Part II of the Students' Chemical Information Project (SCIP), designed to spread the use of computer-based information services among research scientists and technologists, contains details of the project operations, statistics, results of questionnaires and research reports from liaison scientists (See LI 002 562 for Part I). Chapter I: Operation of the Scheme, discusses the objectives, data bases, selected population, liaison scientists and their training, general procedure, and production problems. Chapter II: Statistics, includes relevance in relation to size of output, amendments to profiles, group literature schemes, and the fate of references. Chapter III: Results from Questionnaires, covers the preliminary interview guide, follow-up interview guide, and the final questionnaire. Chapter IV: Research Reports, contains reports by the liaison scientists. The page location of the figures and tables used is listed. The appendices include: circular sent to all participants, cover letter for final questionnaire, example of a search profile, index headings used in the classification of profiles, compound index to profiles, technique and property index to profiles, and profile statistics and titles. (NH)
STUDENTS' CHEMICAL INFORMATION PROJECT,

October 1967 - September 1968,

Final Report

by

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M. Poustie ......................... University of York
The work described in this report has been carried out under grants from the Office for Scientific and Technical Information (OSTI). Any opinions or deductions expressed are solely those of the authors and not those of OSTI or other organisations associated with the project.

The authors acknowledge the assistance given, both during the project and in the preparation of this report, by:-

Dr. R. Baker, Institute of Computer Science, University of London, who carried out the analysis of the final questionnaire.

Dr. A. K. Kent, Chemical Society Research Unit, whose unit was responsible for providing the fortnightly Chemical Titles service.

Dr. G. A. Somerfield, OSTI, who acted as project co-ordinatior.

The report is issued in two parts:

Part I. A review of the project and the major results. This part of the report is being widely distributed to those participating in the experiment.

Part II. Details of operations, statistics, results of questionnaires and research reports from liaison scientists. One copy of this part is being sent to all university libraries and chemistry departments in the U.K. Further copies are available on request from the Office for Scientific and Technical Information, Department of Education and Science, Elizabeth House, York Road, London, S.E.1.
FIG (1) GEOGRAPHICAL DISTRIBUTION OF CT/CBAC PROFILES

- Liaison scientist
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Objectives

The main objectives of the scheme were:

(a) to enable a large group of academic users to gain experience in the use of computer-based services.

(b) to improve general knowledge of all chemical information services within this group of users.

Secondary objectives were:

(1) to gain experience of the routine provision and use of computer-based services, particularly in universities.

(2) to determine whether a network of liaison scientists is a suitable way of providing these services.

(3) to determine what qualities and qualifications are required in a good liaison scientist.

(4) to determine whether pure scientists can be trained on a short course to act as liaison scientists, and if so, to determine what the duration and content of such training courses should be.

(5) to attempt to determine the value and acceptability of the services by limited user participation.

(6) to investigate the information habits of students and the effect upon these habits of the provision of a computer-based service.

Data Bases

The computer-based services Chemical Titles (CT) and Chemical-Biological Activities (CBAC) were chosen for the experiment because these two services had been provided on a routine basis by the Chemical Society Research Unit for nine months prior to the start of the experiment. Chemical Titles is available both on magnetic tape and in a printed version; it consists of a fortnightly listing of about 5,000 titles taken from approximately 700 journals in the fields of pure and applied chemistry and chemical engineering. It is possible to search for specified words contained in titles, for
author names, and for particular journals. Chemical-Biological Activities, also available on tape or in printed form, consists of a fortnightly listing of about 500 titles, together with informative digests, taken from approximately 600 journals; only papers dealing with the biological activity of organic compounds are selected. It is possible to search for specified words contained in titles or digests, for author names, for compound registry numbers, for molecular formulae, and for particular journals. Other computer-based services are being developed by the Chemical Abstracts Service (CAS) and it was thought that wider use of CT/CBAC services would provide a good introduction for both user and operator to the range of services that would be available in the near future.

Selected Population

Mainly for financial reasons, the experiment had to be limited to a selected population and the group chosen consisted of all final-year Ph.D. students in Chemistry supported by the Science Research Council. This was a well-defined population, about 500 strong with good first degrees, and it provided a random sample of chemists from all British universities (except Stirling); the final geographical distribution of profiles is shown on the map (fig. 1). One reason for limiting the scheme to final-year students was that they would carry their experience of computer-based services with them into a wide range of Government, academic, and industrial laboratories. At the same time, OSTI would be under no obligation to continue providing them with a free service. Furthermore, it was hoped that, at this stage of their career, students would still readily accept novel techniques and yet would have sufficient experience of chemical research to carry out a realistic assessment of CT/CBAC.

Liaison Scientists

The requirement for a number of specially-trained personnel to ensure efficient operation of the project has been discussed in Part I of this report (p. 7-8). It was thought that postdoctoral fellows, after a period of training in chemical information, would be very suitable for the liaison posts available. Six chemists were appointed, all of whom either had Ph.D.s or submitted theses during the year (see G. A. Somerfield, Chemistry in Britain, 1968, 4, 71).

Following the initial announcement of the appointments, it was
suggested (R. J. Dannatt, Nature, 1967, 216, 208) that the scheme would be better operated through libraries rather than through a network of liaison scientists. However, subsequent enquiries indicated that most science librarians appeared to be too busy to undertake extensive liaison work.

Although the use of liaison scientists was a quick and precise way of transmitting information and stimulating interest in the scheme, it was also an expensive way; in future, liaison scientists may have to be used in a more limited role, with responsibility for routine profile maintenance being delegated to the user or to a staff member or librarian acting in a local liaison capacity.

Training of Liaison Scientists

To enable the liaison scientist to carry out his work, it was necessary that he should have a knowledge both of profile formulation for CT/CBAC and of general information activities and sources. Owing to the short time available, only the technicalities of profile formulation were covered in detail in the first training session and the rest of the training was spread out throughout the year. Before the first session, each liaison scientist was sent a CT/CBAC Search Manual and various introductory papers to acquaint him with the background to the project. In addition to attending the four formal training sessions held throughout the year, most liaison scientists attended a meeting of the SIC Discussion Group at Aston and a symposium on 'User Studies' at State House. These meetings are tabulated overleaf:
Table 1: Training of Liaison Scientists

<table>
<thead>
<tr>
<th>Date</th>
<th>Place</th>
<th>Speaker</th>
<th>Topic</th>
<th>Time (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>27th September</td>
<td>Nottingham</td>
<td>Dr. G.A. Somerfield</td>
<td>The role of OSTI in the development of information services.</td>
<td>4</td>
</tr>
<tr>
<td>-1st October 1967</td>
<td></td>
<td>Mr. N. Green</td>
<td>Organisation of a university science library.</td>
<td>½</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dr. A. K. Kent</td>
<td>Formulation of CT/CBAC profiles and test runs.</td>
<td>2½</td>
</tr>
<tr>
<td>11th October</td>
<td>York</td>
<td>Review of experience</td>
<td>Review of experience gained in formulating 10-12 'local' profiles</td>
<td>½</td>
</tr>
<tr>
<td></td>
<td>York</td>
<td>gained in formulating</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>York</td>
<td>10-12 'local' profiles</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12th-13th October</td>
<td>National Lending</td>
<td>Dr. K.P. Barr</td>
<td>The literature collections and services of the NLL</td>
<td>1½</td>
</tr>
<tr>
<td></td>
<td>Library</td>
<td>Dr. A.J. Harley</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dr. D.N. Wood</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reports and translations</td>
<td></td>
<td></td>
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<tr>
<td>27th November</td>
<td>State House</td>
<td>Mr. A.E. Cawkell</td>
<td>ISI services from SDC, Dunfermline</td>
<td>½</td>
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<tr>
<td></td>
<td></td>
<td>and Information sheets</td>
<td></td>
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<tr>
<td>25th January</td>
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<td>SIC Discussion Group</td>
<td>SICs: staffing and equipment</td>
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<td>1968</td>
<td>Centre, Aston</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12th-13th February</td>
<td>Nottingham</td>
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<td>CAS registry system</td>
<td>4</td>
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<tr>
<td></td>
<td></td>
<td>Dr. M.F. Lynch</td>
<td>IUPAC notation</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mr. E. Hyde</td>
<td>Wiswesser notation and its use in the ICI system</td>
<td>½</td>
</tr>
<tr>
<td>8th May</td>
<td>State House</td>
<td>Symposium</td>
<td>User studies</td>
<td>1</td>
</tr>
</tbody>
</table>

Over the year, the liaison scientists thus received a broad, if cursory, view of the field of chemical information.

General Procedure

Initial Contact

Initial contact with the various departments was made by Dr. G. A. Somerfield of OSTI; on July 7th 1967, he asked the heads of larger chemistry departments to advertise for liaison scientists. By September 11th, all six posts had been filled and Dr. Somerfield was
able to advise all heads of department of the scope of the scheme and to give them the name of the liaison scientist appointed in their area.

In order to equalise the work load on each liaison scientist, some distribution of area boundaries was necessary; in particular Manchester was covered piecemeal by three of the liaison scientists since it had not proved possible to appoint a liaison scientist there. On 18th September, a letter and information sheet explaining the scheme were sent by OSTI to all eligible students. They were asked to divide their replies into three categories: A - would like to take part; B - would like more information; C - do not want to take part. Less than 5 per cent of students answered in the third category. About 20% did not reply and had to be contacted by the liaison scientist on his first visit, when in fact most of them took up the offer.

First Visit

When search manuals became available in quantity, they were sent out well in advance of the first visit, which was arranged for October or November 1967. A short introductory talk was offered to all members of the department interested in the scheme and many non-participants attended. The talk dealt mainly with the formulation of CT/CBAC profiles but also mentioned other chemical information services. A set of slides showing examples of profile formulation from the search manual was used to illustrate the talk. The liaison scientist then arranged a time-table to see each student individually for an hour. The student was asked to define his research interests and the profile was formulated accordingly. An example of a completed profile is given in Appendix 3. In some cases, the student brought along his card index or reprint collection and this helped in the selection of appropriate search terms. Ten minutes of the interview were spent in filling in the preliminary interview guide and the results from this are discussed in Chapter 3.

Where the head of the department had not attended the introductory talk, the scheme was outlined to him and efforts were also made to contact the science librarian and the member of staff on the library liaison committee.

By the end of November, all departments except Bangor had been visited and preliminary reports on the progress of the scheme were
presented at State House on the 27th. An OSTI circular (Appendix 1) was sent out in December summarising the results from the reports and explaining the use of the terms 'relevant' and 'hit'. The purpose of the circular was to improve the consistency of feedback results as well as to keep participants informed.

Second Visit

The second visit to all participants took place early in the new year; several students felt that the second visit should have been closer to the first as profile amendments were most frequently required after receipt of the first or second printout. One student suggested that an immediate retrospective search of five CT tapes would enable the performance of the profiles to be optimised as soon as possible! At this second visit, profile amendments were discussed and a follow-up guide was completed in order to analyse the impact of the service. The results from this questionnaire are discussed in Chapter 3. In some areas, a brief third visit was arranged. Progress reports on the scheme were presented by the liaison scientists at Nottingham on February 12th.

Final Visit

March and April were 'quiet' months, in which the liaison scientist had some time available for research. However, routine analysis of profile performances and collection of useful references were still carried out. In addition, preparations were made for a final detailed questionnaire at a meeting on April 30th at State House. The final visits took place in June or July and were mostly concerned with the collection and checking of the questionnaires, which had been sent out one week in advance, together with a covering letter from OSTI (Appendix 2). Several students were absent during the final visit and they were requested by post to send in their completed questionnaires as soon as possible. A meeting was held at Warwick on August 26th and 27th to discuss the composition of the final report and small study groups were set up to prepare sections of this report.

Thesis Bibliographies

Each student was asked to send in his thesis bibliography so that recent references cited could be compared with those retrieved by the computer. Nearly 100 bibliographies have been received so far and a sample of ten contained a total of 1,789 references, of which
234 (13.8%) were dated 1967 or 1968. Of these, 190 (83%) were taken from primary journals covered by CT. The individual profiles covered varying periods and only 87 of the primary journal references were possible captures; 63 (69%) were actually retrieved. A measure of recall based on the number of items retrieved by the students is thus obtained: 69% x 83% = 57%.

A fuller report of this work will be published later.

**Precision Cards**

Throughout the year, postcards for each output were used to maintain contact between the user and the liaison scientist. The card contained boxes for marking the total number of titles that were relevant, irrelevant, or of undetermined relevance, and a space for noting comments or amendments. Although vacations caused some delays, the return of the precision cards was good (60-90%). No fall off in return of the cards was noticed throughout the year.

**Index to Profiles (see Appendices 4-7)**

An analysis of profiles according to subject category was carried out so that an index to profiles could be constructed. This will enable future liaison scientists or research workers to consult previous profiles easily to obtain an impression of the performance of the service in their field of work.

**Production Problems**

A number of areas of difficulty can be readily identified.

1. **Establishment of the Profiles**

The nature of the population and the structure of the experiment made it inevitable that a very large number of new profiles were received as input to the scheme over a relatively short period. Approximately five hundred profiles containing an average of twenty terms each had to be keypunched in a period of six-eight weeks. Within the Chemical Society Research Unit the organisation is such that a regular low-volume intake of profiles is easily managed, but a sudden burst of this type creates severe problems. In any future exercise, therefore, it is desirable that adequate keypunching facilities be made available. It would be reasonable to expect a competent keypunch operator to process up to two thousand search terms per day.
(2) Handling of Output

At first the lack of experience of handling very large volumes of output led to considerable difficulties. The experience gained during the experiment has led to a smooth and effective organisation and there is no reason to suppose that this will create any special difficulties in the future.

The need for liaison scientists to receive copies of the output of all profiles under their control suggests that in future each liaison scientist should be allotted a continuous block of profile numbers so that all output for one liaison scientist sorts together. Each institution should be allocated a continuous block of profile numbers for the same reason. It may also be worth considering the possibility of arranging for local redistribution of output at each centre. It would reduce clerical and postal costs if all the output for one institution could be sent in one package.

