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ABSTRACT

The main objective of this comparative survey of the use of classification in science information is to explore the possibility of adopting a standard general classification in this field. Classification is defined as the grouping, division and/or sequencing according to meaning, of subject representations such as catalogue or index terms, descriptors, etc. Classification is used in "intermediate" documents (bibliographies, abstracts, indexes, etc.) to arrange entries in a meaningful sequence and to structure the relations between subject terms. Classificatory arrangements used in a number of secondary publications are compared with general classifications and with each other. Classificatory relations used in some major thesauri are also compared with general classifications and with each other. The general classifications differ from the intermediate documents with which they were compared in two ways: they lack some of the subject terms used by the documents, and differ in some of their classifactory relations (grouping, decision and sequencing). The overall picture is that, although classification schemes do not occur in all intermediate documents, the use of classificatory relations for both arrangement and thesauric information retrieval is widespread. (Author/NH)

# CLASSIFICATION IN SCIENCE INFORMATION

A comparative study undertaken by

ASLIB

for the International Council of Scientific Unions

as a contribution to

the ICSU/UNESCO study of the feasibility of

a World Science Information System ( UNISIST )

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## SUMMARY

This report presents a comparative survey of the use of classification in science information. Its main objective is to explore the possibility of adopting a standard general classification in this field.

Classification is defined in section A2 as the grouping, division and/or sequencing according to meaning, of subject representations. Such representations (catalogue or index terms, descriptors, etc.) occur mainly in the intermediate documents of science (bibliographies, abstracts, indexes, directories, terminologies, etc.). The report compares samples of classifications used in these documents with various published classifications. These include four general classifications (Dewey, UDC, Bliss, Colon), and special classifications prepared by COSATI, the American Institute of Physics, and others.

Classification can be used in intermediate documents (a) to arrange entries such as abstracts in a meaningful sequence, (b) to structure the relations between subject terms. A preliminary survey, reported in section B1, shows that in many of these documents no such use is made of classification. Among those that do use it, there is very little agreement on classification. Insofar as there is a standard classification used by a minority of documents for arrangement, it is the Universal Decimal Classification (UDC).

Classificatory arrangements used in a number of secondary publications (abstracts) are compared with general classifications and with each other in section B3. It appears unlikely that any of the general schemes examined could serve as an adequate source of classificatory arrangement for secondary publications, and also questionable whether any general classification would adequately cater for all special interests.

Classificatory relations used in some major thesauri (word-lists for indexing) are compared with general classifications and with each other in section C. Once again, none of the general schemes examined could serve as an adequate source of terms and relations for the thesauri studied. Considerable differences also occur among thesauri, as illustrated in sections C4 and C5.

The general classifications differ from the intermediate documents with which they were compared in two ways: they lack some of the subject terms used by the documents, and differ in some of their classificatory relations (grouping, division and sequencing). As far as term content is concerned, UDC is the least inadequate. Of the terms used in the classificatory arrangements of secondary publications, the following percentages were found in the general classifications: Dewey 68%, UDC 79%, Bliss 68%, Colon 55%. Of the terms sampled from the thesaurus "TEST", the following percentages were found: Dewey 26%, UDC 51%, Bliss 21%, Colon 14%. As far as classificatory relations are concerned, no one scheme is noticeably closer to those found in intermediate documents. This is illustrated in sections B3, C2 and C3.

The overall picture is that, although formal classification schemes do not occur in all intermediate documents, the use of classificatory relations for both arrangement and thesauric information retrieval is widespread. The classifications so used are very diverse, and could not readily be drawn from one of the general schemes examined. The causes of this situation, and its implications for standardisation, are discussed in section D of the report.

General classifications are particularly concerned to stabilise the higher levels of their hierarchy, relations between broad fields of knowledge. Yet, with the growing interdependence of science and technology, and the development of new interdisciplinary subjects, it is these relations that become inadequate for newly emerging special interests. This is discussed and illustrated in sections D3 and D4. The report therefore considers the possibility of standardisation at a lower level - at the level of facets (homogeneous sets of terms) that may occur in a number of fields. Recent developments of this kind are discussed in section D6. The concluding section briefly discusses work to be done if standardisation at some level were to be attempted.

The report is supplemented by 27 tables, 18 figures, and references to some relevant literature.

# A. INTRODUCTION

## A1. Terms of reference

To assist the ICSU/UNESCO study of the feasibility of a World Science Information System (UNISIST), Aslib was commissioned to prepare "a comparative study of classifications".

The UNISIST project was not then at the stage where it could identify the needed uses of classification in a world science information system. To help towards the elucidation of this problem it seemed useful to explore:

(a) at what points in world science information is subject specification required?
(b) to what extent has classification been found useful at each of these points, and what classifications have been used?
(c) to what extent could these classifications be derived from a single standard classification of science?
(d) what are the relative advantages of some existing general classifications for this purpose?

"Science" was taken broadly to include the fields under the aegis of the International Council of Scientific Unions - including astronomy, biology, biochemistry, biophysics, chemistry, crystallography, geology, geodesy, geophysics, mathematics, mechanics, physics and physiology - but in the course of the survey it has at times been necessary to take into consideration material more properly the concern of the Union of International Engineering Organisations and the Council for International Organisations of Medical Sciences.

This report presents the results of our exploration. Because of the volume of world science information, and our restricted knowledge of languages, the material studied was only a sample of the whole. We believe it to be sufficiently representative to illustrate the main features of the current situation.

## A.2 The meaning of "classification" in documentation

It is as well to be precise about the object of study. The "classification" of a universe of entities - whether they be animals,

plants, chemicals, institutions, books, articles, or words - may involve two operations:

(a) grouping and division : putting together entities that are alike in some way, and keeping apart those that are unlike,

(b) sequencing : arranging the entities of a group in a meaningful sequence.

Either the first or the second operation is essential - without one of them no classification has taken place. If either is used, the other is optional: entities may be sequenced without grouping, and grouped entities may be arranged in a sequence not related to meaning. A third operation is also optional - assigning to each group and each entity a code (notation) that fixes its position in the whole system.

In documentation we are concerned with two types of entity: the physical documents themselves (books, reports, patents, etc.), and words or other symbols that represent other entities (catalogue or index terms, descriptors, class numbers, etc.). Classification is widely used in the physical arrangement of documents, but we have not explicitly examined this (though we have explored the relevance to our problems of library classification schemes). We have studied the application of classification to representations.

Representations themselves are of two kinds - those concerned with the origin of a document (author, publisher, source, etc.), and those concerned with its subject content. Only in the case of the second is meaningful grouping and sequencing relevant. Our study, therefore, has been concerned with the role of classification in subject representations.

The structure of a fully developed classification can be technically described in the following way:

(1) The whole collection (universe) of entities (in this case subject terms) may be divided into a series of fields (for example, Physics into Mechanics, Optics, Heat, Electricity, etc.). Each field is therefore a broad grouping. The fields may be arranged in some meaningful sequence (ref.1).

(2) Each field may be divided into a series of facets (for example,

Chemistry into Substances, Properties, Reactions, etc.). Each facet is therefore a grouping. The facets within each field may be arranged in some meaningful sequence (ref.2).

(3) Each facet may be structured into a hierarchy, subdivided stage by stage by the application of a series of characteristics (such as terms in italics in Figure 1)*. The characteristics are applied in an ordered sequence. Any sequence of terms generated by successive subdivision is a chain (for example, the chain Machines - Mechanical and thermal machines - Nuclear reactors - Heterogeneous reactors - Thermal heterogeneous reactors - Graphite moderated - Gas cooled, in Figure 1). Any one level of subdivision gives rise to a group of terms that constitute an array (for example, the array Bismuth, Lithium, Mercury, Potassium, Sodium, in Figure 1). The terms in each array may be arranged in some meaningful sequence (ref.2).

(4) Rules may be provided for combining (co-ordinating) terms from the same array, from different arrays in the same facet, from different facets in the same field, and from different fields. These rules may involve the use of special relational operators or role indicators. This aspect will not be explored in this report - we draw attention to references 24 and 25.

(5) Each field, facet and term may be coded to fix its position in the whole system, and to facilitate unambiguous combination with other codes.

(6) An alphabetical index to the terms may be provided, showing the code of each.

Where it is necessary to give a technical description of any classification studied, we will use this terminology.

## A.3 Subject representations in science information

Scientific communication is concerned ultimately with transmitting information from person to person, from source to user. Interpersonal communication is as important in science as in other areas of social life, much goes on, and some of it is susceptible to organisation (seminars, conferences, etc.). But even where it is organised, the act of organising it usually generates documents

* All figures are together at the end of the report.

(conference programmes and proceedings, lists of future or past conferences), and in practice the world science information system with which we are concerned is a documentation system. Much scientific communication cannot be other than documentary, because source and user are separated from each other in space and time.

It should be stressed here that we do not restrict the term "document" to mean words printed on paper. Any graphic record can carry information. The physical carrier may be paper or any substitute for it, a photographic medium, a magnetic medium, or any other suitable material. The information may be recorded as words, diagrams, illustrations, in digital form, or in any other way. The only essential features of a document are that it is a record of information, fit for preservation through time, and transmittable in some manner through space.

Documents serve to mediate communication between persons. Because of personal separation in time and space, documentary communication is typically multi-stage. Before a potential user can sit down to study a set of documents providing information (say, scientific papers) he may have to use, perhaps, four intermediate documents: (a) a word-list (terminology, thesaurus, etc.) to help him identify terms under which the needed information may be indexed, (b) an index to published papers, (c) a list of current papers, (d) a guide to libraries that may stock the required papers.

It is these intermediate documents that typically use subject representations - to represent the subject content of a library, a journal, a paper; or to display subject relations between words. Consequently, it is such intermediate documents that we have sampled to explore what part classification plays in their arrangement.

Before reporting on the results of the study, one further aspect of our terms of reference should be discussed.

## A.4 The possible role of a standard classification

Classification is not used in all forms of subject representation - for example, an alphabetical subject index may use no grouping or division, and no sequencing other than A to Z (Figure 2). At the other extreme, there are intermediate documents displaying all

three operations of classification - division, sequencing and coding (Figure 3). In between, all levels of use of classification are found - some documents use grouping alone, some sequencing alone, some both, but not coding. If current practice is a valid guide, the need for classification varies greatly according to circumstances.

Thinking of a world science information system, we may ask whether all classificatory groupings, sequencings and codings - wherever the need is felt for them - could be drawn from a single standard classification of science. The possible advantages of taking this step might be:

(a) The overall intellectual effort put into constructing classifications might be reduced. The subject areas covered by intermediate documents overlap extensively, and what is approximately the same field is classified - in ways that may differ slightly or greatly - a number of times.

(b) If the same groupings, sequences and codings were employed wherever needed, users might grow familiar with them and find it easier to search in diverse documents.

(c) Integration of or exchange between materials in different subject fields might be facilitated.

Arguments against the use of a standard classification are easy to find. They all rest on the belief that the viewpoint of each specialist group is unique, and that it cannot be expressed adequately by classificatory relations developed for other groups or for the non-existent "general user". We know, indeed, that the mental structure of each individual user is unique, but when one is making publicly available information aids one cannot cater for the individual. Some erosion of uniquely tailored service there must be. The gains achieved at each level of standardisation must be balanced against the losses.

Our remit did not include the making of such a balance, but our intercomparison of classifications throws light on the scale of the standardisation problem that would have to be tackled.

It has been suggested (for example, by G.A. Lloyd of the F.I.D. Classification Department) that "the many proponents of special

classifications and thesaurus-type subject lists, which may be excellent and efficient in their own areas, cannot be expected to abandon these in favour of one standard classification ... but they may well agree ... to accept one standard 'switch' language, with which they can establish (a) concordance" (ref. 3).

We will come back to concordances in section D7, but will make one comment here. A classification consists of subject terms and classificatory relations between them. Work has been done on establishing a concordance between terms in two or more classifications (ref. 16) - to show that a term coded PBH in one classification is coded 621-8 in another (many illustrations of this will be given later in our study). But if the relation between PB and PBH represents one subject grouping, and that between 621 and 621-8 represents another, all that we can do is to report a lack of concordance as far as classificatory grouping is concerned (and illustrations of this will also be given later). In this case, all that the "switch" is doing is to link terms with the same meaning, their classificatory relations being ignored. The same task could be performed by a comprehensive dictionary whose entries were numbered (coded) from 1 onwards. The classificatory relations of the standard classification would serve only the "dictionary" function of elucidating, by context, the meaning of each included term. This may be a useful function, but we do not consider it to be the whole point at issue.

To compare two classifications we must, of course, start by discovering terms that they have in common - discovering, in fact, whether their subject fields overlap. But to compare them as classifications we must go beyond this, to examine the grouping and sequencing of the terms in each, and the extent to which these classificatory relations are in accord. It is both these aspects that we have explored in the comparisons to be reported below.

## A.5 The surveys undertaken

The first step was to identify the types of intermediate document to be surveyed. For this purpose, several guides to such documents were consulted (these guides are listed in Appendix 1). From descriptions in these, a sample of 1265 intermediate documents

that appeared to use subject representations was selected. For each document selected we recorded any classification that was used (grouping or sequencing), and noted whether it was a widely used scheme. The results of this analysis are reported in section B1.

The selected items included indexes and current awareness services, abstracts, journals, bibliographies and a few classified dictionaries. About 100 items were looked at in detail. The diversity of the classifications used suggested that it would be difficult to present meaningful comparisons if too many items were included. The next stage of the survey therefore concentrated on some of the major indexing and abstracting services. The arrangements used in these were compared with each other and with several general library classifications that might be considered as candidates for a standard scheme. The results of this are reported in the remainder of Section B.

It was necessary to restrict the number of general classifications so compared. Library classification has a long history (ref. 4), and many schemes have been produced. We decided to concentrate on (a) the first modern bibliographic scheme, that of Melvil Dewey, which has been continuously revised and developed from its first publication in 1876 to date (ref. 5); (b) the most detailed scheme extant, based on Dewey but expanded and developed by Paul Otlet and Henri La Fontaine into the Universal Decimal Classification (UDC), further development being the care of the International Federation for Documentation (ref. 6); (c) schemes developed by two eminent theoreticians of classification - H.E. Bliss (ref. 7) and S.R. Ranganathan (ref. 8).

We are conscious that this is apparently biased towards English language schemes. Partly this is due to our own linguistic background, but mainly it is because the active development of general classification - outside the UDC - has mostly been carried out in English. Recent schemes in other languages have been restricted as to detail (e.g. Kutter, ref. 9, or Clavier, ref. 10). Many special classifications have been produced (ref. 11).

One type of intermediate document is quite different from the secondary publications mentioned above - word lists such as thesauri that may include thousands of terms, many of which are very specific in connotation. Many thesauri have now been published (ref. 12), but

most are in the field of technology rather than science. We wished to examine in some detail the role that classification plays in large thesauri, and therefore concentrated on the study of three examples of major importance but of very different coverage and structure: (a) the Thesaurus of Engineering and Scientific Terms (TEST), developed jointly by the U.S. Office of Naval Research and the Engineers Joint Council (ref. 13); (b) the Medical Subject Headings (MESH) of the U.S. National Library of Medicine (ref. 14); and (c) the Euratom thesaurus developed for the European Atomic Energy Community (ref. 15). Again we must admit to an English language bias, but for the same reasons as already advanced for classifications - it is in English that most thesaurus development has been undertaken. Comparisons of the classificatory relations of these thesauri with those of the library classifications are presented in Section C.

Our survey results are thus reported in Sections B and C, supplemented by material in appendixes. In Section D we give a general discussion of the current state of classification in the documentation of science.

## B. CLASSIFICATION IN SECONDARY PUBLICATIONS

### B.1 General Survey of intermediate documents

The preceding section has noted that a sample of 1265 intermediate documents was selected from the guides listed in Appendix 1. We mainly included in the selection documents that were formally published or otherwise publicly available, and that listed other publications as their main function. Within these limits, documents covering only a small range were excluded.

The purpose of this operation was to sample the extent to which classification is actually used in intermediate documents and, where used, the extent to which general library classifications occur. This information was obtained about each document selected - either from descriptions given in the source guides, or by actual examination of the documents. The results are summarised in Table 1 on the next page.

Over half the sample used no classification, relying instead on alphabetical, geographical or form arrangements. Of the 44.4% using a classification, 37.4% used one privately devised, and only 7% of the sample used a general library classification (usually the Universal Decimal Classification, UDC).

This general survey therefore illustrates, first, that many intermediate documents in science make no use of classification; second, that among those that do use it there is very little agreement on a standard classification; and third, that insofar as there is a standard in minority use, it is the UDC.

The next question to be asked was, to what extent do the private classifications match general library classifications? Do they show merely minor divergences, or do their structures differ markedly both among themselves and as compared with general schemes? In order to reduce this problem to manageable size, it was necessary to make a much narrower selection of items for survey in detail. The classifications chosen for study are presented in the next section.

### B.2 The classifications surveyed

We wished to compare classifications in some typical intermediate documents with some general library classifications, and

TABLE 1

ANALYSIS OF INTERMEDIATE DOCUMENTS TO SHOW USE OF CLASSIFICATION

| | Total (100%) | No Classification* | Own Classification | Library Classification | Type of Library Classification Used: UDC | Dewey | Other |
|---|---|---|---|---|---|---|---|
| Total | 1265 (100%) | 703 (55.6%) | 473 (37.4%) | 89 ( 7.0%) | 75 | 9 | 5 |
| Sci/Tech (General) | 436 | 298 (68.3%) | 97 (22.3%) | 41 ( 9.4%) | 32 | 7 | 2 |
| Maths & Nat.Sci. | 38 | 19 (50.0%) | 15 (39.5%) | 4 (10.5%) | 4 | - | - |
| Astronomy | 30 | 21 (70.0%) | 7 (23.3%) | 2 ( 6.7%) | 2 | - | - |
| Physics | 54 | 20 (37.0%) | 32 (59.3%) | 2 ( 3.7%) | 1 | 1 | - |
| Chemistry | 47 | 26 (55.3%) | 19 (40.4%) | 2 ( 4.3%) | 1 | - | 1 |
| Geology (inc.Geog.) | 64 | 35 (54.7%) | 21 (32.8%) | 8 (12.5%) | 8 | - | - |
| Palaentology | 2 | 1 | 1 | - | - | - | - |
| Anthropology | 21 | 11 (52.4%) | 9 (42.9%) | 1 ( 4.7%) | - | - | 1 |
| Biology | 30 | 15 (50.0%) | 15 (50.0%) | - | - | - | - |
| Botany | 18 | 12 (66.7%) | 5 (27.8%) | 1 ( 5.5%) | 1 | - | - |
| Zoology | 24 | 13 (54.2%) | 10 (41.6%) | 1 ( 4.2%) | 1 | - | - |
| Applied Sci.(Gen) | 45 | 19 (42.3%) | 24 (53.3%) | 2 ( 4.4%) | 1 | - | 1 |
| Medicine (inc.Vet.) | 183 | 106 (57.9%) | 75 (41.0%) | 2 ( 1.1%) | 2 | - | - |
| Engineering & Technology | 185 | 73 (39.5%) | 92 (49.7%) | 20 (10.8%) | 19 | 1 | - |
| Chemical Industry | 88 | 34 (38.6%) | 51 (58.0%) | 3 ( 3.4%) | 3 | - | - |

Notes: (1) Percentages given horizontally
(2)* Alphabetic arrangement; alpha-classed arrangement; geographical or form arrangement; no discernible arrangement

selection in both groups was necessary. Among intermediate documents we concentrated on classifications used for arrangement in major abstracting and indexing services in science, namely:

Bulletin Signalétique, of the Centre Nationale de Recherche Scientifique, Paris (BS)

Referativnyi Zhurnal, of the Institute for Scientific Information, Moscow (RZ)

Mathematical Reviews, of the American Mathematical Society, Providence, R.I.

