DEPARTMENT OF EDUCATION AND SCIENCE

Education and Training for Scientific and Technological Library and Information Work

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Education and Training for Scientific and Technological Library and Information Work

by

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LONDON

HER MAJESTY'S STATIONERY OFFICE

1968

SBN 11 2700 071

This report has been produced by the Postgraduate School of Librarianship and Information Science of Sheffield University under a contract from the Office for Scientific and Technical Information of the Department of Education and Science. The purpose of the contract was to allow a study to be made in depth of the form and contents of education and training required for work in scientific and technological libraries and information departments.

The views and findings expressed in the report are, of course, those of the investigators and the Department can accept no responsibility for them. However, it is felt that the contents will be of considerable value to those responsible for devising curricula for education in special librarianship and information work.

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INTRODUCTION

> "Transfer of information is an inseparable part of research and development. All those concerned with research and development —individual scientists and engineers, industrial and academic research establishments, technical societies, government agencies— must accept responsibility for the transfer of information in the same degree and spirit that they accept responsibility for research and development itself." (Weinberg, 1964.)

The scientific information problem

1. The exponential growth of the literature of science and technology is a phenomenon which scientists have been living with for the past 300 years. It is in the nature of such growth that its effect is recognised only slowly, but when a critical point is reached its consequences can be overwhelming. In science information this point has now been reached. To take but one field, chemistry, it took well over two centuries for the first million papers to be published, and over 30 years, from 1907 to 1938, for the first million to be abstracted in Chemical Abstracts. We are now at the stage where one million papers have been abstracted in a five-year period—1962–1967—and before 1975 the point will have been reached where one million papers, equal to the output of the whole pre-war generation of chemists, will be published and abstracted in a single year. The first scientific serial began publication in 1665. Some 290 years later, in 1956, the Science Museum Library was receiving 9,000 current scientific serials. Within only a further 11 years the National Lending Library for Science and Technology (N.L.L.) was receiving over three times this number. The growth in the *use* of scientific literature is no less spectacular. Thus, for example, in 1930 the number of loans by the Science Museum Library was 10,000. In 1967 the N.L.L., which had taken over the national lending function of the Science Museum Library, lent well over half-a-million items, a total exceeding that of all the loans by the Science Museum Library between 1929 and 1947 (a period which itself saw the discovery of nuclear fission and its application for peaceful uses, enormous progress in antibiotics, developments in synthetic materials and great advances in all branches of science and technology). There are some signs that the rate of increase implied in these examples may not be maintained, but any flattening-out that may develop will be at a very high level indeed.

2. It is rightly claimed that scientists themselves have it within their power to curb this flood to some extent by exercising greater discipline and restraint in the rush into print. But present day science and technology is a highly competitive business and even in the university world, from which much of the vast output originates, "publish or perish" has long since turned from jest to near-reality.

3. But even if far more rigorous criteria were applied in determining what is publication-worthy (and there is ample evidence that an undesirable side-effect of this would be the suppression of unconventional and radically new ideas), the ever-increasing scale of worldwide scientific activity would ensure that the

residue was still so massive and growing so rapidly as to present a barrier of the most formidable dimensions. The scientists who say that they can carry out research or keep up with the literature, but not both; that it is quicker and cheaper to carry out research again than to search the literature to find if it has been done already may represent an extreme point of view, but it is one which has too much validity for comfort.

4. In this situation the role of librarians and information workers, as colleagues and aides of the "bench" scientists in their quest for information, is of crucial and ever-increasing importance. Maximum utilisation of information which is the end-product of the thousands of millions of pounds spent annually on research and development throughout the world is an obvious economic and social need, and the organisation and controlled dissemination of such information must surely warrant very high priority. In the words of Lord Shackleton, "An integral part of national economic planning must consist of the development of systematic arrangements for the control and exploitation of the specialised knowledge generated by mankind." (Shackleton, 1964.)

5. The sheer volume of the literature, though perhaps the major element in the scientific information problem, is not the only one. Paradoxically, the general trend towards increasing specialisation has been accompanied by the development of new studies and new ways of looking at existing ones, which call increasingly for an inter-disciplinary approach and add thereby a further dimension to the problem facing the working scientist or technologist. To the solution of this problem, too, the scientific information worker has a significant contribution to offer: assisting the specialist to "get into" the literature of a fringe field, detecting the significance of work in one field for research being carried out in another, "seeing relevance in apparently unrelated facts" (as one of our correspondents put it), these are activities which many believe to be amongst the most valuable of all the functions of the professional information worker.

The background to the present investigation

6. If the role of the information worker and special librarian is such a key one, then it is clearly of great importance that reliable information should be available about personnel working in these fields, and one of the first projects undertaken by the Office for Scientific and Technical Information (O.S.T.I.), after its creation in 1965, was a national survey of staff employed on scientific and technical information work (Edwards, 1966). This survey revealed estimated future needs for trained personnel greatly in excess of the numbers expected to be forthcoming; it also revealed many gaps in the provision of educational and training facilities for workers in these fields, an absence of firm information on what the content of such education and training should be at the various levels required and the need for an integrated educational and training policy to meet the present and future needs of scientific and technological library and information work.

7. It was against this background that the Office for Scientific and Technical Information placed a contract with the University of Sheffield Postgraduate School of Librarianship and Information Science to make a study, over an 18-month period, of the form and content of educational and training requirements for work at all levels in scientific and technological libraries and information departments. Work commenced in June 1966.

Methods

8. In carrying out this investigation we have tried to take the fullest possible account of the views and experience of those concerned with this field, whether as practitioners or educationists. We sent questionnaires to every university librarian in the country, to professors in all pure and applied science departments in U.K. universities, to the heads of all U.K. Schools of Librarianship, to Chief Librarians of all cities with Public Technical Libraries, to selected Technical College librarians, to the information officers or librarians of all United Kingdom Atomic Energy Authority establishments, the Commonwealth Agricultural Bureaux and the Research Associations. In the case of industrial libraries we felt it unreasonable to send out a questionnaire so soon after that sent out for the O.S.T.I. survey, but we had access to the material gathered in connection with that survey, which we gratefully acknowledge. We invited written observations on general and specific aspects of our enquiry from Industrial Liaison Officers (supplemented in some cases by their visiting Sheffield), from Aslib and Library Association groups, branches and sections, from the Institute of Information Scientists, from the participants (approximately 150) in the 1966 Institute of Information Scientists' Second Conference, from the relevant National libraries, from selected government laboratories, Ministry of Technology Regional Offices, selected government libraries and Research Stations. We also sent letters inviting observations on the subject of our enquiry to the editors of 24 professional librarianship and information journals in various parts of the world and 29 leading journals and newspapers which circulate in the management, industrial and other relevant fields. In addition, we made direct approaches to a considerable number of leading figures in the information and special library field, inviting their written observations; in several cases these were supplemented by personal visits and interviews. We invited "feed-back" information from all science graduates who had passed through our own course at Sheffield. As well as contacting the U.K. Schools of Librarianship, we wrote to nearly 100 leading schools of library and information science in 17 different countries, asking for information about their courses; the replies and material which they sent were supplemented by a very extensive search of the relevant literature.

9. Many prominent workers in the information and special library field have visited Sheffield for discussions, including several from overseas. We ourselves have visited nearly 100 libraries and information units, schools of librarianship and information science, and other institutions, in the U.K., U.S.A., Canada, the Netherlands and Sweden. We have also, through our association with the International Conference on Education for Scientific Information Work, held in London under International Federation for Documentation (F.I.D.) auspices in April 1967, had the opportunity to meet workers in the field from many other parts of the world and to hear about their activities, plans and problems. We would commend the proceedings of this conference (F.I.D., 1967) to all with an interest in the field of scientific information work. Had circumstances permitted, we would have wished to carry out many more visits than we did, but during the course of the investigation we were carrying out our normal duties at the Postgraduate School of Librarianship and Information Science, which set a limit to the time available for visits and, indeed, other aspects of the investigation.

10. In all, we have been in touch with well over 1,000 individuals and organisations, and we cannot over-emphasise the benefit which we gained from the accumulated experience and wisdom which so very many people have freely

contributed to our enquiry. To all of those who have been kind enough to help us in this way we extend our sincere thanks. We are also most grateful to the small steering committee made up of Mr. A. P. J. Edwards, Mr. F. Liebesny and Mr. D. T. Richnell, which met three times during the progress of this investigation; their experience and advice, at significant stages in our investigation, were of the greatest benefit. Our Sheffield colleagues, particularly Mr. G. R. Pendrill, have also made many valuable suggestions, which are very gratefully acknowledged.

11. To derive firm conclusions from evidence and information received from so many different sources is not easy, and in some instances opposing viewpoints are quite impossible to reconcile. In the last analysis, what we report must represent our own views, but we have tried to weigh and take full account of all the information we have received, and to the extent that we have been successful in doing this our report reflects and is supported by the views of the profession at large.

Terminology

12. There is still no general agreement about the meaning of many of the commonest terms used in scientific and technological library and information work. Even "librarian" and "information scientist" mean different things to different people, so that their respective roles are extremely difficult to define. It is sometimes said, for example, that the librarian is the person who organises the material which the information scientist uses, and it is certainly possible to envisage a spectrum of activity with the librarian at the one extreme and the information scientist at the other. But there is a very extensive middle band, where the distinction becomes blurred and their functions overlap and intermingle: there are many librarians who, in addition to organising their libraries for use, are expected to carry out literature searches and evaluate what they find, and many information scientists whose involvement with the literature is not restricted to its use but also requires some concern with its organisation. Indeed, we have been urged during this enquiry, time and again, to stress the unity and interdependence of library and information work and the artificiality of any attempt at rigid separation.

13. In the area of education and training we found variation in the emphasis placed on the different segments of the spectrum: some would emphasise the one extreme, some the other, while yet others might take the view that something is needed of both. The intention of most is frequently clouded by terminological difficulties. While acknowledging the near-impossibility of precision, we have tried, in writing this report, to be as consistent as possible in our use of important terms. When we refer to information scientists we normally mean corporate members of the Institute of Information Scientists, though occasionally we have to mention information science in a more generalised sense (as in Para. 201). To save the wearisome repetition of "scientific and technological library and information work" (or worker) we have, for convenience, used the expression "science information" to include both library and information work. In all cases, we hope that our meaning will be clear from the context.

The organisation of this report

14. The primary objective of our investigation has been to make recommendations about the content, form and organisation of education and training for

science information work. As an essential basis for such recommendations we felt the need for as much information as possible about the work itself, the personnel at present engaged in it, the nature and level of the various tasks being carried out by them and the likely pattern of future developments.

15. From this requirement has followed, quite logically, the division of the report into two parts: Part I, comprising an analysis of characteristics of science information personnel and a survey of the principal types of unit which they serve; and Part II, which translates the pattern of activities and needs revealed in Part I into terms of education and training.

16. Our efforts to find out the relevant information about the different sorts of unit described in Part I met with varying degrees of success, and it is principally for this reason that some types of unit have been dealt with at greater length than others. The length and fullness of treatment of the various sections is certainly not intended to reflect the relative importance of the types of unit described. Since much of the information about present practices and needs which emerged from our survey could be of value to those concerned with the planning and presentation of courses, it has seemed worthwhile to include in Part I all that seems relevant, even though it is not always as full as we might wish.

17. In Part II we have commenced by identifying the categories of work required in the science information field and have given general consideration to the levels and content of courses appropriate to these categories.

18. We have followed with a chapter on courses, in which different types of course are examined in some detail. In this section consideration is also given to the use of one particular type of course—the short course—as a route to professional qualification.

19. A separate chapter is then devoted to the institutions which carry the main responsibility for professional education in this country, the schools of librarianship and information science. The distinctive features of the university-based courses and qualifications are considered, and this is followed by a section devoted to the non-university schools. Since the latter are the schools which have the responsibility of teaching to the Library Association's syllabuses, it was thought appropriate to conclude this section by a fairly detailed examination of these syllabuses in so far as they are relevant to science information work.

20. In the final chapter of Part II, three particular problems—Practical experience, Supply of teachers and Foreign language competence—are brought together for special consideration. The report concludes with a summary of points considered to be of special importance.

PART I

THE CHARACTERISTICS OF SCIENCE INFORMATION PERSONNEL AND THE WORK CARRIED OUT BY THEM

CHAPTER 1

Science information staff characteristics

21. In this chapter we have endeavoured to analyse and identify characteristics of science information personnel which seem to be particularly relevant to our enquiry. The O.S.T.I. Survey (Edwards, 1966) has produced valuable data on this subject, and in the sections which follow we have used many of its figures, often re-interpreting them and analysing them in greater depth from the viewpoint of our own investigation.

22. The knowledge required by staff for the library and information units covered by this investigation is of two kinds:

(i) scientific or technological subject knowledge

(ii) professional knowledge.

23. In 1965, of 1,906 staff engaged in science information work in the U.K. (Edwards, 1966) 278 (14·6 per cent) had at least a second-class honours degree in science or engineering, 586 (30·8 per cent) had at least a first degree in science or engineering, 716 (37·6 per cent) had at least a first degree in science or engineering or were members of a scientific or engineering professional institution, 777 (40·8 per cent) had at least a Higher National Certificate (HNC) or Diploma (HND) in science or engineering and 922 (48·5 per cent) had at least passed in a science subject at the Advanced (A) level in the General Certificate of Education (G.C.E.) examinations.

24. In the same survey 369 (19·4 per cent) staff possessed the recognised qualifications of the Library Association, obtained by examination, and 175 (9·2 per cent) the recognised qualifications of the Institute of Information Scientists, obtained by examination and/or experience.

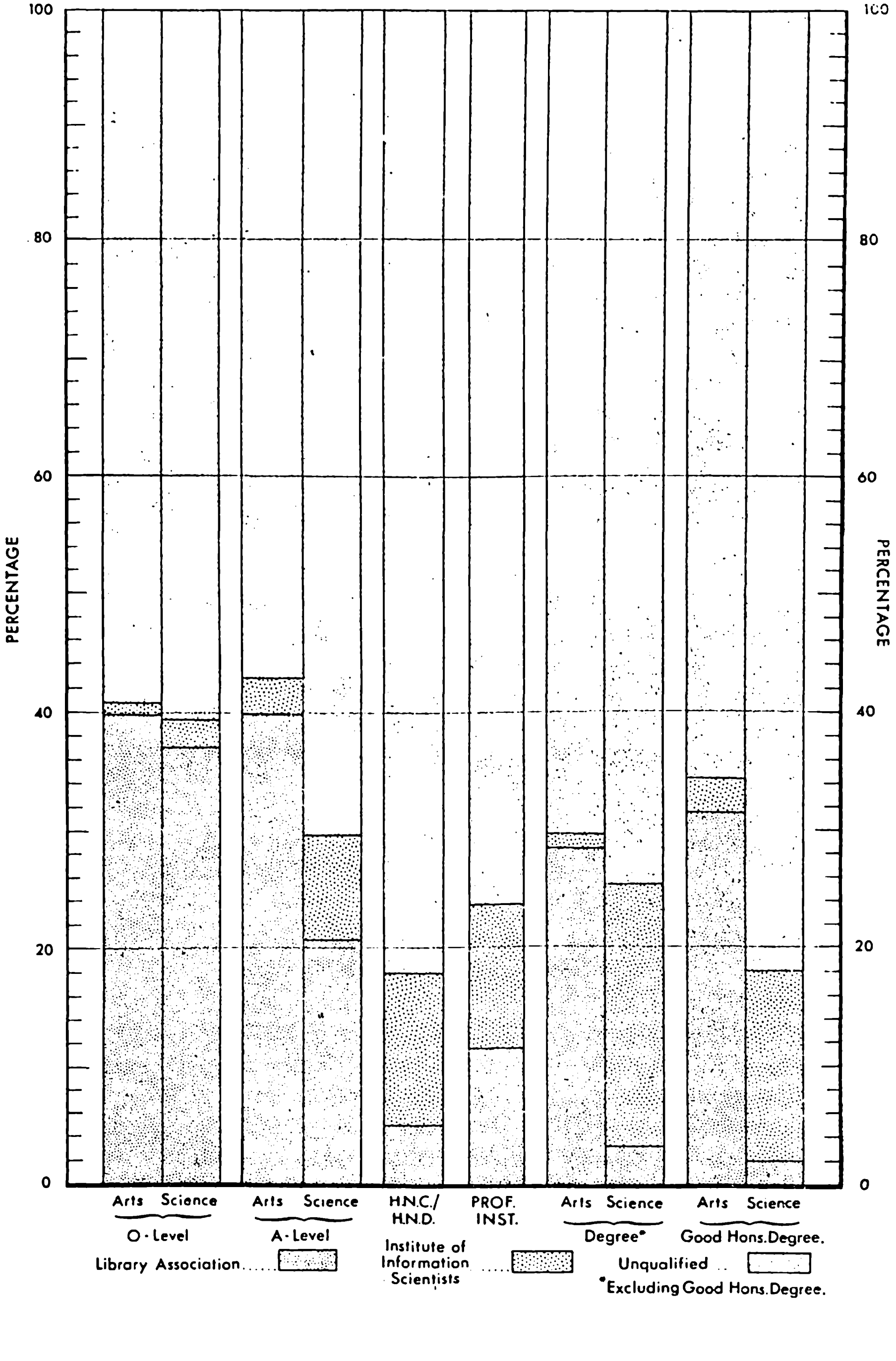
25. The figures show that a professional qualification was held by a smaller proportion of the staff than that holding at least a first degree in science or engineering.

26. The value attached to a professional qualification can be assessed to some extent by the proportion of professionally qualified staff at various educational levels in science and in arts. We found that at all educational levels the proportion of professionally qualified scientists was lower than that of professionally qualified staff with an arts education. The highest proportions of professionally qualified staff were among those with A-level arts education (42·9 per cent), followed by G.C.E. Ordinary (O) level arts (40·2 per cent), O-level science (39·7 per cent), graduates with at least a second-class honours degree in arts (34·3 per cent), A-level science (29·7 per cent), graduates with other degrees in arts (29·6 per cent), graduates with other degrees in science or engineering (25·4 per cent), members of professional science or engineering institutions (23·8 per cent), graduates with at least a second-class honours degree in science or engineering (18·0 per cent) and scientists and engineers with HNC/HND qualifications (also 18·0 per cent).

27. The preferred professional qualification of staff with an arts education was almost exclusively that of the Library Association; the preference of scientists up to and including A-level was also predominantly for the Library Association's

Figure 1

PERCENTAGE OF PROFESSIONALLY QUALIFIED STAFF BY EDUCATIONAL LEVEL



qualification; the qualification of the Institute of Information Scientists was predominant at HNC/HND level and also at science or engineering degree level and above.* Members of professional scientific and engineering institutions split their preferences almost evenly between the Library Association and Institute of Information Scientists qualifications (Figure 1).

28. *Graduates (and equivalent)*. Of the 777 scientists and engineers at and above HNC/HND level only 22 per cent were professionally qualified, compared with 32·5 per cent of the arts graduates. Of these 777, 17·7 per cent were qualified information scientists and 4·3 per cent qualified librarians. Of the 218 arts graduates the proportions of qualified information scientists and qualified librarians were 2·3 per cent and 30·2 per cent respectively. It is worth noting that a significantly higher proportion of the arts graduates held a second-class honours degree or better and, in complete contrast to the science or engineering graduates, the proportion of professionally qualified arts graduates is higher among those with academically better degrees; among science and engineering graduates there is a marked fall in the proportion with professional qualifications, from 25·4 per cent in the case of those below the "good" degree level to 18·0 per cent in the case of those with "good" degrees. The latter level is equal to that reached by the HNC/HND group and just below that of the members of professional science or engineering institutions.

29. These figures suggest that the need for professional qualifications, in addition to academic, is more generally recognised by arts graduates, and particularly good arts graduates, than by scientists and engineers. Another possibility may be that professional qualifications are not considered appropriate or of value for the work actually being carried out. To compare the situation in science information with that in other fields, we estimated the proportion of science, engineering and technology graduates who became members of scientific or professional engineering institutions in recent years, in order to be able to judge what a "normal" percentage of professionally qualified science, technology and engineering graduates might be. This figure is about 40 per cent for physics and chemistry graduates and higher for engineers and technologists. The proportion of professionally qualified science, engineering and technology graduates in science information work therefore appears to be low, even though the Institute of Information Scientists is prepared to admit graduates to its corporate membership on the basis of recognised experience only.

30. *Professionally qualified non-graduates*. For the purposes of this section we intend to regard as non-graduates all scientists and engineers below HNC/HND level and all arts staff below degree level.

