., over the years 1956–57 to 1960–61 inclusive. These projects are estimated to require the expenditure of a further £15 million for equipment.

94. For projects such as technical colleges, which are often large and always complex, the present system of compiling annual programmes only about twelve months ahead of the beginning of the year in which the projects are due to be started is inadequate. In order to give authorities longer notice, the Minister of Education will approve this spring a programme of £15 million for 1957–58 and a [provisional] programme, also of £15 million, for 1958–59. Thus, taking into account the programme of £9 million already approved for 1956–57, the Government's proposals provide for a total of £39 million worth of work to be started during the first three years of the five-year period.

95. When the programme for 1957–58 and the [provisional] programme for 1958–59 have been approved, the Minister will invite advance proposals for 1959–60 and 1960–61 with a view to encouraging authorities to proceed with the planning of at least the larger projects which should be started in those years. The 1959–60 programme as a whole will be approved not later than the spring of 1957.

96. Our best post-war schools have become famous throughout the world because they combine low cost with high quality of design, construction and finish. The lessons which have been learned in school building will be applied to technical colleges. Fine college buildings can illustrate, as nothing else can, the confidence in the future which inspires the expansion of technical education. The Government hope that in view of the importance of these projects local authorities will be careful to choose good architects whether from their own staff or from those in private practice. They hope too that authorities will insist on adequate briefing and planning before building begins and that architects and contractors will combine to show what efficient teamwork can achieve.

97. A technical college is much more than a collection of workshops, laboratories and classrooms. There must be facilities for food, recreation and social life, and at some colleges of advanced technology hostel accommodation will be required. It is hoped that industries for which courses leading to the new technological award have been arranged will help to provide hostels for their employees.

98. At the lower levels many more buildings for technical education will be required close to the homes or work of the young people concerned. Local colleges will be needed both to relieve the colleges of advanced technology of their less advanced work and to provide a location for the day-time courses which will be substituted for some of the evening classes at secondary schools.
THE SUPPLY OF TEACHERS

99. There are at present some 40,000 part-time and about 9,000 full-time teachers in technical colleges. These figures show the dependence of the colleges on part-time teachers. About 9,500 of them are school teachers who teach in technical colleges in the evening. Most of the rest are drawn from industry and commerce on account of their special qualifications and experience. Some are released by their employers to teach part-time day students. Many teach classes in their spare time.

100. A considerable number of the full-time teachers are university graduates with industrial experience. Others have technician or craft qualifications. Many come from the ranks of the part-time: they acquire a liking for teaching when they are given charge of part-time classes and then turn over to full-time service as the opportunity arises. Indeed teachers recruited in this fashion are often among the best. Such transfers from industry by men in mid-career are an important source of strength to the technical colleges.

101. To achieve the objectives set out in this Paper many more teachers will be required. The Government hope that industry will be ready to release yet more of its employees for part-time teaching during the day, so that its apprentices may be given the more through grounding which modern conditions require.

102. The supply of full-time teachers has recently been growing at the very satisfactory rate of 700 to 800 a year. Local education authorities have a substantial measure of discretion over salaries for technical college staffs and by offering the right conditions of service they should be able to attract a reasonable share of the available technical manpower.

103. The success of our plans depends as much on quality of teaching as on numbers. In improving quality training can play an important part. Since 1945 training colleges for technical teachers, mainly for full-time teachers, have been established in London and at Bolton and Huddersfield. The Ministry of Education, local education authorities and Regional Advisory Councils run many short courses for part-time teachers and a number of well-known firms have co-operated in this work, lending staff and lecturers for the courses and giving the teachers opportunities to keep abreast of industrial developments. The professional institutions, which have done so much to raise standards in technical education, have also helped by organising conferences for teachers on modern methods in teaching and industrial practice.

104. The Government hope to see more and more teachers taking advantage of these facilities and as the supply of teachers improves it will be possible for increasing numbers to be released by local education authorities for refresher experience in industry. This experience is invaluable and the practice should be encouraged to the fullest extent possible.

TECHNICAL LITERATURE

105. Every technical college should have a library with adequate supplies of technical books and journals. The library can play an important part in the general life of the college, and especially in the development of its advanced work and in training students in methods of handling technical literature. Its first duty is to the staff and students of the college. It can also, however, give valuable service by making its resources available to local industry and by acting as a centre for the supply of technical information and the exchange of technical ideas. In this way the library can make some return for the release of part-time teachers from industry, which is so
vital to the Government's plans. For these reasons every technical college library should have a grant large enough to enable its acquisition of books and periodicals to keep pace with technical developments.

106. There should also be as much co-operation as possible between college, public and other libraries at local, regional and national levels. This will make easier the interchange of technical material and information, which is particularly desirable in view of the high cost of many technical books.

CHAPTER IV

SCOTLAND

THE STRUCTURE OF TECHNICAL EDUCATION IN SCOTLAND

107. What is said in the introduction to this Paper on the need for and the aims of technical education and on the distinguishing features of the form that kind of education takes in Britain, applies to Scotland no less than to England and Wales. In other ways, too, technical education in both countries has much in common. In both, boys leaving school at fifteen can pursue their studies part-time right up to an advanced standard comparable with that of a university degree. Those completing a full secondary school course at seventeen or eighteen can enter the part-time courses at technical colleges at a higher level, or can enter on full-time courses for a degree or comparable award. Again, the part-time qualifications which are so important a feature of technical education—the National Certificates and the awards of the City and Guilds of London Institute—are the same in both countries. But there has been a considerable difference in the evolution of the structure within which technical education is given in the two countries. After a short survey of secondary education as the foundation of that structure, this chapter describes its development in Scotland and the Government's proposals for carrying forward that development to keep pace with the needs of the new industrial age.

SECONDARY EDUCATION

108. Pupils are allocated to secondary courses, usually between the ages 11½ and 12½ according to their fitness to profit from them, but may be transferred to another course later if necessary. Courses are of two main types, those extending normally to three years, called junior secondary courses and intended for pupils leaving school at fifteen, and those extending to five or six years, known as senior secondary courses. The former correspond roughly to those provided in secondary modern schools in England, while the latter cater broadly for the types of pupils who are there admitted to grammar schools and secondary technical schools. Both provide a general education but are differentiated to suit varying needs and abilities, and both include technical courses. While some schools offer only junior secondary courses and some only senior secondary, in a number of schools of the "comprehensive" type, both are provided.

109. Junior secondary courses are attended by about 70 per cent. of secondary pupils. All the pupils study science and at least some mathematics and all boys receive a training in crafts and in technical subjects. In their recent memorandum "Junior Secondary Education" the Scottish Education Department have recommended a realistic approach to all subjects which will
take account of the lives the pupils will later lead as individuals and as citizens, and of their vocational aims. The great majority of the pupils leave at fifteen to enter employment, but a number of schools have successfully developed intensive fourth year classes in which those who remain at school can prepare themselves for more advanced technical and commercial education, and this development is receiving every encouragement.