(3) Profile Amendment

Profile amendments have, from time to time, been held up unreasonably at the Unit. Some consideration should be given to:-

(a) Instructing liaison scientists in the appropriate way to record profile amendments ready for the keypunch operator.

(b) Improving the format of the profile amendment form to ease the difficulties of the liaison scientists and the keypuncher.

(c) Establishing an agreed time-schedule for receipt of profile amendments and abiding by it.

(4) Type of Output

The easier type of output for the Unit to handle is cards and this would be preferred by the majority of students. This form is, however, significantly more expensive than output on single or multipart paper.

(5) Notice

In any future exercise reasonable notice must be given to the Unit of the anticipated work load so that appropriate administrative action can be taken in time. If programming changes are likely to be needed a minimum of two months notice is required even for apparently trivial changes.
Chapter 2: Statistics

Each entry in table 2 shows the number of profiles in the scheme having an average number of hits and average relevance rate within the ranges given. The distribution of relevance rate and number of hits are given in the histograms at the top of figure 2. The definition of a relevant paper was any paper satisfying the intent of the profile, i.e. the written statement of interest of the user. While some users interpreted 'relevant' to mean 'of value' others used 'of interest' as the criterion and therefore the net effect on the final figures will be small.

Also shown in figure 2 is the distribution of "hits" and "relevance" figures by area. While the dissimilarities in the histograms may reflect the individual liaison scientist's approach to profile construction and possibly his explanation of relevance to the students, there are undoubtedly wide variations between institutions, even if geographical location is of secondary importance.

### Table 2: Relevance in Relation to Size of Output

<table>
<thead>
<tr>
<th>% Rel.</th>
<th>0-10</th>
<th>11-20</th>
<th>21-30</th>
<th>31-40</th>
<th>41-50</th>
<th>51-100</th>
<th>Total</th>
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<tbody>
<tr>
<td>0-4</td>
<td>10</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>13</td>
<td>37</td>
</tr>
<tr>
<td>5-10</td>
<td>3</td>
<td>13</td>
<td>11</td>
<td>9</td>
<td>5</td>
<td>10</td>
<td>51</td>
</tr>
<tr>
<td>11-20</td>
<td>19</td>
<td>18</td>
<td>22</td>
<td>16</td>
<td>13</td>
<td>18</td>
<td>106</td>
</tr>
<tr>
<td>21-30</td>
<td>12</td>
<td>20</td>
<td>16</td>
<td>5</td>
<td>6</td>
<td>12</td>
<td>81</td>
</tr>
<tr>
<td>31-40</td>
<td>12</td>
<td>28</td>
<td>15</td>
<td>6</td>
<td>5</td>
<td>11</td>
<td>77</td>
</tr>
<tr>
<td>41-50</td>
<td>13</td>
<td>14</td>
<td>9</td>
<td>5</td>
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<td>8</td>
<td>54</td>
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<tr>
<td>51-100</td>
<td>13</td>
<td>18</td>
<td>13</td>
<td>7</td>
<td>5</td>
<td>7</td>
<td>63</td>
</tr>
<tr>
<td>&gt; 100</td>
<td>10</td>
<td>10</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>25</td>
</tr>
<tr>
<td>Total</td>
<td>92</td>
<td>124</td>
<td>92</td>
<td>63</td>
<td>44</td>
<td>79</td>
<td>494</td>
</tr>
</tbody>
</table>

The "average profile" produced about 30 hits/fortnight and had 30% relevance (cf. figures of 20 and 40% for the CSRU CT/CBAC experiment). A profile falling in the range 10-50 hits with 20-50% relevance was considered "well-behaved", but the number of profiles falling outside that range was large. Some 20% had less than 10 hits/fortnight; another 20% more than 50. Some 40% had a
Breakdown of Relevance and Output Figures by Area

Relevance

No. of Hits

% of Profiles

0 10 20 30 40 50 100 >100

FIG (2)
relevance rate less than 20% and 15% greater than 50%.

Examination of table 2 shows that there is a general decrease in relevance (precision) with increase in size of output. An exact inverse proportionality would obviously lead to each profile retrieving a constant number of relevant references. Whilst this was not expected, due to differences in scope and construction of profiles, it was noticeable that the variation between students of the number of relevant references was much less than that of the numbers of hits. The reasons for this are presumably:

(1) a very narrow profile will produce a high relevance rate for a small number of hits.
(2) a broad profile will produce a large amount of "trash" for relatively little increase in the number of relevant references.

Amendments to Profiles

From the five areas for which figures were obtained, 617 profile amendments were made in the first four months of the project. The majority (77%) of the profiles (377 x 1) were amended once; 20% were amended twice (95 x 2); 3% were amended thrice (14 x 3) and two profiles were amended four times. The most complete figures available are those for area A; these show that 5% of amendments gave essentially new profiles; 30% changed the profile structure in some way; 11% altered the output; 35% corrected 'avoidable errors' e.g. obvious omissions. The majority of amendments seemed to have little effect on relevance rate or number of hits.

Group Literature Schemes

It is surprising that only about 5% of the population of users take part in a formal group literature searching scheme. The numbers in these groups range from 3 to 12 and the number of journals scanned from 20 to 80 (most estimates seem to be on the optimistic side). Most of these few groups meet regularly, either weekly, fortnightly, or monthly, where abstracts are presented, or papers discussed.

About half the groups have a large central index or store of reprints. Current awareness tools used are CCP, and Current Contents, with Chemical Abstracts used as a long step and, during the past year, CT and CBAC profiles.
The Fate of References

Dr. Leggate (area A) monitored relevant references in the output of some 51 users during his second visits (January 1968) and discovered what action had been taken with respect to them on subsequent visits (June 1968). For a total of 756 references, no action had been taken for 28%. 9% had been indexed and 11% had been photocopied or a reprint sent for. Students who estimated high relevance figures tended to take no further action - although the correlation was weak. Students who used outputs for the storage of references were also likely to report 'no action'.

160 references marked as "relevance undetermined" were also noted. No action was taken for 70%. 
Chapter 3: Results from Questionnaires

Preliminary Interview Guide

An attempt was made to ascertain the users' present knowledge of chemical information services and literature habits by means of a preliminary interview guide. Ten minutes were spent completing this guide in the first interview with each student. The integrated statistics for 460 users are shown in the following table:

Table 3: Integration of Statistics

<table>
<thead>
<tr>
<th>Number of Student Profiles</th>
<th>512</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Universities and Colleges</td>
<td>65</td>
</tr>
<tr>
<td>Number of Interview Guides from which this table was prepared</td>
<td>460</td>
</tr>
</tbody>
</table>

Profiles

Important Authors Included in First Profile: 157 (Areas D and E not included)

Important Institutions Specified during Interview: 41 (Areas C, E and F not included)

Classification (Provisional)

<table>
<thead>
<tr>
<th>Physical</th>
<th>Inorganic</th>
<th>Organic</th>
<th>Biochemical or Pharmacological</th>
<th>Analytical</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>172</td>
<td>98</td>
<td>189</td>
<td>28</td>
<td>7</td>
<td>494</td>
</tr>
</tbody>
</table>

Information Habits

<table>
<thead>
<tr>
<th>Type of Training at Undergraduate Levels</th>
<th>None</th>
<th>Informal Talks</th>
<th>1-2 Lectures</th>
<th>Lectures and Supervised Practical Work</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of Training at Graduate Levels</td>
<td>295</td>
<td>48</td>
<td>35</td>
<td>2</td>
</tr>
</tbody>
</table>

- 16 -

18
<table>
<thead>
<tr>
<th>Primary Journals mentioned by more than 30 students</th>
<th>No. of Students scanning journal (no figures from areas B, E and F)</th>
<th>Own Copy</th>
<th>Obtained on Loan</th>
<th>Look at in Library</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>J. Chem. Soc.</td>
<td>133</td>
<td>2</td>
<td>41</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td>J. Amer. Chem. Soc.</td>
<td>131</td>
<td></td>
<td>53</td>
<td>22</td>
<td></td>
</tr>
<tr>
<td>J. Chem. Phys.</td>
<td>61</td>
<td></td>
<td>25</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>Trans. Farad. Soc.</td>
<td>47</td>
<td>4</td>
<td>19</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Chem. Comm.</td>
<td>46</td>
<td>1</td>
<td>10</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>J. Org. Chem.</td>
<td>47</td>
<td>14</td>
<td>14</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Tetrahedron Letters</td>
<td>38</td>
<td>10</td>
<td>10</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Inorg. Chem.</td>
<td>34</td>
<td>11</td>
<td>11</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>J. Phys. Chem.</td>
<td>31</td>
<td>15</td>
<td>15</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Current Awareness Publications</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CCP</td>
<td>347</td>
<td>13</td>
<td>161</td>
<td>46</td>
<td></td>
</tr>
<tr>
<td>CT</td>
<td>170</td>
<td></td>
<td>34</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td>Current Contents in Chemical Sciences</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preferred Methods for Current Awareness</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>X. Scanning Primary Journals only .... 190</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Y. Current Awareness Publications only 66</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Z. Abstract Publication only ......................... 41</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>X and Y</td>
<td>69</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Y and Z</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>X and Z</td>
<td>28</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>X and Y and Z</td>
<td>33</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interdependence for Information with Colleagues or Supervisor</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Participation in Group Literature Searching Schemes ...... 43</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Poor</th>
<th>Moderate</th>
<th>Good</th>
</tr>
</thead>
<tbody>
<tr>
<td>150</td>
<td>157</td>
<td>134</td>
<td></td>
</tr>
</tbody>
</table>
Retrospective Searching:

Substantial Use is made of:

<table>
<thead>
<tr>
<th>Abstracts</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical Abstracts</td>
<td>428</td>
</tr>
<tr>
<td>Physics Abstracts</td>
<td>4</td>
</tr>
<tr>
<td>Nuclear Science Abstracts</td>
<td>4</td>
</tr>
<tr>
<td>Biological Abstracts</td>
<td>14</td>
</tr>
<tr>
<td>Others</td>
<td>-</td>
</tr>
</tbody>
</table>

Availability of a reasonable set of Chemical Abstracts

1. University Library only 101
2. Departmental Library
   a. within same building as laboratory 299
   b. elsewhere 1
3. None 1

Students' Personal Information Storage Arrangements

<table>
<thead>
<tr>
<th>Storage Method</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>L. Note Book</td>
<td>70</td>
</tr>
<tr>
<td>M. Card File</td>
<td>326</td>
</tr>
<tr>
<td>N. Edge Notched Card</td>
<td>49</td>
</tr>
<tr>
<td>P. Reprints</td>
<td>31</td>
</tr>
<tr>
<td>L and M</td>
<td></td>
</tr>
<tr>
<td>L and N</td>
<td></td>
</tr>
<tr>
<td>None</td>
<td></td>
</tr>
</tbody>
</table>

The numbers in the table refer to positive replies given by students and are therefore minimum figures since there are no figures available from certain areas.

It was apparent that normally students received very little instruction in use of the chemical literature; that which was available ranged from a 'short professorial mutter' to a three day seminar including a practical exercise. Out of the 460 users, at least 200 had never received any training in use of the literature.

For current awareness, about half the students relied mainly on the scanning of 6-10 primary journals almost always obtained from the library. Almost all students were familiar with Current Chemical Papers (CCP); 34% used it regularly and 40% irregularly.
Chemical Titles (CT) and Current Contents (CC) were less popular; 6% used CT regularly and 28% irregularly whilst 6% used CC regularly and 12% irregularly. Rather surprisingly, about 15% of students used Chemical Abstracts for current awareness; this may indicate the need for more information than the title of a paper alone can give.

The section on interdependence of information between the student and his supervisor and colleagues indicated a marked lack of communication (cf. E. Rudd, New Society, 1968, 562). This was substantiated in later interviews, which showed that information from the printouts was in general disseminated inefficiently, if at all. It thus seems advisable to place more emphasis on group profiles so that more people are drawn into the scheme and perhaps to provide multiple copies of the output. One liaison scientist invited supervisors to attend his interviews with their students and this produced a 25-30% response.

For retrospective searching, 95% of students used Chemical Abstracts, a reasonable set of which was available to every student except one.

Most students used a card index for storing retrieved information; about 15% simply used a notebook and 10% used edge-notched cards.

Follow-up Interview Guide

This guide was designed to provide information for progress reports submitted by the liaison scientists in February and dealt with currency, coverage, loan requests, group literature schemes, and important references. Some of the information from this guide was not susceptible to exact interpretation and several students gave vague or incomplete answers so that the data obtained were approximate. No integrated statistics were prepared, so a sample of 89 returns from area C is quoted as an illustration:

Almost half the users thought that the printouts, in general, gave them references before the appropriate journals arrived in the library; 35% thought that the printouts arrived more or less simultaneously with the journals; only 15% said they had already seen most relevant references in the printout. References in American journals such as J. Chem. Phys. seemed to appear in the printouts as much as two months before the journal arrived and this caused some frustration. There seemed to be no doubt that students
were being alerted to references of possible interest more quickly than they would have been without the CT service. However, in view of the fact that the time lag between submission of a paper for publication and its appearance in print may be over a year, advance notice of a few days does not appear to be highly significant. On average, as far as can be ascertained, about 20% of relevant references had already been seen by the user. This percentage obviously depends on how quickly the user scans the primary journals and it was noticeable that one keen student, who was writing a review on n.m.r. spectroscopy, estimated that he had already seen over 75% of the references that appeared in his printouts.

A more important advantage of the scheme seems to be that the student obtains greater coverage of the literature than he would normally do. Two-thirds of the users said that, although they would expect to pick up important papers anyway, their profiles had retrieved titles sufficiently relevant to cite in their theses but which they would not have seen without the CT service. Despite the fact that most of the users said that the service was useful in scanning 'obscure' journals, only 18 (20%) had sent in inter-library loan (ILL) requests (a total of about 75 titles) since last October. Half the users had had articles photocopied during the year and 35% had sent off for reprints. In some departments, e.g. Leicester and Keele, photocopying is restricted because of expense.

Most of the users (90% of the sample) would prefer output on 6 x 4'' cards. However, the new paper format adopted by the Unit was very well received, judging from comments on the precision cards.