Zentralblatt für Mathematik und ihre Grenzgebiete, Berlin

Astronomischer Jahresbericht, Berlin.

Physics Abstracts, London

Physikalische Berichte, Braunschweig

Solid State Abstracts, Cambridge, Mass.

Chemical Abstracts, Columbus, Ohio.

Current Chemical Papers, London

Chemisches Zentralblatt, Berlin and Weinheim

Biological Abstracts, Philadelphia

Berichte über die gesamte Biologie, Abt. A, Berlin.

International Abstracts of Biological Sciences, Oxford.

The classifications in these documents all show a fully hierarchical structure. They have been compared with four general classifications. All four cover the whole field of knowledge. Three (those of Dewey, Bliss and Ranganathan) were designed for the classification of books on shelves and the cards corresponding to them in catalogues, while the fourth (UDC) was envisaged from the start as a tool for information indexing (though it has also been widely applied in shelf arrangement). Detailed descriptions can be found in works already cited (ref. 4) and in prefaces to the schemes themselves. Here we present a brief technical analysis of each scheme, using the terminology introduced in section A2.

The Dewey Decimal Classification (ref. 5) was first published in 1876. It is now in its 17th edition, prepared by the Decimal Classification Office at the U.S. Library of Congress. It is - at any rate on the surface - a hierarchical division of all knowledge on a decimal basis. There are 9 main classes, of which number 5 is Science; there are 9 sciences, of which number 5 is Earth science; there are 9

areas of earth science, of which number 1 is Physical and dynamic geology; this in turn is divided into 9 parts, and so on in successive subdivisions. A sample page is shown in Figure 4.

There is no clear demarcation of fields, since any class at any level can be regarded as the "field" in which its sub-classes are included. There are occasional but unsystematic formulations of facets that can be combined - an example is seen in Figure 5: in the facet "Dynamics of the sea", Ocean currents can be "divided like" (combined with) the facet "Specific oceanic bodies". Most arrays at each level are arranged in a sequence believed to be meaningful and helpful, though the sequencing principle may not be obvious (consider the "specific oceanic bodies" in Figure 5). Each chain of classes may be represented by subdivisions of the notation, for example: 550 Earth sciences, 551 Gross structure and properties of the earth, 551.4 Geomorphology, 551.47 Dynamics of the sea, 551.471 Dynamics (currents) of the North Atlantic Ocean (e.g. the Gulf Stream). We may note, however, that a missing link in the chain, Oceans and Seas, is coded 551.46, and this deviation from consistent hierarchical notation is fairly common. Moreover, many chains end with an uncoded array of more specific terms (such as Heat, Temperature ranges, Isostasy at class 551.12 in Figure 4).

The Universal Decimal Classification (UDC, ref. 6), originally based upon Dewey's scheme, was first published in French in 1905. It is continually being developed and expanded by international co-operation, the work being co-ordinated by the International Federation for Documentation. In broad outline its structure corresponds to the Dewey scheme - for example, 551.4 is Geomorphology in UDC as well as in Dewey - but it diverges in two respects: first, in many of its detailed subdivisions, and second, in its more complex classificatory structure. This can be illustrated more readily by an extract from technology rather than from science (Figure 6).

The fields into which the UDC is divided are signalled by the appearance of distinctively coded facets. Class 66, Chemical industry and technology, is divided into three notational blocks : those in which the code is followed by a hyphen, those in which it is followed by a zero, and those (not shown in Figure 6), in which it is followed by another numeral. The first block is a facet covering general attributes

of chemical products, plant and processes; the second covers specific operations, unit processes and plant used in chemical industry; the third lists specific types of chemical product (e.g. 661.72 Alcohols, 667.2 Dyestuffs). These facets can be combined, for example 661.721 - 932 Methanol : continuous processes; or 667.212.31.067.4 Acridine dyestuffs : pressure filtration. As hinted at in classes 66.022, 66.023 and elsewhere, any class can be combined with any other in the classification by means of a linking colon; thus 66.023:621.642.1 represents (somewhat clumsily) Containers, portable. Sometimes, within a field, a sub-field has its own display of facets - for example, a sub-field within 66 Chemistry is 669 Metallurgy (see Figure 7). There are other combinatory devices available in the scheme. As to arrays and chains, the same remarks apply as for Dewey, though there are fewer chains ending with uncoded arrays.

The Bibliographic Classification of Bliss (ref. 7) was published in outline in 1935, its expanded form began to appear in 1940, and a second edition in 1952. Additions and corrections have since been provided by an informal group of users, and a third edition is planned. Once again, on the surface it is a hierarchical division of all knowledge, but using as a notatical base the letters of the alphabet rather than numerals. The hierarchy differs considerably from Dewey and the UDC, even at the higher levels - particularly in that it draws in applied sciences as subdivisions of the pure sciences (for example, CT Applied Chemistry, is part of C Chemistry, whereas in Dewey, 54 Chemistry and 66 Chemical Industry are in separate main classes).

To some extent, fields are recognisable as two-letter classes, as for example in the summary of main class D (Figure 8). There is usually no clear division into facets, although a number of "special auxiliary schedules" are provided which are combinable with other classes. For example, codes from Figure 9 are combinable with codes for specific plants, thus FTLV, I represents Onion : physiology. Clear representation of chains has been sacrificed in order to provide a brief notation. Figure 10 illustrates two aspects of this: classes ENE and ENF would appear, semantically, to be subdivisions of END, but this is not shown by the notation; and all their possible subdivisions are not coded, but listed en bloc. For the same reason, arrays are not clearly distinguishable, but where they exist are arranged in a

meaningful sequence.

The Colon Classification (ref. 8) was first published in 1933, and is now in its 6th edition. It is still under the direct control of its Indian author, S.R. Ranganathan, who has been most active in exploring classificatory structure. Colon covers the whole of knowledge, and displays structure explicitly. It is divided first into main classes such as C Physics, and these into "canonical divisions" (Figure 11). These are its fields, and the facet structure of each is immediately stated in symbolic form. Thus C3(P) : (E) (2P) implies that there are two facets in Sound, symbolised as (P) and (E) cum (2P), that can be combined. The terms ("foci") included in each facet are then listed in hierarchical form. Arrays are usually in some meaningful sequence. Chains are usually clearly represented by hierarchical notation - e.g. C Physics, C3 Sound, C33 Ultra sound, C33:3 Ultra sound frequency, C33:38 Ultra sound frequency analysis. However, as Ranganathan has begun to develop detailed expansions he is sacrificing hierarchy to brevity in his notation. These expansions are occurring piecemeal, and in general Colon's classification of science and technology is very unevenly developed.

One last classification will be mentioned. In 1964, the Committee on Scientific and Technical Information of the U.S. Federal Council for Science and Technology issued the COSATI Subject Category List (ref. 22). It was put forward as a suggested uniform subject arrangement for the announcement and distribution by U.S. agencies of scientific and technical reports. An extract from the list - concentrating on fields related to science rather than technology - is presented in Appendix 2. Dewey, UDC, Bliss and Colon class numbers are shown against each listed group. The COSATI list displays classificatory grouping, but not meaningful sequence - both levels of array are alphabetical.

## B.3 Comparison of Classifications

Even with the sample for study reduced to the size reported in the last section, it is not easy to display a comparison of classifications. The method we have adopted is as follows. As a "reference base" we have mainly used the classification used for arrangement in one of the large multi-disciplinary abstracts journals,

Bulletin Signalétique. (The choice of this, rather than another such as Referativnyi Zhurnal, was arbitrary.) Against the classes of BS, we placed corresponding class numbers from Referativnyi Zhurnal, the four general library classifications, the COSATI list (where appropriate) and from other schemes examined. In some cases, we used RZ or other schemes as a "reference base", so as not to rely exclusively on comparison with BS. In the case of RZ and some other journals, class numbers had to be devised by ourselves to represent the uncoded classification used. In all such cases, the journal titles are asterisked in the tabulations. As an illustration, we give in Table 2 on the next page an analysis of the main fields of science considered in the survey.

The field names in this table are extracted direct from BS (in all other tables they are in English). The fields are given in the order in which they occur in BS, as shown by the notation on the left. On the right are corresponding class numbers from other classifications. Thus Mathematics may be coded A in RZ, 510 in Dewey, 51 in UDC, AM/AY in Bliss, B in Colon, and 12A in COSATI. Even at this very general subject level, there is considerable difficulty in assigning class numbers. We would not wish to defend all our code assignations against detailed criticism from those more expert in the subject, but we believe them to be adequate to illustrate the situation.

What can be learnt from such a tabulation? (a) In a column, there may be gaps - we have found no codes in the classification readily assignable to some subjects (the only possible example of this in Table 2 is an apparent gap in the COSATI column for 214 Géologie Appliquée). The number of gaps is indicated at the foot of each column. (b) In a column, the sequence of codes may diverge from the alphanumeric, indicating that the sequence in that classification differs from the sequence in the reference base. For example, in the Bliss column of Table 2, we see inversions of alphabetical sequence as B follows D, BE follows BT/BL, C follows CH, and so on. The number of inversions is indicated at the foot of each column. (c) Any one coding in a column may be multiple - for example, in the UDC column we have 52 + 551 and 549 + 55. (We have not treated consecutive classes, such as 531/536, 537/538, B + C or E5 + 6, as multiple coding.) This indicates that a subject treated as a single class in the reference base is spread over

TABLE 2

## BULLETIN SIGNALÉTIQUE - MAIN DIVISIONS CONSIDERED

| | | Ref.Zh.* | Dewey | UDC | Bliss | Colon | COSATI |
|---|---|---|---|---|---|---|---|
| 110 | Mathématiques pures et appliquées | A | 510 | 51 | AM/AY | B | 12A |
| 120 | Astronomie, astrophysique, physique de globe | B+C | 520+551 | 52+551 | ‹D | B9 | 03+08 |
| 130 | Physique mathématique, mécanique, acoustique optique, chaleur, thermodynamique | D+E | 530/536 | 531/536 | B | B7+8+C | 20A+D+F +K+M |
| 140 | Electricité | ‹E | 537/538 | 537/538 | BJ/BL | C6 | 20C+09 |
| 150 | Physique et technologie nucléaires | E3 | 539.7 | ‹539.1 | ‹BE | C9B3 | 18+20G/I |
| 160 | Structure de la matière | E5+6 | 539.1 | 539 | BE | C2 | 20L |
| 161 | Cristallographie | F1a3 | 548 | 548 | ‹CH | H1:8 | 20B |
| 170 | Chimie | F | 540 | 54 | C | E | 07 |
| 210 | Mineralogie, géochemie, géologie, petrographie | ‹G | 549/552 | 549+55 | CG+‹D | ‹H | 08D+G |
| 214 | Géologie appliquée | ‹G | 553 | 553 | DO | H7 | ? |
| 216 | Géologie, paléontologie | ‹G | 550/560 | ‹55/56 | DG/DY+EP | ‹H | 08G |
| 320 | Biochimie, Biophysique, etc. | H+I | 574.19 | 577/578 | ‹E | E9G | 06A |
| 360 | Biologie et physiologie animales | ‹I | 590 | 59 | GD/GF | K | ‹06C |
| 361 | Endocrinologie, reproduction, génétique | ‹I | ‹570 | ‹575/577 | ‹GE+EN | K:6 | ‹06P |
| 370 | Biologie et physiologie vegétales | I4+5 | 580 | 58 | F | I | ‹06C |
| 740 | Metallurgie | J | 669 | 669 | CK | E191 | 11F |
| Gaps | | 0 | 0 | 0 | 0 | 0 | 1 ? |
| Inversions | | 1 | 4 | 4 | 6 | 7 | Note |
| Multiple codings | | 0 | 1 | 2 | 3 | 1 | 4 |

16 BS classes

Note: Since COSATI's fields and groups are only alphabetically sequenced, inversions are not significant.

two or more separate classes in another classification. This is often brought out more adequately in the detailed schedules to be discussed later, where it occurs as "scatter". (d) Some codes in an array of a general classification may be much more specific than others, indicating that these subjects are of less relative importance in the classification than in the reference base. This is true of code 574.19 in the Dewey column of Table 2, and many examples may be found in subsequent tables.

This first glimpse at the situation that Table 2 provides immediately suggests differences between the four general classifications and BS. Fifteen steps lie in the sequence from BS code 110 to 740, and inversions occur on average at five of these steps. In contrast, there is only one inversion in RZ, which in this table appears much more compatible with BS.

In Appendix 3 we present tables showing further comparisons between classifications. In the first of these, Table 3, we break down the main fields of Table 2 to a second level, and once again class by RZ, Dewey, UDC, Bliss, Colon and COSATI. The number of inversions is much the same for all columns (even including RZ). In addition, we see gaps developing in all columns. This is to be expected in COSATI, which is a relatively brief list of main fields and their groups, not going into the detail of the other classifications. Some of the gaps in Colon can be similarly explained - particularly those in BS code 740, Metals, since Colon's technology classes are very inadequately developed.

However, gaps can also develop for two other reasons: (a) Classifications may structure a field differently, laying emphasis on different aspects - thus the BS grouping "Crystalline rocks" at 210E does not appear to be used in the other classifications. (b) One classification may be out of date, not stressing modern developments that others have incorporated - this appears to be the case for BS classes 320D Biological and medical engineering, and 740 IV Lattice defects, which three of the general library classifications do not seem to incorporate.

In Appendix 3, there next follow samples of detailed tables for particular fields of science. COSATI is dropped from the comparison, since it is too general, but abstracting journals other than BS and RZ are brought in. Table 8 uses Physics abstracts as a reference base in

the field of Solid state physics, and Table 6 uses RZ as a base for physics as a whole. From all the detailed comparisons we have made, both the samples shown in Appendix 3 and others, the following summary has been compiled (total classes in reference base = 796):

| | Dewey | UDC | Bliss | Colon |
|---|---|---|---|---|
| A. Gaps | 253 | 168 | 251 | 338 |
| B. Inversions | 188 | 218 | 176 | 143 |
| C. Base minus gaps | 543 | 628 | 545 | 458 |

In this comparison, gaps - indicating the apparent absence of a term in a classification - were greatest for Colon (45%), least for UDC (21%). Since only codes that were present could be inverted, inversions are best reported as a percentage of row C: Dewey 35%, UDC 35%, Bliss 32%, Colon 31% - a fairly uniform picture.

It is of interest to consider how the general classifications as a whole compare with the reference base for each particular field of science. For example, in Table 4 (Astronomy and Astrophysics), we have the following analysis:

| | Dewey | UDC | Bliss | Colon | Mean |
|---|---|---|---|---|---|
| Gaps | 12 | 8 | 7 | 11 | 9.5 |
| Inversions | 12 | 11 | 10 | 12 | 11.25 |

49 BS classes

The average number of gaps per classification is 9.5, of inversions 11.25. The average percentage of gaps is 100 x 9.5/49 = 19%, and of inversions is 100 x 11.25/(49-9.5) = 28%. Similar calculations have been made for a dozen fields of science. The percentage of inversions is fairly uniform, the range being 34 $\pm$ 7%. Percentage of gaps varies more widely, with a range of 32 $\pm$ 21%. Fields with a high percentage of gaps - indicating considerable difference between the reference base and the general classifications - were Mathematics, Electricity, Structure of matter (Table 7), Solid state (Table 8) and Physical chemistry (Table 10). Fields with a low percentage of gaps (indicating relatively little difference) were Astronomy (Table 4) and the broad groupings Chemistry (Table 9) and Biology (Table 11).

If we look in more detail at inversions of sequence we find that many are due to the fact that a grouping, used by a secondary publication such as BS, brings together classes that are scattered in the general classifications. Consider, for example, the group 120aIII in Table 5, Physics of the terrestial globe. The classes in this group are scattered as follows:

| | | |
|---|---|---|
| Dewey | 551 | Physical and dynamic geology |
| | 525 | Earth (astronomical geography) |
| | 526 | Mathematical geography |
| UDC | 525 | Earth (astronomically considered) |
| | 526 | (528 in 1960) Geodesy, etc. |
| | 550 | Geology and meteorology |
| Bliss | DQ | General geography |
| | DFT | Earth as a planet |
| | DH | Physical geology |
| | AW | Mensuration |
| Colon | U1/2 | Mathematical and physical geography |
| | B91 | Earth (astronomy) |
| | D:2 | Surveying |
| | H4 | Dynamic geology |

Scatter of this kind is particularly noticeable in Table 7 (Structure of matter) and Table 8 (Solid state physics). The groupings developed by the secondary publications cut right across the traditional groupings of general classification.

In several tables we have compared the selected "reference base" with classifications in other secondary publications - not only RZ, but also Astronomischer Jahresbericht (Table 4), Physics abstracts (Tables 6,7 & 8), Physikalische Berichte (Tables 6 & 8), Solid state abstracts (Table 8), Chemical abstracts (Table 9), Chemisches Zentralblatt (Table 9), Current Chemical Papers (Table 9), Biological abstracts (Table 11), Berichte über die gesamte Biologie (Table 11), International abstracts of biological sciences (Table 11) and, in tables not presented, Mathematical reviews and Zentralblatt für Mathematik. The classifications used by these publications are less detailed than BS or RZ, sometimes amounting to no more than a sequence

of fields. As the gaps and inversions in the tables show, the classes selected by these publications, and the sequences used, diverge considerably from those of our "reference bases", and from each other. As further illustration of this, in Table 13 we reproduce the sequences of classes used by four secondary publications in the field of general and physical chemistry, comparing them with those of the four general classifications.

What general conclusions can be drawn from the comparisons reported in this section? We should expect that secondary publications, coping issue by issue with newly published scientific literature, able to change their classification to keep pace with changing emphases in science, will give a reasonable picture of the classificatory relations required by current science. Where a general classification differs from such a "reference base", we would expect the former to be defective. Our comparisons have shown that differences do occur, and detailed study of the tables indicates that in many instances this is because the general classifications are out of date - modern terms are missing, some of their low-level terms have become highly important, they do not provide the classificatory groupings currently of interest. In these respects, UDC is less defective in content of terms (covering 79% of those in our reference bases), but not noticeably better in other respects.

We might therefore conclude that none of the general classifications examined could serve as an adequate source of classificatory arrangement for secondary publications. The fact that arrangements in these publications also differ a good deal among themselves suggests that no general classification, even if up-to-date, would necessarily provide satisfactory arrangements for all the special interests served by secondary publications.

## C. CLASSIFICATION IN THESAURI

### C.1 The development of thesauri

The general classifications described in section B2, and the many special library classifications that exist (ref. 11), represent one line of development of aids to information search. Parallel with this there has been another line of development, emphasising the use of natural language terms in alphabetical sequence. This too has a long history, less well documented than classification (ref. 17), but as far as the English language is concerned its modern phase was begun in the same year as Dewey first published his classification, 1876, with a guide to alphabetical subject indexing prepared by another American, C.A. Cutter (ref. 18).