110. Senior secondary courses account for as much as 30 per cent. of the total secondary intake and even this figure is exceeded in some areas. These courses normally lead to presentation for the Scottish Leaving Certificate, which corresponds broadly to the General Certificate of Education in England. Candidates may be presented in the fifth or sixth year in any subject on either the lower or the higher grade. The standard of the lower grade corresponds roughly to that of the ordinary level of the General Certificate of Education, but that of the higher grade, not being based on a period of specialised study in a sixth form in the English sense, is not as high as that of the advanced level. Pupils may also be presented on the lower grade only in the fourth year provided they are leaving school at the end of that year, a condition which it is now proposed to remove.

111. The great majority of boys and girls study both mathematics and science for at least three years, and the number taking these subjects up to the level of the Scottish Leaving Certificate has increased steadily. In 1954, mathematics with 7,418 candidates, was second only to English with 8,499, and science with 4,861 occupied fifth place among the 25 subjects of the examination. Practically all the schools have facilities for craft work and for technical subjects, and 145 out of a total of 235 provide courses in technical subjects leading to the Scottish Leaving Certificate.

112. The relatively high percentage of the secondary intake already admitted to senior secondary courses suggests that expansion of numbers must come mainly from a reduction in wastage. Although the number of pupils in the fifth and sixth years has been gradually increasing, many pupils of ability still leave prematurely, and concerted efforts are being made by approaches both to the pupils and to their parents, to encourage more to complete the course and qualify themselves either for further study or for entry to the professions and to the higher ranges of industry and commerce. If this aim is to be achieved the schools must cater adequately not only for the minority of academic bent, but also for those whose needs would be better met by courses of a more practical character. The curriculum is accordingly now being examined with a view to introducing as much variety and flexibility as possible, and to ensuring proper integration with courses of further education at the various levels.

CENTRAL INSTITUTIONS

113. In Scotland, in contrast to England, the keystone of the system of technical education has been, not the local technical college administered by a single education authority and serving that authority's area, but the central institution functioning on a regional basis. These institutions came into existence in the first decade of the present century under independent governing bodies representing the educational, industrial and other public interests in the region. From the outset, they were designed to provide, in addition to such other less advanced facilities as might be appropriate, the highest forms of instruction in applied science, together with opportunities of research and discovery. In the words of the official announcement of this policy in 1901: "It is from such institutions . . . that decisive advantage to the industries of the country, in so far as that is dependent on educational arrangements, is to be looked for".
Scotland, therefore, began not with a large number of local technical colleges as the broad base of a pyramid on which higher institutions would later be raised, but with a small number of central institutions as pioneer centres which blazed the trail in technical education and round which local outposts—the local further education centres—were later to grow up, drawing inspiration from the central institutions. That technical education in Scotland should originate in this regional framework is largely attributable to factors of geography and population. It has proved itself well suited to the needs of a small country with a limited population heavily concentrated in a few industrial areas. The central institutions—of which 7* are concerned with the strictly "technical" subjects—have grown steadily in importance and usefulness as their range of courses, numbers of students, both full-time and part-time, and buildings have expanded. Not only have they made great strides within their own bounds in developing the higher forms of technical education, but they have exercised a profound influence on the provision made by education authorities at the more elementary levels.

Full-time Courses

115. From the outset, the courses offered at the colleges—full-time and part-time—covered a wide range of subjects including the sciences, pure and applied, and the technologies relating to industries, such as engineering in all its branches, building, printing, baking, brewing and woollen manufacture. The distinguishing feature of the colleges has been the full-time courses leading to their own diploma or associateship. Indeed, in some, the greater proportion of the work is full-time. The numbers taking these courses have risen from 1,600 in 1938 to 2,000 in 1954.

116. The full-time courses are of three or four years' duration, and comparable in scope and standard with university degrees. Age and qualifications for entry are usually similar to those for a university degree, except as regards such requirements as a foreign language. The awards thus instituted by the individual colleges have won for themselves an increasing reputation both in Scotland and beyond which testifies to the high standard of instruction provided. The highest awards of the two leading central institutions—the Royal Technical College, Glasgow, and the Heriot-Watt College, Edinburgh,—are now recognised as being of honours degree standard. That such awards are becoming increasingly attractive to students and acceptable to industry is shown by the striking expansion in the last few years in the numbers completing the appropriate courses at the two colleges. Thus at the Royal Technical College, the number of associateship awards rose from 97 in 1950–51 to 160 in 1954–55 (a number of the same students taking the University degree as well). At the Heriot-Watt College between the same years the number of associateship awards rose from 49 to 65.

117. In addition, under affiliation arrangements with their respective Universities, these two Colleges provide a number of courses leading to the B.Sc. degree of the universities. At Aberdeen, Robert Gordon's College have long had a scheme of co-operation with the University for joint teaching of degree and diploma students in engineering. This has recently been revised to obtain still closer co-operation in future. The other central institutions

* These are:—Aberdeen, Robert Gordon's Technical College; Dundee, Institute of Art and Technology; Edinburgh, Heriot-Watt College; Galashiels, The Scottish Woollen Technical College; Glasgow, The Royal Technical College; Leith Nautical Technical College; Paisley Technical College.
provide courses for external degrees of London University as well as for their own awards and for Higher National Diplomas. A considerable amount of research, much of it for industrial concerns, is carried out at the various central institutions, and post-graduate awards are available at some of them.

118. One of these central institutions—the Royal Technical College—is generally recognised as having pioneered the sandwich course whereby students spend one part of the year in study at the College and the remainder in practical work in industry. This method of training can be traced to the diploma courses at the College as far back as the 1880's and has been maintained there ever since. The same practice has been followed for the engineering degree courses of Glasgow University, both at the University itself and at the College, and is regarded as of the highest value as a method of study in the technological field. In more recent years it has been successfully introduced in certain courses at the Heriot-Watt College, Edinburgh, and at Paisley Technical College.

119. A later development in the associateship courses which has been of some importance and which may be of even greater significance in future is the acceptance into the penultimate year of men who have gained their Higher National Certificates. In this way, these men, by the addition of two years' full-time study to their five or more years' part-time study, can carry their advanced studies to a level comparable with the highest available anywhere in this country, and secure a qualification recognised as equivalent to an honours degree. Students recruited by this means are regarded as of the finest quality obtainable anywhere, and they represent one of the few hitherto untapped pools of real talent from which any substantial additional numbers of technologists of first-class calibre can be drawn.

**Part-time Courses**

120. Alongside their full-time courses, the central institutions provide a wide range of part-time courses. At first these were evening only, but later part-time day classes were added. These courses range from those at Higher National Certificate level to pre-National Certificate courses for boys who have just left school, courses for certificates of the City and Guilds of London Institute or courses of a purely practical nature for young apprentices. Although, as described below, some of these courses are being gradually transferred to local centres run by education authorities, the following figures show the large numbers of part-time students still attending the seven central institutions concerned.