31. Of the 911 non-graduate staff, 270 (29·7 per cent) had a Library Association qualification, 33 (3·6 per cent) had an Institute of Information Scientists qualification and the remainder, 608 (66·7 per cent), no qualification. The proportion of A-level arts staff with a Library Association qualification (39·7 per cent) was almost double the corresponding figure for A-level science staff (20·7 per cent). At O-level the proportions were roughly equal (39·2 per cent arts, 37·3 per cent science). On the other hand, the proportion of A-level science staff with an Institute of Information Scientists qualification (9·0 per cent) was almost three

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* It should be noted that the Institute of Information Scientists normally requires a degree or its equivalent before admission to its corporate membership.

times the corresponding figure for A-level arts staff (3·2 per cent), and at O-level more than double (2·4 per cent and 1 per cent respectively).

32. From these figures it appears that certainly at O-level, and very probably also at A-level, scientific subject knowledge is considerably less important than professional knowledge.

33. *Comparison with U.S.A.* For the purpose of this comparison scientists and engineers with at least an HNC/HND qualification, qualified members of the Library Association and qualified members of the Institute of Information Scientists are regarded as graduate equivalent.

34. Table 1 shows that in the U.K. only a marginally smaller proportion of graduates (and equivalent) are qualified in librarianship or information science than in the U.S.A. (41·9 per cent as against 47·3 per cent in the U.S.A.).

35. The results also indicate that in the U.K. a higher proportion of those not qualified in librarianship or information science are scientists or engineers rather than arts (or social science) graduates, in a ratio of 4 to 1 in the U.K., as against 3 to 2 in the U.S.A. (Table 1).

TABLE 1

QUALIFICATIONS OF GRADUATE (OR EQUIVALENT) STAFF

	U.K.*		U.S.A.	
	Total	%	Total	%
1. Science/engineering only	607	46·8	560	33·3
2. Arts only	147	11·3	327	19·4
3. Librarianship	369	28·4	787	46·8
4. Information science	175	13·5	9	0·5
Graduate or equivalent	1,298†	100·0	1,683	100·0

* Individuals possessing both a graduate level (or higher) subject or academic qualification and a recognised professional qualification (F.L.A., A.L.A., F.I.Inf.Sc., M.I.Inf.Sc., A.I.Inf.Sc.) were counted in groups 3 and 4 only.
† See paragraph 33.
Sources: Edwards (1966), Battelle (1966).

36. Of the 3,040 science information staff surveyed by Edwards (1966) over one-half (58 per cent) were employed in industry (including the United Kingdom Atomic Energy Authority) and nationalised industries, commerce and related profit-making organisations; almost one-quarter were employed in government establishments or local government; just over one-tenth in non-profit organisations such as research associations, professional institutions and learned societies; and only one in fourteen in educational institutions, such as universities, colleges of advanced technology and technical colleges, (Table 2).

37. The distribution of 200 members of the Institute of Information Scientists (including six student members) in full-time employment (Campbell, 1965) shows a distribution remarkably similar to that of all science information staff, except that information scientists are under-represented in educational institu-

tions (⩽ 4 per cent compared with 7 per cent) and more heavily represented in industry and commerce (68 per cent compared with 58 per cent).

38. On the other hand, the distribution of 10,054 members of the Library Association (including non-chartered librarians) (*Liaison*, 1967) shows the heavy public library bias among the membership; two-thirds of the members are employed in public libraries as compared with only one in fourteen in industry, commerce and non-profit-making organisations. Nevertheless, because of the large membership nearly twice as many librarians as information scientists are employed in industry, commerce and non-profit-making organisations.

39. Table 2 shows that in comparison with the U.S.A. a higher proportion of science information staff is employed in industry in the U.K. (58 per cent compared with 43 per cent), but lower proportions in non-profit organisations (11 per cent compared with 16 per cent) and educational institutions (7 per cent compared with 16 per cent).

TABLE 2

DISTRIBUTION OF SCIENCE INFORMATION STAFF AND PERCENTAGE EXPENDITURE ON R & D BY ECONOMIC SECTOR IN THE UNITED KINGDOM AND U.S.A.

Economic sector	U.K.			U.S.A.		
	Science information staff		% of total R & D expenditure[2]	Science information staff		% of total R & D expenditure[4]
	Number[1]	% of total		Number[3]	% of total	
Educational institutions	210[5]	7	7	310	16	8
Government organisations	698[6]	23	25	438	23	15
Non-profit organisations	331[7]	11	2	295	16	2
Industry and commerce	1,768[8]	58	66	788	43	75
Other	33	1	—	45	2	—
Total	3,040	100	100	1,876	100	100

[1] Edwards (1966): includes staff at all levels and both full- and part-time.
[2] Cmnd. 3007: refers to performance in 1964/65.
[3] Battelle (1966): includes graduates and non-graduates in graduate equivalent posts in full-time employment (approximately 15 per cent sample).
[4] O.E.C.D. (1963), p. 83: refers to R & D performance in 1960/61.
[5] Universities, Colleges of Advanced Technology, Technical Colleges.
[6] Government, local government, international organisations (includes defence, civil research and research councils).
[7] Professional institutions, research or development associations.
[8] Private and nationalised industry, trade associations, private consultants.

40. Table 2 also compares the distribution of science information staff with scientific Research and Development (R & D) expenditure in the main types of employment.

41. In the U.K. there is very close agreement between science information staff and scientific R & D expenditure in educational institutions, government

organisations and in non-profit organisations and industry and commerce treated as one group.

42. On the other hand, in the U.S.A. industry and commerce and non-profit organisations account for 59 per cent of science information staff, but as much as 77 per cent of scientific R & D expenditure. It is not clear why this should be so, and further study might be useful.

43. *Distribution and rates of growth of science information staff by industry.* Keeping in mind the close link between R & D expenditure and science information staff (paragraph 40), further, more detailed analysis was carried out (Table 3).

TABLE 3

DISTRIBUTION OF SCIENCE INFORMATION STAFF BY INDUSTRIAL CLASSIFICATION (IN MANUFACTURING PRIVATE INDUSTRY)

	A	B	C	A as a percentage of B	A as a percentage of C
Food, drink, tobacco	127	1,015	1,309	12·5	9·7
Chemicals and allied industries	816	6,914	8,299	11·8	9·8
Metal manufacture	189	461	2,172	41·6	8·7
Engineering and electrical goods	415	4,597	15,797	9·1	2·6
Vehicles, aircraft, shipbuilding, other metal goods	142	841	5,247	16·9	2·7
Textiles, clothing	56	913	1,498	6·1	3·7
Other manufactures	133	1,533	2,802	8·7	4·7
Total	1,878	16,274	37,124	—	—
Average	—	—	—	11·5	5·0

A = information staff (graduate and equivalent and technical supporting).
B = scientists in R & D.
C = B + engineers and technologists in R & D.
Sources: Cmnd. 3103, p. 63, and Edwards (1966).

44. Treating industry and commerce and its supporting non-profit organisations as one group, we obtained a further breakdown of science information staff (A) by industrial classification and compared these figures with the numbers of scientists (B), and scientists + technologists + engineers (C).

45. Taking the ratios A/B and A/C, that is, the "density" of science information staff in relation to successively wider groups of R & D staff, we find that A/B varies from 6·1 per cent to 41·6 per cent (average 11·5 per cent) and A/C from 2·6 per cent to 9·8 per cent (average 5·0 per cent).

46. The ratio A/C shows the number of science information workers per 100 scientists, technologists and engineers in R & D to be on average five, which may be compared with the figure of two information/library staff per 100 persons served, revealed in a survey carried out in 1958 (ASLIB, 1960). There appears,

therefore, to have been a considerable improvement in science information staffing.

47. We tabulated (Table 4) the annual percentage rates of growth of scientists in industry (α), scientists + technologists + engineers in industry (β), the corresponding growths in R & D (γ) and (δ) respectively, and growth in science information staff (ε). In all cases the rate of growth of science information staff was greater than the rate of growth of scientists in R & D, and in all but two cases (metal manufacture and other manufactures) it was greater than the rate of growth of scientists + technologists + engineers in R & D.

TABLE 4

ANNUAL RATE OF GROWTH IN EMPLOYMENT (% p.a.) IN PRIVATE MANUFACTURING INDUSTRY

	α* %	β* %	γ* %	δ* %	ε† %	Average annual science information staff increase
All private manufacturing industry	6·9	4·5	4·7	4·8	10·0	(143·0)
Food, drink, tobacco	13·5	15·0	1·5	3·5	15·0	(12·6)
Chemicals and allied industries	3·4	3·3	4·8	4·7	11·3	(67·2)
Metal manufacture	1·9	5·6	−1·3	10·2	7·0	(10·8)
Engineering and electrical goods	13·0	4·2	6·3	5·4	8·8	(28·6)
Vehicles, aircraft, shipbuilding and other metal goods	4·3	0·8	1·3	1·9	9·4	(10·2)
Textiles, clothing	8·0	3·0	6·5	3·6	7·4	(3·4)
Other manufactures	6·3	11·1	4·8	10·8	9·9	(10·0)

α = scientists in industry.
β = scientists, engineers and technologists in industry.
γ = scientists in R & D.
δ = scientists, engineers and technologists in R & D.
ε = information staff (graduates and technical supporting).
Average *number* of staff increases in brackets.
* Growth rate calculated from staff increase 1962–1965 (Cmnd. 3103, p. 63).
† Growth rate calculated from staff increase 1960–1965 (Edwards, 1966).

48. In two cases (engineering and electrical goods and textiles and clothing) the rate of growth of science information staff was exceeded by that of the scientists in the industry as a whole, and in another ("other" manufactures) by that of the scientists + technologists + engineers in the industry as a whole.

49. The science information staff growth rates of the two industries with the highest ratio of science information staff to scientists + technologists + engineers in R & D (food, drink, tobacco and chemicals) were higher than the growth rates in other industries, and noticeably higher than the growth rate of the engineering and electrical goods industry (8·8 per cent), which has the poorest science information staff ratio (2·6 per cent).

CHAPTER 2

The principal types of scientific and technological libraries and information units

(A) THE INDUSTRIAL GROUP

50. In the 1965 O.S.T.I. Survey (Edwards, 1966) replies giving details of staff qualifications were received from 594 science information units, of which 373 were in private and nationalised industry. Of these, 388 and 253 respectively were in existence in 1960 and reported staff totals for that year as well.

51. The total full-time staff in all the units reporting was 2,505 in 1965 and 1,532 in 1960; in the industrial units alone the totals were 1,452 in 1965 and 909 in 1960.

INDUSTRIAL UNITS

52. On analysing the distribution of the units by number of full-time science information staff in each unit it was found that of the 373 units, just over one-third were one-man units, slightly over one-half had a staff not greater than two, almost four-fifths had a staff of not more than four and nine-tenths a staff of not more than eight. The one-tenth comprising the larger units had staffs ranging from nine to 43.

53. Analysis of the proportion of the total full-time science information staff in industrial units who were employed in units up to a given staff size showed that the one-man units accounted for only 9·3 per cent of all full-time staff, units with staff not greater than two for 19·7 per cent, not over four for 40·8 per cent and not over eight for 58·7 per cent. Thus, 41·3 per cent of the staff in all the industrial units were concentrated in the larger units, i.e. those which comprised one-tenth of the total of all units.

54. *Science, technology and engineering graduates in industrial units.* A total of 274 science, technology and engineering graduates were employed in the 373 industrial units. The distribution of these graduates among units of various sizes is largely independent of the size of units, but is very closely related to the distribution of all science information staff among these units; the "density" of these graduates is nearly constant. Thus, for instance, the "density" of these graduates in the one-man units is 18·2 per cent of all the full-time staff, 16·9 per cent in two-man units, 18·2 per cent in three- to four-man units, 15·0 per cent in five- to eight-man units and 22·4 per cent in units with nine to 43 staff. The "density" for all industrial units taken together is 19·2 per cent.

55. Of these 274 graduates 8·8 per cent are in one-man units, 17·9 per cent are in units with staff not greater than two, 39·8 per cent are in units with staff not greater than four and 51·8 per cent in units with staff not greater than eight. One-tenth of all industrial units, i.e. those with staffs of nine to 43, accounted for 48·2 per cent of these graduates.

56. The proportion of "good" graduates (first and second class honours) among these graduates is lowest in the one-man units, being 29·2 per cent, and highest in the nine- to 43-man units with 51·5 per cent. The proportion in the

two-man units is 44·0 per cent, in three- to four-man units 38·2 per cent and in five- to eight-man units 42·0 per cent.

57. *Chartered librarians.* There are 117 chartered librarians among the 1,452 full-time science information staff in the 373 industrial units. The "density" of librarians averages only 8·1 per cent of all staff, and decreases from 15·9 per cent in one-man units to 5·9 per cent in the largest units with staffs of nine to 43.

58. *Information scientists.* There were amongst the full-time staff 95 members of the Institute of Information Scientists in the industrial units, and the average "density" was 6·5 per cent. The "density" does not appear to be significantly related to the size of the units.

59. *Regional variations.* We also looked for regional variations in the staffing of science information units and found that for this purpose the United Kingdom could be divided into two main regions: London and South East, and other areas.

60. The London and South East region contained 41·5 per cent of the industrial units, 46·5 per cent of the staff, 34·2 per cent of the chartered librarians, 44·7 per cent of the HNC/HND scientists and engineers, 51·6 per cent of the information scientists, 53·6 per cent of the "good" honours science, technology and engineering graduates and as much as 58·0 per cent of all the science, technology and engineering graduates. On the other hand, the London and South East region contained only about 18·8 per cent of the country's population and 19·1 per cent of its industrial employees; its industry accounted for just 21 per cent of the industrial output (value) of the U.K.

61. The "density", in relation to total science information staff, of science, technology and engineering graduates in industrial science information units was 24·2 per cent in the London and South East region, but only 15·0 per cent for all "other" areas; this may be due, in part at least, to the concentration of head offices in London and the South East. There is evidence that the lower "density" in the "other" areas is not caused by a better provision for supporting staff for the graduates, but by the recruitment of relatively small numbers of graduates into science information work. To bring the "other" areas up to the 1965 standard of the London and South East region, their graduate staff complements would have had to be increased by no less than 62 per cent, that is, from 115 to 186 science, technology and engineering graduates. For the average size of each unit also to be brought up to the London and South East region standard, then the increase required would have been 95 per cent, that is, from 115 to 224 science, technology and engineering graduates.

62. In this connection, it is worth noting that no such massive concentration of science information manpower exists in the U.S.A., where their geographical distribution follows very closely that of the scientists in R & D and fairly closely that of the population as a whole.

63. Analysis of the data on "good" honours science, technology and engineering graduates in science information work shows that where employers in the "other" areas of the U.K. are willing and able to recruit graduates, they are more successful in recruiting "good" graduates than units in the London and South East region. The proportion of "good" graduates in "other" areas is 49·5 per cent, that in the London and South East region 41·5 per cent and the proportion in "other" areas is higher than in the London and South East region for every size of unit; this is particularly pronounced for one-man units

(44·4 per cent compared with 20·0 per cent) and two-man units (47·6 per cent compared with 25·0 per cent).

64. The "density" of members of the Institute of Information Scientists is marginally higher in the London and South East region, 7·5 per cent compared with 6·0 per cent in "other" areas, but that of chartered librarians is lower at 6·1 per cent compared with 10·0 per cent in "other" areas. Whilst the distribution of Institute of Information Scientists members among units of differing size shows no marked trend, "density" of chartered librarians in the London and South East region falls from 13·7 per cent in one-man units to 4·2 per cent in units with nine to 43 staff; in "other" areas the decrease in "density" of chartered librarians is not so clear-cut, but the density is as high as 17·3 per cent for one-man units and 7·9 per cent for units between nine and 43 staff.

THE UNITED KINGDOM ATOMIC ENERGY AUTHORITY, THE RESEARCH ASSOCIATIONS AND THE COMMONWEALTH AGRICULTURAL BUREAUX

65. As stated earlier (paragraph 8) we did not consider it practicable to approach industrial units again with a long questionnaire after the brief interval which had elapsed since the O.S.T.I. Survey, and we therefore sent out questionnaires to heads of units in the United Kingdom Atomic Energy Authority (U.K.A.E.A.), Research Associations (R.A.'s) and Commonwealth Agricultural Bureaux (C.A.B.'s), in the expectation of obtaining a wide spectrum of views on education and training requirements against a background of staff details.

66. The three groups represent three different functions of information units: the U.K.A.E.A. units serve principally their own R & D and industrial production establishments, the R.A. units serve their own research establishments as well as their respective industries, and the C.A.B.'s serve agricultural R & D on a world-wide basis, mainly by means of published abstracts, surveys and reviews. Both the U.K.A.E.A. and the R.A. units were, on average, not too untypical of the large industrial units, except that the former had rather greater representation of professional librarians; and the latter, particularly in the smaller R.A. units (full-time science information staffs of between three and eight), tended to have a greater representation of science, technology and engineering graduates and equivalent staff. The C.A.B. units were distinct both in their size (over 90 per cent with staffs of nine or more) and the very high proportion of science graduates (on average, about one-half of the staff of the unit). They also reflected in the staffing the considerable stress laid on sources of information in foreign languages.

67. Whilst these units corresponded in size to the larger industrial units, which account for only 10–20 per cent of all industrial units, it should be remembered that these are just the units in which the great majority of *staff* are concentrated (paragraph 53). The fact that questionnaires were not sent to the smaller industrial units does not imply that their views have been neglected, and we would refer back to paragraph 8 for a description of the coverage of our survey.

68. Of a total of 69 questionnaires sent out, 37 (53·6 per cent) were returned. On the basis of these replies, the number and qualifications of the science information staff employed by the U.K.A.E.A., the R.A.'s and the C.A.B.'s are shown in Tables 5 and 6.

Table 5

Librarianship and Information Science Qualifications of Staff

	U.K.A.E.A.			R.A.			C.A.B.		
	Qualified	Unqualified	Total	Qualified	Unqualified	Total	Qualified	Unqualified	Total
Science/engineering graduates (or equivalent) . .	5	16	21	8	67	75	—	45	45
	23·8%	76·2%	100%	10·7%	89·3%	100%	—	100%	100%
Arts graduates .	3	1	4	—	16	16	1	18	19
	75·0%	25·0%	100%	—	100%	100%	5·3%	94·7%	100%
Non-graduates .	13	29†	42	15	104†	119	5	22†	27
	30·9%	69·1%†	100%	12·6%	87·4%†	100%	18·5%	81·5%†	100%
Total . .	21	46	67	23	187	210	6	85	91
Average .	31·3%	68·7%	100%	10·9%	89·1%	100%	6·6%	93·4%	100%

† Due to variation in the interpretation of the questionnaires some replies included clerical staff in these totals and some did not. Table 6, therefore, omits this non-graduate category.

Table 6

Graduate (and Graduate Equivalent) and Professional Staff

	U.K.A.E.A.		R.A.		C.A.B.	
	Number	% of total	Number	% of total	Number	% of total
Science/engineering graduates (or equivalent)	21	55·3	75	70·7	45	65·2
Arts graduates . .	4	10·5	16	15·2	19	27·5
Professional only . .	13	34·2	15	14·1	5	7·3
Total	38	100·0	106	100·0	69	100·0

69. The composition of staff in the three groups was found to vary to some extent with the different requirements of the work. Estimates were obtained of the proportion of work requiring knowledge of different types and at different levels. These are analysed in Table 7.

TABLE 7

SUBJECT AND PROFESSIONAL KNOWLEDGE: % OF TOTAL WORK

	Science/ engineering graduate (or equivalent) %	A-level science %	Professional librarian/ information scientist %	Other %	Miscellaneous %
U.K.A.E.A.	19·2	9·5	15·9	55·4	—
R.A. . .	32·5	8·5	19·5	36·4	3·1 (languages and other)
C.A.B. .	41·9	1·2	19·4	28·1	9·4 (languages)

70. As will be seen, the proportion of work requiring graduate level scientific knowledge was more than twice as large in C.A.B.'s as in U.K.A.E.A., with the R.A.'s occupying an intermediate position, while the estimated proportion of work calling for A-level scientific knowledge decreased from 9·5 per cent in U.K.A.E.A. and 8·5 per cent in the R.A.'s to a negligible 1·2 per cent in the C.A.B.'s.

71. The estimated proportion of work requiring professional knowledge remained almost constant at about one-fifth or one-sixth of the total work, although, as is shown later, when considering course requirements, the content of this knowledge varies considerably between these three groups of units. "Other work", that is, work requiring neither professional nor subject knowledge, accounted for a significant proportion in all three groups, particularly in the U.K.A.E.A., where it was over half of the total.