Alphabetic lists of terms and subject phrases to be used in indexing have been prepared for many fields (examples of these too are cited in ref. 11). A sample page of such a "subject heading list" is shown in Figure 12. About ten years ago, the word "thesaurus" crept into documentation to label another kind of alphabetical word list (ref. 19). A sample page of the TEST thesaurus is shown in Figure 13. The main difference is that whereas the Figure 12 subject heading "Aeroelasticity - electromechanical analogies" is designed to be complete in itself, usable as a topic description, the thesaurus term "Chemical etching" is designed to be used in co-ordination with others to describe a topic (e,g. Chemical etching of aluminium). (The usage of the word "thesaurus" is now somewhat eroded - there are even "classified thesauri").

During the last decade, many thesauri have been prepared (ref. 12), for use with manual or mechanical "co-ordinate" retrieval systems. Some, particularly those covering a narrow field, are bare lists of allowed indexing terms. But as lists of wider coverage have developed, they have been structured by an elaborate system of cross-references between terms. It is this cross-reference structure with which we will be concerned here, for it is in this form that classificatory relations are encountered in thesauri.

### C.2 Classification in TEST

TEST, a Thesaurus of Engineering and Scientific Terms (ref.13),

was published in 1967, but is related to an earlier thesaurus of engineering terms published in 1964. A collective work and the joint product of the U.S. Office of Naval Research and the Engineers Joint Council, it includes over 17,000 index terms (and over 5,000 USE references) in science and technology. The main sequence is alphabetical (Figure 13) - each term is listed independently. Italicised terms are USE references. Below each allowed term are cross-references: UF (used for) referring to a term not allowed in indexing, BT (broader term) to a term higher in a hierarchy; NT (narrower term) to a term lower in a hierarchy; and RT (related term) to a term having a close but non-hierarchical relation. A dash against any term in the NT or RT lists implies that it too has narrower terms associated with it.

A second sequence in the thesaurus lists 22 major fields(such as Physics) and sub-fields within each (such as Acoustics), and lists terms that occur within them (Figure 14). A third sequence extracts all broad terms that have at least two levels of narrower terms associated with them, and presents each hierarchy (Figure 15). As can be seen, there is no explicit indication of facets, chains are clearly displayed in each hierarchy, all arrays are in alphabetical sequence, and there is no coding. By linking the second and third parts of the thesaurus, longer chains can be derived, for example: Chemistry - Physical and General chemistry - Chemical reactions - Decomposition reactions - Solvolysis - Hydrolysis - Saponification.

From the third part of TEST, we extracted 54 hierarchies in science rather than technology, and coded them by four general classifications. A single example is presented in Table 14 (Appendix 3). It will be seen that (a) of the 49 terms in the hierarchy, we located only 19 in Dewey, 11 in Bliss, 8 in Colon, and 29 in UDC; (b) some of the locations were not specific, e.g. more than the topic Thermal expansion is covered by Dewey 536.41 or Bliss BHQ, and is indicated by the $<$ signs preceding these codes in the table; (c) the topics in a hierarchy may be scattered in a general classification, e.g. Thermodynamic properties as listed by TEST occur in Dewey classes 536.7, 536.4, 536.2, 541.3 and 537.65.

In Table 15 (Appendix 3) a summary of the comparison is presented showing the hierarchies examined, the number of terms in each,

the numbers located in each general scheme, and comments on specificity and scattering. In some cases, the highest term in the hierarchy (recorded on the left) could not be found, and this is signalled by an asterisk: for example, it appears not to be possible to pull together a hierarchy "Body fluids" from any of the four classifications. The overall result of examining 54 hierarchies containing 1893 terms is:

| | Dewey | Bliss | Colon | UDC |
|---|---|---|---|---|
| Terms found in | 493 | 402 | 256 | 961 |
| Highest term not found | 21 | 20 | 26 | 6 |
| Comment "not specific" | 24 | 30 | 6 | 1 |
| Comment "scattered" | 20 | 20 | 13 | 17 |

As far as term content is concerned, even in the best performer, UDC, only 961 (51%) were located, with Dewey (26%), Bliss (21%) and particularly Colon (14%) being even more inadequate. Scattering was a common occurrence in all four classifications, but UDC was rarely "not specific" and usually contained the highest term of the hierarchy. The sample suggests, nevertheless, that none of the four classifications would be adequate as a source of TEST terms and hierarchies.

## C.3 Classification in MESH

MESH, a list of Medical Subject Headings, was first issued by the U.S. National Library of Medicine in 1960. It is used in indexing for the published Index Medicus, and for the Library's computer-based information system (MEDLARS), and is continuously revised (ref. 14). The main sequence is alphabetical (Figure 16). An italic entry (such as Stelazine) is a not-allowed term with a see reference to the term used for it. The large-type entries are index terms, e.g. STARVATION. Against each are coded references to categorised lists in which they appear (A1, A2, etc.). Against each may also be cross-references: "see also related" (and its reference back, XR); "see also specific" (and its reference back, XS); "see under" (and its reference back, XU); and X, which is a reference back to a non-allowed term. The second part of the thesaurus is a collection of categorised lists (for an example, Figure 17). Each list can be reorganised into hierarchical form (some examples will be given in section C5). From them we can also extract chains, for example: Diseases - Cardiovascular diseases - Heart

diseases - Coronary disease - Angina pectoris. There is no explicit division into fields or facets, though each list may be regarded as a facet. All arrays are in alphabetical sequence.

From each of 15 different categorised lists, we constructed a sample chain and compared it to the four general classifications. Sample comparisons are shown in Table 16 (Appendix 3). In Table 17, we report (a) the most specific term in each chain, (b) the length of the chain, i.e. the number of terms from the most general to the most specific, (c) the number of chain terms found in each classification, and (d) a note if the most specific term was not found. The table summary is as follows:

| | MESH | Dewey | UDC | Bliss | Colon |
|---|---|---|---|---|---|
| Terms found | 79 | 50 | 59 | 49 | 38 |
| Lowest terms not found | - | 11 | 7 | 10 | 13 |

In no classification were all the MESH terms found - the highest percentage was UDC (75%), the lowest Colon (48%). The most specific terms in the 15 MESH chains appeared to be missing in 7 instances even in UDC, and in 13 instances in Colon. In all classifications, there were cases of scattering - as in example 1 of Table 16, where the MESH hierarchy is not mirrored by the notation of any classification examined. The sample suggests, in fact, that none of the four classifications would be adequate as a source of MESH terms and hierarchies.

## C.4 Euratom Thesaurus and UDC

The Euratom Thesaurus was first published in 1964, and is an authority list developed for subject control in the Euratom computer-based information system (ref. 15).

It includes about 1200 keywords used in indexing, and another 14,000 non-keywords that are "lead-in" terms, for which the indexer is directed to use an appropriate keyword.

The whole set of over 15,000 terms is listed alphabetically, interrelated by "use", "see", and "see also" cross-references. The keywords are also grouped into 57 clusters or fields, within each of

which relations are displayed in a "terminology chart". An example (chart 52) is illustrated in Figure 18.

Each box encloses a keyword, displayed in bold capitals. Within a box, italicised terms are forbidden synonyms, and the other items are related non-keywords. Relations between keywords are shown by lines between boxes, the thickness of the line varying with the strength of the relation. Along the edges of the chart are more distantly related keywords, that will be found in other charts (for example, "Coolants" figures in chart 51, Reactor materials).

Although relations within and between boxes are not explicitly classificatory (hierarchical), we can regard the contents of a chart as a set of terms that it should be possible to draw together from a classification. In order to ascertain whether Euratom charts could be derived from a classification, we compared 13 of them (lying more specifically in the nuclear field) with the UDC special subject edition for nuclear science and technology (ref. 20).

Each keyword and non-keyword in the 13 charts was sought in the UDC schedules, and if present its class number was noted. The results are given in Table 18.

For each chart examined the table shows (a) the number of Euratom keywords it contains, (b) how many of these appear in the UDC schedules, (c) the number of Euratom non-keywords, (d) how many in UDC, (e) how many of the UDC numbers lie within the central core of the field - i.e. within the class corresponding to the chart name. This class is underlined in the final column, which also gives the other classes in which UDC numbers lie. Of the 247 keywords in the 13 charts, 181 (73%) were found in the UDC schedules examined; of the 784 non-keywords, only 84 (11%). Of the 265 UDC numbers noted, 139 (52%) lay within central core classes.

The implication of these figures is that if one used these central core classes as a way of deriving from UDC relations for display in Euratom fashion, one would extract for display only 139 (13%) of the total 1031 keywords and non-keywords that Euratom find it useful to bring together. Some 126 of the terms not extracted are in the UDC schedules, but not in the core classes; the remaining 766 terms are not in the UDC schedules examined.

## C.5 Comparisons between thesauri

The incompatibilities between thesauri and classifications, illustrated in preceding sections, can be matched by similar incompatibilities between thesauri. Two illustrations of this will be given.

### (a) Euratom and TEST

For each of the Euratom charts previously examined, the core keyword was studied. Each is listed in the following tabulation.

| Chart | Core Keyword | A Assoc: non-keywords | B Assoc: in TEST* | C Linked keywords | D Assoc: in TEST* | E Total Assoc: in TEST* |
|---|---|---|---|---|---|---|
| 44 | Energy | 6 | 1 | 23 | 1 | 11 |
| 45 | Nuclear reactions | 12 | 0 | 22 | 14 | 58 |
| 46 | Radiations | 8 | 3 | 25 | 8 | 76 |
| 47 | Elementary particles | 9 | 2 | 19 | 7 | 58 |
| 48 | Protons and neutrons | 17 | 1 | 19 | 13 | 63 |
| 49 | Leptons and hyperons | 5 | 3 | 16 | 10 | 29 |
| 50 | Reactors | 11 | 10 | 4 | 4 | 62 |
| 51(a) | Reactor fuels | 3 | 2 | 8 | 6 | 42 |
| 51(b) | Coolants | - | - | 5 | 3 | 15 |
| 51(c) | Moderators | 3 | 1 | 5 | 4 | 9 |
| 52 | Fuel elements | 5 | 4 | 5 | 1 | 13 |
| 53 | Reactivity | 7 | 1 | 25 | 4 | 16 |
| 54 | Radiation detectors | 6 | 3 | 22 | 18 | 57 |
| 55 | Plasma | 16 | 6 | 13 | 8 | 57 |
| 56 | Accelerators | 6 | 1 | 9 | 9 | 23 |
| | Totals | 114 | 38 | 220 | 107 | 589 |

* either as subsidiary terms (e.g. Accelerators, NT Betatrons) or alphabetically (e.g. Accelerators, Accelerator targets).

In its box on the chart, the core keyword was associated with non-keywords, the number being shown in column A of the table. Each core keyword was then consulted in TEST, and the number of the non-keywords that could be associated with it via TEST is shown in column B. In the Euratom charts, each core keyword is linked to other keywords, whose number is shown in column C. The number of these associated with the core keyword via TEST is shown in column D.

The Picture is as follows: in the EURATOM thesaurus, the 15 core keywords examined were associated with 114 non-keywords and linked to 220 other keywords. Via TEST only 38 (33%) of the non-keywords and 107 (49%) of the other keywords were so linked. On the other hand, core keywords in TEST were linked to many other terms not linked in the Euratom charts. The total numbers of terms linked in TEST to core terms are shown in column E, 589 in all. So overall we have:

| | | |
|---|---|---|
| Links common to Euratom and TEST (38 + 107) | = | 145 |
| Links found only in Euratom (114 + 220 - 145) | = | 189 |
| Links found only in TEST (589 - 145) | = | 444 |

(b) TEST and MESH

Three fields were selected, representing scientific subjects common to these two thesauri - namely, Biochemistry, Physiology and Viruses. The hierarchical links within each field were traced out for each thesaurus, and are presented in Tables 19 to 21.

The overall picture is as follows:

| | Biochem | Physiol | Viruses |
|---|---|---|---|
| Terms common to TEST and MESH | 8 | 8 | 28 |
| Terms only in TEST hierarchy | 26 | $\lesssim 52$ | 28 |
| Terms only in MESH hierarchy | 44 | $\gtrsim 98$ | 17 |

The way that each thesaurus emphasises different aspects of a field can be seen. In Biochemistry, MESH stresses the details of human metabolism and nutrition, whereas TEST stresses links with Physiology. Neither makes links with biochemical compounds in detail. In Physiology (which overlaps with Biochemistry) MESH again stresses human aspects, and in addition links it with Psychology, whereas TEST's main contribution is to bring in a detailed list of Hormones. The two Virus hierarchies are much more alike, but differ in detail.

# D. GENERAL DISCUSSION

## D.1 Summary of the survey results

The surveys reported in sections B and C have led us to the following conclusions.

(1) Subject specification is required in many of the intermediate documents used in science information. We have particularly explored its use in the arrangement of secondary publications (section B) and in thesauri used for indexing (section C).

(2) In many of these documents, no use is made of classification in any of the senses defined in section A2. This finding is illustrated in section B1.

(3) Among those that do use it, there is very little agreement on classification. This is illustrated for secondary publications in section B3, and for thesauri in sections C4 and C5.

(4) Insofar as there is a standard classification used by a minority of documents for arrangement, it is the UDC. This is illustrated in section B1.

(5) Of the four general classifications surveyed, none appears to be acceptable as a standard either for subject arrangement (section B3) or indexing (section C).

(6) As far as subject arrangement is concerned, all are lacking in term content, even UDC. Colon is somewhat worse than Dewey or Bliss in this respect. (It should be mentioned that had we explored technology in section B as well as science, this defect of Colon would have been even more marked. It comes out clearly in the comparisons of section C, which strayed more into the technical field).

(7) Hierarchical differences, expressible as gaps, inversions and scatter in our comparison tables (section B3), are widespread - whether we compare secondary publications to general classifications or each group within itself. A particular instance is illustrated in Table 13 of Appendix 3. Such differences are particularly marked in developing subjects such as solid state physics (Table 8).

(8) As compared to thesauri, all the general classifications are inadequate in term content. Once again, at a detailed level,

whether we compare thesauri to general classifications or each group within itself, hierarchical differences are widespread (sections C2 to C5).

(9) Although UDC is more adequate than the other general classifications from the viewpoint of the terms it includes, there is no evidence that its hierarchy is any more acceptable as a standard than that of the others.

In ensuing sections we examine the problems of a standard classification in a more general context.

## D.2 The uses of classification in information

The diversity of practice and the difficulty of standardisation revealed by the survey, prompt the enquiry, is there value in classification? is it necessary in science information? can one avoid the difficulties by not using classification?

The need for classification in library arrangement is self-evident. The books in a library form a linear sequence, shelf by shelf, stack by stack. For shelf search - still the most popular form of information search - a sequence based on subject content is most helpful. Library classification - as is clearly evident from the writings of its theoreticians (refs. 1 & 2) - is based on a search for meaningful subject sequence.

The case is not so clear for information search in an intermediate document, a catalogue, or an index, and still less clear for a computer retrieval system. Let us consider in turn various types of classificatory relation.

The division of a collection of items into fields is common in intermediate documents - such as an issue of an abstracts journal. The fields may follow each other in alphabetical order, but a meaningful sequence is often used - as in the examples examined in section B3. It is considered that the information searcher will be glad to find related fields near each other, to facilitate his scanning of the abstracts. In the abstracts journals of wider scope, such as Bulletin Signalétique, there is not only sequence but also classificatory grouping, with sequencing of each array of subclasses.

The division of a field into facets is common in thesauri, as we have seen in the examples of section C. In some cases (such as TEST and MESH) facets may be structured into hierarchies, though within the facet "boxes" of the Euratom thesaurus this is not done. The formation of homogeneous facets is a necessary step in the construction of a logically consistent hierarchy. This in turn is formed because the display of a hierarchy is considered to be an aid to indexer and searcher in choosing a term of appropriate width, and a further aid to the searcher in broadening a search that produces too little information, or narrowing one that produces too much.

The meaningful sequencing of terms in an array is not often found in the thesauri examined. Where it occurs, the justification would be the same as for the sequencing of fields, but an array is usually small, scanned at a glance, and meaningful sequence may be of little help to the searcher.

Both general argument and current practice therefore justify the use of classificatory relations in science information - meaningful sequencing of fields, and the construction of hierarchies. The first relation is used in intermediate documents containing a medium number of items - enough to structure broadly, but not enough to structure in detail. The second relation is used in wider secondary publications and in indexing aids such as thesauri, and hence in any indexes or computer retrieval systems based on the latter. We consider that the evidence of current practice - examples of which have been presented in sections B and C - justifies the use of classificatory relations in science information. The problem of whether they could be standardised, and if so, how, remains to be explored.

## D.3 Classification in science

Classification plays a part in most fields of science at certain stages of their development, and is important whenever a large number of similar entities have to be distinguished (plants, animals, minerals, stars, chemicals, etc.). After an initial period of confusion and competing classifications, there is often a phase of strenuous effort to achieve standard classification, with grouping and division based on an agreed set of "essential" characteristics - "natural" rather than

"artificial", as the argument runs. Once such a standard has settled down, however, the practical development of a science and its associated technologies often leads to the recognition that other characteristics are equally useful for certain purposes.

This process, as it applies to the classification of chemical substances, has been explored (ref. 21). During the whole period up to the eighteenth century, various characteristics were used to group and divide chemicals: physical state, physical behaviour, chemical behaviour, origin, mode of production. With the developments associated with Lavoisier, constitution became firmly accepted as the basic characteristic by which chemicals should be classified. Since that time, both industry and science have begun to reintroduce earlier characteristics and add still others for certain purposes: bond type, use, scale of production.

The upshot of this is that for different purposes it may be necessary to place a given chemical in different classes: for example, Aniline might be classed as a Benzene derivative, an Amine, a Dye intermediate, a Toxic substance, an Organic base, and so on. The same is occurring in other fields. We are faced, in fact, with an increasing problem of cross-classification, in which an entity may fall into as many classes as there are special interest groups associated with it.

We can extend the argument. A homogeneous group of entities forms a facet, for example, chemical substances. In chemistry, substances are the centre of interest, and a classification will relate them to facets such as structure, physical properties, reactions, environmental conditions. In biology, chemical substances are of secondary interest, as cell constituents and reagents, and a classification will relate them to facets such as organisms, organs, tissues, biological processes. In each field, the same facet (chemical substances) will fit into a different pattern.

These features have led to the proliferation, for purposes of arrangement, of many special classifications, each structuring a field from its own point of view, and thus differing from each other in the grouping and sequencing of the same entities. This has been illustrated with respect to classifications used by intermediate documents in

section B, and a study of special library classifications (such as those listed in ref. 11) would amply confirm it. Section C4 has shown that even a single field - nuclear science and engineering - structured from two viewpoints that one would imagine to be similar, may present surprising divergence as to both choice of terms for inclusion, and grouping.

A general classification can adopt one of three ways of meeting this situation: (a) It can firmly place any given entity in only one class, according to what is believed to be its "most generally useful" characteristic. A special interest can only use such a classification as a standard by abandoning any structural relations peculiar to itself. (b) It can place each entity in as many classes as special interests may dictate. It becomes then an assembly of special classifications, held together only by its alphabetical index, and in no sense a standard. (c) It can attempt some uneasy compromise between the two extremes, failing to satisfy any special interest yet annoying the purist by inconsistency.