<table>
<thead>
<tr>
<th>Year</th>
<th>Day</th>
<th>Evening</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1946</td>
<td>...</td>
<td>1,238</td>
<td>5,844</td>
</tr>
<tr>
<td>1954</td>
<td>...</td>
<td>4,422</td>
<td>10,349</td>
</tr>
</tbody>
</table>

**LOCAL CENTRES**

121. Alongside the growth of the central institutions in the first decades of the present century, education authorities greatly developed the provision of evening classes at the more elementary stages of technical subjects, and the “night school” became a traditional feature of the training of the young Scottish worker. But these classes could be accommodated only in school premises, and, in the absence of special equipment, had to be confined within a relatively narrow range. As a result of this factor and the very success of the central institutions in discharging their all-embracing task there was, up to the last war, a tendency in Scotland—which is still all too prevalent—to look to the central institutions for the provision of all types of technical education outside the normal evening classes.
Local Technical Colleges

122. But the increasing range and complexity of scientific and technological knowledge and the steady growth in demand for technical education, both day and evening, made it impracticable and undesirable that the central institutions should continue to cover the entire range of technical education in Scotland. In certain areas, therefore, education authorities even before the last war, began to develop, in addition to their evening class provision, centres for technical education or local technical colleges as they are now called. By this means the central institutions could be relieved of the more elementary stages of their work and left free to develop the more advanced courses and studies and to increase the numbers of the students in them.

123. Some 50 local technical colleges and other day institutes providing pre-vocational or other full-time courses and part-time day-release courses thus came to be established. A few were built specially for the purpose before the war, but the main expansion has taken place since 1940. As a consequence of war-time and post-war restrictions, most of these centres have had to be housed in adapted or improvised accommodation—converted factories and redundant school premises predominating—or have had to share premises with schools. The consequence has been that, in the absence of premises built specially for the purpose, the courses provided in many of the centres have been confined within too narrow a range. The makeshift nature of the accommodation has also tended to depress the demand and interest of employers and prospective students alike. Apart from the enthusiasts among them, they have been tempted to regard technical education as like the premises in which it is given—something second rate in some obscure by-way—and not of the same importance as what goes on in a secondary school, a factory or an office with modern, up-to-date premises.

124. But that opinion is belied by the quality of the work done in these centres and the record of their achievements in various examinations. They complement what is done in the central institutions by providing courses for Ordinary National Certificates—in some cases even Higher National Certificates—the certificates of the City and Guilds of London Institute, and courses of a practical craft and workshop nature. In addition they provide full-time pre-apprenticeship or pre-vocational courses to prepare boys and girls leaving school at fifteen for the trade they wish to enter. In these courses, which generally last one year, the time is divided equally between subjects of general education and the fundamentals of technical subjects on the one hand and practical work on the other. They cover a wide variety of occupations—principally building, engineering, commercial subjects and nursing.

125. The latest feature of technical education—the day-release class whereby the young worker spends one day of his working week receiving instruction and training in the fundamentals of technical work at an educational establishment, while during the other four or five he is learning practical work in the factory—has been developed in the local technical colleges as well as in the central institutions. Although the increase in the figures from 600 in 1939, to 5,000 in 1946, 20,000 in 1951, and 25,500 in 1954–1955 represents substantial progress, development has not been as rapid or as far reaching as it ought to have been or as it has been in England where 355,000 young people were released from their employment in 1954–1955. It is significant also that of the 1954–1955 Scottish total, just over 15,000 were between the ages of fifteen and eighteen, or only 9 per cent. of the total
numbers in these age groups. The development is also uneven as between different industries as appears from the following table:

**TABLE V**

**EDUCATIONAL YEAR 1953-54**

**STUDENTS "RELEASED" FROM INDUSTRY—SCOTLAND**

Boys and girls aged under 18 years released by their employers to attend courses for part-time education shown as a percentage of the estimated number aged under 18 years who are insured under the National Insurance Acts.

<table>
<thead>
<tr>
<th>Industry</th>
<th>Estimated numbers employed at end of May*</th>
<th>Numbers released by employers during year</th>
<th>Numbers released as per cent. of numbers insured</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mining and Quarrying</td>
<td>6,210</td>
<td>2,992</td>
<td>48</td>
</tr>
<tr>
<td>Public Administration and Local Authority services</td>
<td>2,890</td>
<td>1,389</td>
<td>48</td>
</tr>
<tr>
<td>Chemicals and allied trades</td>
<td>1,840</td>
<td>702</td>
<td>38</td>
</tr>
<tr>
<td>Building and Contracting</td>
<td>13,030</td>
<td>2,663</td>
<td>20</td>
</tr>
<tr>
<td>Engineering, Metal Manufacture, Metal Goods and Vehicles</td>
<td>28,940</td>
<td>4,572</td>
<td>16</td>
</tr>
<tr>
<td>Other Manufacturing Industries (including Leather, Wood and Cork, Precision Instruments, Treatment of Non-Metalliferous Mining Products)</td>
<td>7,580</td>
<td>795</td>
<td>10</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>10,360</td>
<td>389</td>
<td>4</td>
</tr>
<tr>
<td>Paper and Printing</td>
<td>6,300</td>
<td>203</td>
<td>3</td>
</tr>
<tr>
<td>Distributive Trades</td>
<td>38,550</td>
<td>1,095</td>
<td>3</td>
</tr>
<tr>
<td>Textiles and Clothing</td>
<td>23,840</td>
<td>430</td>
<td>2</td>
</tr>
<tr>
<td>Food, Drink and Tobacco</td>
<td>11,140</td>
<td>25</td>
<td>1</td>
</tr>
<tr>
<td>Transport</td>
<td>6,580</td>
<td>13</td>
<td>1</td>
</tr>
<tr>
<td>Insurance, Banking and Finance and Professional services</td>
<td>9,100</td>
<td>56</td>
<td>1</td>
</tr>
<tr>
<td>Agriculture, Forestry and Fishing</td>
<td>9,640</td>
<td>2</td>
<td>—</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>176,000</strong></td>
<td><strong>15,326</strong></td>
<td><strong>9</strong></td>
</tr>
</tbody>
</table>

* Figures supplied by Ministry of Labour and National Service.

**Bursary Assistance**

126. Students wishing to take advantage of any of the facilities described above may obtain assistance from public funds through education authorities, who award bursaries in accordance with Regulations made by the Secretary or State for practically all forms of further education. These awards include not only those tenable at university, central institution, teachers’ training college of further education centre, but also pre-vocational bursaries (awarded for pre-apprenticeship courses and courses of a similar type) and apprentices’ bursaries (awarded for courses undertaken during periods of release from employment). In addition, bursaries for the payment of fees, for subsistence if necessary, and for books and instruments may be awarded to evening class students.

127. Education authorities will generally grant a bursary to any persons resident in their area who is qualified for admission to the course he desires to follow. In session 1954–1955, authorities made further education awards including 13,779 whole-time and 1,446 part-time bursaries. Of the whole-time awards, 5,111 were tenable in all faculties at universities, 2,786 in central institutions, and 2,833 in pre-apprenticeship courses; while of the part-time awards, 1,183 were tenable at central institutions and further education centres.
Aid from Industry

128. Parallel with the financial aid available from bursary funds and of no less importance is that given by employers. In the case of evening classes, most employers pay class fees, and in the case of day-release classes they pay wages and fees. A few employers who send selected students to sandwich or other full-time courses at an advanced level are willing to continue to pay wages and to meet tuition expenses. The Government regard all such assistance as valuable both to the student and to his firm and they hope that many more firms will be encouraged to offer it in view of the national need for more and better trained technologists and technicians.