Final Questionnaire

The following results are based on the answers from 429 questionnaires covering 438 profiles (85% of the population). Inconsistencies among some percentages quoted are caused by no answers being given in certain cases. Information from each questionnaire was coded and transferred to punched cards for a detailed analysis.

Section A: Effect of the Service on Information Habits

Section A investigated the effect of the CT/CBAC service on the information habits of the students. The results are shown in the accompanying table. It was found that as a result of their involvement in the project, the time spent by the student in
scanning current awareness publications had decreased for 52% of the users and remained the same for 41%. Time decreases were also shown for scanning abstract journals (40% of users) and primary journals 25%), while no change was reported by 54% and 68% of users for these respective classes of journals.

Effect of the Service on your Information Habits

1. How has your involvement in this project affected:

(a) The amount of time you spend

<table>
<thead>
<tr>
<th>Scanning Activity</th>
<th>Increased</th>
<th>Remained the same</th>
<th>Decreased</th>
<th>No answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i) Scanning Primary Journals</td>
<td>26(6%)</td>
<td>294(68%)</td>
<td>107(25%)</td>
<td>2(1%)</td>
</tr>
<tr>
<td>(ii) Scanning Current Awareness Publications</td>
<td>22(5%)</td>
<td>178(41%)</td>
<td>224(52%)</td>
<td>5(1%)</td>
</tr>
<tr>
<td>(iii) Scanning Abstract Journals</td>
<td>18(44%)</td>
<td>233(54%)</td>
<td>172(40%)</td>
<td>6(1%)</td>
</tr>
<tr>
<td>(iv) Reading Original Papers</td>
<td>189(42%)</td>
<td>238(55%)</td>
<td>6(1+)</td>
<td>4(1%)</td>
</tr>
</tbody>
</table>

(b) The number of Primary Journals which you see regularly

<table>
<thead>
<tr>
<th>Number of Journals</th>
<th>Increased</th>
<th>Remained the same</th>
<th>Decreased</th>
<th>No answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Scanning</td>
<td>66(15%)</td>
<td>315(73%)</td>
<td>42(9%)</td>
<td>6(1%)</td>
</tr>
</tbody>
</table>

2. Current Awareness Publications

For the three publications:

<table>
<thead>
<tr>
<th>Publication Type</th>
<th>Current Chemical Papers</th>
<th>Chemical Titles (printed version)</th>
<th>Current Contents (Life, Physical, or Chemical Sciences)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nil</td>
<td>106(25%)</td>
<td>262(61%)</td>
<td>324(75%)</td>
</tr>
<tr>
<td>Irregular</td>
<td>173(40%)</td>
<td>120(28%)</td>
<td>53(12%)</td>
</tr>
<tr>
<td>Regular</td>
<td>147(34%)</td>
<td>26(6%)</td>
<td>23(54%)</td>
</tr>
<tr>
<td>No answer</td>
<td>3(1%)</td>
<td>21(5%)</td>
<td>29(6%)</td>
</tr>
</tbody>
</table>

(a) Since Sept. 1967, has your personal use been

(b) As the result of receiving regular outputs, has your personal use

<table>
<thead>
<tr>
<th>Change</th>
<th>Increased</th>
<th>Remained the same</th>
<th>Decreased</th>
<th>No answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increased</td>
<td>12(24%)</td>
<td>23(54%)</td>
<td>15(31%)</td>
<td></td>
</tr>
<tr>
<td>Remained the same</td>
<td>259(60%)</td>
<td>246(57%)</td>
<td>314(73%)</td>
<td></td>
</tr>
<tr>
<td>Decreased</td>
<td>148(34%)</td>
<td>115(27%)</td>
<td>49(11%)</td>
<td></td>
</tr>
<tr>
<td>No answer</td>
<td>10(24%)</td>
<td>45(10%)</td>
<td>51(12%)</td>
<td></td>
</tr>
</tbody>
</table>
3. To what extent has the service replaced your own manual scanning of:

<table>
<thead>
<tr>
<th></th>
<th>(a) Current Awareness Publications</th>
<th>(b) Primary Journals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Completelly</td>
<td>97 (22 1/2%)</td>
<td>16 (3% )</td>
</tr>
<tr>
<td>Partially</td>
<td>206 (48%)</td>
<td>168 (39% )</td>
</tr>
<tr>
<td>Not at all</td>
<td>122 (28 1/2%)</td>
<td>242 (56 1/2% )</td>
</tr>
<tr>
<td>No answer</td>
<td>4 (1% )</td>
<td>3 (1% )</td>
</tr>
</tbody>
</table>

The number of users spending more time reading original papers was 42% whilst 55% still spent the same time on original papers. There was no real change in the number of primary journals seen. The figures were: decrease 10%; same 73%; increase 15%. The answers to A1(a)(i) and A1(b) are linked in the following table:

Table 4: Primary Journals

<table>
<thead>
<tr>
<th></th>
<th>Increase</th>
<th>Same</th>
<th>Decrease</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time increased for 26 users.</td>
<td>16</td>
<td>9</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Complete</th>
<th>Partially</th>
<th>Not at all</th>
</tr>
</thead>
<tbody>
<tr>
<td>Numbers of journals seen</td>
<td>0</td>
<td>12</td>
<td>13</td>
</tr>
</tbody>
</table>

Time remained same for 294 users.

<table>
<thead>
<tr>
<th></th>
<th>Increase</th>
<th>Same</th>
<th>Decrease</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of journals seen</td>
<td>36</td>
<td>248</td>
<td>8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Complete</th>
<th>Partially</th>
<th>Not at all</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time decreased for 107 users.</td>
<td>1</td>
<td>71</td>
<td>221</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Increase</th>
<th>Same</th>
<th>Decrease</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of journals seen</td>
<td>14</td>
<td>57</td>
<td>33</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Complete</th>
<th>Partially</th>
<th>Not at all</th>
</tr>
</thead>
<tbody>
<tr>
<td>Service replaced scanning</td>
<td>15</td>
<td>85</td>
<td>7</td>
</tr>
</tbody>
</table>
Question A2 investigated the students' use of current awareness sources and the effect on this usage of receiving regular output. Question A3 examined the extent to which the service had replaced manual scanning of current awareness publications and of primary journals. An apparent inconsistency was found in that 70% of users said that the service had partially or completely replaced their manual scanning of current awareness publications \(^{A3(a)}\) whereas only 52% said that they spent less time scanning these publications \(^{A1(a)(ii)}\). An attempt was made to resolve this inconsistency by examining the answers to questions A2(a), A2(b) and A3(a) in conjunction with A1(a)(ii). The detailed analysis is set out below:

**Table 5: Scanning of Current Awareness Publications**

(a) Time spent increased for 22 users.

<table>
<thead>
<tr>
<th></th>
<th>Nil</th>
<th>Irregular</th>
<th>Regular</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q2(a) Use of</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CCP</td>
<td>2</td>
<td>8</td>
<td>12</td>
</tr>
<tr>
<td>CT</td>
<td>10</td>
<td>9</td>
<td>2</td>
</tr>
<tr>
<td>CC</td>
<td>16</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Q2(b) Personal use of increased</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CCP</td>
<td>0</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>CT</td>
<td>0</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>CC</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

" remained same

<table>
<thead>
<tr>
<th></th>
<th>CCP</th>
<th>CT</th>
<th>CC</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCP</td>
<td>1</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>CT</td>
<td>8</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>CC</td>
<td>14</td>
<td>2</td>
<td>0</td>
</tr>
</tbody>
</table>

" decreased

<table>
<thead>
<tr>
<th></th>
<th>CCP</th>
<th>CT</th>
<th>CC</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCP</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>CT</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>CC</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Q3(a) Service replaced manual scanning

<table>
<thead>
<tr>
<th></th>
<th>Completely</th>
<th>Partially</th>
<th>Not at all</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>7</td>
<td>14</td>
</tr>
</tbody>
</table>
(b) Time spent remained the same for 178 users

<table>
<thead>
<tr>
<th>Use of</th>
<th>Nil</th>
<th>Irregular</th>
<th>Regular</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCP</td>
<td>38</td>
<td>54</td>
<td>80</td>
</tr>
<tr>
<td>CT</td>
<td>115</td>
<td>43</td>
<td>11</td>
</tr>
<tr>
<td>CC</td>
<td>135</td>
<td>16</td>
<td>15</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Personal use of increased</th>
<th>CCP</th>
<th>CT</th>
<th>CC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nil</td>
<td>0</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Irregular</td>
<td>0</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>Regular</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>remained the same</th>
<th>CCP</th>
<th>CT</th>
<th>CC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nil</td>
<td>38</td>
<td>36</td>
<td>75</td>
</tr>
<tr>
<td>Irregular</td>
<td>97</td>
<td>34</td>
<td>9</td>
</tr>
<tr>
<td>Regular</td>
<td>118</td>
<td>12</td>
<td>13</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>decreased</th>
<th>CCP</th>
<th>CT</th>
<th>CC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nil</td>
<td>1</td>
<td>14</td>
<td>6</td>
</tr>
<tr>
<td>Irregular</td>
<td>5</td>
<td>11</td>
<td>1</td>
</tr>
<tr>
<td>Regular</td>
<td>4</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Service replaced manual scanning</th>
<th>Completely</th>
<th>Partially</th>
<th>Not At All</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nil</td>
<td>22</td>
<td>58</td>
<td>96</td>
</tr>
</tbody>
</table>

(c) Time spent decreased for 224 users

<table>
<thead>
<tr>
<th>Use of</th>
<th>Nil</th>
<th>Irregular</th>
<th>Regular</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCP</td>
<td>62</td>
<td>110</td>
<td>52</td>
</tr>
<tr>
<td>CT</td>
<td>134</td>
<td>68</td>
<td>12</td>
</tr>
<tr>
<td>CC</td>
<td>169</td>
<td>34</td>
<td>6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Personal use of increased</th>
<th>CCP</th>
<th>CT</th>
<th>CC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nil</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Irregular</td>
<td>0</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Regular</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>remained the same</th>
<th>CCP</th>
<th>CT</th>
<th>CC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nil</td>
<td>33</td>
<td>28</td>
<td>33</td>
</tr>
<tr>
<td>Irregular</td>
<td>88</td>
<td>16</td>
<td>0</td>
</tr>
<tr>
<td>Regular</td>
<td>132</td>
<td>14</td>
<td>4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>decreased</th>
<th>CCP</th>
<th>CT</th>
<th>CC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nil</td>
<td>27</td>
<td>80</td>
<td>19</td>
</tr>
<tr>
<td>Irregular</td>
<td>37</td>
<td>49</td>
<td>11</td>
</tr>
<tr>
<td>Regular</td>
<td>23</td>
<td>19</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Service replaced manual scanning</th>
<th>Completely</th>
<th>Partially</th>
<th>Not At All</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nil</td>
<td>75</td>
<td>140</td>
<td>9</td>
</tr>
</tbody>
</table>

From this table the following points emerge:

(a) More time was spent scanning current awareness publications by 22 users, although for 7 of these users the service had partially replaced manual searching of current awareness publications. The reason for this seems to be
that the partial replacement of, say CT, was offset by increased use of CCP and CC.

(b) The most obvious anomaly is the case of 22 users for whom the service completely replaced manual scanning of current awareness publications and yet who still spend the same amount of time scanning these publications manually. No explanation is available for this anomaly and it is necessary to discount this relatively small number of answers; it is possible that the 22 users did not understand the phrase 'current awareness publications'.

The same anomaly occurs for the 58 users for whom the service partially replaced manual scanning of current awareness publications and still spend the same amount of time scanning these publications. It could, however, be said as before that the users had spent less time on CT and more on CCP and CC so that the time spent on overall manual scanning had remained constant.

The most important point that this part of the questionnaire was intended to establish was whether the time spent on scanning current awareness publications had in fact decreased as a result of the service. For an answer to this question, it seems better to take the percentage from Al(a)(ii), i.e. 52% of users spent less time, rather than the doubtful figure of 70% given in A3(a). This is substantiated by the figures in the last part of the table:

(c) Less time was spent scanning current awareness publications by 224 users (52%) and the service partially or completely replaced manual scanning in all but 9 cases. In agreement with this, there was a substantial decrease in the personal use of CCP, CT, or CC shown in 2(b) for these users.

Section B: Use of Library Services

This section examined the use of library services by the students. It was intended to cover any library or information service normally used, irrespective of whether it was from a university, departmental, college, or public library.

In only 7% of cases were journals used which were not available
at some time in the library. Some of the larger libraries seemed to have excellent coverage of journals cited in CT. In nearly half the cases where journals were not available, they were obtained by inter-library loan. The library staff were rarely asked for help in finding references apart from routine loan requests; only 21% of users frequently asked the advice of the library staff and 52% never asked.

67% of users were informed of interesting titles in languages they could not read; of these, less than half took any further action. The majority of students (87%) stated that they had never used an index to translations or tried to have a paper translated other than by a colleague (question 9 below). The most frequent language causing difficulty was Russian (71% of readers) followed by German (37%) and Japanese (23%).

### Use of Library Services

**Summary of Replies**

1. How often has a required journal not been available in the library?

<table>
<thead>
<tr>
<th>Frequently</th>
<th>Occasionally</th>
<th>Rarely</th>
<th>Never</th>
<th>No Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>115 (26%)</td>
<td>214 (50%)</td>
<td>89 (20%)</td>
<td>7 (1%)</td>
<td>4 (1%)</td>
</tr>
<tr>
<td>(a) immediatly</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30 (7%)</td>
<td>107 (25%)</td>
<td>158 (37%)</td>
<td>109 (25%)</td>
<td>25 (6%)</td>
</tr>
<tr>
<td>(b) later</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. How often has the required journal been obtained from another library?

<table>
<thead>
<tr>
<th>Frequently</th>
<th>Occasionally</th>
<th>Rarely</th>
<th>Never</th>
<th>No Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>70 (16%)</td>
<td>135 (31%)</td>
<td>123 (28%)</td>
<td>90 (21%)</td>
<td>11 (2%)</td>
</tr>
</tbody>
</table>

3. Apart from initiating a loan request, how often have you asked a member of the library staff for help in finding references?