72. A particular type of subject knowledge, of relatively minor importance in U.K.A.E.A. and the R.A.'s, is knowledge of languages. In the C.A.B.'s, however, it accounted for as much as 9·4 per cent of all the work. The importance of language requirements suggests that certain arts graduates are found useful in C.A.B.'s and, to some extent, in R.A.'s, for their subject (languages) knowledge. We found that whilst in U.K.A.E.A. 10·5 per cent were arts graduates (and three out of four are also professionally qualified), the figure for R.A.'s was 15·2 per cent (none professionally qualified) and for C.A.B.'s 27·5 per cent (with only one in 19 professionally qualified) (Table 6).

73. *Qualities and qualifications required.* Evidence on desirable qualities and qualifications for staff at various educational levels was provided by heads of library and information services.

74. At all levels personality, professional library or information science qualifications and subject knowledge were included among the top four qualifications; a knowledge of languages was included in the top four qualifications in all cases but one. Practical research experience rated fourth or fifth place for graduates and A-level scientists.

75. Whilst there was close agreement on the principal desirable qualification at all educational levels and in all three groups, there were differences in the ranking.

76. Personality was the most highly rated qualification at all levels in U.K.A.E.A. and R.A.'s, and also at O-level in C.A.B.'s; subject knowledge came first in

TABLE 8

QUALITIES AND QUALIFICATIONS REQUIRED (5-point scale)*

		Personality	Professional librarianship/ information science qualification	Subject Knowledge	Languages	Practical Experience			
						Research	Development	Production	Management
Graduate	U.K.A.E.A.	4·4	3·7	4·3	2·7	2·7	2·6	1·7	2·6
	R.A. . .	4·1	2·5	4·1	3·6	2·1	1·9	1·9	1·8
	C.A.B. .	3·1	2·7	4·3	4·3	2·1	1·5	1·2	1·2
A-level	U.K.A.E.A.	4·4	4·0	4·0	2·2	2·6		1·7	2·2
	R.A. . .	3·3	2·9	3·0	2·7	1·7	1·6	1·5	1·2
	C.A.B. .	3·8	4·0	3·5	4·3	2·3	2·0	1·0	1·3
O-level	U.K.A.E.A.	4·2	2·2	3·3	1·8	1·4	1·2	1·2	1·4
	R.A. . .	3·0	1·7	1·8	1·8	0·6	0·6	0·6	0·6
	C.A.B. .	3·2	3·0	2·7	2·7	1·5	1·0	1·0	1·5
Averages	Graduate .	3·9	3·0	4·2	3·5	2·2	2·1	1·5	2·1
	A-level .	3·8	3·6	3·5	3·1	1·5	1·4	1·3	1·2
	O-level .	3·5	2·3	2·6	2·1	2·0	1·5	1·1	1·3

* On this scale five may be taken as indicating an essential qualification and zero an irrelevant or totally unimportant one.

C.A.B.'s and R.A.'s at graduate level, second at all levels in U.K.A.E.A. and at A- and O-levels in R.A.'s; languages were rated first in C.A.B.'s at both graduate and A-levels, and professional library or information science qualifications came second at A-levels in U.K.A.E.A. and C.A.B.'s. Professional qualifications rated equal with or lower than subject knowledge at all levels in U.K.A.E.A. and R.A.'s and at graduate level in C.A.B.'s. Languages rated higher than professional qualifications in C.A.B.'s at graduate and A-level, and in R.A.'s at graduate and O-level; and equal or higher than subject knowledge at all levels in C.A.B.'s, and at O-level in R.A.'s.

77. *Courses.* A pronounced preference was shown for a scientific information work course rather than a traditional librarianship or a mixed course (Table 9), but there was only partial agreement on the relative importance of subjects which such a course should include (Table 10).

78. On the matter of detailed content of courses for scientific information work, all responding heads of units included as very important or important scientific and technical reference work, and over 80 per cent in each group also included

TABLE 9

EDUCATION AND TRAINING PREFERENCES

	Traditional Librarianship	Scientific information work	Mixture	Neither
	%	%	%	%
U.K.A.E.A.	25·0	50·0	25·0	0·0
R.A. .	14·8	59·3	14·8	11·1
C.A.B. .	12·5	37·5	12·5	37·5

the three subjects of abstracting, editing, cataloguing and classifying (conventional); agreement above the 60 per cent level further included the six subjects of general reference work, preparation of critical reviews of the literature, non-conventional indexing and classification, information systems analysis, information systems design and library and information service mechanisation. Thus, at the 80 per cent level there was agreement about the inclusion of four subjects (out of 17 listed) and at the 60 per cent level agreement on 10 subjects (Table 10).

TABLE 10

PERCENTAGE OF RESPONDING LIBRARY/INFORMATION SERVICE HEADS RATING THE FOLLOWING SUBJECTS FOR INCLUSION IN COURSES FOR SCIENCE INFORMATION WORK AS "VERY IMPORTANT" OR "IMPORTANT"

Subject	U.K.A.E.A.	R.A.	C.A.B.
1. Science/technical reference work . .	100·0	100·0	100·0
2. Patent literature searching . . .	100·0	78·3	25·0
3. Economic and trade reference work .	75·0	65·2	0·0
4. General reference work .	87·5	69·6	75·0
5. Abstracting	87·5	100·0	100·0
6. Preparation of critical reviews . . .	62·5	87·0	87·5
7. Editorial work and preparing information bulletins	100·0	91·3	100·0
8. Non-conventional indexing and classification	75·0	87·0	75·0
9. Conventional cataloguing and classification	100·0	87·0	87·5
10. Collection building (printed) . . .	87·5	73·9	50·0
11. Collection building (non-conventional material)	75·0	69·6	37·5
12. Information systems analysis .	100·0	60·8	62·5
13. Information systems design . . .	100·0	69·6	87·5
14. Library/information service mechanisation .	100·0	73·9	87·5
15. Exhibition work .	62·5	26·1	0·0
16. Conference work .	37·5	43·5	12·5
17. Committee work	62·5	43·5	12·5

TABLE 11

"VERY IMPORTANT" SUBJECT RANKING (IN % OF RESPONSES)

	U.K.A.E.A.	%	R.A.	%	C.A.B.	%
1	Science/technical reference work .	87·5	Science/technical reference work .	82·7	Science/technical reference work .	87·5
					Abstracting . .	87·5
2	Editorial work and preparing information bulletins .	75·0	Abstracting . .	74·0		
3	Abstracting . .	62·5	Editorial work and preparing information bulletins	56·5	Editorial work and preparing information bulletins	62·5
	Library/information service mechanisation . . .	62·5			Non-conventional indexing and classification .	62·5
4			Critical reviews .	47·8		
5	Conventional cataloguing and class.	50·0	Non-conventional indexing and classification .	43·5	Conventional cataloguing and classification .	50·0
	Non-conventional indexing and class.	50·0				
	Information systems design . .	50·0				

79. The seven subjects on which there was little agreement were patents literature, which was held to be important in U.K.A.E.A. and R.A.'s (as was economic and trade reference work), collection building (printed material), collection building (non-conventional material), committee work and exhibition work (held important in U.K.A.E.A.), and conference work, which was rated as of some importance, particularly in R.A.'s (Table 10).

(B) THE EDUCATIONAL GROUP

THE UNIVERSITY LIBRARIES*

80. Until recently there has been little or no scope in British university libraries for the specialised application of scientific or technological skills and qualifications. Traditionally, these libraries have offered virtually no direct reference or information service, partly from a belief that such services constitute undesirable spoon-feeding, but principally, perhaps, because of limitations imposed by minimal staffs, barely adequate to carry out the basic functions of acquiring and processing books and journals and providing a machinery for lending them.

* The substance of this section formed the basis of a paper presented by the authors at the International Conference on Education for Scientific Information Work, which took place in London in April 1967 (F.I.D., 1967).

The situation is changing, however. With general university expansion, library staffs are increasing, and recent trends—particularly the move towards organising university libraries on a subject specialisation basis—indicate that many university libraries are aspiring towards special library standards of service in some areas of their activities at least. This trend is welcome, not only for the direct benefit it will bring to the university population, but for the influence it should have on successive generations of students, who will go out into many walks of life, including industry, with an awareness of what a good library and information service can offer and an expectation of similar facilities within their own organisations.

81. To obtain a firmer impression of the significance of this trend, and its implications for professional education, a letter was sent to all university librarians (including those of the new universities and the former Colleges of Advanced Technology), asking specific questions about the present and proposed future use of science and technology graduates in university libraries, and inviting observations on the provision of specialised library and information services for science and technology departments. Thirty-seven (72·5 per cent) of the 51 libraries approached replied, and between them they provide a picture not only of the present position and future aspirations, but of general attitudes in university library circles towards this very important matter of specialised services for science and technology departments.

82. *The extension of present services.* The first question on which we invited observations read "If staff and resources permitted, would you wish to extend the services offered to science and technology departments by your library, perhaps along the lines of the better industrial libraries and information services?" Twenty-six out of 37 librarians replied affirmatively. At the same time many also pointed out that there were important differences between the needs of university and industrial research and that the range of university scientific and technological departments precluded the depth of service that can be offered in an industrial library or information service, which usually operates within the known boundaries of a comparatively narrow field. This may cease to be such a significant factor, however, if university expansion brings with it any considerable trend towards branch or similar types of library specialising in a few related topics.

83. Librarians were asked to give examples of the forms which such extended services might take. They were not provided with a list of suggested possibilities, but were left to produce their own ideas. In this way it was hoped to stimulate more positive thinking than might otherwise have been the case. It also follows that failure by a librarian to mention a particular service does not necessarily imply that it has been considered and rejected. With these considerations in mind, the list of services given in Table 12, which shows in each case the number of librarians who suggested them, is impressive evidence of changing attitudes.

84. *The use of science and technology graduates.* In the university context, the graduate staff are the group of primary significance from the point of view of our enquiry. We asked university librarians how many science and technology graduates are on their staffs at present, the duties assigned to such graduates and how, ideally, the librarians would like to use them. Many librarians commented on the difficulty of recruiting science and technology graduates, though the total of 45 is perhaps unexpectedly high and is probably about 15 per cent

TABLE 12

The positive provision of an information service .	14*
The provision of a current awareness service.	11
Assistance with literature searching . . .	9
Links with national information services, e.g. MEDLARS .	8
Provision of information bulletins	7
Specialised indexing . .	7
Provision of translating services .	6
Literature searching .	4†
Abstracting	3

* Of the 14, five would restrict the service to staff and postgraduates.
† Three of the four were new universities.

of all graduate staff in the libraries in question. Twenty-seven of the 45 are doing work directly relevant to their subject qualifications, such as staffing science libraries (16) or acting as subject specialists (8), while the others appear to be engaged in general library duties such as cataloguing or acquisitions. The principal ways in which the 37 librarians would like, ideally, to employ their science graduates are shown in Table 13.

TABLE 13

Instructing readers in the use of scientific libraries and literature	27
Book selection	25
Classification of scientific literature	20
Reader services	17
Preparation of specialised bibliographies and guides to the literature	16
Liaison with science and technology departments . .	14

85. *Professional education requirements.* A request to assess the importance to university librarianship of various branches of education for scientific information work produced the replies shown in Table 14, which can usefully be considered along with Tables 12 and 13.

86. To complete this part of the enquiry librarians were asked if they would like science and technology graduates joining their staffs to have followed a specialised course in scientific information work or to have received a more traditional type of professional education. It is significant that only four preferred the specialised course and nine the traditional, while 23 chose neither and expressed preference for a course which would combine both scientific information work

TABLE 14

	Very important	Important	Unimportant
Collection building	21	10	5
Literature searching techniques . .	25	10	1
Classification for information retrieval .	17	13	6
Indexing .	5	17	15
Abstracting	—	9	27
Literature analysis and preparation of evaluative reviews of research . .	3	8	26
Preparation of information bulletins and similar editorial work. . . .	3	17	16
*Systems analysis . .	11	13	12
*Systems design . .	10	15	11
*Library mechanisation	21	14	2

* It was quite rightly pointed out by more than one librarian that these are aspects of library management rather than scientific information work, but they have a certain relevance to this enquiry for, as several librarians indicated, they would expect to consult their science and technology graduates on mechanisation matters.

and traditional librarianship. Most of the science and technology graduates at present in university library work are likely to have received a traditional type of professional education. These graduates may well be amongst those for whom short courses on specialised aspects of scientific information work will be appropriate.

87. Examination of Tables 12–14 shows that there should be scope in university libraries of the future for activities which up to now have been largely confined to special libraries and information services, so that science and technology graduates joining the staffs of university libraries in the future can reasonably expect to use their subject qualifications in a direct and purposeful way. This more than any other consideration (including salary) is likely to influence recruiting and bring into university libraries the good science and technology graduates they so badly need.

88. As a sign of new attitudes, the interest shown in such highly specialised activities as current awareness services and the production of information bulletins is, perhaps, particularly significant. A number of librarians were even showing a distinct interest in the possibilities of selective dissemination of information.

89. Of equal significance for professional education is the prominence given in Tables 12–14 to a whole group of activities which required a specialised knowledge of the literature of science and technology, the guides and keys to this literature and specialised sources of information. The need to improve and extend instruction in the effective use of libraries and scientific literature received great stress, and many librarians would have liked to offer quite substantial

courses of this sort, both for postgraduate and undergraduate students. Several librarians, too, made reference to the increasing complexity and sophistication of bibliographical tools and techniques and would have liked to offer their users assistance with literature searches. They also recognised that the search strategies and methodologies which are needed to get the most from a library's own resources would have their counterpart at a higher level, and many librarians looked to a future in which computer-based national and international services, such as MEDLARS, would require skilled intermediaries on the staffs of individual libraries. Tables 12–14 also show the importance attached to the science graduate's role in stock building, in book selection and in the preparation of bibliographies and guides to the literature, all of which underline still further the importance of a thorough grounding in the literature and bibliography of science and technology and in other sources of information. Teachers of library and information science are well aware of the difficulties which this part of the professional curriculum presents, and there is certainly no simple answer. Approaches which attempt to demonstrate a methodology are amongst the most promising, and the "flow-chart" approach to reference work with which F. S. Stych has experimented at the University of Sheffield (Stych, 1966) is one which should commend itself to science graduates, not only as a method of learning, but as a method of teaching which they themselves might well use when they are called upon to assist with courses of instruction for their own library users.

90. The need for a sound background in classification is clearly revealed in Tables 13 and 14 and was more predictable than the not inconsiderable importance attached to indexing (Tables 12 and 14). On the other hand, several librarians wrote at some length against the need for university libraries to produce abstracts, and there was a very positive feeling that literature analysis and the preparation of evaluative reviews of research are not only unwanted but unwarranted in a university library situation. The great interest shown by several librarians in the provision of translation services foreshadows important developments in an area in which recent studies suggest there is need for considerable concern.

91. The belief in the need to include scientific information work in the professional education of science and technology graduates entering university librarianship was expressed by many librarians and is amply borne out by Tables 12–14. One very important aspect of this is the need to plan for a future in which computers will play an increasingly important part. The availability of large computers to university libraries will offer possibilities for implementing new ideas on aims, methods and procedures in university libraries, possibilities which will call for considerable research and development in information technology and science. University libraries will have increasingly to take account of such facilities as commercially available data and information services on magnetic tape and computer-aided programmed learning. Work such as that of Kessler at Massachusetts Institute of Technology (Kessler, 1965) foreshadows a situation in which researchers will be able to search the literature by operating consoles in their own offices. Such developments are clearly of profound long term significance for university libraries, and there is every reason to expect that technological advance will go still further. The university library of the future will certainly require, from some of its staff at least, advanced skills in the science information field.

92. The case for an adequate background in traditional librarianship is equally strong, if only, as several librarians pointed out, to ensure that the science and technology specialists are not a community within a community and have adequate long-term prospects of reaching the senior positions in university libraries. Even some of the specialised duties envisaged for them could not be carried out effectively without the sound background knowledge of university objectives, organisation and procedures that would be included in a good, integrated, professional education. This applies, for example, to such duties as representing the library on science and technology Faculty Boards and also to the extremely important development envisaged by many librarians, and already beginning to get under way, by which science and technology graduates on the library staff will act as library liaison officers with individual science and technology departments and groups of departments. Above all, perhaps, one must keep in mind the great and highly desirable increase in recent years in the movement of staff between different branches of library and information work: a course of professional education should recognise and facilitate such mobility.

THE TECHNICAL COLLEGE LIBRARIES

93. The technical college libraries make up a very large group, serving institutions which range from colleges with little or no advanced work to institutions designated as polytechnics, in which much of the work may be at university level. To generalise about library provision for this group as a whole would be neither feasible nor profitable. What is certain is that considerable and badly needed improvements have taken place in recent years, that there is still a long way to go and that in view of the very large numbers who receive their scientific and technological training in technical colleges of one sort or another, the potential importance of their libraries is very great indeed.

94. In considering this group, then, we have concerned ourselves only with designated polytechnics and colleges known to be giving instruction in the use of libraries. Of the 36 institutions to which we sent a questionnaire, 18 replied, 14 of them being colleges which are to be included in polytechnic institutions. Our "sample" is therefore heavily biased towards large and active colleges, the ones most likely to be setting the standards to which others will aspire in the years ahead.

95. *Composition of the present staffs of technical colleges libraries.* The 18 libraries concerned had 102 staff between them, with qualifications as shown in Table 15.

96. Table 15 shows a marked similarity to that for the public technical libraries (see paragraph 128), with a heavy preponderance of staff holding either a professional qualification only or an arts degree plus a professional qualification. As in the public technical libraries, only a very small number of staff held science or technology qualifications. Five held science or technology degrees, two had HNC/HND or membership of a professional institution and five had science A-levels: a total of 12 out of 102, or 11·8 per cent.

97. *Library services in technical colleges.* Librarians were asked to give details of any special services they were providing in addition to their normal functions. The services most frequently mentioned are listed in Table 16.

TABLE 15

Professional librarianship qualifications only . . .	34
Professional librarianship qualification *plus* arts degree.	17
Arts degree only	5
Professional librarianship qualification *plus* science or technology degree	3
Professional librarianship qualification *plus* A-level science .	3
A-level (non-science) only . .	3
Science or technology degree only	2
HNC/HND or membership of a professional institution	2
A-level science only . .	2
Trainees and general assistants	31
Total	102

TABLE 16

Instruction in the use of libraries (for new students)	15
Provision of accessions lists	8
Specialised instruction in the literature of a student's subject	7
Provision of reading lists and subject bibliographies	6
Publication of an information bulletin	3
Current awareness service	3

98. Other services, provided by one or two colleges, included indexing of papers in periodicals and the extension of library services to local industry.

99. *Extension of present library services.* All 17 librarians who replied to the question on this subject would have liked to extend the services at present offered to college and outside users, if staff and other resources permitted. Twelve of them specifically mentioned services to outside users, such as the libraries of selected firms (rather than individuals), and one suggested the provision of an information bulletin to local firms on a subscription basis.

100. Some of the replies to a question on how librarians would like to use science graduates, if more became available, throw further light on the form which future extensions of service might take. Table 17 is a list of desired services, giving in each case the number of librarians who suggested them.

101. This shows considerable common ground with the university library situation. The emphasis on teaching the use of literature and the library (which is also present in the analysis of present services in Table 16) reflects the very

TABLE 17

Classification	12
Instruction of users in their subject literature	10
Book selection .	10
Staff liaison . . .	8
General assistance to readers (including industry)	7
Current awareness bulletin	6
Abstracting	6
Technical information service (including industry)	5
Cataloguing	5
Indexing	5
Preparation of bibliographies and guides to the literature	5
Translating	5
Assistance with literature searching	5

positive approach to the library's role in higher education which already exists in many technical colleges. Though specialised, more advanced instruction in the student's subject field is at present being given in only a few subjects (most frequently chemistry, at the request of the teaching staff concerned), it seems clear that given the appropriate resources of specialised library staff, this sort of activity would be taken much further.

102. *Professional education for technical college library work.* As with the university library enquiry, librarians were asked whether they would prefer science or technology graduates joining their staffs to have had a specialised course in scientific information work or a more traditional type of education for librarianship. Eight favoured a traditional course, four a specialised, three preferred a mixture of both and three stated that either would be acceptable. A number of replies implied that for administrative posts in libraries, traditional librarianship training would be required. In their views on traditional versus other types of professional education, technical college librarians were in very close agreement with librarians in the public technical libraries, perhaps reflecting their own educational and training background to a greater extent than the needs of their particular sector of scientific and technological library and information work. Thus, the traditional type of course was preferred by 45 per cent of the technical college library respondents and 50 per cent of those in public technical libraries, but by only 25·5 per cent in universities, 25 per cent in U.K.A.E.A., 15 per cent in Research Associations and 12·5 per cent in Commonwealth Agricultural Bureaux.