This last is the path chosen by most general classifications, and the comparisons reported in sections B and C illustrate yet another aspect of the situation. Each chosen compromise differs from the others. This is partly because each classification maker (whether individual or committee) responds differently to the clash of special interests. It is also because interests change with time, and a later classification will emphasise characteristics ignored by an earlier. As a result, each general classification tends to become trapped in a structural framework suitable only to the era in which it was made.

## D.4 Current scientific research

The relatively outmoded character of any general classification is particularly evident if we compare it with the most recent developments in any field. In 1961, Unesco published a survey of current trends in scientific research, prepared by Pierre Auger (ref. 32). His classification of material was "based on a functional division of scientific research rather than on a purely academic classification of sciences." Scientific research was taken to include fundamental, applied and developmental research,

The overall division of the survey is as follows:

I. Fundamental sciences (mathematical, physical, chemical, biological).
II. Earth and space sciences.
III. Medical sciences.
IV. Food and agricultural sciences.
V. Fuel and power research (thermochemical, hydroelectric, nuclear, solar and electrical energy).
VI. Industrial research (metallurgical, chemical, textile, electro-mechanical, transport, telecommunications, automation, construction).

Science is seen as existing not only in the disciplines traditionally so labelled, but also in many areas of technology. So division III includes the science of nutrition; division IV includes nitrogen fixation, ecoclimatology, animal genetics, fish population dynamics; division V includes coal structure, radioisotopes, photosynthesis; division VI includes metallography, high polymers, acoustics of buildings. The interpenetration of science and technology is far greater than is suggested by the sharp separations of Dewey, UDC and Colon (Bliss is a little more up-to-date in this respect).

Even if we restrict our examination to the "fundamental" sciences, differences between Auger and the general classifications are immediately apparent. The differences are illustrated in Table 27, in which Auger's 1961 classification of "fundamental" sciences is coded according to the 1965 edition of Dewey. For example, in the main subdivisions of the physical sciences, the traditional disciplines of Mechanics and Acoustics are missing, and Atomic physics, Electronics and States of matter are much more emphasised. One of the six main subdivisions of the biological sciences is Radiobiology, a subject that barely figures in the general classifications.

At the detailed level, Auger is classing, not the whole of science, but its growth points. Yet it is fair to compare his classification with the general ones, because for current and future use they too must cover the growth points. For example, Auger subdivides States of matter into six sections - Fluid mechanics, Solid state, Semiconductors, Superconductors, High pressures, Low pressures. In Dewey, the terms in this array are coded 532, 530.41, 537.622, 537.623, ?

and 533.5 - at very different levels in very different hierarchies.

As a second example, consider Auger's subdivision of Inorganic chemistry. Instead of a simple division by chemical constitution, as found in the general classifications, we get: Inorganic macromolecules, Transition metal compounds, Fluorine derivatives, Compounds for electronics, Materials for astronautics, Metallurgical chemistry, Vitreous state. Again, among the 24 sections of the biological sciences are subjects that are found at a much more specific level in the general schemes - such as Chromosome biochemistry, Transport through membranes, Renal physiology, Cytobiology of radiation.

Particular areas of science rise and fall in importance, new topics continually emerge, the class relations of current interest alter, whole fields are restructured. We found great difficulty in comparing mathematical abstracts journals with the general classifications, and a series of comments by Auger makes this understandable: "modern mathematics uses techniques which were formerly utterly alien to it", "twenty or thirty years ago many good mathematicians still knew very little about vector spaces, etc., to-day they are part of any general mathematical education", "even a few years ago, the methods used in algebra were almost purely algebraic, to-day the situation is entirely different". There is little wonder that both the detail and the overall structure of Mathematics in all the long-established general classifications appears so inadequate.

It has been maintained by some writers that a science can only be properly classified when it has ceased to develop. What is certainly true is that only in a slowly developing field can current documentation continue to use an old classification. The dynamic of modern science is making outmoded the structural frameworks first laid down by Dewey (1876), UDC (1905), Bliss (1935) and Colon (1933).

D.5 The needed level of standardisation

The maker(s) of a general classification typically stand in front of the universe of information, classificatory knife in hand, and decide how to carve it up - into fields, facets, chains, arrays. Most of them spend a great deal of effort discussing the higher levels of

the scheme - what fields will be recognised? in what sequence will they be arranged? by what principles will these decisions be justified? A brief history of this aspect of the classification of science has been published elsewhere (ref. 23).

In practice, most general schemes end up by using traditional disciplines as the main fields, and this was explicitly justified by Bliss (ref. 1) as representing the "scientific and educational consensus ... an order likely to persist for centuries to come." In actual fact, although the names of traditional disciplines do persist for centuries, their content (particularly in science) changes continually and rapidly.

The inadequacy of division by traditional disciplines has been discussed by writers on physics, which is still conventionally divided into mechanics, acoustics, optics and so on. It has been noted that this classification of physics was originally based on types of sense perception, but that this method of division has lost its meaning. A century ago, these subfields were separate sciences, in very different stages of development, each following its own line of growth independently of the others. To-day the boundaries between them have almost completely gone. These comments could be illustrated from Table 8 (Appendix 3): from all the "sense-perception" fields of physics, material has been drawn together into a new field, Solid state physics.

The method adopted by makers of general classifications - successive subdivision of the universe of information, successive "expansion" of the scheme to keep pace with the growth of the libraries to which it is applied - of necessity implies an attempt to seek for permanence at the higher levels of the scheme. Bliss and many others have sought for a "permanent" set of fields, "the order of the sciences". Ranganathan has rather sought uniformity in a set of facets applicable to every field (ref. 2). Special classified arrangements, as we have noted, display great diversity. We suspect this to be inevitable.

Each particular intermediate document is (or should be) designed to serve the interests of a particular user group. Increasingly, as science and technology interpenetrate, user interests diversify. The discipline-oriented aids typical of the past give way to, or are complemented by, mission-oriented aids drawing material from many

scientific disciplines. The list of science/technology subject categories considered important by COSATI (Appendix 2) is sufficient illustration of this. Each user interest makes its own selection of subject matter, and arranges it according to its own structural pattern. There are as many arrangements of fields as there are interests.

Does this mean that attempts at standardisation must be abandoned? Before so concluding, let us consider more closely the alternative approach that has been adopted by the makers of both special classifications and thesauri designed for detailed indexing rather than arrangement . Each indexing aid, in effect, defines a field not in respect to its position in a wider universe, but by enumeration of its content. In special classifications for indexing, the field embraced can typically be expressed in a "thing-process" phrase, such as "diamond technology", "food science", "container manufacture" and so on. In each case, an enumerable group of things is selected, and from the many relations in which they subsist (their properties, processes, operations, behaviour, activities) a certain number is selected and enumerated. Every such selection can be the "field" of a classified index (ref. 26). If we examine a thesaurus such as TEST (ref. 13), we again find subject category fields defined by the terms that they include. In both cases, the term content of the field is structured hierarchically. Higher level relations between fields may not be displayed.

Essentially, therefore, both types of indexing aid contain many low-level hierarchies. Each hierarchy is usually restricted to a homogeneous set of terms - things, or their parts, constituents, structures, properties, actions or processes, or operations on things, or operating agents, and so on - each homogeneous set thus being what is called in classification theory a facet (refs. 2, 26). Facets are the building blocks out of which special classifications and thesauri may be assembled. Each special information aid may bring together a different set of facets, and arrange them in a different pattern, but the same facet may be common to many fields, and arrangement within the facet may be the same in each field. It is at this level that standardisation may be possible.

D.6 Recent work on faceted classification

In our descriptions of general classifications (section B2), the occurrence of well-defined facets within each was noted. They are distinctively coded in the UDC, which was the first classification to use the technique, but are most clearly and consciously used by Colon, whose maker Ranganathan introduced the term into classification. "Facet analysis" is now an accepted part of classification theory. Many special classifications have been devised along these lines (ref. 26). Exploratory work is going on in England towards the development of a new general faceted classification (ref. 27). Parallel ideas have been published by Farradane and colleagues (ref. 28).

Farradane sees information as representable through four basic facets of terms: entities, activities, abstracts and properties. He develops the outline of his scheme as in Table 22 (Appendix 3). Austin appears to be analysing at a more general level. These schemes are still at a preliminary stage, and cannot as yet be clearly related to the possible practical requirements of a world science information system.

It is worth looking in more detail at schemes recently drafted by the Information Division of the American Institute of Physics (ref.29). In a classification for Physics, two facets are recognised: (1) objects, (2) phenomena and associated properties. Each facet is divided into sub-facets, and each of these is fully hierarchical. The main "objects" of interest to Physics are listed as:

Mathematical entities.
Particles, fields, nuclei, atoms, molecules.
Chemical elements and their compounds.
Ensembles and aggregate matter.
Astro- and geo-physical objects.
Organisms, biological systems, organs.
Artifacts, devices, instruments, systems.

The "phenomena and properties" listed are those associated with each "object" sub-facet - mathematics, particles, fields, chemicals, ensembles and so on. In illustration, Table 23 (Appendix 3) outlines the whole of each facet, and Table 24 lists Ensembles and their associated phenomena.

In a classification for Chemical physics also drafted at the A.I.P. (ref. 29) there is a shorter list of objects, a long list of "properties, processes and phenomena", and a list of "methods". These lists are divided into small groups, which may or may not be hierarchical. Arrays are usually in alphabetical sequence. An outline of the "properties" facet is presented in Table 25, and a detailed extract in Table 26.

As can be seen, in both these classifications there is no attempt to define and arrange "fields" of Physics. There is a strict concentration on homogeneous facets - objects, phenomena, methods - in each of which hierarchy is introduced to a greater or lesser extent. The "sense-perception" disciplines of physics figure only as phenomenological qualifiers (Ensemble class 47 in Table 24), or as phenomena associated with physical ensembles and chemico-physical objects.

The possibility raised at the end of section D5 is that schedules of this kind - unit facets of objects, properties, processes, methods and so on in different fields of science and technology - might well be standardised for use in intermediate documents and information aids. Similar hierarchies already exist in thesauri such as TEST (compare Table 26 with the list of thermodynamic and thermal properties in Table 14). There seems little point in each intermediate document producing its own variant hierarchy for a unit facet.

The comparisons reported in section C suggest that none of the general classifications considered could provide the necessary standard schedules. The facets of Colon are wholly inadequate in detail, although piecemeal expansion of small areas of technology is now taking place (ref. 30). There are many well-defined facets in UDC, but the frequency of scatter noted in section C2 suggests that there is still much inhomogeneity in its hierarchies, and at best we see UDC as a quarry. To create a standard, much work along lines considered in this section would be needed (ref. 31).

## D.7 Conclusion

In placing a contract for a comparative study of classifications, the International Council of Scientific Unions expressed the hope that

the results would provide information that would assist in examining: "(i) the possibility of transfer of information between services using different classification systems, and (ii) the necessity for all information services to convert to a unique classification system".

This survey has indicated that, although formal classification schemes do not occur in all intermediate documents in science, the use of classificatory relations for both arrangement and information retrieval is widespread. Equally it has indicated that there is great diversity among the classifications used.

How does this affect the transfer of information between systems? We are saying, in effect, that there is a strong likelihood that the hierarchical relations of any particular topic will be different in each system. These relations are expressible in codes. The only way to get an item coded 541.34 in one system into the coding CDV, or E:22, or F1a10, or 541.8 of another system, is to recode it in each case. This could be done in advance, by compiling an (exhaustive?) list of all topics to be covered by the co-operating systems, and establishing a concordance of codes (our tables provide small samples of this). Whether this task is worth doing will depend upon the function that such transfer of information is intended to perform - a matter yet to be established in the UNISIST study.

An inconclusive answer must also be given to the second point raised by ICSU - whether it is necessary for all information services to convert to a unique classification system. The present diversity strongly suggests that, if interchange between systems is going to be important, then the use of a standard structure for arrangement and indexing is likely to be a better solution than a concordance between divergent structures. As already stated, we do not believe that any of the general classifications examined would be an adequate standard either for arrangement or for indexing. But the kind of classificatory structure needed can only be determined when the function of information transfer between systems has been settled.

Our final conclusions, therefore, can be expressed as follows: Classification has a definite role to play in science information, both in the arrangement of subject representations, and in their detailed

indexing. To the extent that the present variety of science information aids are to be integrated, the need for standard classificatory relations will increase. The form of such a standard, and the level at which standardisation should be applied (fields, facets, hierarchies, terms, codes), can only be determined when the mode of integration has been chosen. It is unlikely that any existing classification could be adopted as a standard, but both general and special schemes will be useful quarries from which classificatory relations could be drawn.

## E. REFERENCES

(1) Principles by which the fields of science may be arranged in sequence were discussed extensively by H.E. Bliss ("The organisation of knowledge and the system of the sciences", New York 1929, and "The organisation of knowledge in libraries and the subject approach to books", 2nd ed., New York 1939). More recently, principles based on the theory of integrative levels have been advanced - see, for example, D.J. Foskett in "Essays in librarianship in memory of W.C.B. Sayers", London 1961.

(2) Principles by which fields may be divided into facets, and by which terms may be arranged in arrays, have been extensively discussed by S.R. Ranganathan, and conveniently summarised in his "Prolegomena to library classification", 3rd ed., London 1967.

(3) G.A. Lloyd, "The UDC in its international aspects", Aslib Proceedings, vol. 21, No.5, pp. 204-8, 1969.

(4) Sources on the history of classification include W.C. Berwick Sayers "Manual of book classification", 3rd ed., London 1955; E.I. Shamurin "Ocherki po istorii bibliotechno-bibliograficheskoi klassifikatsii", Moscow 1955-59, translated as "Geschichte der bibliographischer Klassifikation", Band 1-2, Leipzig 1964-67; E. de Grolier "Theorie et pratique des classifications documentaires", Paris 1956; M.F. Taube and E. Wise "Classification systems" (State of the Library Art, vol.1, part 3, New Brunswick 1961); B.C. Vickery "Classification and indexing in science", 2nd ed., London 1959; and the writings of Bliss cited in reference 1.

(5) The edition used was the "Dewey decimal classification and relative index", 17th ed., vols.1-2, New York 1965-67.

(6) The UDC is a multilingual scheme, and the full edition has been published at various levels of completeness in different languages. The present state of publication is summarised in Appendix 4. We have used English versions published by the British Standards Institution, sometimes supplemented by German versions. Since no one language version is complete, and alphabetic indexes are

inadequate, classifying over a wide field of science proved difficult, and we have probably overlooked the existence of terms that are somewhere in the UDC schedules.

(7) H.E. Bliss "A bibliographic classification", vols.1-4, New York 1952-53.

(8) S.R. Ranganathan "Colon classification", 6th ed., Asia Publishing House, 1960.

(9) F. Kutter "Koordinierte Klassifikation", Thalwil-Zurich 1951.

(10) H. Clavier "Nouvelle classification universelle, maitre plan" The author, 1967.

(11) See for example the U.S. Special Libraries Association bibliography "Selected materials in classification", New York 1968.

(12) A list of thesauri currently available at Aslib has been compiled, for inclusion in a forthcoming publication.

(13) "Thesaurus of engineering and scientific terms", issued simultaneously by the U.S. Department of Defence (as report AD 672000) and the Engineers Joint Council, 1967.

(14) U.S. National Library of Medicine "Medical subject headings", Washington 1968.

(15) European Atomic Energy Community "Euratom thesaurus", 2nd ed., Luxembourg 1967.

(16) For example, the International Institute of Welding "Concordance between the classification systems of the IIW and UDC", Paris 1960. An earlier more general and more historical study was that of G. Lorphèvre "La concordance entre classifications", Revue de la Documentation, vol.16, pp.8-16, 1949. G.A. Lloyd has made a "Comparison of Dewey and UDC at a minimum 3-figure level", FID publication 329, The Hague 1960.

(17) An American study is that of J. Pettee "Subject headings: history and theory", New York 1946. A vigorous exploration of

the potentialities of alphabetical sequence is provided by J. Metcalfe "Information indexing and subject cataloging", New York 1957.

(18) C.A. Cutter "Rules for a dictionary catalog", Washington 1876.

(19) B.C. Vickery "Thesaurus - a new word in documentation", J. Documentation, vol.16, pp.181-9, 1960.

(20) International Federation for Documentation "UDC special subject edition for nuclear science and technology", The Hague 1964.

(21) B.C. Vickery "The classification of chemical substances: an historical survey", in D.J. Foskett and B.I. Palmer (ed.) "Essays in librarianship in memory of J.C.B. Sayers", London 1961.

(22) U.S. Federal Council for Science and Technology "COSATI subject category list", Washington 1964.

(23) B.C. Vickery, loc.cit. in ref.4, pp.158-94 on "Historical aspects of the classification of science".

(24) E. de Grolier "A study of general categories applicable to classification and coding in documentation", Unesco, Paris 1962 (French edition 1960).

(25) "Proceedings of the international symposium on relational factors in classification", Information Storage and Retrieval, vol.3, No.4, pp. 177-410, 1967.

(26) B.C. Vickery "Faceted classification", London, revised reprint 1968.

(27) A first brief public report is that of D. Austin, "The new general faceted classification", Catalogue and Index, No.14, pp.11-13, April 1969.

(28) J.E.L. Farradane and others "Research on information retrieval by relational indexing, Part 1, Methodology", City University, London 1966.

(29) For example, R.G. Lerner "Development of a multi-co-ordinate vocabulary: chemical physics" (March 1968); Information Division

"Draft classification scheme for physics" (November 1968) - both reports issued by the American Institute of Physics, New York.

(30) Illustrations of Colon expansions will be found, for example, in Documentation Research and Training Centre, annual seminars 2-5, 1964-67, published by the Indian Statistical Institute, Bangalore.

(31) We would like to draw attention to the forthcoming compilation by Jean Aitchison and others "The English Electric thesaurofacet", Leicester 1969 - a thesaurus integrated with a faceted classification, covering large areas of science and technology, with over 16,000 indexing terms.

(32) P. Auger "Current trends in scientific research", Unesco, Paris 1961.

Appendix 1: Guides used to identify intermediate documents

(a) A.J. Walford (ed) "Guide to reference material, vol 1, Science and Technology", 2nd ed, London 1966.

(b) M.J. Fow r "Guides to scientific periodicals: annotated bibliography", London 1966.

(c) NATIONAL FEDERATION OF SCIENCE ABSTRACTING AND INDEXING SERVICES "A guide to the world's abstracting and indexing services in science and technology". Washington 1963.

(d) H.R. Malinowsky "Science and engineering reference sources", Rochester 1967

(e) L.N. Malcles "Sources du travail bibliographique, tome III, Sciences exactes et techniques", Geneva and Paris 1958

(f) W. Totok and R. Weitzel "Handbuch der bibliographischen Nachschlagewerke", 2nd ed, Frankfurt 1959.