<table>
<thead>
<tr>
<th>Frequently</th>
<th>Occasionally</th>
<th>Rarely</th>
<th>Never</th>
<th>No Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>11 (2%)</td>
<td>58 (13%)</td>
<td>135 (31%)</td>
<td>224 (52%)</td>
<td>1 (0%)</td>
</tr>
</tbody>
</table>

4. Have you been notified of interesting titles of papers in languages which you cannot read yourself?

   **YES:** 288 (67%)  **NO:** 140 (33%)  **N. ANSWER:** 1 (0%)

   If yes, please answer questions 5-9.
5. Which languages occurred most frequently?

<table>
<thead>
<tr>
<th>Language</th>
<th>Count</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Russian</td>
<td>204</td>
<td>71%</td>
</tr>
<tr>
<td>German</td>
<td>106</td>
<td>37%</td>
</tr>
<tr>
<td>Japanese</td>
<td>67</td>
<td>23%</td>
</tr>
<tr>
<td>French</td>
<td>21</td>
<td>7%</td>
</tr>
<tr>
<td>Italian</td>
<td>12</td>
<td>4%</td>
</tr>
<tr>
<td>Scandinavian</td>
<td>4</td>
<td>1%</td>
</tr>
<tr>
<td>Spanish</td>
<td>4</td>
<td>1%</td>
</tr>
<tr>
<td>Chinese</td>
<td>2</td>
<td>1%</td>
</tr>
<tr>
<td>East European</td>
<td>16</td>
<td>5%</td>
</tr>
</tbody>
</table>

6. How frequently have you taken further action?

```
<table>
<thead>
<tr>
<th>Action</th>
<th>Always</th>
<th>Often</th>
<th>Sometimes</th>
<th>Never</th>
<th>No Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>43(15%)</td>
<td>75(26%)</td>
<td>36(47%)</td>
<td>24(8.5%)</td>
<td>11(3.5%)</td>
</tr>
</tbody>
</table>
```

7. How frequently have you attempted to find
   (a) an abstract in English?
   (b) a regular cover-to-cover translation?
   (c) a colleague who can read the language?

```
<table>
<thead>
<tr>
<th>Language</th>
<th>Count</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Russian</td>
<td>204</td>
<td>71%</td>
</tr>
<tr>
<td>German</td>
<td>106</td>
<td>37%</td>
</tr>
<tr>
<td>Japanese</td>
<td>67</td>
<td>23%</td>
</tr>
<tr>
<td>French</td>
<td>21</td>
<td>7%</td>
</tr>
<tr>
<td>Italian</td>
<td>12</td>
<td>4%</td>
</tr>
<tr>
<td>Scandinavian</td>
<td>4</td>
<td>1%</td>
</tr>
<tr>
<td>Spanish</td>
<td>4</td>
<td>1%</td>
</tr>
<tr>
<td>Chinese</td>
<td>2</td>
<td>1%</td>
</tr>
<tr>
<td>East European</td>
<td>16</td>
<td>5%</td>
</tr>
</tbody>
</table>
```

8. Have you ever used an index to translations?

```
<table>
<thead>
<tr>
<th>Index Use</th>
<th>Always</th>
<th>Often</th>
<th>Sometimes</th>
<th>Never</th>
<th>No Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>92(32%)</td>
<td>55(19%)</td>
<td>83(29%)</td>
<td>40(14%)</td>
<td>19(6%)</td>
</tr>
<tr>
<td></td>
<td>22(7.5%)</td>
<td>43(15%)</td>
<td>84(29%)</td>
<td>119(41.5%)</td>
<td>21(7%)</td>
</tr>
<tr>
<td></td>
<td>19(6.5%)</td>
<td>38(13%)</td>
<td>97(33.5%)</td>
<td>115(40%)</td>
<td>20(7%)</td>
</tr>
</tbody>
</table>
```

9. Have you attempted to have a paper translated other than by a colleague?

<table>
<thead>
<tr>
<th>Attempted Translation</th>
<th>Yes: 32 (11%)</th>
<th>No: 250 (87%)</th>
<th>No Answer: 7 (2%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

If yes (a) by whom and in which language?

(b) how often were you successful?

The answers to 9(a) and (b) are summarised in the following table:

```
<table>
<thead>
<tr>
<th>Language</th>
<th>Count</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Russian</td>
<td>204</td>
<td>71%</td>
</tr>
<tr>
<td>German</td>
<td>106</td>
<td>37%</td>
</tr>
<tr>
<td>Japanese</td>
<td>67</td>
<td>23%</td>
</tr>
<tr>
<td>French</td>
<td>21</td>
<td>7%</td>
</tr>
<tr>
<td>Italian</td>
<td>12</td>
<td>4%</td>
</tr>
<tr>
<td>Scandinavian</td>
<td>4</td>
<td>1%</td>
</tr>
<tr>
<td>Spanish</td>
<td>4</td>
<td>1%</td>
</tr>
<tr>
<td>Chinese</td>
<td>2</td>
<td>1%</td>
</tr>
</tbody>
</table>
```

- 27 -
Table 6: Translations

<table>
<thead>
<tr>
<th>Methods</th>
<th>Language</th>
<th>Success</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professional Translator</td>
<td>Russian</td>
<td>No - too expensive</td>
</tr>
<tr>
<td></td>
<td>Russian</td>
<td>Once only</td>
</tr>
<tr>
<td>University Staff</td>
<td>Russian</td>
<td>Each only</td>
</tr>
<tr>
<td></td>
<td>German</td>
<td>Each time</td>
</tr>
<tr>
<td></td>
<td>Russian</td>
<td>Always</td>
</tr>
<tr>
<td>Translation Service</td>
<td>(Russian)</td>
<td>Each time</td>
</tr>
<tr>
<td>Library T.S.</td>
<td>(Japanese)</td>
<td>Too expensive</td>
</tr>
<tr>
<td>Computer</td>
<td>Russian</td>
<td>Successful</td>
</tr>
<tr>
<td>ASLIB T.S.</td>
<td>Japanese</td>
<td>Too expensive</td>
</tr>
<tr>
<td>DSIR</td>
<td>Russian</td>
<td>Always</td>
</tr>
<tr>
<td>Libraries:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NLL</td>
<td>Russian</td>
<td>No</td>
</tr>
<tr>
<td>Chem. Soc. Lib.</td>
<td>Chinese</td>
<td>Unspecified</td>
</tr>
<tr>
<td>Science Lib.</td>
<td>German</td>
<td>Unspecified</td>
</tr>
<tr>
<td>Library Staff</td>
<td>Polish</td>
<td>Successful</td>
</tr>
<tr>
<td></td>
<td>Czech</td>
<td></td>
</tr>
<tr>
<td>Industry</td>
<td>Japanese</td>
<td>Once - successful</td>
</tr>
<tr>
<td>ICI</td>
<td>Japanese</td>
<td></td>
</tr>
<tr>
<td>Pharmaceutical</td>
<td>German</td>
<td>Always</td>
</tr>
<tr>
<td>Language Centres</td>
<td>Unspecified</td>
<td>Usually</td>
</tr>
<tr>
<td></td>
<td>Russian</td>
<td>Occasionally</td>
</tr>
<tr>
<td></td>
<td>Slovak</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hungarian</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Japanese</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Italian</td>
<td></td>
</tr>
</tbody>
</table>
+ 4 unspecified methods

In the following sections summaries are given for those answers which could not be coded for the punched card analysis. A complete list of summarised comments is available together with the profile number to identify them. These will be of use if a more detailed analysis is required.

Section C: User's Impression of Scheme

1. What have been the useful feature(s) of the service? More than one item may be marked or alternatively, none.

Provides a more comprehensive search of the literature than previous methods .................. 220 (49%)
Convenience - "makes life easier" .................. 203 (47½%)
Provision of background material .................. 142 (33½%)
Alerting to the appearance of new journals .......... 46 (10½%)
Other useful features (listed below) ............. 30 (7%)
2. What are the disadvantages (if any) of the service?
3. What improvements would you like to see in the scheme?
4. How do you think the service compares with conventional secondary sources of information?
5. Do you consider that the scheme could have been operated without liaison scientists?
   YES: 42 (10%)  NO: 376 (88%)  NO ANSWER: 11 (2%)
6. After experience of the present scheme, do you consider that
   (a) you could formulate an acceptable profile for a new research project?
      YES: 383 (89%)  NO: 41 (9 1/2%)  NO ANSWER: 5 (1 1/2%)
   (b) instruct other research workers how to formulate profiles?
      YES: 295 (69%)  NO: 119 (28%)  NO ANSWER: 15 (3%)
7. Do you know more about methods of obtaining information now than you did before the project started?
   YES: 290 (67 1/2%)  NO: 136 (31 3/4%)  NO ANSWER: 3 (1%)
   If yes, (a) do you consider that the scheme is mainly responsible?
      YES: 274 (94 1/2%)  NO: 10 (3 1/2%)  NO ANSWER: 6 (2%)
      (b) what have you learnt from the scheme?
Cl: Other Useful Features Listed
   (a) Coverage of foreign journals or of other journals that the user was unaware of or did not have available.
   (b) Prior notice of useful references.
   (c) Provided a useful printed list that could be used retrospectively.
   (d) Provided an insurance policy i.e. a check on the user's own search methods.

Almost everyone had remarks to make on the disadvantages of the service and/or improvements they would like. It is possible to classify only broadly the various answers to questions C2 and C3. These are given in order of frequency of appearance. The items marked with an asterisk are really criticisms of the CT data base and the items marked with a cross are also unfair comments on the actual project.
C2: Disadvantages

1. The titles of papers are not very good guides to the full contents, which leads in turn to points 2 and 4.

2. General profiles provide a large amount of irrelevant references. Narrower profiles may well miss references.

3. The range of journals covered is limited.

4. Difficulty in constructing a profile to cover a research interest that is wide or constantly changing.

5. Print-out of references arrives before the journals are available in the library (however, see point 7).

6. Service could make the user lazy in that he neglects to read outside the scope of Chemical Titles.

7. Journals arrive in the library before the print-out arrives and so most references have already been found.

8. References cannot be filed easily because of paper print-out.

9. No facility for retrospective searching.

10. No patent coverage by the service.

C3: Improvements

1. Scan abstracts as well as titles. Cover Chemical Abstracts.

2. A method to carry out a retrospective search.

3. Card output for more convenient filing.

4. Titles of papers should include a set of keywords and/or reflect the contents of the paper. Standardise titles.

5. Extend the range of journals covered.

6. More opportunity to change profile and more time spent on planning the profile.

7. Classify titles.

8. Provision of abstract with print-out, and author addresses.

9. Supply journal list including the abbreviation and code or print-out full title.

10. Make the service available to other students in other years.

11. Extend to group profiles.

12. Some method of formulae and/or structure search.
The answers given to question C4 shows that more users consider the service just as good if not better than other secondary sources of information than consider the service inferior. (259 better or as good; 3 not as good; 27 not as comprehensive as manual search). 50 users commented that the service was quick.

Over 80% though that liaison scientists were necessary for the scheme to operate. About 10% gave methods which could eliminate the need for liaison scientists. Of those users who think that the scheme could run without liaison scientists, about half suggest providing a detailed instruction manual and another quarter suggest using a member of staff in the department who is competent to construct profiles. Others think that the liaison scientist is only required at the beginning when profile construction and introduction to the scheme is taking place. It is noteworthy that only 10% of users think liaison scientists are not necessary especially when 90% think they could construct their own profiles for a new research topic for themselves and 70% could for other research workers.

At the end of the project, 89% of users felt confident that they could formulate a profile for a new project and 69% felt that they could instruct others. The accuracy of these statements will be checked during the present exercise (1968-70) for those students who have moved to new projects in universities in the United Kingdom. The majority (67%) of users said that they now knew more about information methods than before the project started and practically all of these (94%) considered that the scheme was mainly responsible.

**Section D: Future Occupation**

421 questionnaires were analysed to determine the future of the students participating in the scheme.

32 users had already completed their theses when they completed the questionnaire and a further 295 hoped to have finished their theses by October 31st 1968.

301 had definite posts to go to while a further 109 were uncertain about the future.
A break-down of the 301 definite posts is given below:

<table>
<thead>
<tr>
<th>Post Category</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temporary research abroad e.g. postdoctoral fellowship</td>
<td>99</td>
</tr>
<tr>
<td>Permanent research in industry in U.K.</td>
<td>80</td>
</tr>
<tr>
<td>Temporary research in other universities in U.K.</td>
<td>26</td>
</tr>
<tr>
<td>Temporary research in same university in U.K.</td>
<td>19</td>
</tr>
<tr>
<td>Teaching in U.K. universities</td>
<td>16</td>
</tr>
<tr>
<td>Teaching in U.K. schools</td>
<td>7</td>
</tr>
<tr>
<td>Other posts in industry in U.K.</td>
<td>14</td>
</tr>
<tr>
<td>Industry and Government abroad (permanent research)</td>
<td>14</td>
</tr>
<tr>
<td>&quot; &quot; (temporary &quot; &quot; )</td>
<td>7</td>
</tr>
</tbody>
</table>

Of those who did not have definite posts to go to the principal choices of career are given below:

<table>
<thead>
<tr>
<th>1st choice:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Postdoctoral fellowship abroad</td>
<td>31</td>
</tr>
<tr>
<td>Industrial research U.K.</td>
<td>17</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>1st choice:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Postdoctoral fellowship U.K. universities</td>
<td>15</td>
</tr>
<tr>
<td>U.K. university teaching</td>
<td>12</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2nd choice:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Postdoctoral fellowship U.K. universities</td>
<td>15</td>
</tr>
<tr>
<td>U.K. industrial research</td>
<td>14</td>
</tr>
<tr>
<td>Postdoctoral fellowship abroad</td>
<td>9</td>
</tr>
</tbody>
</table>

As can be seen from the figures 130 of the 421 students will be going, or would like to go abroad for temporary university research posts while 97 chose industrial research in the United Kingdom.

Section E: Vital references

A 'vital' reference was defined as one that had a definite impact on the user's research work. Students were asked to list all such references that had appeared since September 1967.