REGIONAL CO-OPERATION

129. In the development of technical education in the West of Scotland as the main centre of industry and population it was early found desirable that there should be some means of liaison between local centres and central institutions and the courses they provide. The first step to secure this co-ordination was taken over 50 years ago when a Joint Committee for Technical Education was set up. It includes both educationists and industrialists and by devising schemes of work for various technical courses and by other co-ordinating arrangements the Committee has done much to ensure uniform standards throughout all the centres within its ambit. It has thus stimulated the expansion and has raised the standard of technical education in the West of Scotland by linking centres of varied types and status with the central institutions. The success of this machinery has led to the establishment in the south-eastern and north-eastern regions of Scotland of similar Committees who have begun to work on the same lines as those followed in the West of Scotland.

130. Another more recent step towards securing a closer welding of technical education was the establishment in 1948 by statutory order under the Education (Scotland) Acts, of five Regional Advisory Councils for Technical Education covering between them the whole of Scotland. These are designed to extend and facilitate the co-operation of education and industry in the development of technical education. These interests have already co-operated on the governing bodies of central institutions, and many education authorities have local advisory committees for different trades to advise them on particular courses. But the purpose of the new Regional Council is to bring together representatives of education and of both sides of industry in the respective regions so that they may jointly advise education authorities and other managers of educational establishments on the development of technical education in the region. By this means technical education secures the full and practical support of industry, and education authorities and central institutions obtain authoritative advice from a regional body to assist them in considering the provision of new facilities. Representatives of the five Councils meet annually to discuss important matters requiring consideration from a national point of view.

SURVEY OF PROGRESS

131. How has this structure of technical education served Scotland in the past? Scotland's pride in the academic traditions of her educational system may have tended to overshadow her achievements in technical education. But these achievements have contributed in no small measure to the renown of her engineering skill throughout the world in the past half century. The foundations of these successes have lain just as much in her technical colleges and evening schools as in the shipyards and factories. That these and similar
further education establishments have hitherto proved capable of expanding to meet the increasing demands made upon them is shown by the following table of the number of further education students between 1938 and 1954:

**TABLE VI**

NUMBER OF STUDENTS IN FURTHER EDUCATION—SCOTLAND

<table>
<thead>
<tr>
<th></th>
<th>1937-38</th>
<th>1946-47</th>
<th>1954-55</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Full-time</strong></td>
<td>5</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td><strong>Part-time day</strong></td>
<td>3</td>
<td>9</td>
<td>25</td>
</tr>
<tr>
<td><strong>Evening only</strong></td>
<td>174</td>
<td>180</td>
<td>206</td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td>182</td>
<td>198</td>
<td>241</td>
</tr>
</tbody>
</table>

132. But these establishments are only part of the wider system of higher education in Scotland. Table VII below illustrates the proportions of the various age-groups following the different forms of post-school education:

**TABLE VII**

Estimated number of persons in Scotland between fifteen and twenty receiving different forms of education expressed as a percentage of each age group in 1953–54*

<table>
<thead>
<tr>
<th>Age</th>
<th>Schools</th>
<th>Universities</th>
<th>Teacher Training Colleges</th>
<th>Central Institutions and Further Education Centres†</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Full-time</td>
<td>Part-time</td>
</tr>
<tr>
<td>BOYS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>—</td>
<td>5.5</td>
<td>0.1</td>
<td>1.1</td>
<td>18.7</td>
</tr>
<tr>
<td>19</td>
<td>—</td>
<td>4.3</td>
<td>0.1</td>
<td>1.0</td>
<td>26.2</td>
</tr>
<tr>
<td>18</td>
<td>1.2</td>
<td>2.9</td>
<td>0.1</td>
<td>0.8</td>
<td>35.6</td>
</tr>
<tr>
<td>17</td>
<td>8.1</td>
<td>1.3</td>
<td>—</td>
<td>1.3</td>
<td>39.9</td>
</tr>
<tr>
<td>16</td>
<td>13.0</td>
<td>—</td>
<td>—</td>
<td>3.1</td>
<td>30.8</td>
</tr>
<tr>
<td>15</td>
<td>23.2</td>
<td>—</td>
<td>—</td>
<td>2.5</td>
<td>12.6</td>
</tr>
</tbody>
</table>

| GIRLS|         |              |                           |           |           |       |
| 20  | —       | 2.6          | 1.4                       | 1.2       | 9.7       | 14.9  |
| 19  | —       | 2.3          | 1.4                       | 1.6       | 12.4      | 17.7  |
| 18  | 0.6     | 1.6          | 1.8                       | 1.7       | 17.8      | 23.5  |
| 17  | 6.2     | 0.8          | —                         | 1.9       | 21.7      | 30.6  |
| 16  | 12.3    | —            | —                         | 2.8       | 20.3      | 35.4  |
| 15  | 22.7    | —            | —                         | 1.5       | 10.2      | 34.4  |

* School figures are for January, 1955. The percentages relate to the estimated population December, 1954. Percentages other than (1) are related to the estimated population December, 1953.

† These statistics refer only to students who took a progressive course of study in one or more subjects.

133. When the large contribution of the Scottish universities to the production of technologists is included the technological departments of these universities and the courses at the Royal Technical College contain no less than one-fifth of the full-time students following graduating courses in technology in the whole of the United Kingdom. At other levels, the numbers of enrolments in evening courses of a technical kind is (at 54,000) greater than at any other time in the history of technical education.

134. Nor is the success of the system to be measured only in figures. Whatever virtues it may lack, it possesses one of the most precious virtues in any educational system—flexibility. It can be entered by many doors, and at many stages; and young people can work their way through it as far as their ability will allow.
135. But if there is much in the development of our system of technical education that is creditable, there is no ground for complacency. The foundations appear to be sound and well able to carry the extensions and adaptations which we must make in our structure to enable it to meet the still greater demands it will have to face in this new scientific and technological age. As has been indicated, the main strength of Scotland's system of technical education has lain in its more traditional features—the comparatively high proportion of students embarking on under-graduate and similar full-time courses, and the maintenance of evening class numbers. In the newer developments in technical education—the pre-apprenticeship classes and the day-release class—her record is less satisfactory. While therefore we must develop to the utmost those aspects in which we are strong, we must also become strong where we are at present weak. Much will require to be done by all concerned with technical education—the Government, education authorities, both sides of industry, parents and young people—if it is to meet the needs of the new age for an ever wider variety of courses and the training of ever increasing numbers of students at all levels.