Appendix 2:

COSATI subject category list (all fields, selected groups)

| | | Dewey | UDC | Bliss | Colon |
|---|---|---|---|---|---|
| 01 | Aeronautics (5 groups) | 629.13 | 629.13 | BT | D53 |
| 02 | Agriculture (6 groups) | 630 | 63 | UA | J+KZ |
| 03 | Astronomy and astrophysics | 520 | 52 | D/DF | B9 |
| | A Astronomy | 520 | 52 | D/DF | B9 |
| | B Astrophysics | 523.013 | 523.03 | DD | B9:6 |
| | C Celestial mechanics | 521.1 | 521.1 | DCC | B9:7 |
| 04 | Atmospheric sciences | 551.5 | 551.5 | DS | U28 |
| | A Atmospheric physics | 551.5 | 551.51 | DSB | U286 |
| | B Meteorology | 551.5 | <551.5 | <DS | U28 |
| 05 | Behavioral and social sciences (11 groups) | 150<br>300 | 159.9<br>3 | I<br>K | S+E |
| 06 | Biological and medical sciences, including | 570/590 +610 | 57/59 +61 | E/H | G+L |
| | A Biochemistry | 574.192 | 577.1 | EH | EgG |
| | B Bioengineering | - | - | - | - |
| | C Biology | 570 | 57 | E | G |
| | D Bionics | - | - | - | - |
| | M Microbiology | 576 | 576.8 | FV | G91 |
| | P Physiology | 574.1 | 576.2 | EJ | G:3 |
| | R Radiobiology | 574.1915 | <577.3 | EAI | G:33C5 |
| 07 | Chemistry | 540 | 54 | C | E |
| | A Chemical engineering | 660.2 | 66.0 | CTE | F |
| | B Inorganic c. | 546 | 546 | CI | EI |
| | C Organic c. | 547 | 547 | CO | E5 |
| | D Physical c. | 541 | 541 | CB | E:2 |
| | E Radio and radiation c. | 541.38 | 541.15 +543.28 | CFD | E:296 |
| 08 | Earth sciences and oceanography | 550 | 55 | DF/D | - |
| | A Biological oceanography | 574.92 | 57(26) | EMT | G9555 |
| | B Cartography | 526.8 | 528.9 | DQL | U11 |
| | C Dynamic oceanography | 551.46 | 551.465 | DRS | U256 |
| | D Geochemistry | 551.9 | 550.4 | DHC | |
| | E Geodesy | 526 | 528 | DQB | U18 |
| | F Geography | 910.2 | 911.2 | DR | U |
| | G Geology and mineralogy | 549/550 | 55+549 | DG+CH | H |
| | H Hydrology and liminology | 551.48/49 | 551.48 | DRH | H422 |
| | I Mining engineering | 622 | 622 | UDD | HZ |
| | J Physical oceanography | <551.46 | <551.46 | <DRS | <U25 |
| | K Seismology | 551.22 | 550.34 | DHK | H413 |
| | L Snow, ice and permafrost | <551 | 551.32/.34 | <DR | H421 |
| | M Soil mechanics | 624.151 | 624.131 | - | - |
| | N Terrestrial magnetism | 538.7 | 550.38 | DHW | C75 |
| 09 | Electronics and electrical engineering including | 621.3 | 621.3 | BME | D65/66 |
| | B Computers | 621.38195 | 681.14 | AMU | D65,8(B) |
| | D Information theory | 001.539 | 621.391 | - | - |
| 10 | Energy conversion (3 groups) | <621 | <621 | <UE | D6,3 |
| 11 | Materials (12 groups) | 660/670 | 66/67 | - | F |
| 12 | Mathematical sciences | 510 | 51 | AM | B |
| | A Mathematics and statistics | 510 | 51 | AM | B |
| | B Operations research | 001.424 | 519.28 | - | - |
| 13 | Mechanical, etc. engineering (13 groups) | 620 | 62 | UO | D6 |



Continued overleaf

| Appendix 2: (continued) | | Dewey | UDC | Bliss | Colon |
|---|---|---|---|---|---|
| 14 | Methods and equipment (5 groups) | - | - | - | - |
| 15 | Military sciences (7 groups) | 355 | 355 | RMB | MV41 |
| 16 | Missile technology (4 groups) | 623.451 | 623.451.8 | - | - |
| 17 | Navigation, etc (10 groups) | | | | |
| 18 | Nuclear science and Technology, including | 621.48 | 621.039 | BEH | - |
| | B Isotopes | 539.74 | 621.039.3 | CCQ | E196 |
| | H Radioactivity | 539.752 | 539.16 | BF | CM96 |
| | K Reactor physics | 539.75/.76 | 621.039.51 | - | D7 |
| 19 | Ordnance (8 groups) | 623.4 | 623.4 | RMG | - |
| 20 | Physics | 530 | 53 | B | C |
| | A Acoustics | 534 | 534 | BP | C3 |
| | B Crystallography | 548 | 548 | CH | H1:8 |
| | C Electricity and magnetism | 537/538 | 537/538 | BJ | C6/7 |
| | D Fluid mechanics | 532 | 532 | BQ | B75 |
| | E Masers and lasers | 537.5+535.58 | | - | - |
| | F Optics | 535 | 535 | BI | C51 |
| | G Particle accelerators | 539.73 | 621.384.6 | BEO | - |
| | H Particle physics | 539.721 | 539.12 | - | C9B |
| | I Plasma physics | 537.16 | 533.9 | - | - |
| | J Quantum theory | 530.12 | 530.145 | BFJ | CNI |
| | Solid mechanics | 531 | 531 | BG | C21 |
| | L Solid-state physics | 530.41 | 539.2 | - | - |
| | M Thermodynamics | 536.7 | 536.7 | BHB | C4:7 |
| | N Wave propagation | 537.12 | 538.56 | BLR | C5:2 |
| 21 | Propulsion and fuels (9 groups) | 629.42 | 629.1.03<U | | D5,7 |
| 22 | Space technology (4 groups) | 629.46/.47 | 629.19 | - | D58 |

Appendix 3: Tabulations

In Tables 3 to 12 we give some examples of class codes in various classifications to schedules taken from Bulletin signalétique and elsewhere. Gaps may mean the genuine absence of a code for a particular subject, or a failure to discover the appropriate code.

In all codes we have used the stroke (/) to mean "all intervening codes" (thus AM/AY means "all codes from AM to AY inclusive"); the plus (+) to mean "and"; and "less than" (<) to mean "included in" (Thus < 523.85 means that the subject classed is included in the class represented by code 523.85). In Colon, the symbol O has been used in an unorthodox way as a generalised link between fields (thus GOC = G related to C = Biology related to Physics = Biophysics).

In all columns headed by an asterisk (e.g. Ref.Zh.*) the notation used is our own, constructed so as to display the hierarchy of the classification. Thus in Table 3, for RZ, B6c Clusters is an entity in the class B6 Stars, and this in turn lies in class B Astronomy; the sequence of classes into which Astronomy is divided is shown by the codes B1, B2, B3, etc.

In Table 13 we compare eight classifications of General and physical chemistry.

In Tables 14 to 18 we report the results of assigning class, codes to terms in thesauri, giving samples and summaries. Tables 19 to 21 compare hierarchies in TEST and MESH.

Finally, Tables 22 to 27 give samples of recent faceted classifications.

Table 3

| Bulletin signalétique - second level heading. | Ref.Zh.* | Dewey | UDC | Bliss | Colon | Cosati |
|---|---|---|---|---|---|---|
| 110 Mathematics | A | 510 | 51 | AM/AY | B | 12A |
| I History | A1 | 510.9 | 51(09) | AM3 | Bv | - |
| II Logic, axioms | A2 | 510.1 | 16 | AMA/AMB | R1 | - |
| III Groups | A4 | 512.86 | 519.4 | AQG | B27 | - |
| IV Arithmetic | - | 511 | 511 | AN | B1 | - |
| V Algebra | A4 | 512 | 512 | AO/AQ | B2 | - |
| VI Topology | A5 | 513.83 | 513.83 | ATQ | B316 | - |
| VII Analysis | A7 | - | 517 | AR | B3 | - |
| VIII Geometry | A6 | 513/516 | 513/516 | AT/AV | B6 | - |
| IX Numerical analysis | A7g | 517.6 | 518 | AOD | - | - |
| X Information, documentation com ters | - | 029.7 | 002 + 518.5 | - | - | 05B + 09B |
| XI Probability and statistics | - | 510.78 | | - | - | |
| XII Teaching, recreation | A8 | 519 | 519.2 | AY | B28 | - |
| 120 Astronomy | A1 | 510.07 | 51:37 | AMD | B0T | - |
| I History | B | 520 | 521/526 | D/DF | B9 | 03 |
| II Spherical a | B1 | 520.9 | 52(09) | D3 | B9v | - |
| III Theoretical a | B3c | 522.7 | 522.7 | DA | B9:5 | - |
| IV Theoretical astrophysics | B2 | 521 | 521 | DC | B9:7 | - |
| V Instruments, techniques | B5 | 523.013 | 523.03 | DDB | B9:6 | 03 |
| VI Sun | B11 | 522 | 52.08 | DB | - | - |
| VII Solar system | B8 | 523.7 | 523.7 | DE | B93 | - |
| VIII Stars | B9 | 523.2 | 523.2 | DF | B94 | - |
| IX Clusters | B6 | 523.8 | 523.8 | DD | B96 | - |
| X Galaxies | B6c | 523.85 | 523.85 | DDU | B963 | - |
| 120a Physics of earth | B6e | 523.112 | 523.85 | DDV | B964 | - |
| I/II General | C | 551 | 550/ 1 | D | U2 | 08 |
| III Terrestrial globe | | | | DG | | |
| IV Glaciology | C4 | 551 | 551 | DH | U21 | 08F |
| V Oceanography | C3c | 551.31 | 551.32 | DRD | H421 | 08L |
| VI Atmosphere | C3a | 551.46/.47 | 551.46 | DRS | U25 | 08A+C+J |
| VII Meteorology | - | 551.5 | 551.51 | DS | - | 04A |
| | C2 | 551.5/.6 | 551.5 | DS | U28 | 04B |

Continued overleaf

Table 3(continued)

| | | | Ref.Zh.* | Dewey | UDC | Bliss | Colon | COSATI |
|---|---|---|---|---|---|---|---|---|
| | VIII | Upper atmosphere and ionosphere | C1a | 551.514 | 551.510.5 | DSP | H294+296 | - |
| | IX | Geomagnetism | C1 | 538.7 | 550.38 | DHW | C75 | 08N |
| 130 | | Physics I | E | 530 | 53 | B | C | ⟨20 |
| | A | General | E | 530.1 | 530.1 | B | C | ⟨20 |
| | B | Mathematical physics | - | 530.15 | - | BAM | B8 | - |
| | C | Mechanics | D | 531 | 531/533 | BC/BD | B7 | 20D+K |
| | D | Acoustics | E7c | 534 | 534 | BP | C3 | 20A |
| | E | Optics | ⟨E5 | 535 | 535 | BI | C5 | 20F |
| | F | Heat, thermodynamics | ⟨E | 536 | 536 | BH | C4 | 20M |
| 140 | | Electricity | ⟨E | 537 | 537/538 | BJ/BL | C6 | 20C+09 |
| 150 | | Nuclear physics | E3 | 539.7 | ⟨539.1 | ⟨BE | C9B3 | 20G/I+18 |
| 160 | | Structure of matter | E5+6 | 539.1 | ⟨539 | BE | C2 | - |
| | A | Condensed state | ⟨E6 | - | ⟨539 | - | ⟨C2 | 20L |
| | B | Atomic and molecular physics | E5 | ⟨539.1 | 539.18/19 | ⟨BE | ⟨C9A | - |
| | C | Spectroscopy | E5c | 535.84 | 535.33 | BFN | C5:3 | - |
| 161 | | Crystallography | F1a3 | 548 | 548 | ⟨CH | H1:8 | 20B |
| 170 | | Chemistry | F | 540 | 54 | C | E | 07 |
| | A | General and physical | F1 | 541 | 541 | C../CF | E:1+2 | 07D |
| | B | Inorganic | - | 546 | 546 | CI/CN | E1 | 07B |
| | C | Analytical | F2 | 543/545 | 543 | CG | E:3 | - |
| | D | Organic | F3 | 547 | 547 | CO/CR | E5 | 07C |
| 210 | | Earth sciences I | ⟨G | 549+550 | ⟨549+55 | ⟨D | ⟨H | ⟨08 |
| | A | Mineralogy | G4b | 549 | 549 | CH | H1 | 08G |
| | B | Geochemistry | G4a | 551.9 | 550.4 | DHC | - | 08D |
| | C | Carbon dating | - | ⟨551.701 | 550.93 | - | - | - |
| | D | Cosmic chemistry | - | - | 523.04 | - | B9:68 | - |
| | E | Crystalline rocks | - | - | - | - | - | - |
| | F | Sedimentary rocks | - | 552.5 | 552.5 | DNJ | H23 | - |

Continued overleaf

Table 3 (continued)

| | | |
|---|---|---|
| 214 | | Applied geology |
| | A | Economic minerals |
| | B | Mining |
| | C | Applied Geophysics |
| | D | Hydrogeology |
| | E | Engineering geology |
| 216 | | Earth sciences III |
| | A | Structural geology |
| | B | Regional geology |
| | C | Palaeontology |
| 320 | | Biological sciences I |
| | A | Biochemistry |
| | B | Biophysics |
| | C | Biological analysis |
| | D | Biological and medical engineering |
| 360 | | Zoology |
| | A | Animal biology |
| | B | Protozoa and invertebrates |
| | C | Vertebrates |
| | D | Vitamins growth factors |
| 361 | | Reproduction, etc. |
| | A | Sexual reproduction |
| | B | Hormones, endocrinology |
| | C | Genetics |
| 370 | | Botany |
| | I | General |
| | II | Cytology |
| | III | Morphology |
| | IV | Physiology |
| | V | Reproduction |
| | VI | Embryology |
| | VII | Parasitism and symbiosis |



Table 3 (continued)

| Ref.Zh.* | Dewey | UDC | Bliss | Colon | COSATI |
|---|---|---|---|---|---|
| <G | 553 | 553 | DO | H7 | - |
| G5+6+7 | <553 | <553 | <DO | <H7 | - |
| - | 622 | 622 | UD | HZ | 08I |
| G8c | 622.15 | <550.8 | <DH | - | - |
| G10a | - | 551.48 | <DR | H422 | 08H |
| G10b | - | <550.8 | - | - | - |
| G | <550+560 | <55+56 | <D | <H | 08G |
| G1b | 551.8 | 551.2 | <DH | H3 | - |
| G1d | 554/559 | <55 | DL | <H | - |
| G2b | 560 | 56 | EP | H6 | - |
| H | <570 | 577/578 | <E | G | <06 |
| H | 574.192 | 577.1 | EH/EI | E9G | 06A |
| I2 | 574.191 | 577.3 | EA | GOC | - |
| - | - | 578 | EB | - | - |
| - | - | - | - | - | 06B |
| <I | 590 | 59 | G | K | <06C |
| <I | 591 | 591 | GA/GI | <K | - |
| I6b | 592/595 | 592/595 | GL/GT | K1/8 | - |
| I8 | 596/599 | 596/599 | GT/GY | K9 | - |
| H4 | 574.1926 | 591.13 | GDP/GDQ | E97 | - |
| <I | <574/575 | <575/577 | <GE | K:6 | <06P |
| I12j | 574.166 | 577.8 | GEO | K:675 | - |
| - | 574.1927 | 577.17 | GEK/GEL | E986 | - |
| I1c | 575.1 | 575 | EN | K:6 | - |
| I4+5 | 580 | 58 | F | I | <06C |
| I4 | 581 | 581 | FA | I | |
| I1b3 | 581.87 | 576.3 | EC | I,11 | - |
| - | 581.4 | 581.4 | FA+FC | I,1 | - |
| I5 | 581.1 | 581.1 | FD/FE | I:3 | - |
| <I4 | 581.3 | 581.16 | FER/FEU | I:67 | - |
| I5g | 581.33 | 581.3 | FDI | I:7 | - |
| - | 581.55 | 576.6 | <FF | I:56 | - |

Continued overleaf

Table 3 (continued)

Table 3 (continued)

| | | Ref.Zh.* | Dewey | UDC | Bliss | Colon | COSATI |
|---|---|---|---|---|---|---|---|
| VIII | Evolution | Id | 581.38 | 576.1 | EO | I:66 | - |
| IX | Ecology | - | 581.5 | 581.5 | FF | I:5 | - |
| 740 | Metals | J | 669 | 669 | CK | E191 | 11F |
| I | General | J1 | 669.0 | 669.01 | CK | E191 | |
| II | Metal physics | E6c | 669.9 | 669.017 | CKB/CKG | E1910C21 | 11F |
| III | Crystalline structure | E6c7 | 669.95 | 548 | CKC | E1910C21:8 | - |
| IV | Lattice defects | - | - | 548.4 | - | - | - |
| V | Microstructure | - | - | - | CKD | - | - |
| VI | Equilibria | J7a1 | - | 669.018.4 | - | - | - |
| VII | Properties, tests | J7b,c | - | 669.018 | CKE | E1910C | - |
| VIII/IX | Metallurgical processes | J2+3+4 | <669 | 669.04/.09 | CKJ/CKO | - | - |
| X | Mineral processing | <J3+4 | 622.7 | <22.7 | CKQ | - | - |
| XI/XII | Refining | <J2+3+4 | <669 | 669.054 | <CK | - | - |
| XIII | Foundrywork | <J2+3+4 | 671.2 | 621.74 | URE | - | - |
| XIV | Powders and wires | <J4+5 | 671.37 | 621.76 | - | - | - |
| XV | Analysis and control | J8 | 669.92 | 669.9 | CKT | E191:893 | - |
| XVI | Heat treatment | J7d | 671.36 | 621.78 | <CKL | - | - |
| XVII | Metal working | J5+6 | 671.3 | 621.77 | <CKL | - | - |
| XVIII | Corrosion, protection | - | 620.162 | 620.19 | CKI | E191:895 | - |
| XIX | Use of metals | - | - | 669.004 | - | - | - |
| | Gaps | 21 | 12 | 4 | 12 | 21 | 70 |
| | Inversions | 31 | 28 | 34 | 30 | 28 | |
| | Multiple codings | 0 | 0 | 2 | 1 | 1 | 2 |
| | 111 BS classes | | | | | | |

Table 3 (continued)

Bulletin signalétique - 120 Astronomy and astrophysics

Table 4

| | | | Ref.Zh.* | Dewey | UDC | Bliss | Colon | Astro.Jb. |
|---|---|---|---|---|---|---|---|---|
| 120 | | Astronomy and astrophysics | B | 520 | 52 | D/DF | B9 | - |
| I | | General | B1 | 520.1 | | D | - | I/II |
| II | | Spherical | B3c | 522.7 | 522.7 | AO | B9:5 | |
| | 1 | Celestial spheres and coordinates | - | 522.71 | 522.71 | DAT | B9:51 | |
| | 2 | Fundamental constants | - | - | - | - | B9:62 | IV33 |
| | 3 | Rotation of earth | B3b | 525.35 | 525.35 | DAP | - | IV38 |
| | 4 | Astronomical time | - | 529 | 529 | DBH | B9:1 | IV35 |
| III | | Theoretical | B2 | 521 | 521 | DC | B9:7 | V |
| | 1 | Celestial mechanics | B2a | <521 | 521.1 | DCC | <B9:7 | V41 |
| | 2 | Shape and rotation of bodies | B2d | - | 521.14 | DCN | B9:76 | |
| | 3 | Determination of orbits | B2b | <521.3 | 521.3 | DCD | B9:72 | V42 |
| | 4 | Cosmology and relativity | <B10 | 523.1 | 523.1 | DDD | <CN | V44 |
| | 5 | Cosmogony | <B10 | 523.12 | 523.12 | DDC | B9:8 | V55 |
| | 6 | Movement of bodies | B2c | 521.13 | 521.12 | DCF | - | V43 |
| IV | | Theoretical astrophysics | B5 | 523.013 | 521.03 | <DD | <B9:6 | VI |
| | 1 | Fluid mechanics | - | - | 521.032 | DCR | B9:0025 | |
| | 2 | Internal structure | B5b | 523.86 | 521.04 | - | B9:68 | V54 |
| | 3 | Atmospheres | B5a | - | - | DD,J | B9:6358 | V53 |
| | 4 | Spectroscopy | - | 522.67 | 521.035 | DDL | B9:653 | |
| | 5 | Statistical methods | - | - | 523.802 | DDS | B90B28 | |
| | 6 | Radio astronomy (theory) | - | <523.016 | 523.162 | - | B9:95 | |
| V | | Instruments and techniques | B3c+11 | <522 | <522 | DB | - | III |
| VI | + | Sun | B8 | 523.7 | 523.7 | DE | B93 | VII |
| | 1 | Astrometric observations | B8a | - | - | DE8 | B93:6 | <VII61 |
| | 2 | Constants and rotation | - | 523.71 | 523.71/73 | DE,F | B93:62/63 | <VII61 |