Section E of the questionnaire was not fully understood by some users and so the liaison scientist had to carefully check the answers and, where appropriate, ask for further information at the final interview. Some students were not available for the final interview and sent in their completed questionnaires by post; in these cases only those answers which appeared to be self-consistent have been used.
Vital References

<table>
<thead>
<tr>
<th>Area</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of refs. first seen in print-out</td>
<td>97</td>
<td>86</td>
<td>106</td>
<td>62</td>
<td>30</td>
<td>140</td>
<td>521</td>
</tr>
<tr>
<td>No. of refs. first seen elsewhere</td>
<td>76</td>
<td>28</td>
<td>69</td>
<td>46</td>
<td>35</td>
<td>64</td>
<td>318</td>
</tr>
<tr>
<td>No. of refs. found only by service</td>
<td>18</td>
<td>24</td>
<td>29</td>
<td>21</td>
<td>14</td>
<td>28</td>
<td>134</td>
</tr>
<tr>
<td>No. of refs. found by conventional methods (inc. service)</td>
<td>155</td>
<td>90</td>
<td>146</td>
<td>87</td>
<td>51</td>
<td>176</td>
<td>705</td>
</tr>
<tr>
<td>No. of questionnaires data taken from</td>
<td>50</td>
<td>37</td>
<td>55</td>
<td>31</td>
<td>23</td>
<td>47</td>
<td>243</td>
</tr>
</tbody>
</table>

Total refs.: 839

62% of all references listed as useful were first seen in the print-out and of the total number of all references an average of 16% would have been missed had the service not been used.

Most papers referred to by the service and listed as useful were available within one week of notification. Those which were not were often papers in foreign languages for which translations were needed.

General Comments

The section on "general comments" in the questionnaire was often used to reiterate points made previously in answer to specific questions. It is therefore permissible to treat these comments as underlining the more important advantages and disadvantages listed by the users. A selection of comments is given below:

Profiles should be made more selective by using negative weighted keywords.

Profile takes time to perfect and so it would be better to start the project in the second year.

If the author name is made a keyword in the profile it is possible to retrieve work of that author.

The longer the profile runs the more useful the service becomes.
Profile can produce an extremely wide selection of references and gives a vital check against missing important references.

Profile should give more individual output.

Difficult to get an exact profile. Should have regular revision and change of profile as research topic develops.

User resorted to manual search because topic changed but profile still covered basic project.

Is enough time spent on planning the search profile?

Would like a method of adding to the profiles more quickly.

Difficult to define general interests and so difficult to formulate a profile to cover these.

Profile to cover reviews would produce too much irrelevant information.

Important references can be missed because of improper design of profiles.

Profile setting up and polishing is quick enough now. If abstracts were added the output would be too large.

Profile needs to be more precisely defined to cut irrelevance.

It is important to define the question precisely before constructing the profile.

Profiles containing common reagent names are not particularly useful because title would not cover these.

It would be better to have 'combination-words' before recording a 'hit'.

A lecture given two weeks before formulation of the profile would give students time to draw up a list of keywords.

User thinks he could do search just as quickly as his very broad profile.

User would like to construct a profile to cover general interests but to give not too much output.

It took a long time to change profiles from CBAC to CT.

A really successful profile can only be constructed after studying titles of important references because "you can say the same thing several ways".
Profile amendment increased relevance without decreasing output.

The scheme is very useful provided you can put a research topic into a profile.

A profile with narrow limits proved successful since relevance was high when a reference was recorded as a "hit".

Profiles should be constructed more carefully.

It is better to have too wide a profile than too narrow.

User would like closer contact with the liaison scientist so that more rapid amendments to the profile can be made as the topic changes.

Profile is only as useful as titles allow.

User would not rely solely on scheme because of inadequacies in the profile. These are: (1) it selects only from titles (2) interest changes with experience.

User had difficulty in formulating a profile which gave specific references rather than general background references.

Profiles do not always contain the right keywords.

It is better to alter the profile as research interest changes.

The scheme is good provided the profiles are kept up to date.

More involvement of the student in formulating the profile and greater explanation by the liaison scientist.

Only one comment does not mention the word "profile" and this one is still concerned with words. By far the most frequent comment concerned the need to amend the profile as the research work changes: several users would have liked "more opportunity to alter the profiles". Clearly, some users were unaware that it was their responsibility to instigate an amendment (cf. Interview Sheet Q3).

It was apparent that some users had a research topic that was not suitable to be covered by a titles-only search and this seemed particularly true for organic chemists engaged in synthetic work and physical chemists interested in particular techniques.

Perhaps the whole scheme can be summed up by the following comment: "the scheme is very useful providing your research topic
can be expressed in terms of keywords and providing the profile is kept up to date”.

**Interview Sheet**

A supplementary sheet to the final questionnaire was filled in by the liaison scientist on his final visit to each user. As can be seen from the combined statistics from 438 profiles for 429 users, most students were satisfied that 3 or 4 visits per year were sufficient. A noteworthy point is that even students with large outputs spent only about 15 minutes per fortnight scanning their lists of titles. The high percentage of users who thought that the scheme was worthwhile offers encouragement for future work.

**Interview Sheet: Combined Statistics**

<table>
<thead>
<tr>
<th>Question</th>
<th>No. of Students</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Number of interviews</td>
<td>1</td>
<td>Total of 1339 visits</td>
</tr>
<tr>
<td>with each student</td>
<td>2</td>
<td>No answer given : 25</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>2. Student would like: More</td>
<td>46</td>
<td>No answer : 59</td>
</tr>
<tr>
<td>Same</td>
<td>290</td>
<td></td>
</tr>
<tr>
<td>Less</td>
<td>34</td>
<td></td>
</tr>
<tr>
<td>interviews</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Profile modifications:</td>
<td></td>
<td>Total : 617</td>
</tr>
<tr>
<td>(a) at interviews</td>
<td>354</td>
<td>No answer : 58</td>
</tr>
<tr>
<td>(b) at other times</td>
<td>263</td>
<td></td>
</tr>
<tr>
<td>4. Average number of references per issue:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-10</td>
<td>70</td>
<td>No answer : 58</td>
</tr>
<tr>
<td>11-20</td>
<td>104</td>
<td></td>
</tr>
<tr>
<td>21-30</td>
<td>82</td>
<td></td>
</tr>
<tr>
<td>31-50</td>
<td>96</td>
<td></td>
</tr>
<tr>
<td>750</td>
<td>54</td>
<td></td>
</tr>
<tr>
<td>5. Time taken per printout:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15 min</td>
<td>267</td>
<td>No answer : 61</td>
</tr>
<tr>
<td>15-30</td>
<td>65</td>
<td></td>
</tr>
<tr>
<td>30-45</td>
<td>5</td>
<td></td>
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<tr>
<td>45-60</td>
<td>24</td>
<td></td>
</tr>
<tr>
<td>60-90</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>90-120</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>120</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Question</td>
<td>No. of Students</td>
<td>Notes</td>
</tr>
<tr>
<td>----------</td>
<td>----------------</td>
<td>-------</td>
</tr>
<tr>
<td>6. Fate of printout:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Throw away *</td>
<td>112</td>
<td>* Includes those who keep useful references by making notes or cutting up the printout.</td>
</tr>
<tr>
<td>Keep</td>
<td>110</td>
<td></td>
</tr>
<tr>
<td>Pass on</td>
<td>133</td>
<td></td>
</tr>
<tr>
<td>Unspecified</td>
<td>83</td>
<td></td>
</tr>
<tr>
<td>7. SRC student on same topic next year:</td>
<td></td>
<td>No answer : 77</td>
</tr>
<tr>
<td>Yes</td>
<td>144</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>108</td>
<td></td>
</tr>
<tr>
<td>Don't know</td>
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<td></td>
</tr>
<tr>
<td>Probably</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td>Unlikely</td>
<td>19</td>
<td></td>
</tr>
<tr>
<td>Possibly</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>8. Students attitude:</td>
<td></td>
<td>No answer : 39</td>
</tr>
<tr>
<td>Enthusiastic</td>
<td>142</td>
<td></td>
</tr>
<tr>
<td>Worthwhile</td>
<td>216</td>
<td></td>
</tr>
<tr>
<td>Apathetic</td>
<td>27</td>
<td></td>
</tr>
<tr>
<td>Waste of time</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>
Chapter 4: Research Reports

The liaison scientists would like to thank OSTI for financial support and their respective Heads of Department for the use of departmental facilities.

A. Calaghan: Chelating Properties of Tetrafluorobenzene 1, 2-dithiol

Introduction

Research was carried out during the year in the field of organometallic chemistry and was concerned with the chelating properties of a potentially powerful new ligand, tetrafluorobenzene 1, 2-dithiol

\[ \text{tetrafluorobenzene dithiol} \quad \text{tfbt} \]

This ligand can be considered as one of a class of 1,2-dithiols, some members of which have been previously investigated. Typical examples of these are:

\[ \text{sdt} \]

Studies of the transition metal complexes of these ligands have been rewarding in the past due to the discovery of a number of unusual features. Firstly, square planar geometries of bis complexes are stabilised over a large range of metals including Fe, Co, Rh, Ni, Pd, Pt, Cu, Ag and Au. Secondly, more than one oxidation state of a bis complex may be stable, e.g. \( \text{Ni(sdt)}^{2+}, \text{Ni(sdt)}^{2-1} \) and \( \text{Ni(sdt)}^{2-2} \) are all known. Thirdly, some of the neutral six-coordinate tris complexes, e.g. \( \text{Re(sdt)}_3 \), have been shown to have trigonal prismatic stereochemistry rather than the more normal octahedral one. Very few molecular complexes have trigonal prismatic stereochemistry, and some unusual physical properties, e.g. magnetic, result.
The position of the present ligand in the range of 1,2-dithiols is an extreme one. The fully fluorinated benzene ring promotes strong acid behaviour and one might reasonably expect to find pseudo-halogen activity, giving an interesting series of new compounds. There were two main problems in working with the ligand. Firstly, it was expensive and difficult to produce, and only a small sample was available (initially 5 ml., later supplemented by a further 2 ml.). This meant that considerable care had to be taken to minimise waste, and work with small quantities. Secondly, the 5 ml. of ligand which was originally available was only \( \sim 75\% \) pure. This resulted in difficulties in the purification and re-crystallisation of some products.

**Experimental and Results**

It is not intended here to present a rigorous research report; a brief outline of the principle points of interest seems more suitable.

It was immediately apparent that the ligand was a powerful complexing agent. In transferring small quantities with a syringe, the dithiol dissolved away part of the metal in the syringe to form a strongly coloured complex. The dissolved metal was shown to be copper, and subsequent experiments proved that the ligand had no difficulty in dissolving this metal at room temperature. (Hopes of a breakthrough in precious metal chemistry were not realised, however, when it was found that Ag, Au and Pt were unaffected.) Isolation of the copper complex produced a black powder of variable composition with the most likely ligand-to-metal ratio being 2 to 1. A second compound was isolated from the reaction between copper and the ligand. This crystallised as pale yellow needles and proved to be an oxidation product of the ligand, tetrafluorobenzene dithione.

\[
\text{Tetrafluorobenzene dithione}
\]

The ligand reacted easily with transition metal ions in a variety of oxidation states to form complexes. Due to impurities, however, the end product tended to be an oil, from which it was difficult in many cases to isolate a pure complex. This problem could be overcome by using the dithallium salt of the dithiol as starting material. This compound was

\[
\text{Dithallium salt of dithiol}
\]
prepared from the reaction between thallium acetate and tetrafluoro-
benzene dithiol in methanol, followed by centrifugation of the product. 
By this means not only were soluble impurities washed away in methanol,
but small amounts of mono-thiol impurity were isolated, this being 
much lighter than the dithiol compound, and was consequently found on 
the surface after centrifugation. In using this salt for the 
preparation of complexes a chloro compound of the transition metal 
under investigation was normally used as co-reactant, whereupon 
thallium chloride would be precipitated. After filtration, this left 
a solution of the pure complex for further study.

Products prepared to date are of two types, neutral complexes of 
first transition series metals, e.g. Ni(tfbt)2, and charged complexes 
of second row metals, e.g. \( \text{Et}_4N^+\) \(\text{Mo}(\text{tfbt})_3^-\). Charged 
complexes of first row transition metals have also been identified, but 
seem to be stable only with very large cations of the type \(\text{Et}_4\text{As}^+\).

With the tetraethyl ammonium cation a variety of products are produced. 
Unfortunately the analysis of arsenic in the presence of fluorine 
and sulphur is causing problems, and so new large cations are being 
investigated with which to precipitate the first row metal charged 
species. At the present time data is most complete for the 
molybdenum compound mentioned above. This will therefore be presented 
now in some detail as an example of the line of approach used, and will 
conclude this section.

The starting material for this product was Mo II acetate. (This 
had to be prepared independently from molybdenum hexacarbonyl and 
glacial acetic acid.) Mo II acetate was dissolved in acetone and 
tetrafluorobenzene dithiol was added. A dark green solution resulted, 
from which it was impossible to isolate anything except a viscous oil. 
On addition of tetraethyl ammonium chloride, however, the colour 
changed to deep blue, and a blue crystalline product could be forced 
out of solution with benzene. The analysis of this product was 
as follows (%):

C: 41.4  H: 4.1  N: 3.1  F: 22.8  S: 19.1

The calculated analysis for a compound of composition 
\(\text{C}_2\text{H}_5\text{N}^+\text{Mo(C}_6\text{F}_4\text{S}_2)_3^-\) is:

C: 41.1  H: 4.0  N: 2.8  F: 23.0  S: 19.3

This is a very good agreement.

As a 2:1 electrolyte the compound would be expected to have a molar
conductivity of approximately 150 mhos. Experimentally the value found was 159 mhos, again in good agreement.

The formal oxidation state of the molybdenum is IV, giving a d^2 system. With octahedral stereochemistry this should result in a magnetic moment of $\sim 2.83$ B.M. Instead, the compound was found to be diamagnetic at both room and liquid nitrogen temperatures. The measured diamagnetism was $X_M = -500 \pm 50 \times 10^{-6}$ cgs, compared with a theoretical value of $X_M = \sim -527 \times 10^{-6}$ cgs, and so there was no underlying paramagnetic component. This result is consistent with trigonal prismatic stereochemistry, as it is possible in this configuration for both d electrons to be paired in a low-lying dz^2 orbital, resulting in diamagnetism.