PLANS FOR THE FUTURE

136. On its side the Government is determined to ensure that the facilities are provided which will permit of a substantial increase in the numbers of trained people required by industry, whether at the level of the technologist, the technician or the craftsman. This will entail developments at Scottish universities, central institutions and local technical colleges. To make possible the advance at the central institutions and local technical colleges, to which university expansion will be additional, it is the Government's aim to have a building programme of a capital value approaching £10 (m) started within five years.

UNIVERSITIES AND CENTRAL INSTITUTIONS

137. The universities and central institutions are the sources of supply of technologists for the most advanced forms of work. The Government's plans for the development of higher technological education at university level throughout the United Kingdom are referred to elsewhere in this Paper. In these, Scotland plays a prominent part. In Glasgow, the University and the Royal Technical College in association form one of the main centres specially selected for major development and extension. Great developments have already been launched there. At the University, a building programme of £2 (m) has been completed since the war, the great part of it for scientific and technological work. A further major building project for a modern engineering building costing over £½ (m) has been begun. At the Royal Technical College a large extension providing accommodation for the mechanical, civil, chemical and mining engineering departments is nearing completion at a cost of about £1 (m). A further extension costing about £½ (m) has just been begun, and land has been acquired for still further building. A residential centre for management studies—the first of its kind to be opened in the United Kingdom as part of educational institution—was recently established and is to be further extended. In Edinburgh, the Heriot-Watt College is pressing ahead with developments on a smaller scale but of equal importance. In conjunction with the University, a department in the important subject of chemical engineering has been established, and a building extension costing nearly £½ (m) is in progress, with other smaller extensions in prospect.
138. At all the central institutions, despite steady extension of buildings over many years, over-crowding persists and many buildings are ill-designed and unsuited to the requirements of modern technological studies. Substantial improvements have been made in recent years. Further projects have been approved. Others are being prepared for approval. Tribute is due to the maintenance by the Scottish industry of its traditional support of the provision of the advanced levels of technical education. Large sums of money have been contributed or have been promised for the new buildings and equipment at various central institutions. To these contributions are added capital grants from the Education (Scotland) Fund to cover the cost of the developments.

139. With regard to revenue, special grant arrangements have been made so that the Secretary of State may make such payments as he thinks fit beyond the normal 60 per cent. grant to enable the colleges to meet the heavy cost of maintaining first-class facilities.

140. Coupled with this building development, attention is constantly devoted to the development of new facilities and courses at all the central institutions. The diploma and associateship courses are under review to ensure that they keep pace with the needs of modern industry, and in this review the possibility of extending the use of sandwich courses occupies a prominent place. In addition, the Regional Advisory Councils have been asked to consider the general problem of the extent to which that type of course might be usefully extended to other levels of training.

LOCAL TECHNICAL COLLEGES

Transfer of courses

141. The great need in Scotland is, however, for better provision for the technical education appropriate to the local technical colleges run by education authorities. Emphasis has been laid on the need for relieving the central institutions of the more elementary courses to allow them to extend the number of places available there for more advanced work and to re-arrange their curricula to provide a still greater variety of courses. For reasons already indicated, the process of transfer from the central institutions to these local colleges has been slow. Only in Glasgow has striking progress been possible. There the Royal Technical College has divested itself almost entirely of work of sub-university standard. Elsewhere much still requires to be done before the central institutions will be able to devote themselves solely to the more advanced level of training.

142. Education authorities must therefore expand their facilities substantially in order to train in large numbers the technicians on whom industry is going to rely more and more in the future if full advantage is to be taken of the ideas of our scientists and technologists. In the new provision which education authorities will have to make, pre-apprenticeship and day-release courses must play an increasing part.

Pre-apprenticeship and day-release courses

143. Alongside the effort thus required from education authorities, both employers and trade unions in industry will have to keep in mind that pre-apprenticeship and day-release courses are modern forms of technical education which experience in other countries suggests are pre-requisites of success in the modern science-based industries. The development of pre-apprenticeship courses would be stimulated if substantial remission of the apprenticeship period could be given for time spent in taking the classes—
here the trade unions have great responsibilities—and if employers would give due weight when engaging apprentices to the value of this sound training in the fundamentals of their trade. Part-time day education, as compared with evening classes, is to be preferred both educationally in the short term and from the point of view of industrial efficiency in the long term. To the present figures for day-release in Scotland already quoted, at least a further 15,000 students will be needed if Scotland is to attain proportionately the same number of day-release students as there is already in England, and more if she is to keep in step with expansion there. Factors of geography, population and industrial structure account in part for the disparity which has hitherto existed between the two countries. But the essential factor is the full co-operation of all concerned—education authorities in providing facilities and both sides of industry, especially the employers, in releasing boys and encouraging their interest. Every effort will be made to foster this co-operation through the Regional Advisory Councils and otherwise. As part of the plans to stimulate technical education, these Councils have just been reconstituted, with both the industrial and educational elements strengthened.

Provision of Craft Courses

144. One need which must receive attention at this level of technical education is to devise courses with a high practical content suitable for boys who are not fitted for much theoretical work. In the present courses, such as those leading to the Ordinary National Certificate or the City and Guilds examinations, in which a substantial element of theory is included, the high degree of wastage is disturbing. Large numbers of students who embark on the courses are sooner or later found to be ill equipped to obtain full benefit from them. Hitherto, alternative practical courses designed to improve their attainments as craftsmen have not been often available. The development of this type of course is, therefore, being encouraged. Not only will this result in the reduction of wastage in the theoretical courses, but in a marked improvement in the standards of craftsmanship in industry.

Buildings and Teachers

145. This expansion of the responsibilities of education authorities in the field of technical education will require a major building effort by the authorities to make good the slow progress in providing such facilities in the past. A start has already been made by one education authority with the building of the first entirely new local technical college to be provided in Scotland since the war. Ten others, mainly in the industrial areas, have had projects approved or have them at various stages of preparation.

146. A major increase in recruitment of teachers will also be required as facilities expand, mainly to man the new local technical colleges. There are 1,150 full-time and 6,100 part-time teachers in central institutions and technical colleges and these numbers will have to be substantially increased when the new colleges are working to capacity. The teaching staffs are recruited from two sources. One is the teaching profession. The new scales of salary for full-time teachers of further education in Scotland, which took account of the special needs and conditions in further education, are already proving a successful stimulus to recruitment to this work. The transfer of teachers to the technical colleges from the schools may further be eased to some extent when the “bulge” has passed out of the schools. Industry has proved an equally valuable source of recruitment of both full-time and part-time teachers. It is hoped that industry will, in view of the great need for and advantages of expansion of technical education, be willing
to release many more staff qualified to teach and that more and more of those who undertake part-time teaching will, as the need increases, be encouraged to become full-time teachers.

147. Much is already done by part-time or short vacation courses to equip teachers in further education, whether recruited from the profession or from industry, for the special requirements of that work. Considerable development of this form of training will be necessary as more teachers are recruited from industry. For those entering teaching direct from university or college, the establishment of new training courses specially designed to fit them to engage in further education will be considered as part of the forthcoming review of teacher training in Scotland.