103. The importance of various subjects in courses of professional training was assessed as shown in Table 18.

TABLE 18

Subject	Very important	Important	Unimportant
Collection building (printed material) .	15	2	—
Collection building (non-conventional) .	7	8	2
General reference work . . .	10	7	—
Science and technology reference work .	15	2	—
Patents literature searching .	1	7	9
Teaching the use of libraries . . .	10	7	—
Teaching the use of other sources of information	4	12	1
Conventional cataloguing and classification	10	7	—
Non-conventional indexing and classification	8	8	1
Abstracting	—	10	7
Preparation of critical reviews of the literature	1	9	7
Editorial work and the production of information bulletins	7	9	1
Library mechanisation	4	13	—

Additions to this list by individual librarians were library planning and administration (four times), teacher training (twice), library management (once) and O & M (once).

104. *Qualities and qualifications required for work in technical college libraries.* Librarians were asked to assess the importance of a number of factors for success in technical college library work by marking each item on a 5-point scale (5 = essential, 0 = irrelevant or totally unimportant). The results, in order of importance, are shown in Table 19.

TABLE 19

	Average rating
Personality	4·65
Professional librarianship or information qualifications. .	4·6
Subject knowledge . .	3·1
Languages . .	2·8
Teaching experience	2·2
Practical experience in research, development, production or management.	1·75

105. *Factors influencing recruiting*. Librarians were also asked to list the factors which, in their view, would favourably influence recruitment of science and technology graduates into library and information work.

106. First came "better salaries" (10 out of 16). Higher "status" (7 out of 16) and "more publicity" (7 out of 16) were considered to be the factors next in importance. There was a general belief that not enough information was given to either graduates or school-leavers about the work involved in running a library, the career prospects or the more exciting developments in the field of library mechanisation. Five replies suggested that recruitment of scientists would be encouraged if the library services could be developed further and more information work included, and four librarians specifically mentioned the need for opportunities for research. The provision of more staff to relieve the librarian of routine duties, particularly at clerical level, was also mentioned by four librarians.

107. *Short courses*. Librarians were asked if they felt the need for short courses on specific topics. Thirteen expressed a need for such courses, and only one stated that sufficient short courses were already available. The topic most frequently suggested was computer applications (four times), with systems analysis, literature searching and indexing each being mentioned twice. Other suggestions included micro-reproduction techniques, teaching methods, patent literature and the literature of subjects taught by the college.

108. Although most librarians were prepared to release staff for short courses, this was difficult under present staffing conditions. One librarian said he was unable to release staff because "any absence created a state of emergency". Fourteen librarians were prepared to release staff to attend courses and two were not; these two, however, stated that this was due to shortage of staff. Nine librarians would be prepared to release staff for short three-day courses, five for day-release and three for full-time courses.

109. *Conclusions*. Present trends in higher education make it plain that considerable progress can be expected in colleges of technology during the years ahead. In some of the larger institutions the advent of Council for National Academic Awards (C.N.A.A.) courses and the general increase in advanced work, to which reference has already been made, will present their libraries with problems and opportunities similar in many respects to those of the universities.

110. General tendencies towards expansion, and the development of improved services, are likely to be reinforced by progress and change in particular fields of study. There is a continual increase in the "sophistication" of research, development and production, and a need for flexible and adaptable engineers and technologists at all levels of industry. The role which the college library staff must play is important, for scientific and technical literature and sources of information will be needed by the engineer long after his lecture notes have become dated. This means that library staff of sufficient quality and in sufficient numbers must be available to provide the teaching staff with the services they require, to fulfil the teaching function of the library and to provide students with their full range of requirements.

111. It has been suggested to us by a number of Industrial Liaison Officers that college libraries, perhaps in association with the Industrial Liaison Officer, industrial libraries and the public technical library, would be suitable centres for short intensive courses on aspects of scientific and technological information

problems of interest to local industry and commerce and, in particular, on aspects of commercial/technical information. This, again, implies a competent, well-qualified library staff which is itself up-to-date and close to the user.

112. Developments in technical college libraries, as in the universities and public technical libraries, point to the need for more qualified staff providing improved levels of service. There is clearly scope for a considerable increase in the number and proportion of library staff with scientific qualifications at degree level or equivalent, and the activities of the more progressive institutions suggest that work in a good technical college library can be sufficiently stimulating and challenging to satisfy staff with such qualifications. If they are to be recruited in sufficient numbers, however, heed must be taken of the present deficiencies in salary expectations, status and publicity mentioned in paragraph 106.

(C) THE PUBLIC TECHNICAL LIBRARIES

113. The services offered by public reference libraries make a most important contribution to the nation's scientific and technical library and information network. In many cases, and particularly in the larger public library systems, the reference library's holdings of scientific and technical literature are brought together to make up a special library, usually known as the Technical Library and manned by a separate staff. Sometimes the Technical Library is combined with the Commercial Library.

114. These libraries are very heavily used—one of the largest reported an annual total of 15,000 telephone enquiries, 10,000 personal enquiries, 1,500 by Telex and 1,000 by letter. Their staffs can be quite large: one has a staff of 18, another 11 and several have between six and nine. Many of these libraries organise and act as the base for co-operative schemes for the benefit of industrial and other special libraries in their areas, such as LADSIRLAC at Liverpool, SINTO at Sheffield, NANTIS at Nottingham.

115. A recent survey by D. W. G. Clements of O.S.T.I. (Clements, 1967), which covered the various types of public reference library providing a technical and/or commercial service, including all the largest ones, showed that the principal user groups were students, teachers, industry, commerce, civil service, local government, research associations and professional and learned societies. Students comprised the largest group of users making *personal* visits (52·6 per cent), while industry was the second largest (10·7 per cent). Of users making telephone, Telex and postal use of the service, industrial firms were by far the largest group (30·3 per cent).

116. In making our own enquiries we concentrated on public library systems known to operate a separate technical or combined technical and commercial library. A letter and questionnaire was sent to 18 municipal and two county libraries, and replies were received from all except three*. The questionnaire was also sent to Hatfield College of Technology, which in its role as the base for HERTIS has much in common with public technical libraries. The HERTIS

* These are: Birmingham, Bradford, Bristol, Ealing, Glasgow, Hull, Leeds, Leicester, Lewisham, Liverpool, Manchester, Middlesborough, Newcastle, Nottingham, Sheffield, Essex and Lancashire.

figures are not incorporated in the various combined figures quoted in this section, but account is taken of their comments and experience in making our observations.

117. *The nature of the use made of public technical libraries.* It is significant that of users who make personal visits to these libraries students are overwhelmingly the largest category. Though the great majority of them merely require a quiet place to work, they cannot but be influenced by frequent exposure to a well-stocked, well-organised and well-exploited scientific and technical library and information service, particularly if it is adequately equipped with bibliographical and reference works. To this extent the public technical library has an important opportunity to influence the library and information expectations and habits of the rising generation of scientists and technologists.

118. Of the non-student *visitors* to the libraries he surveyed, Clements found that 52·5 per cent had come to seek information and 16·6 per cent wanted a known item of literature. In the case of telephone, Telex and postal enquiries, he found that about 70 per cent were for information and about 30 per cent for loans of literature. Speed is an important element in the work, and one of the librarians replying to our enquiry about the qualities required of staff in such libraries stated that "the most important requirement is the ability to work at a consistently high speed with complete accuracy in an environment of continual interruption". Clements found that 30·8 per cent of personal users wanted their requirements within a day.

119. He also concluded that the vast majority of enquiries made were straightforward and fairly specific and that factual enquiries predominated. It is clear, too, that many of the enquiries made are not of a directly scientific or technical nature. Without pressing the comparison too far, it is interesting to note that Slater's survey of "private" technical libraries and information units (industrial firms, government laboratories, academic institutions and learned societies) (Slater, 1964) showed that the two most common categories of information required were descriptions of an object, process or method and requests for simple facts.

120. *The level of knowledge required to meet users' needs.* A distinctive feature of the demands made on public technical libraries, and one with obvious implications for staffing, is that they are called upon to deal with enquiries for information, for books and for other documents, over a wide range of levels, from postgraduate at the one extreme to requests for simple factual information at the other.

121. *Proportion of work requiring graduate level scientific or technical knowledge.* We asked the librarians whom we circularised for their own assessments of the proportion of the work carried out in their technical libraries which called for scientific knowledge at various levels. The assessments of the 15 librarians who replied are shown in Table 20.

TABLE 20

PROPORTION OF WORK REQUIRING GRADUATE LEVEL SCIENTIFIC OR TECHNICAL KNOWLEDGE

10% or less	9 libraries
15%	1 library
20%	3 libraries
40%	1 library
50%	1 library

122. It is perhaps significant that the 50 per cent, the 40 per cent and one of the 20 per cent estimates came from three of the four major public technical libraries which Clements found to be covering, between them, 56 per cent of all technical and commercial enquiries covered by his entire investigation.

123. HERTIS, relatively strong in scientifically qualified staff and probably in a better position to answer this question than any of the other libraries, estimated 10 per cent, with a further 15–20 per cent requiring knowledge at the level of membership of a professional institute (a category virtually unrepresented in the replies from the public technical libraries).

124. A random sample taken by Clements showed that, for those making personal visits, from 10–15 per cent of the technical enquiries covered by his investigation could be considered to be at postgraduate level (Clements, 1967), though for items requested on loan he reported higher figures: 20 per cent of the books and 50–65 per cent of the scientific journals thus requested being classed as postgraduate.

125. *Proportion of work requiring A-level scientific knowledge.* Eight libraries estimated that 20 per cent or more of their work called for knowledge at this level, and four of the eight estimated 40 per cent or more.

126. *Proportion of work coming within the competence of a trained librarian with no formal scientific qualifications but with relevant library experience.* This category covered by far the largest proportion of the work. Eleven out of 15 libraries put 40 per cent or more of their work in this category, and four of them estimated over 90 per cent.

127. The figures we have given are not sufficiently precise to justify categorical statements about levels of work being carried out at present, but it would probably not be unrealistic to suggest that 10–15 per cent of it calls for knowledge of science or technology at graduate level and a further 30–40 per cent at A-level: furthermore, it seems probable that the larger and more effective the service becomes, the higher the proportion of its work that is likely to call for graduate level knowledge.

128. *Composition of present staffs of public technical libraries.* With the above considerations in mind we can turn to the staffing position as it actually was at mid-1967. The 17 libraries concerned had 114 staff between them, with qualifications as listed in Table 21.

129. A striking point about the figures in Table 21 is the small proportion of staff with science or technology qualifications—only four graduates and 15 at A-level. Having regard to what has been said about the level of work carried out, it is clear that much work considered to call for graduate or A-level scientific or technical knowledge is, in fact, carried out by staff without such qualifications.

130. There seems to be no doubt that for the services offered at present in public technical libraries, professional librarianship qualifications supplemented by considerable experience on the job can go a long way towards compensating for lack of formal scientific qualifications. Outside, and not always welcome, testimony to this is the eagerness of industrial (and other) scientific libraries to recruit staff from public technical libraries. It should be recognised, however, that technical library work is amongst the most exacting of public library tasks and, in consequence, the staffs of these libraries probably include more than their share of the best and most promising members of the public library

systems' staff. Furthermore, many of the senior staff are of the calibre of good honours graduates, but came into library work at a time when it was the exception rather than the rule for the best school-leavers to go on to university. To maintain the level of ability which they represent, the public libraries will have to look for graduate rather than O-level or A-level G.C.E. qualifications. Undoubtedly, too, the greater the number of staff with good scientific qualifications, the greater the possibilities of extending the scope of the present services.

TABLE 21

Professional librarianship qualification only .	42
Professional librarianship qualification *plus* arts degree .	9
A-level science and no other qualifications . . .	9
Professional librarianship qualification *plus* A-level science .	6
Arts degree only	4
Professional librarianship qualification *plus* science or technology degree	3
Science or technology degree only	1
Trainees and general assistants	40
Total	114

HERTIS, which is not included in the above analysis, includes in its staff of 11, three science graduates, two holders of membership of professional institutions and one with A-level science.

131. *Qualities and qualifications required for work in public technical libraries.* In replying to our question on this subject, Chief Librarians placed very great stress on personality and personal qualities in general. Heavy emphasis was laid, too, on the value of professional qualifications and on wide scientific interests, especially in current scientific developments. For long-term career prospects in the public library service a professional librarianship qualification is essential for those who aspire to reach the top, and it was generally taken for granted that the librarian-in-charge of the Technical Library would be professionally qualified.

132. The extremely small number of science graduates revealed in Table 21 might suggest that public libraries have reservations about the value of science degrees, but as Table 22 shows, this is by no means the case. One or two Chief Librarians did say that science graduates have not stood out from the rest, or even that they have not measured up to their standards, but this could well be the result of having experienced only poor quality science graduates. This would accord with our very strong impression that an unduly small proportion of the best graduates who enter librarianship each year, whatever their disciplines, are taking up careers in public libraries.

133. *Chief Librarians' estimates of their needs for science graduates.* All except one Chief Librarian (where special circumstances applied) said that they could usefully use science or technology graduates in their technical libraries. They were also asked how many they could usefully use, and the 12 who specified actual numbers would, between them, require a total of 32 members of staff with science qualifications. The distribution of the 32 was as shown in Table 22.

TABLE 22

4 Chief Librarians would like 1 such graduate
3 Chief Librarians would like 2 such graduates
2 Chief Librarians would like 3 such graduates
1 Chief Librarian would like 4 such graduates
1 Chief Librarian would like 5 such graduates
1 Chief Librarian would like 7 such graduates

134. On the question of which degree subjects would be of most value, there were two distinct schools of thought. Six would prefer graduates in general science, seven would prefer specialists in particular disciplines. The general science preference usually came from libraries thinking in terms of small staffs. Those which specified particular disciplines were in most cases envisaging a team of specialists covering, between them, the major scientific and technological disciplines; the four largest libraries, referred to in paragraph 122, were included in these. The subjects most frequently mentioned were engineering, chemistry and physics.

135. *Extension of the scope of present services.* The main deterrent to the expansion implied in the above figures is financial. Chief Librarians, quite understandably, cannot consider their technical libraries in isolation from their service as a whole, and several of them expressed the view that the key to improvement of technical library services was an all-round improvement in their library systems' general financial circumstances, from which such specific improvements as attracting science graduates to their staffs might be expected to follow.

136. All except two Chief Librarians did, in fact, express the wish to extend the scope of the services offered at present, if staff with scientific or technological qualifications were more readily available. The form which such extension would take was seen in the great majority of cases to be the improvement of the services offered at present, "the better, fuller, more effective exploitation of existing resources", as one librarian put it. Table 23 shows the ways in which

TABLE 23

Type of work	Number of Chief Librarians mentioning this type of work
Book selection	9
Technical information service	8
General assistance to readers	6
Indexing	5
Abstracting	4
Classification	4
Information bulletins	4
Preparing bibliographies and guides to the literature	4
Literature searching	3
Liaison with industry and other libraries	3

Chief Librarians believe science graduates would be useful. It also gives, incidentally, an indication of the activities of qualified staff employed on the present services.

137. The problems of staffing, finance and inadequate accommodation, which are a recurring theme in most of the replies to our enquiry, probably account in large measure for the concentration on improving existing services. Few librarians were inclined to think beyond their present restrictive conditions and envisage additional types of service which their technical libraries might offer if better conditions prevailed; this is understandable and realistic in present circumstances. The same caution was displayed in the modest estimates of numbers of science graduates who could usefully be used in these libraries. It is significant, however, that by and large the boldest thinking about using more scientifically qualified staff and establishing new services came from the largest libraries, those which are already relatively well staffed and which, as Clements showed, are dealing with more than the average proportion of scientific and commercial enquiries. It was one of the largest libraries which felt that all the professionally graded posts should ideally be occupied by graduate scientists who are also chartered librarians, which would like to add seven graduate scientists to its staff and which rated literature analysis and the preparation of evaluative reviews of research as a "very important" element in professional training. At a somewhat different level, service to the small firm with no information or library service of its own was mentioned as an important aspect of technical library work which should be extended and developed, and there was a generally implied desire to establish closer contact with neighbouring industry and commerce.

138. *Professional education for public technical library work.* Table 23 gives a clue to the nature of the professional training favoured by Chief Librarians for the senior staff of their technical libraries. They were also explicitly asked whether they would prefer science graduates to have had librarianship training of the traditional kind or a course placing heavy emphasis on scientific information work. Opinion was equally divided on this, eight favouring each approach. One large library which favoured the traditional approach modified its preference by stressing the need for traditional training to be supplemented by short, specialised courses.

139. Requests for assessment of the importance of particular subjects in courses of professional training produced the results shown in Table 24.

140. Comparison with the corresponding table for university libraries shows a marked similarity in emphasis. The remarks made in paragraph 89 about the importance attached to the science graduate's role in collection building and book selection, and the need for a thorough grounding in sources of information and in the bibliography and literature of science and technology, apply with equal force to science graduates in public technical libraries. The limitations of scientists, however well qualified in their subjects, who are without this specialised professional knowledge, was stated very forcibly by one Chief Librarian who declared: "We have many readers here with doctorates in chemistry, etc., whom we can lose in the specialised literature of their subjects, on their own admission."

141. Like the university libraries, too, these libraries base their activities and services on large collections which need processing and organising for use and call for traditional librarianship skills such as classification. A point made by

TABLE 24

	Very important	Important	Unimportant
Collection building	14	3	—
Literature searching techniques . .	14	3	—
Classification for information retrieval .	8	7	2
Indexing .	6	10	1
Abstracting	3	8	6
Literature analysis and preparation of reviews of research	3	2	12
Preparation of information bulletins and editorial work	1	12	4
Systems analysis .	1	7	9
Systems design . .	1	7	9
Library mechanisation	1	8	8

Slater's enquiry is relevant here, too: that the better a library is organised, the easier it is to use on a "self-service" basis, with a consequent lessening of demands for assistance from the staff. It was emphasised time and again by Chief Librarians that professional librarianship qualifications are, in practice, found to be the most valuable of all assets for those engaged in public technical library work. Furthermore, as in university libraries (see paragraph 92), excessive specialisation in scientific information work skills, to the exclusion of an adequate background in general librarianship, would obviously be detrimental to long-term career prospects. In short, the most important need in terms of professional education for public technical library work is for a course in which traditional librarianship and scientific information work are integrated to the greatest possible extent. In some areas, for instance subject bibliography and sources of information, and the collection, storage, retrieval and dissemination of information, there would clearly be a great deal of common ground between university, technical college and public technical library needs, and this would accord with and facilitate a desirable mobility between these important branches of scientific and technical library work.

142. *Future developments.* The public technical libraries, often under difficult conditions, are at present making a very significant contribution to the nation's scientific information needs. We believe that there is potential for very considerable development of their services, probably to a much greater extent than most Chief Librarians can realistically contemplate in their present restrictive financial circumstances. Nevertheless, when they begin to think in terms of such activities as reviews of research and literature analysis (as one or two of them have), they are already thinking beyond the role normally accepted as appropriate to public technical libraries.

143. These libraries are part of, and can draw on the resources of, an established and accepted public service, with a well-defined organisational structure; they

have behind them long experience of their specialised type of librarianship; and many of them are backed by fine collections of scientific and technical literature. It would seem to be in the national interest to extend and develop these assets to a much greater extent than present resources permit, particularly, perhaps, in improving and strengthening services to the small firm and industry in general.

144. We understand that, early in 1968, O.S.T.I. intends to carry out a survey of the various types of schemes for library co-operation, both formal and informal; this we welcome, since it should throw some light on the present operation of these schemes and their potential. The Public Libraries and Museums Act, 1964, makes provision for the charging of fees for certain specific services by public libraries; other than at LADSIRLAC, this does not seem to have been followed up, and we feel that in suitable cases libraries and industry might exploit this provision to their mutual advantage.

145. Though the greater part of the work carried out in these libraries does not call for high-level scientific or technological qualifications, there is a substantial and very important residue which does. Once scientifically qualified personnel of graduate or near-graduate level were working in these libraries, new horizons of service would be likely to emerge, which could lead to a change in the balance of staff in the direction of a higher proportion of professionally qualified science graduates than most librarians at present contemplate. The basic prerequisite for such developments is no doubt financial—a general improvement in public library financial resources and the possibility of offering scientifically qualified librarians salaries higher than the levels prevailing at present. The usual salary for the librarian-in-charge of a public technical library is the £1,665–£2,265 per annum range, and for their deputies £1,220–£1,665. Such salary expectations are not likely to be attractive to people with good scientific qualifications. Financial incentives are not the only ones of course: the work itself has to be such as to attract and satisfy good science graduates. This it undoubtedly is in many cases, but far too little is known about it by university appointments officers and others in a position to influence science graduates in their choice of career. An intensive publicity drive to secure more science graduates for technical library work would probably pay dividends and could, in the long run, lead to science graduates being numbered amongst our City Librarians, to the benefit of the public library service and librarianship in general.