Optical spectra were taken on a Unicam SP 800 from 325 mu to 700 mu. There were two broad absorption bands, one at $\sim 17,000$ cm.\(^{-1}\) and one at $\sim 29,000$ cm.\(^{-1}\), both with high extinction coefficients of the order of 10^4. This result should be compared with the spectra of the Re(sdt)_3 neutral complex mentioned earlier. In the Re case there were also two broad bands with high extinction coefficients, but these were at 14,000 cm.\(^{-1}\) and 24,000 cm.\(^{-1}\). In the case of the charged species therefore there has been an appreciable shift to shorter wavelengths.

Conclusions

The initial objective of the research - to demonstrate the potential of a new ligand - has been achieved. Further work is open-ended in the number of new compounds which may be prepared, any one of which could have interesting properties.

Total time doing active research was about a month, most of it wasted. Even simple preparations take time, and machines may take days to get working in the way one wants. There can be few practical projects that can be carried out concurrently with a job that requires some time every day and which may take one away unexpectedly at short notice.

The completion of the thesis has been long delayed, and probably not given full attention for periods longer than a day or two. Some writing was possible in the periods late February/early March, mid-May and July/August. One chapter has been written (and a few confirmatory experiments done), one rewritten, and the rest edited and transcribed since October.

Also, a chemistry part II student was started on his project and advised periodically, although this did not cause undue strain.

Summary of Ph.D. Thesis

This work describes some aspects of dynamic nuclear polarisation (the Overhauser Effect) and its application to various chemical problems.

Chapter one gives a general introduction to dynamic polarisation, showing how, when the electron paramagnetic resonance absorption of a free radical in solution is partially or totally saturated, the solvent nuclear resonances are drastically modified, being either enhanced or inverted. The theory of the effect, based on a treatment by Solomon of a two spin system, is given. A short discussion of spectral densities and correlation times, and their importance in the interpretation of Overhauser effect experiments, follows. The various models for modulation of nuclear-electron coupling and experiments to distinguish between them are described. A summary of Natusch's theory of the three-spin effect is given and the final section deals with a novel phenomenon, chemically induced dynamic nuclear polarisation.

Chapter two deals briefly with the apparatus used in Overhauser effect experiments and especially with aids in detecting weak signals. The possibility of stimulated emission in Overhauser effect experiments is investigated and concluded to be a very small correction for most measurements.
Chapter three deals with the dependence of dynamic enhancements on the nature of the free radical used. It starts with a review of the properties, reactions, detection and identification of stable free radicals and includes a list of radicals used in these experiments. Dynamic enhancements of solvent resonances are tabulated for the various radicals (a) in benzene, the protons of which are dipolar coupled to the unpaired electron, and molecular parameters may be calculated, (b) in hexafluorobenzene, where the fluorine nuclei show mixed dipolar and scalar (contact) coupling to the electron, so that complete evaluation of results is not possible but a qualitative comparison of radicals can be made; and the applicability of equations based on various models is discussed. Less strictly quantitative measurements on $^{31}$P and $^{13}$C, using various radicals, are also briefly mentioned.

Chapter four investigates the differences in dynamic enhancement between different protons within the same molecule. Consistent differences of the order of 10% are found between aliphatic and aromatic protons. Geometrical considerations show that this may be accounted for by variation in distance of closest approach between proton and radical electron.

Chapter five deals with the application of the Overhauser effect to observe natural abundance (1%) $^{13}$C spectra. Surprisingly the $^{13}$C nucleus in simple organic molecules shows a considerable degree of scalar coupling to the free radical electron, especially in halogenated aliphatic compounds. The mechanism of scalar coupling is explained in terms of "spin-conducting" and "spin-insulating" atoms and groups in the structure of the molecules. $^{13}$C spectra are ideal for observation of "three-spin" effects, where the proton polarisation affects the $^{13}$C polarisation. This is especially noticeable at low concentrations of radical. Finally, the observation of an isotope shift in $^{13}$C spectra, between benzene and perdeuterobenzene, is observed and explained.
Chemical mutagenesis arising from the action of various aminoacridines on bacteriophages has been extensively studied. It has been proposed that the mechanism of action involves intercalation of the planar acridine molecule between successive base pairs in the DNA structure, with increase in the spacing of the latter from 3.4 Å to approximately 7 Å. This increase in spacing gives rise to a misreading of the genetic code, one consequence of which can be recognised as mutation.

Convincing evidence of intercalation has been provided by studies of viscosity and small angle X-ray diffraction. Clearly the intercalated base might be more effective if specific hydrogen-bonding could occur with a purine or pyrimidine base in the complementary nucleic acid chain. All naturally occurring nucleotides contain hydrogen-bond donor and acceptor sites in a 1:3 relationship, and in consequence it is of interest to generate such systems involving acridine and related nuclei. Since donor as well as acceptor capacity is required, attention was paid to aza-substituted carbazoles, e.g. carbolines, pyrrolopyridines, and pyrimido-indoles.

On irradiation in a variety of solvents, diphenylamine undergoes oxidative photocyclisation to carbazole. By analogy, anilino-pyridines should yield carbolines, dipyridylamines should yield pyrrolopyridines, and anilinopyrimidines should yield pyrimido-indoles. Last year's work provided examples of the first two cases and the third is illustrated by the present work, in which 4-anilinopyrimidine (IV, Fig.3) is photoconverted to 9H-pyrimido-(4, 5-b) indole (V).

The anilinopyrimidine was prepared by catalytic dehalohydrogenation of 4-anilino-6-chloropyrimidine (VIII). Hydrogenation of 4-anilino-2, 6-dichloropyrimidine (II) was less successful as a mixture of 4-anilino-3-3-prymidine (VI) and 4-anilino-2-chloropyrimidine (IV) was obtained. Irradiation of the anilinopyrimidine for 48 hours gave the required ring system in 80% yield.

In order to determine if cyclisation involving a ring nitrogen atom could be effected, 2-anilinopyrimidine was irradiated for 36 hours in tetrahydrofuran. The main chromophore was gradually destroyed but no new peaks appeared in the u.v. spectrum of the reaction solution. Irradiation in the presence of iodine also
Preparation of 4-anilinopyrimidine and photocyclisation to the pyrimidoindole (V)
failed to bring about cyclisation.

A proposed cyclisation involving the formation of a six-membered ring is now being investigated with 9-anilinofluorene, prepared from 9-chlorofluorene.

**REFERENCE**


**P. Leggate: Further Information Work**

Time allocated for research work was used for the preparation of various standard parameters and on an extra project involving the follow up of marked references. (See section in Chapter 2 on fate of references).
C. M. Lee: Inventory of Secondary Information Sources*

In essence, ALL time was spent on information work with a few hours a week spent discussing research problems with postgraduate students. The major part of time (between visits) in 1968 has been the preparation of "An Inventory of Some Secondary Services in Science and Technology". The Inventory covers over 100 different secondary services (see list) and attempts to provide a convenient synthesis of information on information. An example of the layout for the inventory is also included (on MEDLARS). A paper entitled 'The Jigsaw Puzzle' has also been written trying to examine the differences between scientific and artistic creativity and presenting some of the recent trends in Information Science.

An Inventory of Some English Language Secondary Services in Science and Technology

Introduction

This Inventory was designed to keep me aware of all the variety of secondary services available to the scientist and technologist. Believing in the heuristic approach, I know that the best way to learn is to teach and I have tried to present a survey of some of the multitudinous ways one can search for information in Science and Technology.

Method

Perhaps a word is in order on the method of data compilation for this Inventory. In the great majority of cases I was able to examine the printed version of the service in detail along with descriptive literature and references. At this stage a "work-sheet" on the service(s) was prepared and sent to the Service for their comment and correction. In most cases this cooperation was forthcoming and the revisions incorporated in the final copy; however, any and all errors remain my responsibility. Because of budgetary and other considerations the layout is not as attractive, in some cases, as I would have liked; furthermore certain errors have managed to pass my 'sparrow-like' scrutiny. I would greatly appreciate being informed of any errors of commission or omission as well as errors of stupidity in the event another edition is published.

* Updated and reproduced by OECD, March 1969.
Indexes

I have included a number of indexes so we can look at the raw information from many different viewpoints. The **Subject Index** (by colour) is based on different disciplines and I have included some services (e.g. law) that are not strictly science and technology. The **Source Index**, divided into governmental and non-governmental (societies and commercial) includes organizations that have been helpful to me even though no 'products' appear in the Fact Sheets (e.g. SATCOM, OSIS). The **Functional Index** classifies the different approaches to Information Retrieval and the **Alphabetical Index** provides a complete listing of **ALL** Publications and Services mentioned in the Fact Sheets and Source Indexes.

Features

Some special features of this Inventory might be noted. The Fact Sheet format has the following features: unbound pages, two services on a sheet, and colour subject indexing. The unbound sheet, besides being more convenient production-wise allows easy additions and one can make side-by-side comparisons of similar services in different subject areas (e.g. the three **Current Contents**, **Current Chemical Papers** and **Current Papers in Physics**). One can also compare all the services in one area at one time. I have tried to place similar services of the same subject on the same sheet so that direct comparisons may be made (e.g. DMS and Sadtler IR Spectra Services). Finally the Colour Coding makes all of the comparisons easy and also looks attractive.

Coverage

A few facts about the coverage of Secondary Services are shown in the table appended to the end of this Introduction. They show that a very low percentage of the journals scanned are required to provide 90% coverage. The first 15% of **Chemical Abstracts** coverage is contributed by only 18 journals while the last 15% requires scanning of over 8000 journals (1). The number of journals scanned is not necessarily a reflection of the comprehensiveness of coverage. **Chemical Abstracts** scans about 12,000 publications a year but only 6000 different serials are cited in each half-yearly volume. Whether it is necessary to cover the last 10% of journals at great expense and time (because they are usually obscure foreign journals) is debatable.
The ICSU-Abstracting Board (whose members are the services shown on the attached table) has listed 107 'Major' journals in Physics, 220 'Major' journals in Biology and 259 'Major' journals in Chemistry; coverage of only these journals would yield most of the important papers in their respective areas (2).

I have tried to indicate whenever possible how comprehensive the coverage is e.g. 'Journals completely abstracted'. Science Citation Index (SCI) is probably unique in its comprehensive coverage with twelve different categories indicated: original articles, papers or reports; abstracts; book reviews; corrections; discussions; editorials; awards etc.; letters; meetings; notes; patents; and reviews. Another interesting feature of SCI is that it is a calendar year index, i.e. the 1967 SCI covers all issues of a journal published in 1967 be it one or fifty-two issues.

It is my hope that my effort will help not only scientists and technologists but management and administration to be aware of the wealth of access points to the pieces of the jigsaw puzzle available today. I hope you also have fun using it!

Acknowledgements:

I wish to thank those mentioned in the Source Indexes for their cooperations (especially those who took time out to see me on my last US trip in January 1968). This work was supported by OSTI, Chelsea College, Apple Corps., and myself.

References:

2) See ICSU-AB in the Source Index: Governmental & International.

Bibliography:

AN INVENTORY OF SOME ENGLISH LANGUAGE SECONDARY SERVICES
IN SCIENCE AND TECHNOLOGY

CHEMICAL SCIENCES
Chemical Abstracts / Chemical Abstracts Basic Journal Abstracts
Chemical Titles (CT) / Chemical Abstracts Condensates
Current Contents Chemical Sciences / Current Chemical Papers (CCP)
Polymer Science and Technology - Journals/Patents (POST-J/P)
Index Chemicus (IC) / Analytical Abstracts

CHEMICAL/BIOLOGICAL CODES
Chemical Abstracts Registry System / Auxiliary Chemical Module
Index Chemicus Registry Service / Derwent Ring Chemical-Biological Code
de Haen Chemical-Biological Code / DMS Chemical Code

BIOLOGICAL SCIENCES
Chemical Biological Activities (CBAC) / International Pharmaceutical
Abstracts
RINGDOC / VETDOC / PESTDOC
MEDLARS (Medical Literature Analysis and Retrieval System) Tape /
Printed
Research Grants Index (PHS) / WHO Biomedical Information Centre
Excerpta Medica Abstracts / Excerpta Medica Information Retrieval System
Unlisted Drugs / de Haen Pharmaceutical Information Services

PHYSICAL SCIENCES
Physics Abstracts / Computer-based Physics Abstracts
American Institute of Physics (AIP) Information Project / Technical
Infor. Proj.
Current Contents Physical Sciences / Current Papers In Physics (CPP)
Nuclear Science Abstracts (NSA) / EURATOM Nuclear Documentation System
(ENDS)

SPECTRAL SERVICES
Preston NMR Abstracts / DMS NMR Literature Lists
Preston GLC Abstracts / DMS Infrared Literature Lists
Sadtler Infrared Spectra / DMS Infrared Spectra
Sadtler NMR Spectra / Sadtler Ultraviolet Spectra
Mass Spectrometry Bulletin / Sources of Mass Spectrometry Information

MULTIDISCIPLINARY AND SOCIAL SCIENCES
Science Citation Index (SCI) : Source Index / Citation Index
SCI: Formulm Indes / ASCA III (Automatic Subject Citation Alert)
DATRrax (Direct Access to Reference Information: Xerox) / Dissertation Abs.
Science Information Exchange (SIE) / National Referral Centre
PANDEX / Educational Resources Information Centre (ERIC)
PATENTS, REPORTS AND DATA
Derwent World Patents Abstracts / World Chemical Patents Index
FARMDOC / AGDOC AND PLASDOC
US Govt. R and D Reports / US Govt. R and D Reports Index
Uniterm Index to US Chemical Patents / Other Sources of Patent
Information
Bureau of Census Data Files / 1970 US Census of Housing and
Population
Materials Data / Technical Data
INDATA