Continued overleaf

Table 4 (continued)

| | | Ref.Zh* | Dewey | UDC | Bliss | Colon | Astro.Jb. |
|---|---|---|---|---|---|---|---|
| 3 | Photosphere | ‹B8b | - | 523.741 | DEP | ‹B93:6358 | VII64 |
| 4 | Chromatosphere | ‹B8b | ‹523.75 | 523.752 | DER | ‹B93:6358 | VII66 |
| 5 | Corona | B8c | ‹523.75 | 523.755 | DET | ‹B93:6358 | VII67 |
| 6 | Radiostronomy | B7a | ‹523.016 | 523.7:523.162 | - | B93:95 | |
| 7 | Activity cycle | B8e | - | 523.745 | - | | |
| 8 | Relation to earth | B8d | 523.73 | - | - | - | |
| 9 | Internal structure | - | 523.76 | 523.76 | DEB | B93:68 | VII62 |
| 10 | Eclipses | - | 523.78 | 523.78 | DEW | B93:57 | |
| VII | Planets and solar system | B9 | 523.2/6 | 523.2/6 | DF | B94/95 | VIII/X |
| VIII | Stars | B6 | 523.8 | 523.8 | ‹DD | B96 | XI/XIII |
| 1 | Catalogues | B6a | 523.8908 | 523.89 | DDH | - | IV32 |
| 2 | Movement | - | 523.83 | 523.83 | DDP/Q | B96:611 | XI 102 |
| 3 | Parallax | - | ‹523.81 | 523.813 | DDJ | B96:522 | |
| 4 | Photometry and colorimetry | - | ‹522.62 | 523.821 | DDK+DDM | B96:64 | XI 103 |
| 5 | Classification and spectrum | - | 523.87 | 523.87 | DDL+DDO | B96:653 | XI 104 |
| 6 | Atmospheres | - | - | - | DD,J | B96:6358 | |
| 7 | Global properties | - | - | - | - | B96:6 | XI 105/107 |
| 8 | Variables | - | 523.844 | 523.841 | DDS | - | XIII |
| 9 | Novae, supernovae | B5c | 523.8446 | 523.841.1 | DDT | - | XIII 126 |
| 10 | Binaries | B6b | 523.841/.843 | 523.842 | ‹DDR | B962 | XII |
| 11 | Pulsating variables | - | - | - | ‹DDS | - | XIII 122 |
| 12 | Eruptive variables | - | - | - | ‹DDS | - | XIII 124 |
| IX | Clusters | B6c | 523.85 | 523.85 | DDU | B964 | XV 141/144 |
| X | Galaxies | B6c | 523.112 | 523.855 | ‹DDU | ‹B964 | XV 145 |
| | Gaps | | 12 | 8 | 7 | 11 | |
| | Inversions | | 12 | 11 | 10 | 12 | |
| | 49 BS classes | | | | | | |

Table 4 (continued)

Bulletin signalétique - 120 a: Physics of earth

| 120a | | Physics of earth | Dewey 551 | UDC 550 | Bliss DR | Colon U+H4 |
|---|---|---|---|---|---|---|
| I/II | | General | | | | |
| III | | Terrestrial globe | 551.1 | 525 | - | U21 |
| | a | Weighing | <525.1 | 525.11 | DQD | B91:622 |
| | b | Triangulation | 526.33 | 526.3 | DQH | U112 |
| | c | Measure of distance | - | 526.2 | DQG | U114 |
| | d | Levelling | 526.36 | 526.95 | < DQH | D:21 |
| | e | Shape of the earth | <525.1 | 526.1 | DFT,H | B91:621 |
| | f | Cartography | 526.8 | 526.8 | DQL | U11 |
| | g | Aerial photography | 526.9823 | 526.9185 | - | D:28 |
| | h | Photogrammetry | 526.982 | 526.918 | AWV | - |
| | i | Internal composition | 551.11 | 551.1 | DHE | B91:68 |
| | j | Geothermy | <551.12 | 550.836 | DFT,N | - |
| | k | Radioactivity | <525.2 | 550.378 | - | - |
| | l | Vulcanology | 551.21 | 551.21 | DHG | H411 |
| | m | Slow crust movements | <551.14 | <551.14 | - | H413 |
| | n | Seismology | 551.22 | 550.34 | DHK | H4132 |
| | o | Geophysical observations | <551 | 550.3 | - | - |
| IV | | Glaciology | 551.31 | 551.32 | DRD | H421 |
| | a | Ice | 551.31/34 | <551.32 | <DRY | - |
| | b | Glaciers | 551.31 | 551.324 | DRG | - |
| | c | snow | - | <551.322 | - | - |
| | d | icebergs | 551.342 | 551.326 | - | - |
| V | | Oceanography | 551.46/47 | 551.46 | DRS | U25 |
| | a | Bathymetry, ridges | <551.46084 | 551.462 | <DRS | - |
| | b | Sea floor and shore | <551.46084 | 551.462 | DRU | U253 |
| | c | Sea water | 551.4601 | 551.463 | - | U255 |
| | d | Ocean level | - | 551.461.2 | - | U252 |
| | e | Currents | 551.4701 | 551 465 | <DRT | U2562 |
| | f | Tides | 551.4708 | 525.6 | <DRT | - |
| | g | Swell | - | - | - | - |
| | h | Internal waves etc. | <551.4702 | - | - | - |
| | i | Technique | - | 551.46.018 | - | - |

Continued overleaf



Table 5

Table 5 (continued)

| | | Dewey | UDC | Bliss | Colon |
|---|---|---|---|---|---|
| VI | Atmosphere | 551.5 | 551.5 | ⟨DS | U28 |
| a | Composition | 551.511 | 551.510.4 | DSC | U2863 |
| b | Water vapour | 551.571 | 551.57 | DSL | U285 |
| c | Radioactivity | - | 551.510.7 | - | - |
| d | Air masses | 551.5512 | 551.515.8 | - | - |
| e | Pressure | 551.54 | 551.54 | DSE | U282 |
| f | Temperature | 551.525 | 551.524 | DSF | U284 |
| g | Acoustics | - | 551.596 | - | U2862C3 |
| h | Actinometry | - | 551.521.12 | DSG | - |
| i | Radiation | 551.527 | 551.521 | ⟨DSG | U2862C5 |
| j | Optics | 551.565/.567 | 551.593 | DSQ | U2862C51 |
| k | Electricity | 551.561/.564 | 551.594 | DSY | U2862C6 |
| l | Troposphere | 551.513 | 551.510.52 | ⟨DSH | - |
| m | Dynamics | 551.5153 | 551.511 | DSH | - |
| n | Air circulation | 551.517 | 551.513 | ⟨DSH | - |
| o | Winds | 551.518 | 551.55 | DSI | U283 |
| p | Cyclonic perturbations | 551.552 | 551.515.2 | DSJ | - |
| q | Fronts | 551.5512 | ⟨551.515.8 | - | - |
| r | Tornadoes, storms | 551.553 | ⟨551.515 | DSK | U22835 |
| s | Turbulence | - | - | - | - |
| VII | Meteorology | 551. | 551.5 | DS | U28 |
| a/c | Technique | ⟨551. | 551.50 | DSD | - |
| d | Forecasting | 551.63 | 551.509 | DSU | U2891 |
| e | Clouds | 551.576 | 551.576 | ⟨DSM | U2853 |
| f | Precipitation | 551.577 | 551.577 | DSN | U2855 |
| g | Agricultural | - | 551.5:63 | DSV | U280J |
| h | Climatology | 551.62 | 551.58 | DSR | U287 |
| i | Climatic variation | - | 551.583 | ⟨DSR | - |

Continued overleaf



Table 5 (continued)

Table 5 (continued)

| | | | Dewey | UDC | Bliss | Colon |
|---|---|---|---|---|---|---|
| VIII | a | Upper atmosphere and ionosphere | 551.514 | 551.510.3 | DSP | U29 |
| | b | Density, composition | - | <551.510.3 | - | - |
| | c | Displacement, turbulence | 551.557 | - | - | - |
| | d | Ionisation | 551.561 | 551.594.12 | - | - |
| | e | Electromagnetic waves | - | - | - | - |
| | f | Magnetic field conductivity, trapped particles | - | 551.594.13 | - | - |
| | g | Ionospheric layers | 538.767 | <551.510.535 | - | - |
| | h | Ionospheric perturbations | - | - | - | - |
| | i | Solar eruptions | - | 551.590.21 | - | - |
| | j | Polar aurorae | 538.768 | 551.594.5 | <DSY | - |
| | k | Luminous emissions | - | - | - | - |
| IX | | Geomagnetism | 538.7 | 550.38 | DHW | C75 |
| | a | Observations | 538.79 | 550.38 | <DHW | - |
| | b | Distribution | - | 550.389 | - | - |
| | c | Magnetism of rocks | 549.127 | 550.382 | - | H20C7 |
| | d | Palaeomagnetism, secular variations | <538.72 | 550.384.3 | <DHW | - |
| | e | Periodic variations | 538.74 | 550.[illegible].4 | <DHW | - |
| | f | Telluric currents | 538.748 | 550.387 | - | - |
| | g | Magnetic perturbations | 538.744 | 550.385/.386 | <DHW | - |
| | | Gaps | 18 | 7 | 29 | 40 |
| | | Inversions | 21 | 26 | 13 | 13 |
| | | 83 BS classes | | | | |



Table 5 (continued)

Referativnyi Zhurnal - E Physics

Table 6

| E* | | | Bull.sig. | Dewey | UDC | Bliss | Colon | Phys.Abs. | Phys.Ber. |
|---|---|---|---|---|---|---|---|---|---|
| | | Physics | 130/160 | 530 | 53 | B | C | PA | PB |
| 1 | | General, methods | 130A | - | 53.08 | BB | - | 01.00 | I |
| 2 | | Theoretical | 130B | 530.1 | 530.1 | BA | C1 | 02.00 | II |
| | a | Quantum mechanics | 130BV | 530.123 | 530.145 | BFJ | CNI | 10.00 | IIa |
| | b | Statistical physics | 130BII | 530.13 | 531.19 | BEV | CN2 | 02.40 | IIb |
| | c | Irreversible processes | 130FIII | - | 530.161 | - | - | - | - |
| | d | Special relativity | 130BIV | <530.11 | <530.12 | BCL | <CN | 02.30 | IIc |
| | e | General relativity | 130BIV | <530.11 | 530.12 | BAR | <CN | 02.30 | IIc |
| | f | Quantum electrodynamics | 140XII | - | 535.14 | - | C68 | - | |
| | g | Field theory | - | 530.14 | - | - | - | - | IIc |
| | h | Elementary particles | 150III | 539.721 | 539.12 | - | C9B | 12.00 | V |
| 3 | | Nuclear physics | 150 | 539.7 | 539.14/.17 | BEH | C9B3 | 13.00 | <V |
| 4 | | Plasma physics | 140XIII | 537.16 | 533.9 | - | - | 14.60 | VIIa |
| 5 | | Atoms and molecules, etc. | 160B | 539.1 | 539.18/.19 | <BE | C9B1/2 | 14.00 | VI |
| | a | Atomic electron shells | 160BIIa | 539.14 | 539.184 | BED | - | 14.20 | VIa |
| | 1 | Atomic spectra | 160BIIa | <539.14 | - | - | - | - | - |
| | 2 | Electrical, magnetic props. | - | - | - | - | - | - | - |
| | 3 | Interatomic forces collisions | - | - | 539.186 | - | - | - | - |
| | b | Molecules (subdivide as ε) | 160BIIb | 539.12 | 539.19 | BER | - | 14.30 | VIb |
| | c | Spectroscopy | 160C | 535.84 | 535.33 | BFN | C5:3 | <08.35 | - |
| | 1 | Individual atoms | 160CIc | - | <535.33 | - | - | - | - |
| | 2 | Individual molecules | 160CId | - | 535.333 | - | - | - | - |
| | 3 | Intermolecular interactions | - | - | - | - | - | - | - |
| | 4 | Plasma, flames | - | - | 535.343.1 | - | - | - | - |
| | 5 | Crystals | - | - | 535.343.2 | - | - | - | - |
| | 6 | Methods | 160CIb | - | 535.33.03 | - | - | 08.35 | - |

Continued overleaf



Table 6

Table 6 (continued)

| | | Bull.sig. | Dewey | UDC | Bliss | Colon | Phys.Abs. | Phys.Ber. |
|---|---|---|---|---|---|---|---|---|
| d | Magnetic resonance | - | - | - | - | - | 14.32 | - |
| 1 | Nuclear | - | - | - | - | - | - | - |
| 2 | Electron | - | - | - | - | - | - | - |
| e | Luminiscence | 130EIIe | 535.35 | 353.37 | BIC | C5:73 | 17.95 | VIII15 |
| f | Physical optics | 130EVI | 535.2 | <535 | <BI | - | 08.40 | - |
| g | Geometrical optics | 130EVIII | 535.32 | 535.31 | BIK | - | 08.20 | - |
| h | Light sources, etc. | 130EVa | - | 535.89 | BIC | C51:1 | - | - |
| 1 | Pyrometry | - | - | 536.52 | - | - | - | - |
| 2 | Photometry | 130EIV | 535.22 | 535.24+.65 | BIG | C51:28 | 08.10 | - |
| i | Physiological optics | 130EIIIa | 612.84 | 535.7 | HWB | L185:3 | 08.60 | - |
| j | Photography | 130EXIV | 770 | 77 | CFP | M95 | 08.50 | - |
| 6 | Gases, liquids, solids, polymers | 130C+160A | 530.4 | - | BG | C2 | 15/17 | VII/VIII |
| a | Gases, vapour, liquids | 160AIII | 530.42/.43 | 532/533 | BGG | C25/28 | 15.00 | VII |
| b | Macromolecular and vitreous | 160AIf | - | 539.213 | - | C215 | 17.10 | - |
| c | Solids | 130C+160AI | 530.41 | 539.21 | <BGP | C21 | 17.00 | VIII |
| 1 | Theory | - | - | - | - | - | - | - |
| 2 | Structure | - | - | <539.2 | - | C21,8 | 17.05 | VIII1 |
| 3 | Elastic properties | 130CV | 531.38 | 539.3 | <BGE | C21,2 | <17.50 | VIII3 |
| 4 | Diffusion | - | - | 539.378.3 | - | C21,93 | 17.37 | - |
| 5 | Phase equilibria | - | - | - | - | - | - | - |
| 6 | Crystallisation and melting | | 536.42 | 536.421 | BGV | C4:51 | 17.34 | - |
| 7 | Real crystal | | 548.8 | 548.7 | - | - | 17.15 | VIII 1 |
| 8 | Mechanical properties | 130CVI | - | - | BGE | C21:2 | 17.50 | VIII3 |
| 9 | Effect of radiation | - | - | - | - | C210C5 | 17.45 | VIII 2 |
| d | Solid dielectrics and semiconductors | | | 537.311.33 | | | | |
| e | Solid metals | 160AIc | 669.9 | 537.311.31 | CK | C21E191 | 17.61 | VIII10 |
| 7 | Radiophysics, electronics, acoustics | - | - | - | - | - | - | - |
| a | Radiophysics | 140XIV | 537.12 | 538.56 | BLR | C5 | 07.00 | IVg |
| b | Physical electronics | 140IX+XI | 537.5 | 937.533.7 | - | C9B5 | <11.00 | <IV |
| c | Acoustics | 130D | 534 | 534 | BP | C3 | 03.30 | IIIe |
| | Gaps | | 23 | 13 | 26 | 26 | | |
| | Inversions | | 13 | 15 | 13 | 10 | | |
| | 56 RZ classes | | | | | | | |

Table 6 (continued)

Bulletin signalétique - 160: Structure of matter

Table 7

| | | | Ref.Zh.* | Dewey | UDC | Bliss | Colon | Phys.Abs |
|---|---|---|---|---|---|---|---|---|
| 160 | | Structure of matter | E5/6 | 530+539 | 539 | BG | C2 | |
| A | | Condensed state | | - | - | - | - | |
| I | a | Solids, general | E6c | 530.41 | 539.2/.8 | BGP | C21 | 17.00 |
| | b | Superconductivity | | 537.623 | 537.312.62 | <BKF | - | 17.63 |
| | c | Magnetism | <E6d/e | 538 | 538.22 | BL | C210C7 | 17.80 |
| | d | Semiconductors, dielectrics | E6d | 537.24+.622 | 537.226+.311 | BJH | - | 17.66+17.69 |
| | e | Metals and alloys | E6e | 669.9 | 537.311.31 | CKB | - | 17.61+17.05 |
| | f | Vitreous and amorphous | <E6b | - | 539.213 | - | C215 | 17.10 |
| II | | Mesomorphic state | | - | 548-15 | BGN | - | |
| III | | Liquids | <E6a | 530.42 | 539.266 | BGL | C25 | 15.50 |
| B | | Atomic and molecular physics | E5 | 539.1 | 539.18/.19 | <BE | - | 14.00 |
| I | a | Theoretical, general | E5a | - | 539.1.01 | - | | |
| | b | Classical theories | | - | - | BEF | - | |
| | c | Quantum theories | | 530.12 | 530.145 | BFJ | CNI | 10.00 |
| | d | Electron wave functions | | - | - | - | - | |
| | e | Methods of calculation | | - | - | - | - | |
| II | | Particular systems | | | | | | |
| | a | Levels, electron structure and atomic spectra | E5a1 | 539.14 | 539.184 | BED | - | 14.20 |
| | b | Ditto, molecular spectra | E5b1 | 539.12 | 539.194 | BER | - | 14.31 |
| | c | Molecular assemblies | | - | - | - | - | |
| | d | Structural studies | <E5c | - | 539.2 | - | - | |
| III | | Diffusion and collisions | <E5a/b | - | 533.72 | - | - | |
| | a | Elastic and melastic | | - | - | - | - | |
| | b | Reactive | | - | - | - | - | |
| | c | Ionisation, electron capture | | - | - | BEQ | - | 14.50 |
| | d | Excitation, lifetime | | - | 539.186+.196 | - | - | |