FURTHER EDUCATION FOR GIRLS

148. As in England, the further education of girls raises special problems. Too often further education—particularly part-time—is regarded as important only for boys. But it is desirable not only in the interests of the girls themselves but in the national interest that they should have equal opportunities with boys, and should take every advantage of these opportunities, to carry their education and training to as advanced a standard as possible. On the vocational side, they will thus be better equipped to do their particular job more efficiently in the days when they are in employment. On the personal side, they will have a better general education which will enable them to lead a full life in their leisure from employment and make them all the more fitted to carry out at a later stage that most important function of all, which the great majority of them will be called upon to undertake—the foundation of a home and a family.

149. The need for developing further education for girls is shown by the fact that only one girl in five takes any form of further education at all even at the age when such education is generally most popular. At the pre-vocational stage, demand is concentrated on courses for nursing, homecraft, and secretarial subjects. Demand among girls for day-release courses is limited very largely to commercial and general subjects, distributive trades, clothing and textiles, hairdressing and nursing.

150. Much therefore remains to be done to stimulate among girls a greater demand for further education generally, even to bring the numbers up to what they should be in courses linked with what are traditionally regarded as girls' careers. But an even greater problem confronts us in tapping the resources of talent and labour available among girls in order to swell the numbers of trained personnel needed for the more strictly technical occupations. There is no doubt that at present much talent is lost to industry at both advanced and craft levels because the resources of technical and scientific ability among girls are not drawn on as they might be. It is true that some of the courses already taken by girls such as those concerned with textiles and nursing, have a considerable technical or science content. At the level of technology, only a few girls take engineering subjects, but numbers of girls take science subjects. In 1954 more than 15 per cent. of the students gaining their National Certificates in chemistry and applied physics were girls. In pharmacy, too, 40 per cent. of those who took their qualifications in 1954 were girls.

151. But we must do much more than this if we are to succeed in the drive to train the technicians and technologists we need. A new outlook among parents and in schools on the careers which are open to girls is required, so that those with a practical or scientific bent can be encouraged to grasp the opportunities open to girls as well as to boys. Education
authorities and the governors of central institutions might well consider what they should do to encourage a greater demand for technical training among girls; they might establish special courses for girls in particular industries and set aside special classes in technical colleges for girls only. More employers, particularly in the new light industries, might consider recruiting girl technicians and training them on the job. Those who already do so have found the girls more nimble with their hands at particular kinds of work and no less quick to pick up technical processes. In these ways and by the exercise of foresight and imagination on the part of parents, industry and education, much can be done to provide worthwhile careers for women while assisting in the recruitment of trained people for industry.

PROGRAMME OF CAPITAL EXPENDITURE

152. All the developments on the foregoing lines at both Central Institutions and Technical Colleges involve a large-scale programme of capital expenditure. It will be a major aim of Government policy over the next five years to ensure that the necessary resources are available. The Government are ready to authorise a programme of buildings for technical education to be started within the next five years to the value of £10 million, with a further £2 million for the necessary equipment. How far this programme can be realised will depend largely on how soon education authorities can expedite their local technical college projects. The Government look to the authorities to bring forward as quickly as possible all such projects which they have had in mind for the future. For these projects alone £6 million of the £10 million will be required. The Government will look to the authorities further to start within the period such additional projects as may prove to be within their compass and in this way to make full use of the total resources available.

153. The Secretary of State intends forthwith to discuss with the authorities concerned how progress can best be made on the projects already under consideration and how soon further projects can be undertaken.

CHAPTER V

CONCLUSION

154. Success is carrying out the plans set out in this Paper depends on attracting many more students and placing them in the right courses, and on their own willingness to work hard and go through with their studies. All these are human problems, closely related to the student's background.

155. Many enquiries in secondary schools have shown that again and again a good home accounts for the widely different rates of progress made by children between whom there was nothing to choose at the age of eleven. Parents easily over-estimate what formal education can do for their children and under-estimate their own influence, be it for good or evil. As soon as education becomes voluntary, as it does at the age of fifteen, there is a crucial decision to be taken. Sometimes it is the boy or girl who takes it, but more often than not what the family and the neighbours think about continuing to study determines the decision. If mother and father cannot see the advantage of further education, it is a brave child who goes against their wishes.

156. Every effort must be made, therefore, to win the support of parents for further education. The schools and technical colleges are fully alive to this need, and through personal contacts and parents' associations steady
progress is being made. The campaign by our leading firms, in the national press and by visits and conferences, to illustrate the careers open to boys and girls has done much to stir up interest in the schools in the future of British industry.

157. The good firm is the ally of the good home, and if a boy comes from a home hostile to further education, his firm is his lifeline. Both sides of industry, speaking through their official representatives, fully recognise this responsibility. Managers and trade union leaders who sit on many bodies concerned with education have been insistent that the Government should expand technical education. In accepting this advice the Government now look to the individual employer and trade union leader to give all the practical help they can to make the new plans a success. The more representatives of industry get to know the colleges, the better. They are already helping the colleges in many ways: by acting as members of regional bodies and governing bodies of colleges and as part-time teachers. They can be of particular service by taking an interest in the working out of new courses and the drawing up of building programmes. It is greatly to be hoped that more and more of the leading men and women on both sides of industry will give some of their time to the problems of further education. They can be sure that their interest and example will always have a most stimulating effect upon the colleges.

158. In the end it is the attitude of individual firms to further education which will count most. The Government hope all employers will consider every young worker as someone who still has to find his or her feet in the world and for whose education and character the employer bears a responsibility second only to that of parents. Many private firms and the nationalised industries, in spite of the present shortage of labour, go out of their way to encourage their young workers to improve their qualifications. Some large firms have established works schools in which vocational and general education is given to apprentices from whom the most able are chosen for advanced courses at a university or technical college. Others rely for technical education wholly on the colleges and among these are the strongest advocates for the expansion of the facilities available today. Small firms find greater difficulty in providing opportunities for young people owing partly to the restricted scope of their work, and partly to the problem of releasing apprentices when the total number in a shop is small. The spread of group apprenticeship schemes designed for small firms will go some way towards overcoming these difficulties. It is likely to increase the number of apprentices and correspondingly increase the requirements for part-time day facilities in technical colleges.

159. Finally, there is the general public. How are we to get their full support for our plans which must cost a great deal of money? The old idea that advanced education is good only for a small selection of the people is dead. The management of full employment, with its much greater need for a responsible attitude to work and its challenge to greater output per man as the only way further to raise living standards, has brought a sense of our dependence on education as the key to advance. Everyone can now see the value of giving all children, wherever they come from and whatever their financial circumstances, the best possible chance to develop their own talents and contribute to the national well-being. Technical education must be brought within the reach of all in this country and offered generously to those from overseas. The Government are confident that this task will be undertaken willingly by the nation.