(D) THE NATIONAL LIBRARIES

146. Since this chapter attempts to survey the principal types of unit concerned with scientific and technological library and information work, it would be inappropriate to conclude it without some reference to the national libraries. It is not possible to generalise about these libraries in the same way as the groups already covered, since each has a highly specific role. From the viewpoint of this investigation, the differences between, for example, the N.L.L. and the National Reference Library for Science and Invention, are much greater than the similarities.

147. In the N.L.L. the qualities most prized in the senior grade of staff are research experience and potential, and since such people will normally come

into library and information work at a mature age, after some years in research, full-time professional training is considered inappropriate. In stressing the importance to librarianship of increasing the number of staff with this type of background, the Director of the N.L.L. urged the need for more research fellowships and research activities in libraries and library schools, and the value of intensive short courses.

148. Both the National Reference Library and the Science Museum Library have science graduates on their staffs—in very considerable numbers in the case of the former—but less importance has been attached to the matter of their formal professional education than to their scientific qualifications. Our impression is that the needs of both of these libraries have a great deal in common with those of the university libraries, already described, and that like most of the university libraries they would welcome science graduates who had undergone a course of professional training which set out to integrate traditional library skills and those associated with information science.

149. Though this section on national libraries is necessarily short, it should be mentioned that views on many general matters connected with this investigation have been expressed by the librarians concerned and are often incorporated or reflected in relevant parts of our report.

(E) THE LEARNED SOCIETIES

150. Again, this is a group about which we have not felt able to generalise because of great differences in the size of the libraries and the wide range of services provided. We would only wish to record a strong impression that in many cases the work carried out in these units is amongst the most exacting in the science information field and frequently calls for both highly specialised subject knowledge and advanced professional skills.

PART II

EDUCATION AND TRAINING

CHAPTER 3

Categories of work and level and content of courses

151. In Part I of this report the general characteristics of science information personnel have been examined in some detail. Consideration has also been given to the principal types of science information unit, and a considerable amount of information has emerged about the tasks being carried out by the staffs of these units, the professional skills required of them and the direction which future developments are likely to take.

152. Though we are conscious of gaps and would have welcomed fuller information on several matters, we believe that Part I provides a reasonably firm basis for recommendations on professional education and training. In this second part of the report, which is concerned exclusively with education and training, our touchstone throughout has been the pattern of needs and activities revealed in Part I, supplemented by the qualitative and less tangible impressions formed on the basis of visits of observation, discussions and the other sources of information indicated in paragraph 8.

153. *Four categories of work.* In the activities of the various types of library and information unit described above, there appears to be scope and need for four categories of work which, in industrial terms, could be described as follows:

1. Production
2. Development (and design)
3. Applied Research
4. Background Research.

154. *Category* 1, *Production.* For our purpose this means the day-to-day operation of a unit, including both special library and information work. The overwhelming majority of the staff covered by our investigation fall into this category, which includes the full range of levels of qualification and experience.

155. *Category* 2, *Development (and design).* This type of activity is concerned with adapting the store of existing knowledge to particular circumstances. It includes systems analysis and design of a library or information unit, or part of the unit, or of particular operations. A notable example is the adaptation of mail-order store techniques by the National Lending Library for Science and Technology; another is the adaptation of punched-tape typewriters for producing catalogue cards and lists, for computer input and, in several industrial units, for the recording and automatic typing of chemical structures.

156. We believe that development work should be considered an essential part of the activity of all but the smallest science information units, just as R & D is considered essential by most of the parent bodies which they serve. In staffing any unit, allowance should accordingly be made for appropriately qualified staff, who would give at least part of their time to development work.

157. It may be relevant at this point to mention that of all scientists, engineers and technologists in manufacturing industry, 37·7 per cent are engaged in R & D, and if scientists alone are considered, the proportion is 51·7 per cent.

158. Development work frequently reveals a paucity or even a complete absence of basic data, and this leads to the next category, Applied Research.

159. *Category* 3, *Applied Research.* In the library and information context, this would include such activities as the application of new discoveries for information purposes, work on computerised typesetting, new types of index, such as MEDLARS, CBAC, Ringdoc, and other research intended to yield a product, process or service with useful characteristics at an economic cost. There is need for further data centres and for the evaluation of existing ones; for experimental studies of user needs in terms of levels of information, ease of access to this information and information channels used; and for the study of numerous other social, engineering and technological aspects of information transfer. We believe that the larger and more sophisticated units in industry (including Research Associations), in universities, colleges of technology and public technical libraries should be encouraged to carry out applied research of this type, perhaps in association with departments of librarianship and information science or Aslib.

160. *Category* 4, *Background Research.* This would include the study of such topics as the information transfer process, the dissemination of innovation, the role of information in scientific research, the fundamental processes of indexing and classification and, in general, topics of potential value in providing the necessary background for Category 3 above. This type of research, which has been relatively neglected in the past, is pre-eminently suitable for academic institutions, particularly schools of librarianship and information science, and warrants continued and increasing financial support. We believe it is especially important that experienced and qualified science information workers, both in industry and other employment, should be encouraged and enabled to take part in research of this sort.

161. If we now consider the work carried out in the types of unit we surveyed in Chapter 2, suitably modified by developing the four categories of activity described above, it is possible to make some general observations about the place of scientific or technological subject knowledge and of professional knowledge.

162. *Subject knowledge.* Before considering in detail the place of specialised scientific knowledge, it is worth mentioning the fact, well known to workers in the field, that first class work is being carried out at senior levels by arts graduates and non-graduates. Good qualified librarians, whatever their subject background, can quickly come to terms with most fields of knowledge, at the bibliographical and organisational level; certainly in scientific fields the vocabulary, the terminological barrier, is a very real difficulty, but once this is overcome a non-scientist can often operate with confidence at a reasonable practical level, and as his experience and familiarity with the needs of his specialised clientele and the relevant specialised information sources increases, his contribution becomes more and more significant.

163. We believe that scientific or technological subject knowledge is rarely significant, *as such,* below at least degree level or equivalent. This level of knowledge of relevant subjects is indispensable for work involving the critical assessment and evaluation of scientific and technological information, and also for the indexing and classification in depth of such information. Such a qualification is also a great asset in work involving the analysis, design and operation

of specialised library and information units. If these units are to broaden their functions to include as a minimum development work, then a knowledge of scientific method, such as might be gained by a study of science to at least degree level, is essential. The knowledge of a specific subject—organic chemistry, physics, or whatever it may be—will often be relevant in itself, but even more important, perhaps, is the appreciation of experimental method and the knowledge of mathematics, which should follow from a scientific education; in particular, a knowledge of statistical techniques can often be of special value. A less tangible but very important benefit conferred by the possession of a degree in science is that as "a scientist among scientists", its holder is much more likely to be accepted by the community he serves: to that extent his position is much stronger and the possibilities of really effective service are greatly enhanced. That degree-level scientific qualifications are essential for research in most branches of science information goes without saying.

164. *Professional education.* While we do not feel that professional qualifications are necessary for all the tasks carried out in the units we are considering, we strongly advocate the need for such qualifications for all those who will take up work in this field as a career and who aim for the highest posts.

165. In most fields in which a professional qualification is not a statutory requirement there are those who deny its value, and scientific and technological library and information work is no exception. An analogous situation arises in the field of management, and the case for an academic educational programme, which was made by Professor Eilon in 1964, applies with equal force to the situation in the science information field. He states: "Let us face it: some people go through an engineering college and never become good engineers; others become first class engineers without any formal education. This does not prove that engineering education is not worthwhile. Similarly, I do not think that the question whether management education can produce good managers or not is a relevant one. The question is whether it can produce *better* managers. Naturally you must have a flair for management and certain personal attributes, as indeed for any subject or profession you choose as a career, and without appropriate pre-requisites it is doubtful whether any educational programme can guarantee to produce good managers, good engineers, good doctors or indeed good practitioners in any field of human endeavour. But given the aptitude and the inclination for a certain subject, surely the individual stands to benefit from a course which provides a broad background, which attempts to knit together relevant problems and issues and which relates past and present human experience in the field, rather than to struggle on his own and learn from his slowly accumulating narrow experience." (Eilon, 1964.)

166. Our general view of the whole matter of "learning on the job" in preference to formal professional education is that whilst it may be suitable for the production of skilled craftsmen and specialised technicians, there is no evidence to suggest that better information scientists, engineers or physicists can be produced by this method than by education in academic institutions. On the contrary, it suffers as a method from inbreeding and a narrowness of outlook which inhibits imagination and initiative. The absence of a framework of general principles and basic knowledge leads to the *ad hoc* tackling of each problem as it arises, with little feeling for the overall situation and a very limited awareness of alternative possibilities for dealing with the problem. If progress is to be achieved

in the science information field, then staff will be required with imagination and initiative based on a broad foundation of professional education and training.

COURSES: CONTENT AND LEVELS

167. In the next two chapters we shall consider courses and the types of institution which present them. Our present concern is with the different types of course and their principal elements.

168. *Five types of course.* The needs of scientific and technological library and information work call essentially for five types of course. They are as follows:

1. Assistant (technical)
2. Non-graduate Professional
3. Graduate Professional Information Technologist
4. Postgraduate Professional
5. Advanced Professional. This will be considered separately

(Items 2–4: The professional grades)

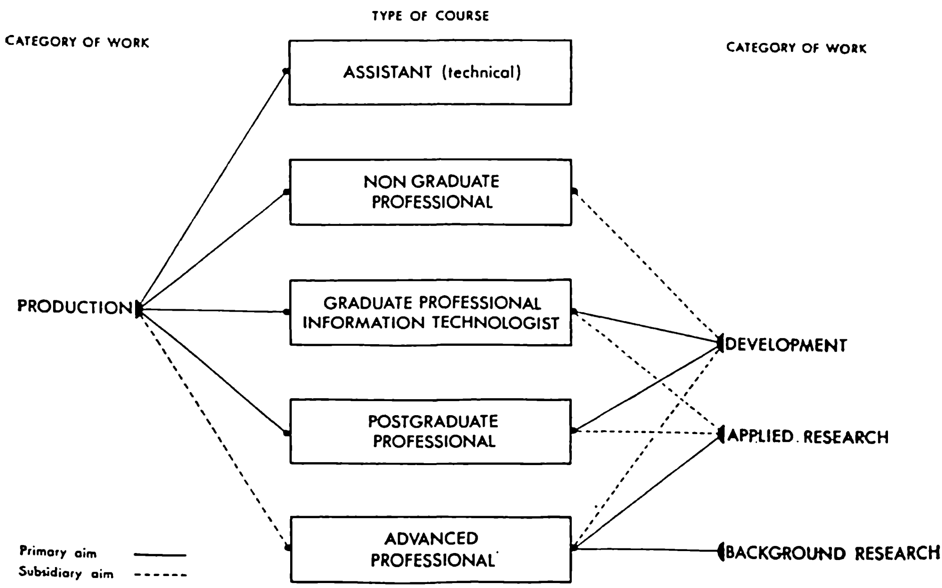
169. These courses are related, though not on a one-to-one basis, to the four categories of work described above. *Production*-type activity can call for all five types of qualification, according to the size and sophistication of the unit. *Development* will be the province mainly of the upper three levels of qualification plus the best of the Non-graduate Professionals; *Applied Research* will normally call for Advanced Professional and the best of the Graduate Professional Information Technologist and Postgraduate Professional levels of qualification; and *Background Research* for the best of those at the Advanced Professional level. This relationship can be seen from the diagram in Figure 2.

170. In suggesting these five types of course we have no wish to imply an over-rigid approach, and we would subscribe to the view put forward by Dr. D. G. Christopherson (1967) that the principle of promotion from one course to another is fundamental to good educational planning. Everything possible should be done to facilitate such a progression for those who have the ability and desire to undertake it.

171. *Assistant (technical).* There are many routine and technical operations which are at present being carried out in scientific and technological library and information units by general clerical or professionally qualified staff, because of a shortage of suitably qualified and trained staff to whom this work could be delegated. As services develop, and with the increasing use of machines which require new skills and demand greater accuracy of work at all levels, a new grade of staff, the Assistant (technical), is needed. We envisage that this grade will be staffed by school-leavers with the Certificate of Secondary Education (C.S.E.) or G.C.E. O-level passes. On completion of the appropriate course they should be able to undertake reliably, and without detailed supervision, routine tasks such as alphabetical and numeric filing in accordance with explicit instructions; up-dating, scrutinising, checking and cross-checking of records and material held in the unit; acquisition of material in accordance with explicit instructions; use of equipment such as Telex, tape-typewriter, key-punch and punched-card equipment (including optical coincidence cards); use and routine

Figure 2

RELATIONSHIP BETWEEN TYPES OF COURSE AND CATEGORIES OF WORK



maintenance of reprographic equipment and preparation of master copy for reproduction; use of microphotographic equipment; simple précis work and drafting, etc. The sort of course which we have in mind could be provided for under the City and Guilds arrangements for a Library Assistant's Certificate, which is referred to again in paragraph 228.

172. The Assistant (technical) courses could be supplemented by courses in such academic subjects as would be required to bring the student up to the level of five G.C.E. O-level passes, including English and Mathematics or Statistics or a Science and, preferably, at least one foreign language; the outstanding student should be encouraged to study two or more subjects to G.C.E. A-level, preferably in mathematical and/or scientific subjects.

173. It is recognised that at this level and in this age group staff should not be expected to be permanently committed to library and information work. The type of course envisaged above would also equip them for careers in other fields.

174. *The professional grades.* The balance and relative emphasis of the elements which make up the professional content of the three professional grades will

vary from one level to another and, within each level, from one course to another. At the present stage in the development of librarianship and information science there is scope for many different approaches, and for some years to come this very diversity should be a source of strength.

175. We do feel, however, that it is useful to indicate guide-lines, and the three broad areas of study which we suggest below will provide a useful framework for course-building and will also indicate the way in which a librarian or scientific information worker should be encouraged to look at his job. We have not considered it appropriate or useful to indulge in detailed syllabus-making, but an examination of Tables 10, 14, 18 and 24, which indicate the varieties of skill and knowledge required in different types of library and information work, should be a useful guide to those engaged in framing new syllabuses.

176. We see the following three areas of study as covering the essentials of a professional education programme for scientific and technological library and information work:

1. *Scientific and technological communities and their information and library needs.* This would involve study of the information and library needs and the information and library-using behaviour of scientists and technologists, and also of the factors which may and do influence this behaviour. It would involve the study of different types of community—industrial, academic, governmental, etc.—their objectives and the way in which they are organised to meet these objectives: the structure of industry, the organisation of research in the private sector, the universities, the governmental sector and the quasi-governmental sector (Research Associations, etc.).

2. *The sources of information from which the needs of scientific and technological communities may be met.* This includes the study of bibliographical sources of all kinds, both published and unpublished, with emphasis on content and irrespective of form. It would also include the location and exploitation of personal, institutional and other non-bibliographical sources of information.

3. *Techniques by which the needs of scientific and technological communities may be met.* (That is, the means by which areas 1 and 2 above are brought together.)

(*a*) The organisation of knowledge: principles and techniques of information storage, retrieval and dissemination.

(*b*) Techniques of library/information unit organisation and management.

177. It is assumed that the treatment of the various topics included in these three areas would be such as to ensure the inclusion of basic knowledge relevant to librarianship and information work, such as the outstanding information sources in the humanities and social sciences, general principles of cataloguing and classification, etc.

178. We believe that the areas of activity indicated above provide a suitable basis for all three types of professional grade course, which we shall now consider.

179. *Non-graduate Professional.* We envisage the Non-graduate Professional, on completion of his course and at least one year of practical experience (which may have been concurrent with his course), as being capable of taking charge of a small "easy" special library or of carrying out professional special library work in a larger unit. This Non-graduate Professional group is likely to continue to provide the great majority of professional staff for *production* work in special libraries and information units for some years to come.

180. We recognise that entrants to this grade will not always be firmly committed to a career in scientific and technological library and information work, but it would be a great asset if the five G.C.E. passes (including two at A-level), which we see as the minimum entrance requirement, could include English, a foreign language and two A-level passes in mathematical and/or scientific subjects.

181. For this group the "core" of *general* (as distinct from science information orientated) professional knowledge required as background for effective work in any type of library or information unit should receive a fair amount of emphasis and should probably account for a quarter to a third of the whole course. Part I of the Library Association's syllabus (see paragraph 252) should provide a suitable framework for such a course.

182. The three areas of work described in paragraph 176 would provide a basis for the main part of the course and should be drawn upon and interpreted as individual circumstances require. It is recognised that the emphasis on particular topics would vary from course to course, but we would nevertheless suggest that certain subjects in each area require particular attention or emphasis. In indicating these topics, in the three paragraphs which follow, we should make it clear that in each case there are many others which will qualify for inclusion.

183. *Area 1. Scientific and technological communities, etc.* Amongst the subjects covered by this area (see paragraph 176:1) should be the organisation of scientific and technological R & D at various levels, but with emphasis on that performed in an industrial concern and its relation to the concern's other activities.

184. *Area 2. Sources of information* (see paragraph 176:2). This area would include not only published, bibliographically accessible material, but also other materials such as microforms, maps, photographs, engineering drawings, magnetic tape records, etc. Unpublished sources of information would include manuscript material such as technical correspondence and laboratory notes. Non-bibliographical sources of information, such as Research Associations, learned societies, etc., should also be studied.

185. *Area 3. Techniques, etc.* (see paragraph 176:3). Within this area particular stress should be laid on non-conventional methods and techniques and the associated "hardware" leading up to and including computers. We do not consider it necessary for students to study computer applications in detail at this stage, but they should be aware of their possibilities and limitations, in both data retrieval and library operations. The treatment of this topic will need frequent review: considerable advances in the application of computers to science information work are to be expected in the U.K. within the next few years, both in the number of units making use of a computer and in the sophistication of the applications.

186. Part of the course should include some basic study of the organisation and management of science information services and also of the units providing them.

187. *The Graduate Professional Information Technologist.* We expect to see the emergence of degree courses in which Information Technology will be the central, unifying discipline, providing the focus for all the constituent parts of the course.

188. Such a course would differ from that for the Non-graduate Professional in being much more demanding in the study of fundamentals. It would take a longer-term view than the non-graduate course and would naturally include, for example, ideas and studies which so far as the practitioner is concerned are at present of theoretical interest only, thereby speeding up the application of innovation and the development of new methods and techniques. What is *not* wanted is a course which inflates an existing non-graduate professional syllabus by the mere addition of a few academic subjects.

189. The three areas of work outlined in paragraph 176 will again indicate the general scope of the course, but in the case of a degree course of this type the treatment should be academic, with both elements carefully integrated into a unified whole. The professional element would be similar in general scope to that of the non-graduate professional course but, as already indicated, would be taking a longer-term view. Subjects such as classification theory and appropriate elements of psychology, which are fundamental to information work, should be included; and so should the study of scientific method, mathematics and statistics, for these are essential foundation subjects for anyone wishing to specialise in the field of information technology. It would not be desirable or possible to accommodate the *traditional* study of scientific subjects such as physics or chemistry within the scope of a course such as this, but they could very usefully be included as "complementary" subjects, studied from the standpoint of the specialised needs of information work. From a different viewpoint, there is scope for studying the logic, physics and chemistry of science information service instrumentation, by which we mean topics such as digital and analogue devices, the applications of mechanical, thermal, optical, acoustic, magnetic, electrical and other physical phenomena, and the study of applications of chemical properties and reactions in a wide variety of devices used in science information services.

190. We believe a course of this type is both feasible and desirable at the present stage in the development of the subject and that it could be accommodated within the normal three-year period for a first degree course. It could well be that there would be advantages to be gained from including a year of practical work between years two and three, thereby lengthening it to a four-year sandwich course. The C.N.A.A. framework, referred to in paragraph 247, would seem to be particularly well suited for a course such as we have described.

191. A graduate from such a course, after one or two years' experience, should be capable of undertaking *development* work utilising, for example, systems analysis and design. The emphasis on a good grounding in fundamentals will ensure that outstanding students are capable of proceeding to higher degree work in information technology and science.

192. Minimum entry requirements would be determined by the regulation of the institutions in which the courses were conducted, but we believe they should preferably include two good passes at G.C.E. A-level in mathematics and/or scientific subjects, with English and at least one foreign language at O-level.