Continued overleaf



Table 7

Table 7 (continued)

| | | | Ref.Zh.* | Dewey | UDC | Bliss | Colon | Phys.Abs. |
|---|---|---|---|---|---|---|---|---|
| C | | Spectroscopy | E5c | | 535.33 | BFN | E:3E5 | 08.35 |
| I | a | Structures determined optically | | | | - | - | |
| | b | Apparatus, techniques | E5c6 | 535.84 | <535.33 | BFN | - | |
| | c | Atomic spectra | E5c1 | 539.14 | <535.33 | - | - | |
| | d | Molecular spectra | E5c2 | 539.12 | <535.33 | - | - | 14.31 |
| | e | Raman spectra | | 535.846 | - | - | E:3E7 | |
| | f | Electro-magneto-optics | | 537.56 | 535.215+ 538.61 | BFQ/BFR | C51:38 | |
| | g | Faraday effect, optical rotation | | 535.524 | 535.56 | BIV | C51:6 | |
| | h | Molecular refraction | | <535.324 | <535.32 | <BFM | C51:23 | |
| II | a | Structures determined by Hertzian waves and multipolar moments | | - | - | - | - | 07.20 |
| | b | Apparatus, techniques | | - | - | - | - | |
| | c | Magnetic moments | | - | 535.336.3 | - | E:3G | |
| | d | Electric moments | | | - | - | E:3F | |
| | e | Quadrupole moments | | - | - | - | - | |
| | f | Cyclotron resonance | | - | - | - | - | |
| III | | Structures determined by Mossbauer effect | | - | - | - | - | |
| IV | | Structures determined by mass spectrometry | | - | 535.336.2 | - | E:3T5 | 14.10 |
| V | | Structures determined by mechanical waves | E6c3 | - | - | - | - | |
| | a | Elastic constants | | - | - | - | - | |
| | b | Relaxation time | | - | - | - | - | |
| | | Gaps | | 25 | 18 | 26 | 31 | |
| | | Inversion | | 9 | 10 | 7 | 3 | |
| | | 46 BS classes | | | | | | |



Table 7 (continued)

Table 8

Physics abstracts - 17. Solid state physics

| | | Dewey | UDC | Bliss | Colon | Solid State Abs. | Phys.Ber. | Ref.Zh* |
|---|---|---|---|---|---|---|---|---|
| 17.05 | Structure of solids | 530.41 | 539.2 | BGP | C21,8 | | | E6c2 |
| 06 | Phase transformations | - | - | BGW | - | ‹A2 | | E6c5 |
| 07 | Surfaces | - | 539.211 | - | C21,4 | ‹A5+B1 | VIII.17 | |
| 08 | Films | - | 539.23 | - | - | ‹A5+B2 | VIII.16 | |
| 09 | Adsorption | - | - | ‹BGQ | - | | | |
| 10 | Non-crystalline state | - | 539.213 | - | C215 | | | E6b |
| 15 | Crystallography | 548 | 548 | CHC | H1:8 | | | |
| 20 | Microstructure | - | 539.24 | - | - | | | |
| 25 | Crystal lattice structures | - | 548.1 | CHH | - | A5 | VIII.I | |
| 30 | Lattice mechanics | - | - | - | - | C2 | VIII.4 | |
| 32 | Acoustical properties | 534.22 | 539.21:534 | ‹CHI | C210C3 | ‹C3 | | E7c |
| 34 | Thermal properties | 548.86 | 539.21:536 | ‹CHI | C210C4 | C4 | VIII.5 | E6c3+d3+e3 |
| 37 | Diffusion | ‹531.7 | 539.378.3 | ‹BGQ | C21,93 | A4d | | E6c4+d4+e4 |
| 40 | Defect properties | - | 548.4 | - | - | A6 | VIII.2 | E6c7 |
| 42 | Colour centres | - | | | | | | |
| 45 | Radiation effects | - | 539.21:535.21 | | C210C5 | ‹B3 | ‹VIII.2 | E6c9+d7+e7 |
| 50 | Mechanical properties | 548.84 | 539.3 | ‹BGQ | C210B7 | A7+C3 | VIII.3 | E6c8+d3+e3 |
| 55 | Electron states | - | - | - | - | C2b | | E6c1+d1+e1 |

Continued overleaf

Table 8

Table 8 (continued)

| | | Dewey | UDC | Bliss | Colon | Solid State Abs.Phys.Ber. | | Ref.Zh* |
|---|---|---|---|---|---|---|---|---|
| 60 | Electrical properties | 548.85 | 539.21:537 | CHK | C210C6 | C5/8 | | E6d5+e5 |
| 61 | Metals, conductors | ‹548.85 | 537.311.31 | BKF | C210C6:21 | C7 | VIII.10 | E6e5 |
| 63 | Superconductivity | 537.623 | 537.312.62 | ‹BKF | - | C8 | VIII.9 | |
| 64 | Superconducting materials and devices | - | - | - | - | C8i | | |
| 66 | Semiconductors | ‹548.85 | 537.311.33 | - | - | ‹C7 | VIII.II | ‹E6d |
| 67 | Semiconducting materials | - | ‹537.311.33 | - | - | | | |
| 68 | Semiconducting devices | - | 621.382 | - | - | | | |
| 69 | Dielectrics | ‹548.85 | 537.226 | BJH | C210C6:211 | C6 | VIII.6 | E6d |
| 70 | Thermoelectric properties | 537.65 | 537.323 | BKP | C210C6:44 | C4e | VIII.12 | |
| 73 | Photo-conductive,-voltaic effects | 537.54 | 535.215 | - | C210C6:45 | C5e | VIII.13 | |
| 77 | Electron and ion emission | 537.533 | 537.58 | BKT | C210C6:25 | C7e | | E7b1 |
| 80 | Magnetic properties | 538 | 538.22 | BLC | C210C7 | C9 | VIII.7 | E6d6+e6 |
| 81 | Paramagnetic | 538.43 | 538.222 | ‹BLC | C210C73 | C9b | | |
| 82 | Ferromagnetic | 538.44 | 538.221 | ‹BLC | C210C74 | | | |
| 83 | Ferrimagnetic | 538.45 | - | - | - | | | |
| 84 | Antiferromagnetic | - | - | - | - | | | |
| 85 | Magnetic resonances | - | - | - | - | ‹C1 | | E5d |
| 90 | Optical properties | 535.2 | 539.21:535 | ‹BI | C210C51 | C5 | VIII.15 | E6d5+e5 |
| 95 | Luminescence | 535.35 | 535.37 | BIC | C210C51:73 | | | E5e2 |
| | Gaps | 17 | 9 | 16 | 17 | | | |
| | Inversions | 7 | 10 | 5 | 6 | | | |

Table 8 (continued)

Bulletin signalétique - 170 Chemistry, main divisions

Table 9

| | | Ref.Zh.* | Dewey | UDC | Bliss | Colon | Chem Abs. | Chem. Zentr. | Curr. Chem. Pap. |
|---|---|---|---|---|---|---|---|---|---|
| 170 A | General and physical | F1a | 541 | 541 | CA/CF | E:1/2 | | | |
| I/II | General | | - | - | CA | - | 65 | | |
| III | Determination of atomic and molecular weights | | 541.222 | 541.23/24 | CCC | E:14 | | | |
| IV | Structure | F1a1 | 541.22 | 541.6 | CBD | E:218 | | | 2 |
| V | Equilibria | <F1a7 | 541.392 | 541.121 | CDD | E:2133 | <68 | <A4 | 3 |
| VI | Solutions | F1a10 | 541.34 | 541.8 | CDV | E:22 | <68 | | |
| VII | Diffusion | | 532.7 | 532.7 | - | - | | | |
| VIII | Rheology, viscosity, adherence, cohesion | | 532.58 | 532.13 | BGG | C2,9 | | | |
| IX | Chemical kinetics | <F1a8 | 541.39 | 541.124 | CDE | E:213 | <67 | A7+B6 | 8 |
| X | Catalysis | <F1a8 | 541.395 | 541.128 | CDI | E:88 | <67 | A7+B6 | |
| XI | Combustion | <F1a8 | 541.361 | 536.46 | <CDG | E:2131 | | | |
| XII | Termochemistry | <F1a7 | 541.36 | 541.11 | CDP | E:24 | 69 | A4+B3 | 7 |
| XIII | Activity and fugacity | | - | - | CDW | - | | | |
| XIV | Radiation chemistry | <F1a9 | 541.35 | 541.15 | CF | - | 74 | | |
| XV | Electrochemistry | F1a11 | 541.37 | 541.13 | CE | E:26 | 77 | A5+B5 | 6 |
| XVI | Surfaces | F1a12 | 541.3453 | 541.183 | CDU | E:232 | <66 | <A6 | 4 |
| XVII | Colloidal and dispersed states | F1a13 | 541.3451 | 541.182 | CDT | E:235 | <66 | <A6 | 5 |
| B | Inorganic | F1b | 546 | 546 | CI/CN | E1 | 78 | | |
| I | History and general | | 546.1 | 546(09) | CI,3 | - | | | 9 |
| II | Kinetics and reaction mechanism | | <541.39 | 546:541.124 | <CD | E1:213 | | A7 | |
| III | Apparatus | | <542 | 546:542.2 | - | - | | | |
| IV | Preparations and properties | | <546 | <546 | CI,P | E1:4 | | A8 | |

Continued overleaf



Table 9

Table 9 (continued)

| | | | Ref.Zh.* | Dewey | UDC | Bliss | Colon | Chem.Abs. | Chem.Zentr. | CurrChemPap. |
|---|---|---|---|---|---|---|---|---|---|---|
| C | | Analytical | F2 | 543/545 | 543 | CG | E:3 | | | |
| I/IV | | General | F2a | <543/545 | 543.2/.5 | CG | - | | G1 | 12a |
| V | | Inorganic | F2b | <543/545 | 543.7 | CI,G | E1:3 | 79 | G2 | 12b |
| VI | | Organic | F2c | 547.3 | 543.8 | CO,G | E5:3 | 80 | G3 | 12c |
| D | | Organic | F3 | 547 | 547 | CO/CR | E5 | 21/30 | | |
| I/IV | | General | F3a | | 547.1 | CO | - | | | |
| V | | Preparations and properties | | <547 | <547 | COT | | | C | |
| | a | Synthesis | F3b1 | 547.2 | - | COM | E5:4 | | | |
| | b | Organometallics | F3b6 | - | <547 | COV | E5191 | 29 | | 10 |
| | c | Aliphatics | F3b2 | 547.4 | 547.2/.4 | CPA | E6 | 23 | C1 | 11a |
| | d | Benzene compounds | <F3b4 | 547.611 | 547.5 | CQH | E71 | 25 | <C2 | 11d |
| | e | Aromatics condensed | <F3b4 | 547.615 | 547.6 | CQJ | E7 | 26 | <C2 | 11d |
| | f | Cyclanes, terpenes, steroids | F3b3+F3c2 | 547.5+.7 | 547.51+ 547.59+ 547.92 | CQA+ CRN | E79+996 | 24+30+32 | | 11e |
| | g | Heterocyclics | F3b5 | 547.59 | 547.7/.8 | CR | E8 | 27/28 | C3 | 11b |
| | h | Carbohydrates | F3c1 | 547.78 | 547.45 | CRO | E68 | 33 | | 11c |
| | i | Amino-acids and peptides | F3c7 | - | 547.96 | CPM | E92Z | 34 | | 11b |
| | | Gaps | | 4 | 3 | 2 | 9 | | | |
| | | Inversions | | 13 | 10 | 11 | 8 | | | |
| | | 38 BS classes | | | | | | | | |

Table 9 (continued)

Table 10

Bulletin signalétique - 170A: General and physical chemistry

| | | | Ref.Zh* | Dewey | UDC | Bliss | Colon |
|---|---|---|---|---|---|---|---|
| 170A | | General & physical chemistry | Fla | 541 | 541 | CA/CF | E:1/2 |
| I | | General and history | | - | 541(09) | CA | - |
| II | | Apparatus & techniques | | 542 | - | CAL | - |
| III | | Determination of atomic and molecular weight | | 541.222 +225 | 541.23/.24 | CCC | E:14 |
| IV | | Chemical structure | Fla1 | 541.22 | 541.6 | CBD | E:218 |
| V | a | Equilibria | <Fla7 | 541.392 | 541.121 | CDD | E:2133 |
| | b | Homogeneous | | - | 541.122 | - | - |
| | c | Heterogeneous | | - | 541.123 | - | - |
| VI | a | Solutions | Fla10 | 541.34 | 541.8 | CDV | E:22 |
| | b | Properties | | 541.341 | - | - | - |
| | c | Solubility curves | | 541.342 | 532.739 | CCK | E:2201 |
| | d | Dissociation constants | | 541.3722 | 541.132 | CEH | - |
| | e | Solvents | | 541.3482 | - | - | - |
| VII | | Diffusion | | 532.7 | 532.7 | - | - |
| VIII | | Rheology, viscosity, adherence, cohesion | | 532.58 | 532.13 | BGG | C2,9 |
| IX | a | Chemical kinetics | <Fla8 | 541.39 | 541.124 | CDE | E:213 |
| | b | Analysis of reactions | | - | - | CDG | - |
| | c | Chain reactions | | <541.393 | 541.124.7 | - | - |
| | d | Reaction rate measurement | | 541.394 | 541.127.1 | CDH | - |
| X | | Catalysis | <Fla8 | 541.395 | 541.128 | CDI | E:88 |
| | a | Homo-and hetero-geneous | | - | 541.128.1 | - | - |
| | b | Catalysts | | - | <541.128 | - | - |
| XI | | Combustion and flames | <Fla8 | 541.361 | 536.46 | <CDG | E:2131 |
| | a | Explosions | | - | 541.126 | - | - |
| | b | Deflagrations | | - | - | - | - |
| | c | Detonations | | - | - | - | - |
| | d | Heats of combustion | | 541.362 | 536.662 | - | - |
| XII | | Thermochemistry | <Fla7 | 541.36 | 541.11 | CDP | E:24 |
| | a | Theories | | | | | |
| | b | Thermodynamic properties | | <541.369 | <536.7 | CDN | - |
| XIII | | Activity and fugacity | | - | - | CDW | - |
| XIV | a | Radiation chemistry | <Fla9 | 541.35 | 541.15 | CF | |
| | b | Chemical changes | | - | - | CFD | - |
| | c | Chemi-luminescence | | - | 535.379 | - | - |
| | d | Photochemistry of sensitive layers | | - | 541.14 | CFI | E:25 |
| XV | a | Electrochemistry | <Fla11 | 541.37 | 541.13 | CF | E:26 |
| | b | Electrolytic solutions | | 541.372 | <541.13 | CEE | - |
| | c | Interfaces | | - | - | - | - |
| | d | Electrochemical kinetics | | - | - | - | - |
| | e | Electrodeposition | | 545.34 | 621.357.7 | - | - |
| | f | Anodic solution and oxidation | | - | <541.138.2 | CER | - |
| | g | Corrosion, cathodic and anodic protection | | 620.162 | <541.138.2 | CKI | - |
| | h | High temperatures | | 541.3687 | 541.136.86 | CDR | - |
| | i | Electrochemical generators | | 621.35 | 541.136 | CEK | - |
| | j | Surface treatment | | - | 621.357.8 | CKV | - |
| | k | Electrochemical preparations | | - | 542.8 | CET | E:86 |

Continued overleaf

Table 10 (continued)

| | | | Ref.Zh* | Dewey | UDC | Bliss | Colon |
|---|---|---|---|---|---|---|---|
| XVI | a | Surfaces | Fla12 | 541.3453 | 541.183 | CDU | E:232 |
| | b | Surface tension and capillarity | | <ditto | 532.6 | BGU | C2,4 |
| | c | Interfaces, liquid gas and liquid-liquid | | ditto | 532.613.4 | - | - |
| | d | ditto, solid-liquid | | ditto | 532.613.2 | - | - |
| | e | ditto, solid-gas | | ditto | 532.613.3 | - | - |
| | f | ion exchange, selective adsorption | | 541.3723 | 541.183 | - | - |
| | g | Adsorbents | | - | <541.183 | - | - |
| | h | Surface-active substances | | 668.1 | - | - | - |
| XVII | a | Colloidal and dispersed states | Fla13 | 541.3451 | 541.18 | CDT | E:235 |
| | b | Apparatus and techniques | | - | 541.18.05 | - | - |
| | c | Granulometry | | - | - | - | - |
| | d | Physical & chemical studies | | - | - | - | - |
| | e | Micelles | | - | - | - | - |
| | f | Thin films | | <541.3453 | - | BGU | - |
| | g | Electrokinetic phenomena | | - | - | - | - |
| | h | Constitution and structure | | - | 541.18.02 | - | - |
| | i | Emulsions, suspensions, gels, aerosols | | <541.3451 | 541.182 | BGR | E:236+238 |
| | j | Porosity | | 531.7 | 539.217.1 | - | - |
| | k | Permeability | | <532.7 | 539.217.3 | - | - |
| | | Gaps | | 25 | 16 | 30 | 45 |
| | | Inversions | | 14 | 19 | 12 | 5 |
| | | 65 BS classes | | | | | |

Bulletin signalétique - 320/370: Biology, main divisions

Table 11

| | | Ref.Zh* | Dewey | UDC | Bliss | Colon | Biol.Abs* | Ber.ges.Bicl.* | Int.Abs.Biol.Sci* |
|---|---|---|---|---|---|---|---|---|---|
| 320 | Biochemistry, biophysics etc. | | 574.19 | 577/578 | - | - | | | |
| A I | Biochemistry | H | 574.192 | 577.1 | EH/EF | E9G | 14+32 | C | C |
| II | Chemical constituents | | 574.1921 | 577.11 | EHF | - | | | |
| III | Body fluids and tissues | Ille/f | - | - | <EHF | - | 25 | | F11 |
| IV | Enzymes | H3 | 574.1925 | 577.15 | EIP | E982 | 16 | <D | C6 |
| V | Metabolism | | <574.13 | 576.343 | EJM | G33E | | <D | |
| B I | Analytical biochemistry | | <543/545 | 578 | EHG | E9G:3 | | | C15 |
| II | Physical methods | | 543.08 | 578.088 | EHB | E9G:3B | | | |
| III | Chemical methods | | - | 578.088.1 | EHG | E9G:3J | | | |
| IV | Biological methods | | - | - | - | E9G:3X | | | |
| C I | Biophysics | I2 | <574.191 | 577.3 | EAB | GOC | 15+32 | | |
| II | Physical properties | | - | - | - | - | | | |
| III | Physical Agents | | 574.191 | - | - | - | 10 | | |
| IV | Physical phenomena | | - | - | - | - | | | |
| D | Biological and medical engineering | | - | - | - | - | | | |
| 360 | Zoology | I6 | 590 | 59 | G | K | | | |
| A I | Animal biology | | 591 | 591 | GA/GI | - | | | |
| II | Geographical distribution | I6a4 | 591.9 | 591.9 | GH | KOU | | J | |
| III | Ecology | I6a3 | 591.5 | 591.5 | GG | K:5 | <13 | I | |
| IV | Ethology | | - | <591.5 | - | - | | | |
| V | Cytology | I1b4 | 591.8 | 591.81 | EC | G11 | <4 | H | F1 |
| VI | Morphology & histology | I6a2 | 591.4 | 591.4+8 | GA | K:2 | 17 | | A |
| VII | Embryology | I10b | 591.33 | 591.3 | EE | K:7 | | | F3 |
| B | Protozoa & invertebrates | I6b | 592/595 | 592/595 | GL/GT | K1/8 | 42+43 | | |
| C I | Vertebrates | | 596/599 | 596/599 | GU/GY | K9 | 44 | | |
| II | Cellular physiology | | 574.876< | 576.3 | ECT | G11:3 | <4 | | |
| III | Tissue culture, etc. | | 636.08 | 578.085.23 | EBC | | | | F4 |
| IV | Development | | 591.3 | 591.3 | GDQ | K9:7 | | | |
| V | Metabolism | I11c | <591.13 | 591.133 | GDH | K9:33 | 20 | D | F2 |