In this appendix are set out some of the available figures and facts about the output of technical manpower in certain foreign countries. Comparisons between countries in this field are hard to make, and are necessarily unreliable for several reasons. Firstly, it is difficult to be sure of the facts. Secondly, systems of education, and of employment of technical manpower, vary very greatly between different countries; this makes it almost impossible to equate with any certainty the standards of attainment represented by the different degrees, diplomas, certificates, etc. Thirdly, even the meaning of the different categories—technologists, technicians and craftsmen (defined for the purposes of this White Paper on page 1)—varies from country to country. Moreover, a comparison of the position at one point in time is misleading unless regard is also had to the trends over a period.

2. Even within this country there is such a wide range of technical qualifications that there is ample room for argument about which qualification should be included in which category. Moreover, many craftsmen and some technicians are trained solely on the job and do not figure in any statistical returns. The difficulty of making comparisons is less severe in the case of the highest category—broadly speaking, technologists. This appendix is therefore concerned mainly with them. Though they constitute a relatively small proportion of a country's technical manpower, their numbers give quite a good indication of the scale of its efforts in technical education.

Great Britain

3. As indicated in paragraphs 50 and 56 of the White Paper, this country, with a population of close on 50 million, produced in 1954:

- 2,800 University graduates in the engineering and other applied sciences (or holders of diplomas awarded at universities) 57 per million of the population. Some 2,300 of these students obtained their qualifications by three or four years' full time study at universities—the rest by full time or part time study at technical colleges.

- 8,100 holders of Higher National Certificates (or broadly equivalent qualifications)—164 per million of the population. These qualifications were obtained largely by part time study at technical colleges. Their holders range from those, possibly rather less than one half, who eventually become members of Professional Institutions to others who should be classed as high grade technicians.

4. No comparable figures are available for those with lower qualifications. Their numbers have undoubtedly increased substantially since 1945, but not enough to keep pace with the demand.

U.S.A.

5. In the U.S.A., with a population of 162 million, there are a large number of institutions of university status which train engineers. There were produced from them, in 1954, a total of:

- 22,000 engineering graduates—134 per million of the population. This was less than half the output of 50,000 in 1950, when the age groups were larger and the total was swollen by ex-servicemen. The Americans estimate that the number will rise to 43,000 by 1964, following the bulge in the post-war birth rate.

6. The university courses leading to a bachelor's degree in engineering in the U.S.A. usually last four years, but generally start from a lower standard than that of the normal entry to our universities. The standard of the U.S. Colleges, and of the engineering graduates produced from them, varies greatly. Many American bachelor degrees are, in technical subjects, little if any higher than the standard of the High National Certificate, but a considerable number of American graduates proceed to higher degrees.

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7. Technicians in the United States come from three sources: holders of bachelor degrees, students who spend one or two years at a university without attempting a degree, technicians trained by a number of technical institutes and others trained on the job. Figures of the total output of technicians are not available, but it is authoritatively stated to be inadequate to supply the “three to five engineering aides” who are considered necessary to support every professional engineer.

8. The American authorities are known to be disturbed about the present output of both technologists and technicians and are understood to be anxious to expand it considerably. They are however faced with a very serious shortage of science teachers in the schools.

U.S.S.R.

9. The following information is taken from “Soviet Professional Manpower”, a study published in 1955 by Mr. Nicholas de Witt of Harvard University. He says that the figures quoted are mostly estimates, compiled from a variety of sources, but carefully cross-checked; they have been accepted by the United States National Science Foundation.

10. With a population of 214 million, the U.S.S.R. claim to be producing per annum:

60,000 “professional engineers”—280 per million of the population. These qualify after courses of 5½ years at “specialist institutes”, where the standard is said to be high.

70,000 engineers—326 per million of the population, at the “Technicums”. These provide a four year course for students about half of whom have already had ten years schooling. The other half enter the “Technicum” at the age of fourteen, after only 7 years at school. The official aim is to limit the entry to “Technicums” to boys and girls who have had ten years at school.

11. The Russians are clearly determined to produce the maximum number of scientists and technologists, and have announced a target of a 50 per cent, increase in the number of professional engineers. The general conclusion of a number of observers from this country who have visited Russia recently, as well as that of Mr. de Witt, is that the standard of Russian scientific and technological education is high. The numbers of engineers turned out are well ahead of any other country, both in absolute figures and per head of population. This is achieved in part by what some American observers described as a ruthless sacrifice of the arts—though the schooling of scientists and technologists is by no means narrow. Both in salaries and in other privileges, the careers of scientists and technologists are made very attractive. Moreover, there is far larger use of woman-power in Russia than in any other country; for example, about three-quarters of the medical doctors, and one quarter of the engineers, are women.

Western Europe

12. In Western Europe (except in Italy) the majority of professional engineers are trained in specialised technical institutes of university status such as the well-known “Grandes Ecoles” of France and the “Technische Hochschulen” in Germany, Holland and Switzerland. The entrance requirements for these institutes are generally high, though broadly based, and the length of the course is usually four to five years and sometimes longer. The graduates from such institutes will thus in general have received more advanced technological training than is possible in the three year university course in Britain.

13. In addition, many countries have technical schools of a slightly lower status, such as the Dutch “Middelbare Technische Scholen” and the German “Fachschulen”. Unfortunately no comprehensive figures are available of the numbers trained in such schools, but the standard reached is thought to correspond very roughly with our Higher National Certificate. The Colleges are mainly full-time, and the course lasts some three years.
14. Figures for the output in 1953 of technologists (and also of pure scientists) in Western European countries (other than Western Germany), have been obtained through a questionnaire issued by the Organisation for European Economic Co-operation, and the results have recently been published. The figures give a total output for France, Italy, Western Germany (estimated), Switzerland, Scandinavia and the Low Countries in 1953 of:

12,054 graduates in technology—largely educated at the specialised technical institutions mentioned above. This figure is equivalent to 67 per million of the population, the figures for France, Western Germany, Switzerland and Italy being respectively: 70, 86, 82 and 39. These figures exclude students trained in technical colleges or engineering schools.

15. By way of contrast, the O.E.E.C. returns show that these countries produce, proportionately to the population, less than half the graduates in pure science produced in Great Britain (many of whom go into industry). The figure for Western Europe as a whole is 48 per million of the population, compared with our figure of 105; the Russian figure is 56. The relative importance which these countries attach to engineering is in itself instructive, and the standards achieved by the specialist institutes of technology in which most of these continental engineers are educated, set examples of quality which cannot be ignored.

APPENDIX B

NATIONAL ADVISORY COUNCIL ON EDUCATION FOR INDUSTRY AND COMMERCE

REPORT ON SANDWICH TRAINING AND EDUCATION

1. The National Advisory Council have had under consideration for some time past the sandwich system of education and industrial training in which substantial full-time periods are given alternately to education and to training in industry, and the question of securing a greater degree of interest and cooperation by industry in the development of such courses as a step towards remedying the deficiency of technologists trained to professional level. Regional Advisory Councils have been consulted and discussions have been held with representatives of industry and everywhere the Council finds support for its view that all necessary steps should be taken for the development of sandwich courses and particularly of those leading to a high standard of professional training.