193. *Postgraduate Professional.* Members of this group will differ from the last in having carried out a full-length degree course in traditional scientific disciplines before turning to their professional studies. For most of those who have not taken an honours degree, a one-year postgraduate course similar in scope and emphasis to that followed by the Non-graduate Professional should provide a sound professional background for library and information work in which degree-level scientific knowledge is an asset, but in which the bias is not towards highly specialised subject knowledge. The level to be reached should be such that after completing the course, and a year or two of experience, the graduate should, if necessary, be capable of undertaking *development* work.

194. In the case of graduates of high academic calibre, analysis of the data indicates that in 1965, of the 594 units of which staff details are available, only some 20 or so had two or more "good" science, technology or engineering graduates and sufficient other supporting staff to have been capable of sustaining even a modest continuing *applied research* programme. Nevertheless, if science information work is to progress from the craft to the automation level, then a growing applied research effort, supported by background and basic research work, will need to be developed, and this will require additional resources not only of money, machines and material but, especially, of manpower. In order to attract staff of the requisite high academic quality, the work will need to be sufficiently challenging and adequately rewarded, with opportunities at least equal to those for similar graduates in other fields of applied research.

195. A course for such graduates should preferably be preceded by brief but systematically organised practical training in a progressive unit; experience as an information user—perhaps in a laboratory or in industrial production—would be an additional advantage. It is also very desirable that such students should bring to the course a working knowledge of at least two foreign languages so that they can, with the aid of a dictionary, make sense of papers in a familiar subject field.

196. Such a course should cover the elements of the "core" of general professional knowledge required by the Non-graduate Professional, with emphasis on general principles rather than on details of current techniques. The need for such a core of professional knowledge, even in advanced courses, was clearly implied in a recent discussion of education in information retrieval in the U.S.A. (Garfield, 1967), where one of the contributors stated: "It seemed almost ludicrous for computer scientists and engineers to be discussing automation in libraries when they did not have the slightest acquaintance with elementary bibliographic apparatus. Indeed, the lack of training and exposure to such systems may account for the large number of absurd "solutions" offered by hardware-oriented engineers who were not conscious that one might retrieve information in one minute by use of a printed index that would require hours on the most sophisticated computer available."

197. In the main, however, the course would be concerned with orientating the graduate's specialised subject knowledge and abilities towards the needs of science information work. It is possible, with this more specialised aspect of the course, to consider two stages. The first would cover at a broad and general level the basic groundwork: the generation and use of information, information resources of all kinds and the communication of information. Stage two should then permit the choice of a number of much narrower fields of study, in which

greater depth and rigour could be achieved; for example, the application of computers in pattern recognition, operational research studies, aspects of advanced classification, etc.

198. For students of the calibre envisaged, the postgraduate course should certainly provide opportunities for carrying out small-scale exercises in research, and it would be reasonable to make the production of a dissertation based on such an exercise an important part of the course. The combination of a dissertation with the courses outlined above should be strong enough to justify the award of a Master's degree to successful students. After a year or two of experience, staff from this group should be capable of carrying out *applied research.*

199. It is from the ranks of the best of the Postgraduate Professional group and the best of the Information Technologist group that we should expect to emerge most of those who will go on to do Advanced Professional courses and be capable of carrying out the *background research* referred to in paragraph 160 above.

200. *Advanced Professional.* It is of great importance that an increasing number of graduates with the appropriate aptitudes and inclination, and particularly those holding science or engineering degrees, should follow courses of training in research methods leading, as in other disciplines, to a Master's degree or a Doctorate. We welcome the liberalisation in the regulations governing research training which is now taking place in many universities and which, in suitable cases, enables postgraduate students to spend part of the period of training in recognised institutions (including industry) both at home and abroad. Similarly, we welcome the policy of the Research Councils in encouraging such activity. It is also essential to encourage those research workers at the postdoctorate level who have shown some considerable aptitude for original and independent research to continue their work, with support such as that offered by the research fellowships and similar awards of the Research Councils.

201. At the level of advanced research, information science and technology will give scope for a genuinely multi-disciplinary approach, and it is likely that for many years to come research in this field will need to draw on expertise in a wide range of disciplines, from mathematics to linguistics, from psychology to computing science. We would endorse the view expressed at the recent International Conference on Education for Scientific Information Work, held in London in April 1967 (F.I.D., 1967), that as yet no discrete, generally accepted body of knowledge can be identified as being "Information Science" or "Information Technology". It may be that time and experience will produce, from the varied disciplines on which information science and technology now draw, a subject as definite as, say, chemistry or physics. Until such a time we must accommodate to an interdisciplinary situation.

202. One implication of this is that not all advanced researchers in our field will have professional qualifications or experience. At the same time, however, we feel that in the long run this should be the case only in certain highly specialised and theoretical areas of information science and that increasingly, as facilities for professional education improve, we shall be able to assume that those at the centre of research activity will have had a full professional education, with specialists from other fields being brought in as particular needs arise.

203. *Facilities for future leaders.* Before concluding this section, we wish to draw attention to a type of course which we believe to be very important, but which

cannot be accommodated within the framework mentioned above. In library and information work, as in other fields, the comparatively small number of future leaders will often be identifiable at an early stage in their careers, perhaps by their late twenties or early thirties. We believe there should be facilities for bringing these people together in "Staff-college" type situations, as do the armed forces and some of our larger industrial organisations. There would be some virtue in gatherings of this type made up just of professional library and information workers, but probably even more in bringing together not only professionals in our own field but working scientists, scientific administrators, management personnel and others who had been marked out as future leaders. In recent years many of our leading industrial organisations have found it worthwhile to invest very large sums of money in sending potential top-management personnel on courses carried out at universities in this country under the expert auspices of the Harvard Business School. A similar investment in future leaders in the science information field should bring rich long term returns.

CHAPTER 4

Courses

FULL-TIME, FULL-LENGTH COURSES

204. In this section we shall be considering various types of course—full-time and part-time, full-length (including "sandwich") and short. We recognise that for very good reasons it is neither reasonable nor practicable to insist that the only route to professional qualification should be via a full-time, full-length course. At the same time we feel very strongly indeed that all other routes have such disadvantages that they should be used only when circumstances make it completely impracticable to follow a full-time, full-length course of study.

205. A good full-time course provides the basic corpus of knowledge which is an essential basis for a career that may develop in any one or more of a number of specialised directions. This basic knowledge cannot and should not be neatly divided into a number of subjects, each studied in isolation from the others. Certainly for teaching purposes, a programme may have to be broken up into various courses of lectures or seminars, each with its own teacher; but in the context of a full-time programme, carefully planned phasing can ensure that the course as a whole develops in a meaningful way, that the relationships and interactions between the various subjects studied are brought out naturally, at the appropriate time, and that the individual elements are, by the end of the course, integrated into a unified whole. Such a planned progression, in which subjects are studied in parallel rather than in series, leads in the minimum amount of time to a situation in which a student can see the objectives, the scope, the tools and the techniques of his profession as a whole. To that extent he will be more confident and more competent to make professional judgments and decisions when the time comes, supported by a sound background of general principles and a knowledge of the range of choices and possibilities open to him when faced with a particular problem. Senior practitioners from the United States, where the part-time, "bit-at-a-time" approach to professional qualification is

widespread, have been deeply impressed by the advantages of our own full-time approach to professional education, and we ourselves have no doubt at all that a full-time, full-length course is not only the speediest but the most effective way of making a person professionally productive, both in the fields of librarianship and scientific information work.

BASIC COURSES

206. By this we mean the type of course which leads to a professional qualification: either the Associateship of the Library Association (A.L.A.), the Diplomas or Master's degrees of the University Schools, or the Certificate of the Institute of Information Scientists. The duration of basic courses in most professions—and librarianship and information science is no exception—is likely to be influenced by economic considerations and social attitudes and expectations rather than by strictly educational criteria. At present, and for the foreseeable future, a basic course of two years' full-time study for non-graduates and one year for postgraduates appears to be the most realistic basis for planning.

207. Courses of a duration so limited, in relation to the amount of ground to be covered, must clearly be concerned above all with identifying basic principles. Such is the rate of change and new developments in the library and information field that no basic professional qualification can be expected to take a practitioner through his professional life without reinforcement from time to time by specialised courses relevant to his particular needs at particular stages in his career. Furthermore, there are subjects which, in a basic course, are not appropriately studied beyond the level of general principles, but which may call for specialised study after some years of practical experience; various aspects of management, for example, would come into this category. It must come to be recognised that attending supplementary courses from time to time, as the need arises, is an indispensable part of the continuing education that is required of those who are to be successful workers in the library and information fields. This leads us to the matter of short courses.

SHORT COURSES

208. Since a policy for short courses in the field of librarianship and information work is being worked out at national level, under the auspices of the Department of Education and Science (D.E.S.) (paragraph 232), we shall restrict our comments to aspects of special significance to our own investigation.

209. We recognise the need for a wide variety of short courses of all types, at many levels, with many different objectives and aimed at a great variety of audiences, and would identify the following, at least, as being of special importance in our field:

(i) *Up-dating, refresher, re-training type courses.* These are intended, essentially, to bring up to date professional knowledge which may for various reasons have become out of date.

(ii) *Courses on current trends and new developments.* Obvious examples of courses of this type are those concerned with computer applications, developments in the area of centralised processing, etc.

(iii) *Courses on specialist topics.* These would involve the intensive study, for the particular needs of an individual or institution, of specialist topics such as patents, technical report literature, computer programming, abstracting, etc.

(iv) *"Gap-filling" courses.* By this we mean courses intended to fill gaps in professional training or knowledge. For example, someone who has a heavily scientific information orientated background may feel the need to study traditional classification or basic non-scientific bibliographical and reference materials; short, intensive courses could meet such needs. Similarly, many senior practitioners without professional qualifications would benefit from short courses on the national and international library and information network.

(v) *Scientific subjects.* Intensive short courses to provide background in subjects such as chemistry, engineering or physics for the benefit of science information personnel who may have professional background but little or no formal scientific knowledge. Such a course could also be of value to translators. We understand that courses of this type have been successfully presented in the U.S.A., and also courses on various aspects of present-day science and technology, which meet a similar type of need.

210. *Duration.* There is obviously a limit to the amount of time for which an employer will be prepared to release an established member of his staff, particularly if he is in a senior position, and this sets a practical limitation to the length of short courses. Our enquiries suggest that in the industrial sector three weeks is the maximum period of release that would be acceptable to most employers, and individuals would be unlikely to obtain such release at very frequent intervals. A similar enquiry in the United States (Georgia Institute of Technology, 1962, p. 17) showed two to three weeks as the preferred period and once a year as the likely expectation of any particular individual.

211. In the university sector strong emphasis has been placed for many years on the importance of making study leave and similar dispensations available to library staff. Few universities have as yet implemented such a policy to any significant extent, but the experience at Sheffield University of running one-week courses on mechanisation for senior university library staff provides encouraging evidence that virtually all universities are prepared to release staff for this sort of purpose and to pay the quite substantial cost of fees and maintenance involved in attending such courses. It seems reasonable to expect that university authorities should agree to periods of study leave of perhaps up to six weeks to enable library staff to attend relevant short courses, and also that they would provide the requisite financial backing. One would hope that a similar policy could be expected from employers in other public and quasi-public sectors. This is not to suggest, of course, that the length of a course is the only index to its value: we have heard of many excellent short courses of only a few days in duration, such as those on scientific literature offered by the N.L.L. and the courses on biological literature organised by Dr. R. T. Bottle of the University of Bradford.

212. Experience in this country and the United States has shown that really intensive courses of quite short duration can cover a great deal of ground and clear the way for further study by the student in his own time. Professor R. M. Hayes of the University of California, Los Angeles, has described a two-week course of Information Retrieval and Storage, made up of 40 hours' lecture time

and 40 hours of study and participation by the student, which covers in a *broad* way material which he considers could occupy a three- or four-year graduate course (Georgia Institute of Technology, 1962, p. 54). For maximum benefit from short courses, whatever their length, students should have carried out suitable preparatory reading prior to joining the course, supplemented by continued study after the course has finished.

PROFESSIONAL QUALIFICATION BY SHORT COURSES

213. The O.S.T.I. investigation of manpower needs (Edwards, 1966) showed that considerable numbers of scientifically qualified workers in this field had no professional qualification, and because of late entry into information work could not reasonably be expected to undertake full-time courses of professional education. Such late entrants have formed and will continue to form a substantial and very important group, including among them many very experienced research and development personnel who have turned to information work after years of valuable experience as practising scientists and technologists. To their employers, the value of such people derives perhaps above all from their knowledge of the firm or organisation. Rightly or wrongly, many industrial employers would probably attach little importance to the possession, by such staff, of professional librarianship or information qualifications. From the point of view of the staff themselves, however, a professional qualification would add to their chances of moving elsewhere if they so wished and thereby, indirectly, would also improve their prospects within their own organisations. Above all, it would enable them to be far more effective practitioners in the information and special librarianship fields. Employers might also benefit, in that the increased mobility produced by such a situation would widen their field of recruitment.

214. For such reasons we have, from the beginning of our enquiry, been thinking along the lines of recommending means by which genuinely mature entrants to the profession could build up credits towards a professional qualification by attending suitable short courses. At a fairly early stage we discovered that the Library Association was already planning along these lines, and one of the writers of this report, Prof. W. L. Saunders, was invited to attend meetings of the Library Association Sub-committee which prepared the scheme for mature entry approved by the Library Association Council at its meeting in October 1967 (Richnell, 1967). This opportunity was very valuable and greatly appreciated. We are in agreement with the general principles of the scheme proposed by the Sub-committee, which would enable mature entrants of graduate standing to qualify for admission to the Library Association's register by accumulating 30 credits, at least 20 of which must be gained by attending approved courses, combined with private study and the submission of papers. Our only significant point of difference from the Library Association recommendations relates not to the scheme but to details in the suggestions for the guidance of the Board of Admissions: we would be less generous in allowing credit for language competence. It goes without saying that in a scheme of this type there is need for the utmost vigilance in safeguarding proper standards, particularly in the matter of accrediting courses and ensuring that passively "putting in the hours" does not entitle a student to credit. The role of the Library Association's Board of Admissions would obviously be a key one.

215. (i) *Aslib.* Aslib has very extensive experience in this field and we have received testimony from many directions to the importance of their courses—very frequently the only professional training received by industrial library and information personnel. Aslib's Education Department, with contacts over the whole special library and information field, is in a particularly strong position for sponsoring specialised courses on such subjects as Patents, Trade literature or Eastern European literature, often using Aslib's members as lecturers. They are also well placed for organising re-training, up-dating, refresher-type courses and "appreciation" courses. The latter, though not intended for professional workers in the field of information or library work, can be of considerable indirect significance; they are intended to give particular groups who may have a responsibility for information functions—especially management—an awareness and appreciation of what is involved and required in producing an effective information service. Mention should be made, too, of Aslib's "conversion" courses, which aim to convert experienced scientists and other specialists into potential information officers.

216. With the recent significant increase in the scale of Aslib's research activities, there is clearly scope for disseminating the results of new research findings through the medium of periodical short courses, and it is encouraging to hear that plans are under way for a series of integrated courses within two of Aslib's special fields of research interest, Mechanisation and Co-ordinate indexing. This type of course can be valuable in disseminating not only the results of work carried out by Aslib's own research department, but also that of their members, who may contribute to the lecturing.

217. The dissemination of research findings by means of short courses is common practice in many scientific fields, and as the scale of research in library and information science increases—not only in Aslib but in the universities and elsewhere—such courses should, we believe, become a permanent and substantial element in educational provision in the science information field.

218. Much of Aslib's activity has necessarily been concentrated in the London area, though it has also been active in the provinces and in Scotland. If the Schools of Librarianship, which are distributed over many parts of the country, should become active in the provision of short courses, there may well be possibilities for very fruitful co-operation with Aslib in the mounting of short courses in scientific library and information work. The special expertise to which Aslib has access would often complement that of the Schools. We understand that Aslib would, in principle, be in favour of such developments. Indeed, they have already co-operated with London Schools and, through their presentation of "Wide-horizons", have established links with several others.

219. (ii) *The Schools of Librarianship.* The Schools of Librarianship would seem to be obvious centres for sponsoring short courses, and several of them are already active in this field. The Liverpool School, in particular, has made a strong feature of short courses, and some of them, for example those on Library and information sources for management, Patents, Information work today, Classification and indexing for information retrieval, are in the specialised fields with which this report is concerned.

220. In addition to offering courses of specialised interest, the schools are in a particularly strong position for mounting the basic "professional core" types of

course and courses on the national and international library and information network, both of which are important elements in any "mature entry" type of qualification.

221. Replies to our enquiries make it clear that the library schools are in general very willing to provide short courses. Since the pattern of the teaching year varies from one institution to another, it seems that the most convenient time for offering short courses would also vary from one school to another, so that there is the possibility of courses not only in different parts of the country, but at most times of the year. This should be of very great convenience for those qualifying by a "mature entry" route. From the point of view of the schools, the vacations are, of course, the best times for mounting short courses, though vacation time would not necessarily meet the needs of all who wished to attend. The extensive experience of the American library schools of summer courses, workshops, institutes, and the like, could be studied with considerable profit. One of the problems encountered is the provision of teaching staff during the vacation period, for this is the time when much of their research and lecture preparation is carried out. It leads the American schools, amongst other things, to bring in staff from elsewhere—including overseas—and to pay extra salary to their own staff who take part in vacation courses.

222. A similar policy might be followed in our own schools. They might also make summer courses the means of associating local and other practitioners with the work of the school; release of such people for a short or part-time teaching assignment is a possibility which, in view of the general shortage of teachers, should be pursued with the utmost vigour.

223. (iii) *Other agencies.* Short courses are also organised by many other agencies, such as Library Association branches and sections, the Standing Conference of National and University Libraries (SCONUL) and individual libraries. Some of our great libraries in the field of science and technology, such as the N.L.L. and the National Reference Library of Science and Invention, are obviously in a particularly strong position to offer specialised courses of the sort which require great strength in scientific and technological literature and expertise in certain specialised aspects of scientific and technological library work. There are encouraging indications that these libraries will be prepared to play their part in offering relevant courses to the extent that their resources permit.

PART-TIME STUDY

224. (i) *Evening courses.* Qualification by this route has a long and honourable history, but post-war developments in the direction of ever-expanding facilities for full-time higher education have greatly reduced its significance. Evening study is a long, hard route and, on general educational grounds, we regard it as inferior and very much a "second-best" to a full-time course. With the higher standards towards which it is now essential to aspire, it is also likely to be far less practicable to achieve results by evening study than used to be the case. We have, too, the very strong impression that increasing mobility is making it less likely that significant numbers of employees will be prepared to commit themselves for the long periods of time required for obtaining professional qualifications by the evening-class route. A further factor telling against such

study is that outside the Greater London area the number of potential students is so thinly spread (paragraph 60) that making up classes of an acceptable size can often present a great problem.

225. Nevertheless, we recognise that in some circumstances evening classes still have an important contribution to make; for example, they may constitute the only route to professional qualification open to personnel in a small unit. Indeed, we have received many tributes to the value of the evening classes conducted in the London area for the Certificate of the Institute of Information Scientists, and it has been suggested to us that similar courses would also be of benefit outside London.

226. It has also been suggested that many people who could not commit themselves for one or two evenings a week over a long period may be able to do so for shorter periods, such as a single term, during which they could study a specialised subject of interest to them or their organisation—courses similar, in fact, to those mentioned under Short Courses (paragraph 209). It should be kept in mind, too, that evening courses could make a useful contribution to the facilities available in connection with any "mature-entry" scheme that may be developed.

227. Evening courses or other forms of part-time study may also be relevant in another context. If the "mature-entry" route (paragraph 214) is to be reserved for graduates, as we believe it should be, it means that a group remains which is not provided for under present circumstances. This comprises staff who for perfectly good and valid reasons are unable to take full-time courses, though they have the G.C.E. A-level and O-level qualifications required by the Library Association's examination system. It is clear from numerous observations made to us that the general discontinuance of part-time courses for the Library Association's examinations has been a great blow to many individuals in this category, and also to many of the employing units covered by this study. It should be remembered, too, that in the case of the Institute of Information Scientists' part-time Certificate course, first preference is normally given to graduates, so that this route to qualification is also closed to such candidates. We believe that the provision of a suitable part-time study route to professional qualification for students in this category would be one of the most useful tasks to which a Library Association/Aslib/Institute of Information Scientists, etc., group of the sort referred to in paragraph 232 might address itself.