TECHNOLOGY AND OTHER AREAS
Engineering Index / Current Awareness and Document Retrieval (CADRE)
LITE (Legal Information Thru Electronics) / Sources of Legal
Information
Electrical and Electronics Abstracts / Control Abstracts
Solid State, Electronics, Information Processing Abstracts / Sources Computer Prog.
International Aerospace Abstracts (IAA) / Scientific and Technical
Aerospace Rept.
SYMBIOSIS (System for Medical and Biological Science Information
Searching) SUNY
MARC II (Machine Readable Cataloguing) / Sources of Library
Information
Current Research Information System (CRIS) Agriculture
American Petroleum Institute Refining Abstracts in Literature /
Patents

A sample sheet from the Inventory is reproduced overleaf.
Biomedical Sciences

MEDLARS (Medical Literature Analysis & Retrieval System)
Free Demand Retrospective & SDI Searches

Comprehensive Coverage of *2300 Biomedical Journals (45% foreign, 40 languages) plus monograph & serial titles
*250 Primary Journals with Median Currency of 56 days

Jan 1964: Store of *700,000 Citations from mid 1963 & 30,700 cataloged citations since 1966 from monographs & serial titles
1967: *180,000 citations & 18,000 titles added

For Printed Services see Right

SEARCH BY:

1) FIXED TEXT TERMS (MeSH, Medical Subject Headings) *7500 terms. Average 6.7, with 10 from 'depth' journals 5 non depth journals
2) JOURNALS
May be limited by language, time, location journal etc.
Different Forms of output & arrangement e.g. cards or paper author, journal title, language year of publication, subject headings
Three Levels of Searching
AND/OR/ NOT Logic
MeSH headings printed with citation

Time of Search in US (11-30 days)
Other Centres (US: UCLA, Colorado, Alabama, Michigan, Harvard, Ohio State), UK: Newcastle, Sweden: Karolinska Institute

One 12 inch tape = 30,000 Citations (File = 23 tapes)
Usually batch 25-30 searches a time

OTHER COMPUTER-BASED PHOTOCOMPOSITION
a) PHOTON ZIP 901 (800 characters/sec)
b) LINOTRON T010 (CBS-Mergenthaler) *1100 characters/sec, used by GPO
c) RCA VIDEOCOMP (Spectra 70)
d) IBM 2680 (Produced by Alphanumeric)

NLM: Honeywell H-800, H-200 with printing by GRACE (Graphic Arts Composing Equipment, Photon 900: 226 characters, speed *300 characters/sec) 7 magnetic tape drives
Other computers: English Electric KDF 9, IBM 360, 7094, 7040, 7090

NLM STAFF: *175
US Tape Searches *8500/year
UK Tape searches *1900
Cost 1,000,000 $ + a year

MEDLARS II:
New hardware in 1970, Abstracts on file
On-line Access and time -sharing facilities

PRINTED MEDLARS SERVICES

A) INDEX MEDICUS (same data base as MEDLARS) Monthly 3 Print Index Terms
B) CUMULATED INDEX MEDICUS: 1 author 3 subject volumes (IM subscribers *7000)
C) Medical Subject Headings (MeSH)
D) List of Journals Indexed In Index Medicus
E) Bibliography of Medical Reviews
F) NLM CURRENT CATALOGUE: Biweekly quarterly & annual cumulations
G) RECURRING BIBLIOGRAPHIES
   1) Bibliography on Medical Education(monthly)
   2) Cerebrovascular Bibliography (quarterly)
   3) Fibrinolysis, Thrombolysis, and Blood Clotting (monthly)
   4) Index of Rheumatology (monthly)
   5) Index To Dental Literature (quarterly)
   6) International Nursing Index (quarterly)
   7) Artificial Kidney Bibliography (quarterly)
H) DEMAND BIBLIOGRAPHIES:
   Some 100 e.g Dimethly Sulfoxide
   List available from Assistant to the Director NLM, 8600 Rockville Pike, Bethesda, Md 20014, USA
Three reactions of lead tetracarboxylates have been studied, viz., the reaction in acetic acid of lead tetra-acetate with iodine; the reactions in trifluoroacetic acid of lead tetra-acetate and lead tetrapropionate with tetramethylsilane; the reactions in dimethylformamide and acetic acid of lead tetra-acetate with the acids Ph-(CH$_2$)$_n$-COOH for n = 1-4.

The Reaction of Acetic Acid of Lead Tetra-acetate with Iodine

It had previously been found that lead tetra-acetate and iodine in acetic acid react at room temperature (to give iodine acetate?) and that this second-order reaction is catalyzed by the presence of sodium acetate.

It has now been discovered that with an excess of lead tetra-acetate reaction continues to give a precipitate which has the following properties:

(i) it is insoluble in all organic solvents
(ii) it dissolves in c.HCl with liberation of chlorine
(iii) in other aqueous solvents it reacts to give iodine, lead diacetate and lead iodate.

Gravimetric determinations of the lead content coupled with iodometric titrations suggest the precipitate to be composed of a 1:1 molar mixed crystal of lead diacetate and lead iodate (94%) and lead iodide (6%).

The Reaction in Trifluoroacetic Acid of Lead Tetra-acetate and Lead Tetrapropionate with Tetramethylsilane

Previous results had shown that it was not possible to use tetra-methylsilane as an internal reference for NMR spectra of lead tetracarboxylates in trifluoro-acetic acid, as the tetramethylsilane reacted with the lead salts. The products of this reaction have now been identified as follows:

for lead tetra-acetate - Methyl acetate and methyl trifluoroacetate - by vapour phase chromatography (VPC) and NMR spectra.

Trimethylsilyl acetate - by treatment of a reacted solution with excess ethereal diazomethane, removal of the low-boiling esters so-formed and of ether, hydrolysis of the liq. organic residue and analysis of VPC and mass spectrometry of the products of this

55 - 53 -

ERIC
hydrolysis, acetic acid and hexamethyldisiloxane (Me₃SiOSiMe₃).
(Trimethylsilyl acetate on hydrolysis would yield acetic acid and
trimethylsilanol, the latter readily dehydrates in acid solution to
give hexamethyldisiloxane).

**for lead tetrapropionate** - Methyl propionate replaced
methyl acetate.

(Trimethylsilyl propionate presumably replaces the acetates, but has
not been looked for).

If the reaction takes place in mixed pyridine-trifluoracetic
acid the yield of methyl trifluoroacetate increases and that of
methyl acetate (or propionate) falls to almost nothing.

The Reactions in Dimethylformamide and Acetic Acid of Lead
Tetra-Acetate with Carboxylic Acids (Ph-(CH₂)ₙ-COOH

Reactions between lead tetra-acetate and w-phenyl-acetic,
propionic, butyric and valeric acids has been found to give products
as shown below:

\[
\begin{align*}
\text{Ph} - \text{CH}_2 - \text{COOH} & \xrightarrow{\text{LTA, DMF}} \text{Ph} - \text{CHO} & \text{LTA} = \text{Pb(OAc)}_4 \\
\text{Ph} - \text{CH}_2 - \text{COOH} & \xrightarrow{\text{LTA, NaOAc, AcOH, O}_2} \text{Ph} - \text{CHO} \\
\text{Ph} - \text{CH}_2 - \text{COOH} & \xrightarrow{\text{LTA, NaOAc, AcOH, N}_2} \text{Ph} - \text{CH}_2 - \text{OAc} \\
\text{Ph} - (\text{CH}_2)_2 - \text{COOH} & \xrightarrow{\text{LTA, DMF}} \text{Ph} - \text{Et} \\
\text{Ph} - (\text{CH}_2)_3 - \text{COOH} & \xrightarrow{\text{LTA, DMF}} \text{Ph} - \text{nPr} \\
\text{Ph} - (\text{CH}_2)_4 - \text{COOH} & \xrightarrow{\text{LTA, DMF}} \text{Ph} - \text{nBu} + 1,2-3,4 tetrahydronaphthalene
\end{align*}
\]

The formation of these products can be accounted for by a free
radical reaction as follows:

\[
\begin{align*}
\text{Pb(OAc)}_4 + \text{Ph(CH}_2)_n\text{COOH} \xrightarrow{\text{LTA, DMF}} \text{Pb(OAc)}_3(\text{OCO(CH}_2)_n\text{Ph}) + \text{AcOH} \\
\text{Ph(OAc)}_3(\text{OCO(CH}_2)_n\text{Ph}) \xrightarrow{\text{LTA, DMF}} \text{Pb(OAc)}_3 + \text{CO}_2 + \text{Ph(CH}_2)_n
\end{align*}
\]

with subsequent reaction of the so-formed Ph(CH₂)ₙ radical.
Appendix 1: Circular sent to all Participants

OFFICE FOR
SCIENTIFIC AND TECHNICAL INFORMATION
State House, High Holborn, LONDON W.C.I
Telephone: Chancery 1262

Christmas, 1967.

Students' Chemical Information Project

The aim of this circular letter is to inform all participants about the overall progress of this experimental project. Both OSTI and the liaison scientists welcome any comments you may have on the scheme or the content of this letter.

The first series of interviews between students and liaison scientists was completed in October and early November, and most participants will have received at least one output before the end of the first week in December. If there are no delays in the supply of magnetic tapes from Chemical Abstracts Service, outputs will now arrive by post at fortnightly intervals. We hope that the lists of references will prove useful in your research work, but do not hesitate to contact your liaison scientist if you think your output might be improved in any way.

We are keen to provide an acceptable service during this experiment but can only do so if there is close contact between yourself and the liaison scientist. The postcards supplied by the liaison scientist are one means of doing this and we hope that you will complete and return these within a few days of receiving your computer print-out. The following definitions may help you to complete these cards:

**Total hits** - the number of references included in the print-out. This is given at the end of the list.

**Relevant** - those references satisfying the short description of your research interests which you gave to the liaison scientist.

These cards provide a good indication of your profile's selectivity and accuracy and the results will help us to decide whether the experiment should be continued in future years. Furthermore, the cards provide an easy way for you to express your satisfaction or other feelings about the scheme: constructive comments are most welcome.

About 450 interviews have been held and the liaison scientists have learned much about your present literature habits. Many students were not familiar with the "current awareness" type of publication, designed to give a quick appraisal of new literature, or the mechanised version of the service which they are now receiving. However, Current Chemical Papers is used regularly by about one-third of the students and is more widely known than any other current awareness publication. A surprising number rely upon Chemical Abstracts to keep up-to-date but the majority of students scan about 10 primary journals. Chemical Abstracts is used almost universally for retrospective searches.
Inadequate knowledge of information tools and services may be due to the lack of training. Nearly half the students interviewed said that they had received no training (or by the time of the interview had forgotten completely about it) and of the remainder only about 10% had received formal training which included practical work. The most usual form of training seems to be a short lecture or a short chat with the student's supervisor.

The project has been received enthusiastically in most chemistry departments. The outputs have been seen by many colleagues and keen interest has been shown by supervisors, some of whom sat in during the initial interviews. Already questions are being asked about the future developments of the project, but a decision on its extension for a further year cannot be reached until March, 1968, at the earliest. Many students consider that the time spent with the liaison scientists has been most valuable as a means of learning about present and future information handling techniques. The liaison scientists have enjoyed the work so far: however, this method of operation, while necessary in the first place, is expensive and changes may be necessary if the scheme is to continue and perhaps expand in the future. If liaison scientists are retained, it may be necessary to charge some of the costs to the users or their departments or to an alternative source of support. On the other hand, it may be possible for departments to perform the liaison scientist's functions, with the help of experience gained in the present exercise and after some training for staff members or senior research workers, thereby making liaison scientist redundant. The experimental approach of this year's study will provide a basis for such decisions.

Developments in the mechanised services themselves are also planned and perhaps the most interesting of these is the addition of selected key-words to the titles of the articles, which will permit the retrieval of topics not included in the titles. Such a system is planned by Chemical Abstracts Service for all articles appearing in Chemical Abstracts.

May we repeat once again that your comments and suggestions for improving the scheme are most welcome.

G. A. Somerfield.
E. W. Herbert. University of Warwick.
M. Poustie. University of York.
Appendix 2: Covering Letter sent out with Final Questionnaire

OFFICE FOR
SCIENTIFIC AND TECHNICAL INFORMATION
State House, High Holborn, LONDON W.C.1
Telephone: Chancery 1262

Our ref: SI/21/23

May, 1968.

To all participants in

STUDENTS CHEMICAL INFORMATION PROJECT

The main purpose of this project has been to improve knowledge about methods of finding chemical information and in particular to extend experience of mechanized chemical information services. From the results so far both OSTI and the liaison scientists have formed the impression that the project has been well received in chemical departments throughout the country and that it has been successful - in particular that the service of references has assisted research work.

The preliminary results of the project have clearly established that there is a need for further education and training in the use of chemical information for all research workers. Accordingly, OSTI has decided to develop a new project which, whilst similar to the present scheme, will place greater emphasis on education and training. It is hoped to increase both the number of participants in the scheme and the range of services available, but in return more detailed evaluation of the services will be required from participants. The project will last for two years and staff are being recruited at present, but the exact details will be determined only when the final results of the present scheme are available.

Your liaison scientist will wish to make his final visit in the near future and will be seeking to find out whether our impression of the success of the scheme is correct. To help this assessment the liaison scientists and OSTI have prepared the enclosed questionnaire and we hope that you will complete it to help evaluate the project. Many questions can be answered simply by ticking the appropriate answer. Others seek an opinion and the liaison scientists will discuss any answers which are not clear during the final interview. They will make their own arrangements with you to ensure that the completed questionnaire is returned to them either before or at the interview. The results of the questionnaires and interviews will be analysed when all visits have been completed and in due course a report will be available.

I hope that you personally have found the project beneficial and that the experience gained will be of value to you in your future career. Please do not hesitate to put your comments and suggestions frankly at the interview or if you prefer, send them direct to me.