2. Sandwich courses are already in being at a number of technical colleges and these range from courses covering a period of 2 years leading to the Ordinary National Diploma to courses covering 4 to 5 years leading to the Higher National Diploma and College Associateships. Increasing interest has been shown in this kind of provision during the past twelve months and this stirring of interest is no doubt due to the discussions taking place both regionally and centrally which have resulted in a wider, though still limited, knowledge of the sandwich system and the opportunities it offers.

3. The National Advisory Council support the sandwich system of organisation of courses at all appropriate levels. They are, however, most strongly impressed with the opportunity which the system offers of developing schemes for training to professional level school leavers and other young people with ability to become professional engineers and technologists capable of filling responsible posts in industry. In view of the urgent need to increase the supply of engineers and technologists of this calibre there can be little room for doubt about the value of a system which provides another and complementary method of training to that whereby a young man undertakes a university course together with two years' apprenticeship in industry, and which is particularly suited to those who wish to enter industry direct from school and who would benefit from studies being closely related to industrial experience.

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4. The Council have considered carefully the principles that need to be followed in the development of professional type sandwich courses in technical colleges and they offer the following observations and recommendations for the Minister's attention.

5. The professional type of sandwich course should normally cover a period of 4 to 5 years for selected students and should be of such a standard that it may be expected to satisfy the requirement for the new technological award to be administered by the Council over which Lord Hives presides. Students may now look to this new award for recognition of the successful completion of high standard courses such as these and industry will have a measure of the quality of training and the level of ability of young people who attain this qualification.

6. While maintaining this standard, the content of the courses can be varied to meet particular technological and industrial needs and it is an essential feature of sandwich training that there must be close co-operation between the college and the industrial organisation concerned in the formulation and design of the course and the plans for linking college education and industrial training in the most effective way. In general, however, the emphasis should be on training people to think and developing a critical mind. This can probably best be achieved by stressing fundamental science and study in the art of communication. One aim of the courses should be to produce an awareness of the importance of human relations and of management techniques. In view of the importance of developing cost consciousness, some attention should also be given to the principles of economics. Opportunity for the students to live together as a community is most desirable.

7. The staffing of courses of this kind will of course, present new problems, for the colleges will not only need full-time staff of high quality but other specialist lecturers to provide part-time services during the day-time. It is essential, therefore, for industry to co-operate fully with the colleges in providing such specialists.

8. There is evidence that periods of 5 months in the college and 7 months in the works or of about six months in each will normally be the most effective and convenient arrangements, but where these arrangements are found to present difficulties other periods can be adopted having regard to the needs of the particular industry and the need to even the load both in the college and in the works.

9. It is important that the college should maintain contact with the students during their works periods. Such contact might take the form of tutorial classes or guided studies.

10. The selection of students for this type of course needs particular care and the firm and the college should collaborate in selecting those entrants with the aptitude, ability and personal qualities necessary both for undertaking the training and proceeding to posts of responsibility. The several sources of recruits seem to be

   (a) young people leaving school at 18 with two appropriate advanced level passes in the General Certificate of Education;
   (b) selected employees who have obtained a good Ordinary National Certificate, and
   (c) young people with appropriate passes at ordinary level in the General Certificate of Education who have been given a suitable preliminary or introductory course.

11. With large firms the groups may be big enough in each case to justify special provision and there should be no difficulty in securing satisfactory training during the works periods. In the case of medium sized firms there will be a nucleus of students available to enable students from smaller firms to complete a class. It may be desirable, however, for the college to arrange with a larger firm for some of the training facilities for those attending from the smaller firms.

There may be a need to organise college based courses for students entering upon training before taking up employment in industry. These may either join up with works based students during the college periods or, if they are sufficient
in number, form groups of their own. In either case it is hoped that firms will co-operate in assisting the college to provide satisfactory training facilities during the works periods; and furthermore, that when the employers have had the opportunity of seeing the college based students during the first period in the works they may then be prepared to sponsor them as works based students. The main consideration is that industrial training should be broad and closely related to the education in the college, whether the students are works based or college based.

12. It is believed that the essential co-operation between the firms and colleges, both in the selection of the students and in their training, is greatly facilitated when firms sponsor their students during the whole of the period of training, whether in the college or works and pay their wages and college fees. This arrangement is already widely accepted by many firms which co-operate in this kind of training, for they have found that it fosters loyalty on the part of the students towards their employers and acts as a considerable stimulus to recruitment.

Not all firms may be in a position to help deserving students to the fullest extent required. In such cases suitable students should be able to look to local education authorities for adequate assistance, according to their needs. As these are courses of professional level, the students should be eligible for assistance on a similar basis to students going to university. Further, those who have the necessary ability and intend to pursue courses of sufficiently high level will have the opportunity to apply for Technical State Scholarships.

13. The Council understand that it is the normal policy of the Ministry to require student fees to be charged for courses of all kinds although provision is made for remission in cases of hardship. They feel that there are sound reasons why the normal policy should be followed in the case of sandwich courses. The fees charged by local education authorities are not economic fees and represent only a fraction of the actual cost to the authority of the provision it makes.

14. There should be the fullest regional consultation before new courses of this kind are started so as (a) to avoid duplication and consequent uneconomic use of staff and facilities and (b) to ensure that courses are located at centres which can best provide them in a proper environment and which offer suitable opportunities of continued contact between the firms, the colleges and the students. On the other hand it is essential for regional machinery to work promptly so as not to prejudice the negotiations between industry and the colleges or delay the establishment of courses.

15. It is an essential pre-requisite for the development of professional sandwich courses that local education authorities should plan out-county arrangements on a free trade basis especially where the courses are works based. Thus if a firm arranges with a particular college for a sandwich course to be provided for selected employees who may come from a wide area each local education authority should accept without question responsibility for the appropriate inter-authority payment in respect of such of its own students as are accepted for admission to the course.

16. Where firms have factories in different parts of the country it will often be beneficial for students to go to the different factories in turn for their industrial training and it is understood that in those cases where the firm certifies that such arrangements are being made, the student would not be regarded as belonging to the area of any one authority and consequently the pooling arrangements would operate.*

17. Finally, the National Advisory Council believe that this method of providing the country with more technologists should be widely advertised as an

* Note.—Under the Local Education Authorities Recoupment (Further Education) Regulation, 1954, the full cost (less fees and main grant) of providing further education for students not regarded as belonging to the area of any local education authority is met from a central "pool" to which all authorities contribute.
additional means towards meeting a requirement that is vital to industry and, in fact, to the nation. The Council is aware that certain sections of industry are already co-operating in the development of sandwich courses but the tempo should be quickened and the negotiations which the Ministry is conducting at the national level with industry should be supplemented by similar discussions at the regional level. It is hoped that this will be facilitated by arrangements which are being discussed between the Ministry and the Federation of British Industries.

Much of the success of these developments will depend on the ability of the Ministry and the local education authorities to provide facilities. Improvements are required in the accommodation and staffing at the technical colleges and many colleges require hostels. The matter is urgent and the National Advisory Council hope that the necessary capital investment will be made available for this purpose.

Signed on behalf of the Council,
R. M. WEEKS,
Chairman.

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