228. (ii) *Day-release*. Day-release courses are very appropriate for the Assistant (technical) type of training referred to in paragraph 171. Again, however, the wide geographic dispersion of potential students outside the London area may create problems, though observations made to us from many quarters suggest the possibility of considerable latent demand for a course at this level, which would produce "the touch-stone of a piece of paper readily recognisable by personnel officers". We see the duration of such a course as one year, and the City and Guilds' Library Assistants' Certificate course should provide a very suitable framework.

SANDWICH COURSES

229. This type of course is well known in industry and highly regarded by many industrial employers. It offers possibilities that should be very attractive, especially to those industrial employers who sometimes attribute to full-time

courses "lack of contact with the facts of life". The Liverpool School of Librarianship has had successful experience in offering a sandwich course for the Library Association's non-graduate syllabus, operated on the basis of alternate six-month periods in college and in a library. As yet it has had no candidates who have been sponsored by industry, but it reports signs of increasing industrial interest. They believe six-month periods to be the optimum basis for such a course.

230. The Industrial Training Act offers important possibilities for developing courses of this and other types in the field of scientific and technological library and information work. The Act enables employers to claim, via the appropriate Industrial Training Boards, against time spent in approved training by workers they are sponsoring. It is clearly of the greatest importance to educational and training activity in our field to enlist the support of the Industrial Training Boards and gain their recognition for as many courses in our field as possible.

"MIXED" COURSES

231. In some continental countries—for example, Germany, Czechoslovakia and Holland—courses are presented which are made up of periodical full-time attendance at an educational institution for a short period—perhaps a few days or a week—followed by a period of "works-based" or "home-based" private study. It is claimed by some that this periodical exposure to a longer period of full-time study is preferable to the more normal one day a week of day-release, even though the intervals between attendance at the educational institution may be fairly long. Contact between tutors and students could, of course, be maintained by correspondence, though it must be recognised that correspondence procedures impose a heavy burden on teachers and are economically dubious. Possibilities of this sort may be well worth considering, however, as offering, for example, a means by which married women, perhaps living in remote districts, may prepare themselves for careers in library and information work when their families have grown up.

COLLABORATION BETWEEN PROFESSIONAL BODIES

232. (i) With an increasing variety of courses and qualifications and the involvement of a wide range of educational institutions and agencies, the need to establish general, nationally accepted standards and to identify the relevance of particular courses and qualifications for particular purposes becomes increasingly urgent. It is therefore encouraging to know that a beginning has already been made in one of the areas with which we are concerned. The Department of Education and Science has recently set up a committee on the provision, planning and co-ordination of short courses in all aspects of librarianship and information work and consisting of representatives of the Library Association, Aslib, the Institute of Information Scientists, Association of British Library Schools and SCONUL, together with observers from the Education Departments. A list of short courses to be run in 1968 is now available from O.S.T.I., which is providing the secretariat for the committee, and relevant extracts from this list are to be published in the journals of the appropriate organisations.

(ii) This coming together accords very much with the view constantly expressed to us that there should be a drawing together of library and information work and that national and professional needs point to integration rather than separation. It would be entirely in accordance with these views if this collaboration were to be extended to all aspects of activity in the field of professional education and training.

CHAPTER 5

The institutions providing professional education*

THE UNIVERSITY SCHOOLS

233. Postgraduate courses are offered at the University College London School of Librarianship and Archives, the University of Sheffield Postgraduate School of Librarianship and Information Science, the Queen's University of Belfast School of Library Studies, the University of Strathclyde and the City University. The City University course leads to an M.Sc. and, with effect from 1968, the Sheffield course will also lead to a Master's degree. In both cases the course is of a full calendar year's duration. The other courses lead to a Diploma in Librarianship and last for an academic year, that is, about nine to ten months.

234. Though all five schools welcome scientists, it is at Sheffield and City that the greatest emphasis has been placed on information science and scientific information work. The specialised course in Scientific and Industrial Information Work at Sheffield and City University's M.Sc. in Information Science have both been accepted by the Science Research Council (S.R.C.) as qualifying for the tenure of their advanced course studentships.

235. In the 1967/68 session nine science graduates were following City University's M.Sc. course, and at Sheffield 15 out of 35 students were science graduates specialising in scientific and industrial information work. In addition, there was one science graduate at the Queen's University of Belfast, two at Strathclyde and three at University College, London (which has just established a new course entitled Scientific and Industrial Library and Information Work).

236. Experience at Sheffield and City Universities shows that science graduates are being attracted in increasing numbers into special library and information work, and during the last year or two one of the most gratifying results of publicity from the University of Sheffield Postgraduate School of Librarianship and Information Science has been the increasing interest shown by university appointments officers in this type of work as a career for science graduates. There is still, nevertheless, widespread ignorance of the scope and possibilities of scientific and technological library and information work: extensive and continued publicity is called for, both at school-leaving and at university level. A practical point which is worth emphasising is that the starting salaries of graduates entering scientific information work are better than is generally appreciated. In 1967 £1,200 or £1,250 per annum was a very normal starting salary for those leaving the Sheffield School at the age of 22 or 23, and consider-

* A list of Schools and their addresses is provided in the Appendix.

ably higher levels were by no means uncommon. The long-term career prospects, however, give some cause for concern.

237. It should, of course, be clearly understood that poor science graduates are no more likely to find a satisfactory refuge in scientific library and information work than in any other career, and one of the striking features in the Sheffield and City University situations is that not only are science graduates coming forward in increasing numbers, but that they are graduates of good academic standing, as the figures for 1967/68 in Table 25 show.

TABLE 25

SHEFFIELD AND CITY UNIVERSITY SCIENCE INFORMATION STUDENTS 1967/68

Class of Degree		City University	Sheffield University	Total
Honours	Class 1 . .	1	1	2
Class	2(i) or undivided 2	4	6	10
	2(ii) . .	2	4	6
	3 .	—	1	1
General/Pass . . .		2	3	5
Total . . .		9	15	24

238. Recruitment at this level suggests that those now entering the profession are academically of higher standing than many of those already in it. There is evidence that many graduates of high calibre who in the past would automatically have turned to postgraduate research in the fields of their first degrees are now preferring to carry out their postgraduate work in the field of information studies.

THE UNIVERSITY SETTING

239. A university setting carries with it certain assets and at least one disadvantage. Foremost amongst the assets are the research-orientated environment in which teaching is carried out and the membership of a community of scholars covering between them a wide range of academic disciplines. The principal disadvantage, at least at the present time, is the difficulty of obtaining resources for expanding teaching staff and student numbers, however desirable such expansion may be.

240. (i) *Research.* It is a normal expectation—often a contractual obligation—that university teachers should carry out research in addition to teaching, and the mutually advantageous interaction of teaching and research is an article of university faith to which we fully subscribe. The university schools of librarianship and information science should be natural centres for research in their fields, and this has already been recognised by the award of research grants and contracts to some of them. An important concomitant of research activity is the preparation of students for research degrees: all of the university schools now offer facilities for obtaining higher degrees by thesis. Research degree activity is

still at only a very early stage, but we believe that training in research and research degrees should become an accepted element in the general pattern of educational provision for scientific and technological library and information work, just as they are in other university disciplines.

241. In one important respect, however, there is a difference from other disciplines. It is normally desirable for a research student in information science to have had practical experience on the job between gaining his professional qualification and starting a research degree. For this reason, the S.R.C. Industrial Fellowships and Research Fellowships are more likely to be appropriate as a means of promoting research degrees than the S.R.C. research studentships which are the normal support for higher degree students in other scientific subjects. There are, of course, some areas of information science where practical experience is not essential, to which this observation does not apply, but these are comparatively few in number.

242. For the basic professional qualification itself, S.R.C. Advanced Course Studentships are of the very greatest importance and have played a major part in attracting good science graduates into information work.

243. (ii) *Inter-disciplinary possibilities.* The second advantage of the university-based schools—their membership of communities which cover a wide range of academic disciplines—offers possibilities for inter-disciplinary co-operation, at both formal and informal levels, that are of particular importance in a field such as information science, which needs to draw on a wide range of scientific and other subjects. We believe, too, that the university schools have a special opportunity—indeed, a responsibility—for making other teaching departments library- and information-conscious and for engaging the interest of good undergraduates in the possibilities of careers in library and information work.

244. The emergence of new degree structures which encourage the introduction of relevant aspects of science information work into the undergraduate curriculum is particularly welcome. At University College London, for example, third year students of a new B.Sc. course may take two subjects from those offered by the School of Librarianship and Archives, and we understand that possibilities of this sort are also being explored in some of the new universities. It is similarly gratifying to note that the Council of Engineering Institutions now includes "science information" subjects in its compulsory Part II paper. The new polytechnics should also be in a strong position to support developments of this kind in C.N.A.A. and other courses in scientific and technological subjects.

245. (iii) *The need for expansion.* The university schools are likely to prove particularly attractive to good science graduates wishing to make a career in science information work (see Table 25), and the urgent need to attract many more recruits of this calibre establishes a strong case for increasing the number of places in the university schools. At present, the most economic and efficient method of doing this would be to enable the present schools to expand, if they so wish, rather than to create new university schools. The present schools are small and have quite a long way to go before they approach the sort of size at which full benefit is obtained from economies of scale, with a reasonable number of specialist staff including, for example, representatives of at least each major group of scientific and technological subjects. A comparatively small number of strong university schools is at this stage greatly to be preferred to a larger number, competing with one another for scarce resources of specialised staff and scientifically qualified students.

THE NON-UNIVERSITY SCHOOLS

246. The 12 schools of this type are nearly all attached to institutions designated as future polytechnics. They have expanded very rapidly in recent years and between them have more than 2,000 full-time students. Their full-time staffs are large (two have more than 30, several have more than 20) and include a number of very experienced special librarians, though none of the latter, so far as we are aware, have degrees in science or technology. These schools are preparing students for the Library Association's examinations—a two-year full-time course in the case of non-graduates and a one-year postgraduate course for graduates. As indicated below, many of them offer combinations of subjects which provide a very useful course for special library work in the fields of science and technology.

247. As the polytechnics develop, there should be most valuable opportunities for offering courses with a much stronger scientific content than is possible at present, by joining forces with the appropriate science and technology departments. This possibility should do much to encourage the promotion of C.N.A.A. courses, such as the one recently accepted at Newcastle, and should facilitate the development of courses in information technology such as are described in paragraph 187.

248. At least two schools have plans for offering first degree courses in association with science departments in their local universities; this, too, is a most important and promising development.

249. We understand that the polytechnics, while not engaging in research of the same type or on the same scale as the universities, will be expected to orientate such activity towards the special needs of the areas in which they are located. For the library schools this could mean consultant and research activity in association with local libraries including, of course, special scientific and technological libraries. Such activity—which is already under way in some library schools—is clearly of the greatest importance both as a service to librarianship and the local community and as a source of strength for the teaching in these institutions.

250. The potential of these library schools as providers of short courses, and other courses, has been referred to in paragraph 219.

THE LIBRARY ASSOCIATION'S EXAMINATIONS

251. As the Library Association's qualifications at present outnumber all others in our field, it seems appropriate at this point to make a close examination of their content. Since the Schools of Librarianship have to work to the Library Association's syllabuses and have never hesitated to criticise any aspects of them of which they disapproved, it was felt that their views on the adequacy of the present two-year and postgraduate syllabuses, for specialised scientific and technological library and information work, would be of particular value. They can be summarised as follows.

252. *Two-year syllabus for non-graduates.* There was a generally expressed view that the education of scientific and technical *librarians* is a specialist function within the general framework of education for librarianship rather than a separate discipline. From this standpoint, Part I of the two-year syllabus was felt by many to be a satisfactory basic course, though the view was expressed

by some schools that the break between Parts I and II was to some extent both artificial and undesirable. The scope of Part I is as follows:

Four compulsory papers:
1. The library and the community.
2. Government and control of libraries.
3. The organisation of knowledge.
4. Bibliographical control and service.

253. Part II was generally felt to offer a sufficient variety of options to produce a "package" highly relevant to the needs of special librarianship, if the appropriate subjects are chosen. These are generally considered to be adequately covered by the following, though some detailed criticisms were made which will be referred to later. One paper from List A must be taken, and one or more papers from each of Lists B and C, to make a total of six.

List A	2	Special libraries and information bureaux.
List B	11	Theory of classification.
	12	Theory of cataloguing.
	13	Practical classification and cataloguing.
	31	Handling and dissemination of information.
List C	501	Bibliography and librarianship of mechanical engineering.
	502	Bibliography and librarianship of civil engineering, building and mining engineering.
	503	Bibliography and librarianship of electrical engineering.
	505	Bibliography and librarianship of chemistry and chemical technology.
	506	Bibliography and librarianship of natural history and biological sciences.
	507	Bibliography and librarianship of medicine.
	508	Bibliography and librarianship of science and technology.

254. Two of the larger schools commented on the complete absence of scientific "subject" content in the syllabus. This limitation is realistic in view of the small amount of scientific background likely to be possessed by most candidates. The very wide scope of B31, Handling and dissemination of information, was criticised by a number of schools and the view was expressed that there was enough in it for two or even three papers. The classification and cataloguing group, B11–13, came in for criticism too, on grounds both of content—too traditional—and of the fragmentation and artificiality involved in separating them from B31. There was general dissatisfaction with the narrowness of the List C papers, though this may be met to some extent by the introduction in 1968 of a general paper covering the whole of Science and Technology (C508).

255. There was, however, a general feeling that this syllabus offers the possibility of a course which is a good preparation for special library work for students having no pretensions to specialised subject knowledge. Several schools referred to special library employers who had been "satisfied by the products of the course". One school—and there are undoubtedly others—does not confine itself to what the Library Association syllabus requires. It teaches C505–507 as an integrated whole because it is better taught that way, even though candidates are not examined in all three of these subjects. It also requires students following this specialised course to study two languages—Russian and German—for three hours a week over the two years. On the basis of the present syllabus, it

seems that the schools can go some way towards producing a very useful course for scientific and technological library work. Given the additional freedom that would come with internal examining, they could obviously do much more.

256. The feeling that this syllabus can go a long way towards meeting the needs of special librarianship was given practical manifestation in the suggestion from one school that those who have covered the appropriate "package" should have their A.L.A. endorsed in some way to show its bias on the side of scientific information work: the plain A.L.A., they believe, conveys a misleading image to management and industrial librarians. Another suggestion was that students would do best to take the *general* Science and Technology papers in List C as they would not know at that stage the particular specialisation to which they would eventually turn; subsequently, when in post, they could take the appropriate List C subjects and their A.L.A. certificates could be endorsed accordingly.

257. *The postgraduate one-year syllabus.* This syllabus received a fair amount of criticism from the schools, much of which derives from the very short period of time (which in terms of working time may be considerably less than a calendar year) that is available for covering a great deal of ground. The syllabus comprises five compulsory and two optional papers, as follows:

Section A Compulsory Papers

- G1 The library in society.
- G2 The management of libraries. (In addition to covering general principles of management, the syllabus allows for specialisation in special libraries and information bureaux.)
- G3 Classification and cataloguing.
- G4 Practical classification and cataloguing.
- G5 Subject bibliography.

(G4 and G5 are assessed on examined course work.)

Section B Optional Papers (two to be chosen)

The relevant papers would be two of the following:

- G10 Indexing, abstracting and information retrieval.
- G17 Library services for science and technology.
- G19 etc. List C papers, as detailed in the two-year syllabus, paragraph 253.

258. As with the two-year syllabus, there was criticism of the artificial separation of cataloguing, classification and information retrieval, and the point was also made that there is over-lapping between G1, G2 and G17. The scope for effective treatment of the specialised management of Special Libraries and Information Bureaux was felt to be too limited, but again this is largely a consequence of the limited amount of time available.

259. As with the two-year course, we have gained the impression that the present syllabus gives scope for a sound course of professional education for special librarianship and that, given the freedom of internal examining, such a course could be made even more effective. Both syllabuses necessarily stop short of the specialised needs of information science and technology, as they do not give scope for building from and developing advanced scientific subject knowledge.

CHAPTER 6

Special Problems

260. The following topics are singled out for special mention at this stage in the report, since they are believed to warrant somewhat fuller and more specific treatment than has been given by incidental references to them in earlier chapters.

PRACTICAL EXPERIENCE

261. Our own experience and that of others has shown that students gain more benefit from a course if, before commencing it, they have had practical experience in a library or information unit. The optimum length of such experience depends on the time and trouble that employing units are prepared and able to take over their trainees. Our own view is that one term in a really good practical training situation would be adequate for most students, and we have found that highly motivated graduate students can extract a great deal of benefit even from six or eight weeks long vacation experience in a *carefully selected* science information unit.

262. With greatly expanding schools and a greatly expanding demand for practical experience placements at various stages in a student's course, even the largest libraries are finding it a very great burden to take trainees and give them the amount of senior staff time which an adequate traineeship demands. The situation in the small units is, of course, even more difficult. We would support the view put to us by a number of experienced practitioners that for a satisfactory long-term solution to the problem of practical experience placements it will be necessary to make some sort of payment, directly or indirectly, to units which agree to take trainees. With this, of course, would go the right to expect an acceptable training programme and the possibility, perhaps, of designating certain "approved" units as training institutions, with concomitant subsidies or other special dispensations.

VISITS OF OBSERVATION AND CONTACT WITH PRACTITIONERS

263. At all levels carefully selected visits of observation to library and information units are of the greatest possible importance, and we feel they should be an integral part of all courses. Similarly, great benefit derives from carefully phased contributions to courses from leading practitioners, brought in to give occasional lectures or seminars on their specialised subjects or about their particular institutions. From every point of view, the importance of maintaining close contact between academic institutions and those who employ their products cannot be over-emphasised.

THE SUPPLY OF TEACHERS

264. Effective teaching in any field of professional study calls for a combination of successful practical experience at a senior level, academic and professional

qualifications and teaching ability. Individuals who match this specification are rare in any profession and, in the case of science information work, the overall shortage of practitioners (Edwards, 1966) means that the obvious source of supply is itself very limited.

265. All library schools are finding it difficult, sometimes virtually impossible, to recruit suitably qualified staff for this area of work. Though there have been signs of a slight improvement in the recent past, shortage of teachers must be recognised as a major constraint in any programme for expanding the supply of qualified science information personnel.

266. We recognise that in the same way as much effective science information work is carried out by practitioners with no formal scientific background, so can a great deal of the teaching be carried out by staff who are generalists rather than science information specialists. Nevertheless, there is an important and very substantial residue which calls at least for considerable experience of special library or information work; and for institutions with any pretensions to advanced work there is a relatively small but vitally important area for which scientifically qualified staff are indispensable.

267. In established scientific and other academic disciplines it is normal for a proportion of the most able men and women to be attracted by the possibility of teaching their subject in institutions of higher education. Quite commonly, they prepare themselves for this by advanced study, including work for research degrees. As science information work becomes accepted and established, and facilities for research and advanced study improve, it is reasonable to expect that the problems of recruiting teachers will to some extent be eased in this way. This, however, is a long-term expectation and is unlikely to affect the situation significantly for some years to come.

268. In the short-term, the most fruitful approach would be a determined attempt to overcome the disincentives which make suitably qualified practitioners reluctant to leave work which they know and enjoy for what is in many respects a new and different career. A reasonable and obvious expectation for someone who is contemplating a change to teaching is the opportunity to "try it out" without finally committing himself. A spell of part-time teaching, or participation in short courses, may go some way towards achieving this, and it is clearly in the interest of schools to offer suitably qualified practitioners every opportunity for experience of this kind and to maintain the closest possible links with special librarians and information workers in their areas. Quite apart from its potential as a stage in the recruitment of full-time staff, the employment of senior and experienced practitioners as part-time lecturers is, in its own right, an educational asset of the very greatest importance. In this context, too, it is worth emphasising that mobility between educational institutions and the field, in both directions, is a means of ensuring a flow of new ideas, both into and out of the schools.

269. Most effective of all, probably, would be opportunities for secondment to teaching for fairly lengthy periods, or exchanges of staff between schools and operational units. The problems involved in such arrangements are considerable, and not the least would be the requirement that security of tenure and career prospects should not be prejudiced by a lengthy absence from the parent institution. This is obviously a very serious problem in the private industrial sector, and one to which we can offer no easy solution. We would only say that by facilitating such arrangements industrial management would be making an investment which in the long run would yield a rich return.

270. In units which rely in whole or in part on public funds, such as government libraries and information departments, or Research Associations, many of the difficulties involved in exchanges or secondment from private industry should not be allowed to apply. It would seem to be well worthwhile exploring the possibilities of enabling and encouraging staff from such institutions to participate in schemes for exchanges and secondments.