Yours sincerely,

(G. A. Somerfield)
### Appendix 3: Example of a Search Profile

<table>
<thead>
<tr>
<th>Parameter Number</th>
<th>Term Type</th>
<th>Logic</th>
<th>Term Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>T</td>
<td>Or</td>
<td>HEAT*</td>
</tr>
<tr>
<td>1</td>
<td>T</td>
<td>Or</td>
<td>ENERG*</td>
</tr>
<tr>
<td>1</td>
<td>T</td>
<td>Or</td>
<td>ENTROP*</td>
</tr>
<tr>
<td>1</td>
<td>T</td>
<td>Or</td>
<td>ENTHALP*</td>
</tr>
<tr>
<td>2</td>
<td>T</td>
<td>Or</td>
<td>REACTION*</td>
</tr>
<tr>
<td>2</td>
<td>T</td>
<td>Or</td>
<td>COMBUSTION</td>
</tr>
<tr>
<td>2</td>
<td>T</td>
<td>Or</td>
<td>FORMATION</td>
</tr>
<tr>
<td>3</td>
<td>T</td>
<td>Or</td>
<td><em>SULF</em></td>
</tr>
<tr>
<td>3</td>
<td>T</td>
<td>Or</td>
<td><em>THIO</em></td>
</tr>
<tr>
<td>3</td>
<td>T</td>
<td>Or</td>
<td><em>THIA</em></td>
</tr>
<tr>
<td>3</td>
<td>T</td>
<td>Or</td>
<td><em>MERCAPT</em></td>
</tr>
<tr>
<td>3</td>
<td>T</td>
<td>Or</td>
<td><em>CYST</em></td>
</tr>
<tr>
<td>4</td>
<td>T</td>
<td>Not</td>
<td>THEORET*</td>
</tr>
<tr>
<td>4</td>
<td>T</td>
<td>Not</td>
<td>CALCUL*</td>
</tr>
<tr>
<td>4</td>
<td>T</td>
<td>Not</td>
<td>ESTIMAT*</td>
</tr>
</tbody>
</table>
Appendix 4: Index Headings used in the Classification of Profiles

The "general" headings, which are marked with an asterisk, are provided for use where no specific heading is considered to be suitable.

**Compound Index**

<table>
<thead>
<tr>
<th>Category</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atoms</td>
<td>All phases</td>
</tr>
<tr>
<td>Ions</td>
<td>All phases</td>
</tr>
<tr>
<td>*Simple molecules</td>
<td>All phases</td>
</tr>
<tr>
<td>Non-metals</td>
<td></td>
</tr>
<tr>
<td>Fluorinated compounds</td>
<td></td>
</tr>
<tr>
<td>Non-transition metals</td>
<td>Or not specified</td>
</tr>
<tr>
<td>Transition metals</td>
<td>Not complexes or organometallics</td>
</tr>
<tr>
<td>Complexes</td>
<td>All metals</td>
</tr>
<tr>
<td>Organometallics</td>
<td>All metals</td>
</tr>
<tr>
<td>*Organic</td>
<td>General</td>
</tr>
<tr>
<td>Aliphatic</td>
<td></td>
</tr>
<tr>
<td>Alicyclic</td>
<td></td>
</tr>
<tr>
<td>Aromatic</td>
<td></td>
</tr>
<tr>
<td>Heterocyclic</td>
<td></td>
</tr>
<tr>
<td>Dyes and paints</td>
<td></td>
</tr>
<tr>
<td>Alkaloids</td>
<td></td>
</tr>
<tr>
<td>Steroids and terpenes</td>
<td></td>
</tr>
<tr>
<td>*Natural products other than above</td>
<td></td>
</tr>
<tr>
<td>Synthetic polymers</td>
<td></td>
</tr>
<tr>
<td>Organic macromolecules</td>
<td>Peptides, nucleic acids, polysaccharides</td>
</tr>
<tr>
<td>Radicals</td>
<td>Gas or liquid phase, organic or inorganic</td>
</tr>
<tr>
<td>Molecular complexes</td>
<td>Charge transfer</td>
</tr>
</tbody>
</table>

**Technique and Property Index**

<table>
<thead>
<tr>
<th>Category</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biosynthesis</td>
<td></td>
</tr>
<tr>
<td>Synthesis</td>
<td></td>
</tr>
<tr>
<td>Structure determination</td>
<td>Degradative and unspecified methods</td>
</tr>
<tr>
<td>Stereochemistry</td>
<td>Conformation, configuration</td>
</tr>
<tr>
<td>Mechanism</td>
<td>Action or reaction</td>
</tr>
<tr>
<td>Thermochemistry</td>
<td>Thermodynamics, thermophysics, pyrolysis</td>
</tr>
<tr>
<td>Kinetics</td>
<td>Including rates of physical growth and relaxation</td>
</tr>
<tr>
<td>Physical properties</td>
<td></td>
</tr>
</tbody>
</table>
Electrochemistry
Catalysis
Photochemistry
Diffraction methods
Scattering, light or particle
Radiation chemistry
Ultraviolet and visible spectroscopy
Infrared spectroscopy
Raman spectroscopy
Microwave spectroscopy
E.p.r.
N.m.r./n.q.r.
Mössbauer
Mass spectroscopy
*General spectroscopy
Optical rotatory dispersion
Chromatography
Miscellaneous techniques
Theoretical chemistry

Including polarography and electrophoresis
Homo - and heterogeneous, and surface chemistry
Including fluorescence and phosphorescence
X-ray, electron, neutron
Including molecular beams
Radiolysis and tracer techniques
Also X-ray spectra

Unspecified
All types including ion exchange
Appendix 5: Compound Index to Profiles

ATOMS
E76  M16  M46  S00  T04  X60

IONS
C80  M52  P12  X60

RADICALS
B52  C76  D78  F44  J20  M80  M98  P20  Q04  Q08  Q56  S56
X20  X32

* SIMPLE MOLECULES
(i) Gas Phase:  B16  D20  D32  E76  H12  H68  H72  J20
K56  P56  R04  R12  R16  S28  S64  X60
(ii) Liquid or Solution:  D44  J12  M56  W44
(iii) Unspecified:  K80  M02  P12  P20

NON-METALS
(i) Organic compounds of:  C56  C96  F34  F58  F66  H44
L64  M08  M34  M96  P32  P36  W26
(ii) Metal compounds of:  B28  B40  C00  L84  M40  R44  T12
T18  W36
(iii) Inorganic compounds or unspecified:  C44  E00  E50  F32
K28  L60  L72  L96  R40  R62  R86  S56  T40  W32  X36  X72

FLUORINE
CO4  K74  P44  P60  P64  P84  R32  R82  S40  W48  X36

METALS non-transition or not specified
B52  C16  D12  F50  F60  K04  K28  K32  M24  M98  P00  P32
P40  P48  P56  P92  Q36  Q60  R16  R24  S64  W06

TRANSITION METALS not complexes or organometallic
C40  F02  F50  H16  H20  H72  K12  K64  M42  P04  P12  P28
P32  R44  T08  T30  W14

COMPLEXES All metals
B24  B28  F40  F12  HCO  J26  J88  K16  K20  K24  K40  K60
K62  L44  L84  M32  P04  P12  P48  P80  Q32  R24  R28  S20
S80  W10  W28  W36  W40
ORGANOMETALLIC All Metals

B32 B36 B48 F12 F16 F22 F24 F26 F36 F64 H16 J44
K08 K36 M10 M14 M18 M36 M48 M58 M72 M96 M98 P08
P16 P32 P40 Q32 Q64 F28 R32 T06 T14 T16 T22 T32
W02 W10 W46 W92 X78

* ORGANIC General, not in categories below

B41 B72 C04 C56 C76 C96 D84 D94 E32 E40 E44 E72
F42 F46 F54 H28 H44 H68 L64 M08 M34 M52 M58 M88
M92 M96 P24 P32 P64 P76 Q58 R66 S72 T10 T40
W14 W26 W28 X00 X04 X08 X32 X36 X56

ALIPHATIC

C08 C36 C92 D94 F28 F30 F42 H12 H24 H48 H68 H92
J48 L16 M88 P04 P20 P32 P44 P64 P84 R74 R78 S32
S52 W94 W96 X16 X32 X72 X76 Y08

ALICYCLIC

B64 B80 B92 B66 E20 E36 F28 F60 F68 H54 H68 L04
M88 P84 Q16 Q44 S68 V00

AROMATIC

B76 D13 D78 E04 E36 F18 F20 F42 H20 H28 H48
H56 J40 L16 L80 M98 P60 Q04 Q24 Q44 Q48 Q52 R50
R74 S16 S40 S44 S48 S52 W06 W16 W54 W73 X00
X20 X52 X99 Y16

HETERO CYCLIC

B72 C24 C48 D50 D84 E36 E56 E60 E84 E96 F52 H08
J32 J60 J80 L20 L28 M52 P68 P72 Q16 S36 S88 T32
V20 W72 X68 X76 Y32

DYES, PAINTS

B02 B14 B08 B12

ALKALOIDS

E16 E60 E84 H32 H36 H56 J24 J52 M64 M70 R54 W60
W72 W50 W82

STEREIDS and terpenes

D66 E08 F14 H32 H36 H48 H64 L92 M30 Q28 R70 W60
W68 X98 X90 Y28

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Appendix 6: Technique and Property Index to Profiles

**Biosynthesis**

F14 H36 H56 L88 M26 M28 M70 Q24 R70 X52 Y36

**Synthesis**

B80 B92 D84 D90 E48 E60 H60 H64 J40 J84 K08 L12 L72 Q36 T26 W64 X16

**Structure** determination, degradative and unspecified methods

B04 C28 F18 F34 K04 L48 L96 M24 M32 M40 Q36 Q60 T08 T14 T22 V24 X68

**Stereochemistry** Conformation, Configuration etc.

E20 L36 L52 Q16 Q28 S52 V12 X56

**Mechanism** of action or reaction

(i) Splitting, Reactions, -Lysis, decomposition

B92 E32 F48 H24 H52 H92 L80 M62 P04 Q92 R74 S72 X32 X60

(ii) Addition reactions

E00 F12 F28 F58 P32 P36 R24 S44 X08

(iii) Oxidation or reduction

C92 H56 H68 M64 P04 S16 S88 V04 Y16 Y32

(iv) Methatheses or displacement reactions

D94 F44 F46 F56 H28 H32 L20 L28 M96 P44 R50 W94 Y08

(v) Other, including physical interactions

C48 D54 D63 E50 H64 J36 J40 J44 K06 K72 L48 L92 M16 M90 P48 Q24 R66 S28 S36 S48 S68 T26 X90 X98 Y00 Y04 Y38

**Thermochemistry** Thermodynamics, Thermophysics, High Temperature work, Pyrolysis etc.

B16 B48 D12 H04 H16 J04 P92 R20 R82 S68 S72 T10 T40 V08 W98 X04 X36 X60 X88

**Kinetics** including rates of physical growth and relaxation

(i) Gas

E92 H68 M12 W26 W62 X04 X32 X36 X60

(ii) Solution

L34 D36 D72 S76 T30 T34 T50 W84
(iii) Phase unspecified

PHYSICAL PROPERTIES

E28  F38  F64  F72  M48  M80  Q92  Q96  Q98  VO4  Y40

ELECTROCHEMISTRY  Polarography, Electrophoresis

B44  D16  D24  H96  J28  Q20  S24  T50  W84  X24

CATALYSIS AND SURFACE CHEMISTRY

B16  E32  F50  H20  H72  K56  K84  M44  M50  M52  P48

PHOTOCHEMISTRY  Fluorescence, Phosphorescence

COO  C44  D16  D62  F40  H88  J16  K48  K74  L40  L92  M12

DIFFRACTION  X-Ray, electron, neutron

F22  Q32

SCATTERING  Light or particles; molecular beams

K12  K32  K48

RADIATION CHEMISTRY  Radiolysis, Tracer techniques

F14  F40  H88  J12  K48  W12  X12  X64

UV, VISIBLE OR X-RAY spectra

D32  E68  E88  H88  K80  M46

IR, RAMAN OR MICROWAVE spectra

B40  E92  J26  J50  J92  J96  K00  K28  M02  M20  R04  W14

E.P.R.

B52  D00  D05  D78  H96  K16  M22  M94  Q04  Q08  Q80  V16

N.M.R., N.Q.R.

C84  C88  D00  D03  D12  D44  E64  H96  J84  K20  K74  L24

Mossbauer

K12  M04  M32  M42
MASS SPECTRA
E96 J48 K48 LOO M16 P52 R78 X12 X80
O.R.D., C.D.
E08 L44 S80 X52
SPECTRA General and unspecified
C36 C64 E88 F66 H48 K62 L16 M34 P92 S64 W44 X56
CHROMATOGRAPHY including ion-exchange
F32 M52 R78 T12 X36 X72
* MISCELLANEOUS techniques
THEORETICAL
C84 H96 K62 L32 L68 M06 M66 Q72 Q80 R20 S00 S04 S20
## Appendix 7: Profile Statistics and Titles

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*B08 10 57 4 PHARMACY Pseudomonas
B02 10 52 2 PHARMACY Antibiotics or Pigments and Pseudomonas Aeruginosa
B04 10 242 5 ORGANIC Degradation of Proteins and Dyestuffs, Acids or Bases
B08 6 113 38 ORGANIC (Photo or Semi Conductivities and Organic Dyes) or Light Fastness
B12 10 256 33 ORGANIC Pigments and Particle Size or Colour
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<td>B31 10 455 66 &quot; (Carbonyl, Phosphine, Arsine, Amine) and Nickel or other Transition metals</td>
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<td>B32 10 401 54 &quot; (Alkyl, Aryl, Acyl, Sulphonyl, Azide) and Group VIII (or other Transition) Metals</td>
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**INORGANIC** Magnetic Properties and Bi or Poly Nuclear Transition Metal Complexes

**PHYSICAL** Thermodynamic and Fluid Systems

**ORGANIC** Thiophenes or Sulphur Hetero Cycles

**INORGANIC** (Thermochemistry and Organo Metallic Compounds or Transition Metal Oxides) or Metalloccenes

**"** Gold Palladium Alloy or Hydrogenation or Deuteratior and Alkyl Benzenes and Metallic Catalysis

**PHYSICAL** Pyrolysis or De Hydro Halogenation and Halo Hydrocarbons
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% Relevance: This is $100 \times \text{No. of Relevant Hits}$ in no. of issues stated except profiles E, H, P, V (*) where % relevance is $100 \times \text{No. of Relevant Hits}$ No. of Hits where relevance is determined

No combined figures are available for profiles D, K, R and X.