271. Salary expectations for really able practitioners in the science information field appear to be superior to those in teaching, and it is essential that promotion prospects for those entering teaching should not only be good but be seen to be good, with an appropriate allocation of senior posts to the science information specialists. For part-time teachers many local education authority rates of payment are quite inappropriate and are in need of very considerable upward adjustment.

272. Finally, we would urge in the strongest possible terms that speedy and effective action be taken to facilitate the transference of pension rights. A national scheme for this purpose is very much overdue, and here, at least, would appear to be one disincentive to moving into teaching which can be overcome by determined administrative action.

FOREIGN LANGUAGES

273. About one-half of the world's potentially useful scientific and technological literature is in languages other than English. The relative importance of the different languages varies from period to period and from subject to subject. In the field of chemistry, for example, publications in German accounted in 1913 for nearly half the world's output, but German now occupies only third place, after publications in English and Russian. In the field of science and technology as a whole, English has occupied first place since at least the First World War and is currently being followed, in most fields, by Russian, German, French and Japanese. It should be noted that Chinese, too, in spite of present difficulties, is rapidly increasing in importance and that this trend seems likely to continue.

274. The problem of exploiting the wealth of potentially useful information recorded in foreign languages is three-fold. First, there is the need to be able to find out what exists; secondly, there is the need to find out whether what exists is useful; and thirdly, the information must be made available.

275. The need for the scientist to be capable of using foreign language material has continually been discussed in universities, and the range of views is reflected by the range of practices in testing the students' competence in languages. Although we would not go so far as to agree with those who would wish to make formal evidence of some foreign language competence a precondition to the award of a degree in any science, we do support the view that every scientist should be capable of using basic material, such as handbooks and abstracts, in foreign languages. There is need for more research into the design of special purpose foreign language courses, and more studies of the type now being undertaken at the University of Essex (on the teaching of Russian to physicists) should be initiated and supported.

276. Science information workers are required for work at four levels of foreign language competence:

(i) finding out what relevant materials in foreign languages exist;

(ii) abstracting scientific papers;
(iii) translating full-length scientific papers;
(iv) interpreting at scientific meetings.

277. The first level is the minimum foreign language competence which should be achieved by science graduates (paragraph 275). We would, however, strongly advocate that this level should be reached in at least two languages, preferably in different language groups, and including at least one major language of science and technology (e.g. Russian, French or German). In the course of our enquiry the value of a recognition knowledge of several languages has frequently been represented to us, and the point has also been made that a very sound knowledge of one language will give the entreé to others in the same group.

278. At level two the need is for a thorough knowledge of both languages and relevant subjects, but not to such a high degree as at level three.

279. At the third level the need is for a combination of considerable subject competence and considerable language competence, preferably in one person. Such a combination is increasingly rarely to be found—a situation not unconnected with the poor rewards offered for such skills. The tendency for scientists to be less capable of dealing with foreign language materials was demonstrated by a recent enquiry which found that whilst 22·0 per cent of scientists aged 50 or over were fluent in French, the figure for the 30–50-year age group was only 7·5 per cent and that for the under-30s 6·3 per cent; for German the corresponding figures were 16·3 per cent, 5·1 per cent and 1·8 per cent (Wood, 1967).

280. It is expected that with the renewed closer contacts with European Economic Community countries increasing opportunities will be likely to occur for undergraduate and postgraduate science students and science information workers to spend some time studying and working in these countries, and it is recommended that the development of such contacts should be explored. Such extended visits should be preceded by intensive language courses of at least three months' duration and be supplemented by brief courses (say of one week's duration) in the host countries, to reinforce the foreign language learning "on the job".

281. At level four we are aware of the shortage of competent interpreters in science and technology and suggest that a small number of scholarships be created to allow outstanding translators in science and technology to be trained in interpreting, partly in this country and partly abroad.

SUMMARY OF CONCLUSIONS

282. The paragraphs which follow draw attention in summary fashion to some of the principal conclusions which have emerged from this investigation.

Introduction

283. The exponential growth of scientific and technological literature (paragraphs 1–3) brings increasing urgency to the need for greater numbers of librarians and information workers to control and exploit it (paragraph 4).

284. In matters of professional education and training, though some would

place emphasis on the skills of the librarian and others on those of the information scientist, there is an overwhelming case for stressing the unity and interdependence of library and information work and the artificiality of any attempt at rigid separation (paragraphs 12, 13).

PART I THE CHARACTERISTICS OF SCIENCE INFORMATION PERSONNEL AND THE WORK CARRIED OUT BY THEM

Chapter 1. *Science information staff characteristics*

285. The O.S.T.I. Survey (Edwards, 1966) and our own further analysis reveals the small proportion of science graduates (and especially "good" science graduates) with professional qualifications. This proportion is lower than in other fields of science and technology (paragraphs 21–32).

286. In the U.K. a higher proportion than in the U.S.A. of those not qualified in librarianship or information science are scientists or engineers rather than arts or social science graduates, though the proportion of the total professionally qualified science information workers among the graduate science information staff is similar in the two countries (paragraphs 33–42).

287. There appears to have been a considerable improvement in the ratio of science information workers to industrial R & D personnel during the last decade (paragraphs 43–48).

Chapter 2. *The principal types of scientific and technological libraries and information units*

(*A*) *The Industrial Group*

288. Analysis of industrial science information units by size shows that only one-tenth have a staff greater than eight.

289. This one-tenth employs over 40 per cent of all the science information staff (paragraphs 52, 53).

290. Science, engineering and technology graduates are distributed in proportion to the size of the units (paragraphs 54–56).

291. There is a relatively heavy concentration of graduate science information personnel in London and the South East region. For other areas to be brought up to the same standard considerable increases in staff would be required (paragraphs 59–64).

292. The distribution of information scientists does not appear to be strongly related to the size of the unit or to the area; the distribution of chartered librarians is such that their proportion, relative to the total full-time information staff, is highest in the smallest units and also higher outside London and the South East (paragraph 64).

293. In the U.K.A.E.A. and the R.A.'s, which are not too untypical of large industrial units, and in the C.A.B.'s, personality, professional library or information science qualifications and subject knowledge were included among the top four qualities and qualifications for work at all levels (paragraphs 73–76).

294. On the matter of detailed content of courses, particular importance was attached to scientific and technical reference work, abstracting, editing and cataloguing and classification (paragraphs 78, 79).

(*B*) *The Educational Group*

295. *The University Libraries.* In the university libraries increasing emphasis on subject specialisation and improved standards of specialised service should give professionally qualified science and technology graduates a satisfactory outlet for both their subject knowledge and their specialised professional skills (paragraphs 80, 83, 84, 87).

296. The type of professional education considered most useful for science graduates employed in university libraries is a course which combines scientific information work and traditional librarianship. Amongst the specialised skills to which particular importance is attached are collection building, literature searching techniques, classification for information retrieval and library mechanisation (paragraphs 85, 86). The need to improve and extend instruction in the effective use of libraries and literature receives very great stress (paragraph 89).

297. The availability of large computers to university libraries enhances the value of scientific information skills and offers important possibilities for new developments (paragraph 91).

298. An adequate background in traditional librarianship is also of great importance, if only to ensure that science information specialists are not a community within a community and will have adequate long-term career prospects (paragraph 92).

299. *The increasing and highly desirable mobility between different types of library and information work will be facilitated by a background which combines both scientific information and traditional librarianship skills* (paragraph 92).

300. *The Technical College Libraries.* In a sample of technical college libraries, which was heavily biased towards the larger units designated as polytechnics, only a very small number of staff held science or technology qualifications (paragraph 96).

301. There is a desire to extend services at present offered to college and outside users, if staff and other resources permit (paragraph 99).

302. There is already heavy emphasis on instruction of students in the use of libraries, and this is ranked second to classification as a task for which Chief Librarians would like to use science graduates (paragraphs 100, 101).

303. Book selection and liaison with teaching staff are also seen as important duties for which the services of science graduates would be utilised.

304. Forty-five per cent of technical college librarians favoured professional education of the more traditional type for science and technology graduates joining their staffs. This accords with the public technical library response, but not with that of the universities (25·5 per cent), U.K.A.E.A. (25 per cent), the R.A.'s (15 per cent) and the C.A.B.'s (12·5 per cent) (paragraph 102).

305. On the matter of detailed content of courses, particular importance was attached to collection building, scientific and technical reference work, cataloguing and classification, general reference work and teaching the use of libraries (paragraph 103).

306. The qualities and qualifications most prized in staff are personality and professional librarianship and information qualifications, followed, at some distance, by subject knowledge (paragraph 104).

307. *The factors which it is believed will most influence recruiting to the increasingly important area of technical college library work are better salaries, improved status and more publicity* (paragraphs 105, 106).

308. A need was expressed for short courses on specific topics, but shortage of staff makes it difficult to release staff under present conditions (paragraph 108).

(C) *The Public Technical Libraries*

309. The public technical libraries provide service over a very wide range of levels (paragraph 120), with great emphasis on speed and accuracy (paragraph 118).

310. Probably 10–15 per cent of the work calls for knowledge of science or technology at graduate level (paragraphs 121–124, 127); the great majority of the work comes within the competence of a trained librarian with no formal scientific qualifications but with relevant library experience (paragraph 126).

311. *The proportion of present staff in public technical libraries with formal scientific or technological qualifications is very small* (paragraph 129) *and there is scope for a considerable increase in graduate level staff of this kind* (paragraph 133).

312. *Present salary levels* (paragraph 145) *and the generally restrictive financial circumstances of public libraries are a major deterrent to the recruitment of staff with formal scientific or technological qualifications.* Given the staff and resources, there could be considerable and beneficial extensions of present services (paragraphs 135–137).

313. In the public technical libraries personality and professional qualifications are the qualities and qualifications to which greatest importance are attached (paragraph 131); the latter being essential for long-term career prospects in the public library service.

314. On the matter of whether scientific information work or traditional librarianship should predominate in the professional education of graduates, opinion was equally divided. Of individual subjects, collection building, literature-searching techniques and classification for information retrieval received greatest emphasis (paragraphs 138–141).

315. *The greatest need in public technical libraries would appear to be for a professional education which integrates traditional librarianship and scientific information work to the greatest possible extent* (paragraph 141).

316. *It would appear to be in the national interest to develop the services of these libraries to a much greater extent than present resources permit, particularly in improving and strengthening services to the small firm and industry in general* (paragraph 143).

PART II EDUCATION AND TRAINING

Chapter 3. Categories of work and level and content of courses

317. *In science information units there is scope and need for four categories of work* (paragraph 153):

Production
Development (and design)
Applied Research
Background Research.

318. *Production-type activity* (paragraph 154) *is recognised as the mainstay of any unit. Development work should be an essential part of the activity of all but the smallest science information units* (paragraphs 155–158). *The larger and more sophisticated units should be encouraged to carry out applied research* (paragraph 159). *Background research is pre-eminently suitable for academic institutions* (paragraphs 160, 161).

319. *We would particularly stress the importance of the last two categories, hitherto almost completely neglected. If science information work is to progress from the craft to the automation level, then a growing research effort will need to be developed* (paragraph 160).

320. *It is especially important that experienced and qualified science information workers, both in industry and other employment, should be encouraged and enabled to take part in research of this sort* (paragraph 160).

321. *Subject knowledge and professional knowledge.* Scientific or technological subject knowledge as such becomes important at degree level (paragraph 163). Professional qualifications, though not necessary for all the tasks carried out in science information units, are strongly advocated for all who take up this work as a career (paragraph 164). "Learning on the job", in general, leads to inbreeding and a narrowness of outlook which inhibits imagination and initiative (paragraph 166).

Courses: content and levels

322. *The needs of scientific and technological library and information work call essentially for five types of course:*

1. *Assistant* (*technical*) (paragraphs 171–173)
2. *Non-graduate Professional* (paragraphs 179–186)
3. *Graduate Professional Information Technologist* (paragraphs 187–192)
4. *Postgraduate Professional* (paragraphs 193–199)
5. *Advanced Professional* (paragraphs 200–202)

(Items 2–4: The professional grades)

323. These are related, though not on a one-to-one basis, to the four categories of work set out above.

324. *The professional grades.* The balance and relative emphasis of the elements which make up the professional content of the three professional grades will vary from one level to another and, within each level, from one course to another. At the present stage in the development of librarianship and information science there is scope for many different approaches, and for some years to come this very diversity should be a source of strength (paragraph 174).

325. *The following three broad areas of study are recommended as a framework for course building* (paragraphs 175, 176).

1. *Scientific and technological communities and their information and library needs.*
2. *The sources of information from which the needs of scientific and technological communities may be met.*
3. *Techniques by which the needs of scientific and technological communities may be met* (*i.e. the means by which areas 1 and 2 are brought together*).

326. The treatment should be such as to ensure the inclusion of basic professional knowledge (paragraph 177).

327. *At the advanced professional level it is of the greatest importance that there should be opportunities for research training and research degrees* (paragraph 200).

328. At the level of advanced research, information science and technology give scope for and must accommodate a genuinely multi-disciplinary approach (paragraph 201).

329. *Science information work, as much as any other field of activity, needs a means of bringing together potential leaders in "staff-college" type situations, preferably together with workers of similar promise from fields such as scientific administration, research and management* (paragraph 203).

Chapter 4. Courses

330. Full-time, full-length courses are the quickest and most effective means of making a person professionally productive in the field of science information (paragraph 205).

331. The most realistic basis for planning basic courses of professional education is to think in terms of one year of full-time study for graduates and two years for non-graduates (paragraph 206).

332. *Short courses.* No basic professional qualification will take a practitioner through his professional life without reinforcement from time to time by relevant specialised courses (paragraph 207).

333. There is a need for short courses of many types and levels, with many different objectives and aimed at a great variety of audiences (paragraph 209).

334. In the industrial sector three weeks is the maximum period of release likely to be acceptable to most employers (paragraph 210). In the university sector there should be possibilities of study leave for longer periods (paragraph 211).

335. *Professional qualification by short courses.* There is a very important category of scientifically qualified workers who move into science information after considerable and valuable experience of research and development and other relevant activities. It is rarely reasonable or realistic to expect such people to undertake normal full-time courses of professional education, but it is in the interest of the workers themselves, their employers and the profession in general that they should be enabled to become professionally qualified.

336. *We urge the need for a "mature entry" route to professional qualification for genuinely mature entrants of graduate standing and consider the Library Association's proposed mature entry scheme to meet the great majority of our criteria. Such a scheme, operated under the rigorous conditions set out by the Library Association, would be no "soft-option" and would be the means of bringing many valuable recruits into professional life and affairs* (paragraphs 213, 214).

337. The policy for short courses in the field of librarianship and information work, which is being worked out at national level, is welcomed. It seems clear that Aslib and the Schools of Librarianship are in a particularly strong position for organising and presenting short courses (paragraphs 215–222), and so are some of our great libraries, such as the N.L.L. and the National Reference Library for Science and Invention (paragraph 223).

338. *Evening courses have still a part to play in providing a suitable part-time route to professional qualification for students whose exceptional circumstances preclude the normal, full-time route* (paragraphs 224–227). At Assistant (technical) level, day-release courses also have a part to play (paragraph 228).

339. Sandwich courses merit careful consideration, and the Industrial Training Act offers important possibilities of support. *The support and recognition of the Industrial Training Boards should be sought for as many courses in the science information field as possible* (paragraphs 229, 230).

340. *The needs of professional education in the science information field call for maximum collaboration between the Library Association, the Institute of Information Scientists, Aslib, the Association of British Library Schools and other relevant organisations concerned with education and training. Such collaboration could be particularly fruitful in establishing general, nationally accepted standards and in the accreditation of courses for particular purposes and qualifications* (paragraph 232).

Chapter 5. The institutions providing professional education

341. *The University Schools.* All five university schools welcome science graduates, and at Sheffield University and City University specialised courses in science information work have been accepted by S.R.C. for the tenure of their advanced studentships. The students on both of these courses are of encouragingly high academic calibre (paragraph 237).

342. *There is still widespread ignorance of the scope and possibilities of science information work and extensive and continued publicity is called for to make its attractions more widely known to good graduates* (paragraph 236).

343. *Increased availability of S.R.C. advanced course studentships for suitably qualified students would be in the national interest.* These studentships have already played a major part in attracting good science graduates into information work (paragraph 242).

344. *Research and higher degree activity is particularly appropriate to the university schools, which should be natural centres for research in their fields. Such activity should be extended and encouraged* (paragraph 240). Maximum advantage should be taken of the possibilities for inter-disciplinary co-operation, which are also a feature of the university schools (paragraph 243).

345. *A general weakness of the university schools at present is that they are too small to benefit from the economies that come with a greater scale of operations. More professionally qualified science and technology graduates are badly needed for science information work. It is urged that the most effective and efficient way to produce them would be to enable the present university schools to expand, if they so wish, rather than create new university schools which would merely add to the competition for scarce resources of specialised staff and scientifically qualified students* (paragraph 245).

346. *The Non-university Schools.* The 12 non-university schools are offering, through the Library Association's syllabuses, combinations of subjects which provide very useful courses for special library work in the fields of science and technology (paragraph 246). *Given the additional freedom that would come with internal examining, the non-university schools could obviously provide still more effective courses for special library work* (paragraphs 255, 259).

347. With the emergence of polytechnics and possibilities of degree courses within the C.N.A.A. framework, there should be important opportunities for offering courses with a much stronger scientific content (paragraphs 247–249).

Chapter 6. Special Problems

348. *Practical Experience.* Students gain more benefit from a course if it is preceded by relevant practical experience (paragraph 261). *The problem of trainee placements is recognised, and it is believed that a satisfactory long-term solution will involve some sort of payment to units which agree to take trainees* (paragraph 262).

349. *The Supply of Teachers. It is difficult, sometimes virtually impossible, to recruit suitably qualified teachers for science information work, and a determined effort is needed to overcome disincentives to moving into teaching* (paragraphs 264–268).

350. *Opportunities for secondment to and from teaching should be created, salary and promotion expectations should be given careful consideration and speedy and effective action should be taken to bring about a national scheme for the transference of pension rights* (paragraphs 269–272).

351. Movement in both directions, between educational institutions and the field, is of great importance in ensuring a flow of new ideas both into and out of the schools.

352. *Foreign Language Competence.* With half of the world's output of scientific and technological literature in languages other than English, foreign language competence is of great importance to scientists and science information workers (paragraph 273).

353. Science information workers are required for work at four levels of foreign language competence:

(i) finding out what relevant materials in foreign languages exist;
(ii) abstracting scientific papers;
(iii) translating full-length scientific papers;
(iv) interpreting at scientific meetings (paragraph 276).

354. *There is need for more research into the design of special purpose foreign language courses* (paragraph 275).

355. At its highest levels, work with foreign language materials calls for a combination of considerable subject competence and considerable language competence, preferably in the same person. Such a combination is becoming increasingly rare (paragraph 279).

356. *Schemes should be developed for the "on-the-job" learning of foreign languages in countries abroad for science students and science information workers* (paragraph 280).

357. *A small number of scholarships should be created to allow outstanding translators in science and technology to be trained in interpreting, partly in this country and partly abroad* (paragraph 281).

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APPENDIX

UNIVERSITY SCHOOLS

School of Librarianship and Archives
University College London
Gower Street
London, W.C.1

Postgraduate School of Librarianship and Information Science
University of Sheffield
Sheffield
S10 2TN

The School of Library Studies
Queen's University
Belfast 7
N. Ireland

Department of Librarianship
University of Strathclyde
George Street
Glasgow, C.1

Department of Management Studies
The City University
St. John Street
London, E.C.1

OTHER SCHOOLS

Aberdeen School of Librarianship, Robert Gordon's Institute of Technology, Aberdeen, Scotland.

College of Librarianship, Wales, Llanbadarn Fawr, Aberystwyth, Cardiganshire.

School of Librarianship, City of Birmingham College of Commerce, Gosta Green, Birmingham 4.

School of Librarianship, Brighton College of Technology, Moulsecoomb, Brighton 7, BN2 4GJ.

Department of Librarianship, Leeds College of Commerce, 28 Park Place, Leeds 1.

School of Librarianship, College of Commerce, Tithebarn Street, Liverpool 2.

School of Librarianship, Ealing Technical College, St. Mary's Road, Ealing, London, W.5.

School of Librarianship, North Western Polytechnic, 207–225 Essex Road, London, N.1.

School of Librarianship, Loughborough Technical College, Loughborough, Leicestershire.

School of Librarianship, Manchester College of Commerce, Aytoun Street, Manchester 1.

Department of Librarianship, Municipal College of Commerce, College Street, Newcastle-upon-Tyne 1.

Printed in England for Her Majesty's Stationery Office by McCorquodale & Co. Ltd., London
Dd. 138326 K40 11/68

Published by
Her Majesty's Stationery Office

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