Continued overleaf

Table 11

Table 11 (continued)

| | | Ref.Zh* | Dewey | UDC | Bliss | Colon | Biol.Abs.* | Ber.ges.Biol.* | Int.Abs.Biol.Sci.* |
|---|---|---|---|---|---|---|---|---|---|
| VI | Nutrition | I11j | <591.13 | 591.13 | GDK | K9:573 | 21 | | F6 |
| VII | Respiration | I11i | 591.12 | 591.12 | GEE | K9:36 | 27 | | F7 |
| VIII | Communication | I12d | 591.59 | 591.58 | GFY | - | | | |
| IX | Excretion | I11k | 591.14 | 591.149 | GEI | K9:35 | 26 | | F8 |
| X | Circulation | I11g | 591.11 | 591.112 | GEA | G3 | 24 | | F9/10 |
| XI | Nervous system | I12a/c | 591.48 | 591.18 | GF | G7 | | | F9/10 |
| XII | Integument | I10j | <591.47 | <591.47 | GEW | G87 | | | |
| XIII | Skeleton | <I10e | <591.47 | 591.471.3 | GCT | G82 | 31 | | |
| XIV | Muscular system | <I10e | 591.47 | 591.473 | GER | G83 | 30 | | |
| XV | Movement | | 591.18 | 591.17 | GEP | - | | | |
| XIV | Applied physiology | | - | - | - | - | | | |
| D | Vitamins, growth factors | H4a | 574.1926 | 577.16 | GDP | E97 | | <C | C8 |
| | Reproduction, endocrinology, geretics | | - | - | - | E:6 | | | |
| A | Sexual reproduction | | 574.166 | 577.8 | GEO | G:675 | 28 | | F12 |
| B | Hormones | H4b | 574.1927 | 577.17 | GEL | E:986 | 29 | <C | C9+F13 |
| C | Genetics | I1c1 | 575.1 | 575.1 | EN | G:6 | 5 | | |
| I | Botany, plant biology | I4 | 580 | 580 | F | I | | | |
| II | Cytology | I1b3 | 581.8 | 576.3 | EC | G11 | <4 | <B | E14 |
| III | Morphology and systematics | | | | | | | | |
| IV | Physiology | | 581.1 | 581.1 | FD/FF | I:3 | <32 | | |
| V | Reproduction | | 581.16 | 581.16 | FER | I:67 | | | |
| VI | Development | I5g | 581.3 | 581.14 | FDI | I:7 | | | E8/11 |
| VII | Parasitisin & symbiosis | | 581.55 | 581.557 | <FF | I:56 | | <I | |
| VIII | Evolution | <I1d | 581.38 | 576.12 | ENZ | I:66 | <3 | | |
| IX | Plant and environment | | 581.5 | 581.5 | FF | I:5 | | | |
| | Gaps | | 9 | 8 | 9 | 12 | | | |
| | Inversions | | 18 | 18 | 20 | 14 | | | |
| | 54 BS classes | | | | | | | | |

Table 11 (continued)

Table 12

Bulletin signalétique - 320 A Biochemistry

| | | | Ref.Zh.* | Dewey | UDC | Bliss | Colon |
|---|---|---|---|---|---|---|---|
| 320 A | I | Biochemistry | H | 574.192 | 577.1 | EH/EI | E9G |
| | II | Chemical constituents | | 574.1921 | 577.11 | EHF | - |
| | a | Inorganic, mineral | | 574.19214 | :546 | EHI | EI |
| | b | Glucides | | - | :547.918 | EIR | E6898 |
| | c | Lipoids | | 574.19293 | :547.915 | EIT | E96 |
| | d | Steroids, terpenes | | - | :547.92 | EIU | E996 |
| | e | Protides | H2b | 574.19296 | :547.96 | EID | E92Z |
| | f | Alkaloids | | - | :547.94 | EIL | E92 |
| | g | Nucleic acids | H2c | - | - | EIl | - |
| | h | Pigments | | 574.19297 | :547.97 | EIV | E95 |
| | i | Natural substances, plant | | 581.192 | :547.992 | - | - |
| | j | ditto, animal | | 591.192 | - | - | - |
| | k | Vitamins, hormones | H4 | 574.1926 | 577.16/.17 | EIO | E97+986 |
| | III | Body fluids and tissues | | - | - | GCW | - |
| | a | Blood | | 612.11 | 612.12 | GEB | G35 |
| | b | Urine | | 612.461 | 612.46 | GEI | G515 |
| | c | Tissues | | 574.82 | 576.72 | GC | G12 |
| | d | Cellular biochemistry | | 574.876 | 576.311.1 | ECU | E9G11 |
| | IV a | Enzymes | H3 | 574.1925 | 577.15 | EIP | E982 |
| | b | Hydrolases | | - | 577.152 | - | E9822 |
| | c | Oxidases reductases | | 574.19258 | 577.158 | - | E9821 |
| | d | Desmolases | | - | 577.158 | - | - |
| | e | Transfer, isomerising and synthesising | | - | - | - | - |
| | V | Metabolism | | 574.13 | 591.133 | EJM | G:33 |
| | a | Inorganic, mineral | | 581.1335 | 591.133 | EHJ | G:33E1 |
| | b | Intermediate | | - | - | - | - |
| | c | Glucides | | - | - | EIR | G:33E6898 |
| | d | Nitrogen | | - | 581.133.1 | EHL | G:33E150 |
| | e | Lipids and steroids | | 581.13346 | - | EIT/EIU | G:33E96+996 |
| | f | Other plant substances | | - | - | - | - |
| | g | Photosynthesis | | 581.13342 | 581.132 | EAJ | G:33E981 |
| | | Gaps | | 12 | 7 | 8 | 8 |
| | | Inversions | | 5 | 6 | 8 | 6 |
| | | 31 BS classes | | | | | |

Classifications of general and physical chemistry (see also the Bulletin signalétique classification in Table 8) Table 13

Chem.abs.

65 General phys. chem.
66 Surface chem., colloids
67 Catalysis, reaction kinetics
68 Equilibria, solutions
69 Thermo-dynamics, - chem.
70 Crystallisation and crystal structure
71 Electric phenomena
72 Magnetic phenomena
73 Spectra, optical props.
74 Radiation and photochem.
75 Nuclear phenomena
76 Nuclear technology
77 Electrochem.

Chem.zentr.

A General, physical inorganic chem.
A1 Atomic nuclei
A2 Atoms, molecules
A3 Solids, liquids
A4 Thermodynamics, equilibrium gases, liquids
A5 Electrochem
A6 Colloid chem, interfaces
A7 Kinetics, catalysis
B Physical organic chem.
B1 Optical, electric, magnetic props, spectra
B2 Structure determination
B3 Thermodynamics
B4 Equilibria
B5 Electrochem.
B6 Kinetics, catalysis

Ref.zh.*

0 General
1 Theory of molecular structure and chemical bonding
2 Experimental structure determination
3 Crystal chem. and crystallography
4 Chem. of solids
5 Gases, liquids, amorphous
6 Radiochem., isotopes
7 Thermo-dynamics, -chem., equilibria
8 Kinetics, combustion, explosions, topochem, catalysis
9 Photo-, radiation and plasma chem.
10 Solutions, acids and bases
11 Electrochem.
12 Surface chem.
13 Colloid chem.

Curr.chem.pap.

1 Subatomics
2 Atomic and molecular structure
3 Phases
4 Surface props
5 Colloids and macromolecules
6 Electrochem.
7 Thermodynamics
8 Kinetics, mechanism

Dewey

541.2 Theoretical chem.
.22 Molecular structure
.24 Atomic structure
.26 Stoichiometry
.28 Quantum chem.
.3 Physical chem.
.34 Solutions, colloids
.35 Photochem
.36 Thermo-chem,-dynamics
.37 Electro-magnets-chem
.38 Radiochem.
.39 Kinetics, mechanism
.7 Optical activity

Bliss

CB Physical chem.
D Chem. constitution
E Constitution and props.
G Stereochem.
J Chem. combination
O Isomerism, etc
S Adsorption
T Polarization
CC Stoichiometry
C/G Atomic, molec. weights
H/J Thermal props.
K Solubilities



Continued overleaf

Table 13 (continued)

UDC

| | |
|---|---|
| 541.1 | Physical chem. |
| .11 | Thermochem.,-dynamics |
| .12 | Chem. mechanics |
| .13 | Electrochem. |
| .14 | Photochem. |
| .15 | Radiation chem. |
| .17 | Topochem |
| .18 | Colloid chem. |
| .2 | Atomic theory |
| .5 | Valency, affinity, bonds |
| .6 | Structure in relation to properties |
| .7 | Allotropy |
| .8 | Solutions |

Bliss (continued)

| | |
|---|---|
| CD | Chemical dynamics |
| C | Statics |
| D | Equilibria |
| I | Catalysis |
| L | Piezochem |
| M | Valency |
| N | Thermodynamics |
| P | Thermochem |
| T | Colloids |
| U | Surface chem |
| V | Solutions |
| CE | Electrochem |
| CF | Radio-,photo-chem |

Colon

| | |
|---|---|
| E:2 | Physical chem. |
| 21 | Chem.combination (incl:Molec.structure) |
| 22 | Solution |
| 23 | Mixture (incl. Surface, colloid) |
| 24 | Thermodynamics |
| 25 | Photochem |
| 26 | Electrochem |
| 27 | Magnetochem |
| 28 | Stereochem |
| 296 | Radiochem. |

Sample comparison with TEST

Table 14

| | Dewey | UDC | Bliss | Colon |
|---|---|---|---|---|
| Thermodynamic properties | <536.7 | <536.7 | <BHB | <C4:7 |
| Dissociation energy | | - | | |
| Enthalpy | | - | | |
| Entropy | 536.73 | 536.75 | BHE | |
| Free energy | | 536.77 | | |
| Gibbs free energy | | <536.775 | | |
| Helmholtz free energy | | <536.775 | | |
| Solidification points | <536.42 | 536.421.4 | <BGV | |
| Thermal expansion | <536.41 | 536.41 | <BHQ | |
| Thermochemical | <541.362 | | CDP | |
| Heat of ablation | | - | | |
| absorption | | - | | |
| activation | | - | | |
| adsorption | | 536.658 | | |
| crystallization | | - | | |
| mixing | | - | | |
| Heat of reaction | <541.362 | 536.66 | | |
| Calorific value | | - | | |
| Combustion | <541.362 | 536.662 | | |
| Dissociation | | 536.657 | | |
| Formation | <541.362 | - | | |
| Hydration | | 536.664 | | |
| Heat of solution | <541.362 | 536.653 | | |
| transformation | | 536.656 | | |
| Latent heat | | 536.65 | | |
| of fusion | <536.42 | 536.652 | | C4:514 |
| of sublimation | 536.445 | 536.654 | | |
| of vaporisation | <536.443 | 536.655 | | C4:554 |
| Thermophysical | | | | |
| Boiling point | <536.443 | 536.423.1 | <BGV | C4:552 |
| Critical point | <536.443 | 536.44 | <BGV | C4:582 |
| pressure | | - | <BGJ | |
| temperature | | - | <BGV | |
| volume | | - | | |
| Emissivity | | | <BHW | |
| Melting point | <536.42 | 536.421.1 | <EGV | C4:512 |
| Peltier effect | | 537.322 | | |
| Pyroelectricity | 537.65 | 537.227 | BKW | |
| Seebeck effect | | - | | |
| Sensible heat | | - | | |
| Softening points | | 536.421.2 | | |
| Specific heat | 536.63 | 536.63 | BHJ | C4283 |
| Sublimation pressure | | 536.422.15 | | |
| Surface energy | | - | | |
| Thermal conductivity | 536.2012 | 536.2.022 | BHU | <C424 |
| Thermal diffusivity | 536.2014 | - | | |
| Thermal stability | | - | | |
| Vapour pressure | | 536.423.15 | | |
| Volatility | | 536.423.16 | | |

Table 15

Summary of comparisons with TEST

| Hierarchy | Terms | Dewey | Bliss | Colon | UDC | Comments |
|---|---|---|---|---|---|---|
| Acid halides | 6 | 1 | 1 | 1 | 6 | B and C not specific |
| Acyclic alcohols | 9 | 1 | 6 | 6 | 9 | B not specific |
| Aerodynamic characteristics | 14 | 10 | 1 | 0 | 11 | B not specific |
| Aldehydes | 10 | 5 | 1 | 6 | 10 | B and D not specific, D scattered |
| Algebra | 54 | 15 | 19 | 18 | 23 | B,D,C not specific & scattered, U scattered |
| Alkaloids | 26 | 1 | 1 | 1 | 24 | |
| Alkene compounds | 32 | 2 | 3 | 9 | 32 | B not specific; C scattered |
| Aluminum alloys | 16 | 1 | 1 | 1 | 16 | |
| Aluminum inorganic compounds | 13 | 3 | 1 | 13 | 13 | Some B not specific C scattered |
| Amides | 43 | 6 | 1 | 4 | 35 | B,D,C not specific, D scattered |
| Analysis (maths) | 90 | 19* | 42 | 40 | 42 | B often not specific; B,C,D scattered |
| Aquatic animals | 49 | 45 | 45 | 7* | 16 | D and U often not specific, B sometimes; B,C,D,U scattered; U has few vernacular names in schedule. |
| Bacteria | 180 | 24 | 38 | 1 | 48 | D often not specific. B scattered |
| Beams(radiation) | 12 | 2* | 1* | 1* | 6 | D and B not specific, U scattered |
| Body fluids | 13 | 8* | 10* | 4* | 8* | B,C,U scattered, B and D not specific |
| Bosons | 9 | 4* | 2* | 1* | 3* | B not specific, U scattered |
| Capacitors | 12 | 1 | 1 | 0* | 11 | B not specific |
| Carbides | 18 | 18 | 0* | 18 | 18 | B scattered |
| Carbohydrates | 33 | 6 | 20 | 13 | 30 | |
| Cardiovascular system | 13 | 10 | 8* | 8 | 12 | B and D not specific |
| Celestial bodies | 32 | 25 | 25 | 20 | 24 | B and D scattered |
| Cements | 26 | 3* | 2 | 1 | 7 | |
| Chemical properties | 27 | 9* | 3* | 2* | 12* | D not specific and scattered, U scattered |
| Chemical reactions | 92 | 27* | 4* | 4* | 32 | B,C,D scattered and not specific |
| Chemical tests | 30 | 21* | 14* | 11* | 25 | B and D not specific, B,C,D,U scattered |
| Circuits | 48 | 2 | 1 | 0* | 8 | B not specific, U scattered |
| Computer systems hardware | 37 | 2 | 0* | 1 | 13 | C not specific |
| Congenital abnormalities | 37 | 1 | 10 | 0* | 30* | D not specific, B U scattered |
| Crystal defects | 10 | 0* | 0* | 0* | 1 | |
| Crystals | 13 | 1 | 2 | 1 | 6 | |
| Diodes | 12 | 2 | 0* | 0* | 6 | |

Continued overleaf

Table 15 (continued)

| Hierarchy | Terms | Dewey | Bliss | Colon | UDC | Comments |
|---|---|---|---|---|---|---|
| Dispersions | 16 | 7* | 3* | 3* | 6 | B scattered, D not specific |
| Drugs | 89 | 22* | 20* | 1 | 54 | B and D not specific |
| Earth atmosphere | 36 | 12 | 6 | 1 | 5 | D scattered, B not specific |
| Electrical properties | 32 | 10* | 11* | 1* | 15* | B and D scattered and not specific, U scattered |
| Electric current | 18 | 4* | 4 | 3 | 12 | B,U scattered |
| Electromagnetic interference | 23 | 0* | 1 | 0* | 17 | B not specific |
| Electromagnetic properties | 23 | 15* | 11 | 11* | 14 | B,C,D scattered, some not specific, U scattered |
| Electromagnetic radiation | 63 | 12* | 12 | 14 | 26 | B,C,D,U scattered |
| Electron tubes | 46 | 14* | 5 | 0* | 27 | B and D not specific; D scattered |
| Enzymes | 76 | 12 | 5 | 3 | 27 | D scattered |
| Magnetic properties | 22 | 12 | 7* | 5 | 12 | |
| Mechanical properties | 118 | 20* | 6* | 0* | 53 | B and D scattered and not specific |
| Mechanical tests | 37 | 12 | 0* | 0* | 19 | D not specific |
| Mechanical waves | 22 | 6* | 4* | 2* | 11 | B,D,U scattered |
| Number theory | 23 | 8* | 9 | 4 | 14 | B and D not specific, B,C and D scattered |
| Numerical analysis | 25 | 4 | 7 | 4* | 8 | B and D not specific; B,C, D,U scattered |
| Operations research | 22 | 2 | 0* | 0* | 1 | |
| Particle accelerators | 17 | 8 | 3 | 0* | 12 | B and D not specific |
| Spectra | 29 | 8 | 8 | 4 | 23 | B and D not specific, B scattered |
| Statistical analysis | 38 | 1 | 1 | 0* | 6 | |
| Stochastic processes | 5 | 0* | 0* | 0* | 0* | |
| Thermodynamic properties | 49 | 19 | 11 | 8 | 29 | B and D not specific; B,C, D scattered |
| Welding | 48 | 10 | 5 | 0* | 33 | D not specific |
| Totals | 1893 | 493 | 402 | 256 | 961 | |
| Asterisks | - | 21 | 20 | 26 | 6 | |
| Not specific | - | 24 | 30 | 6 | 1 | |
| Scattered | - | 20 | 20 | 13 | 17 | |
| Hierarchies | 54 | - | - | - | - | |

* Highest term not in schedules

Sample comparisons with MESH

Table 16

| | Dewey | UDC | Bliss | Colon |
|---|---|---|---|---|
| 1) Parts of body | 611 | 611.9 | <HD | - |
| Head | 611.91 | - | <HDO | L18 |
| Face | 611.92 | 611.92 | - | L181 |
| Mouth | 611.31 | 611.31 | <HFC | L21 |
| Tongue | 611.313 | 611.313 | <HFC | L213 |
| Taste buds | <611.313 | 611.87 | <HGW | - |
| 2) Nervous system | 611.8 | 611.8 | HG | L7 |
| Peripheral nerves | <611.83 | 611.83 | HGI | L75 |
| Cranial nerves | " | 611.831 | HGGW | L7518 |
| Acoustic nerves | <612.858 | 611.831.8 | HXG | L76183 |
| Cochlear nerve | - | 611.831.81 | - | - |
| 3) Cells | 574.87 | 576.3 | EC | G11 |
| Cytoplasm | 574.8734 | 576.311 | ECH | G112 |
| Organoids | - | - | - | - |
| Endoplasmic reticulum | - | - | - | - |
| Ribosomes | - | - | - | - |
| 4) Animals | 592/599 | 592/599 | GK | K |
| Invertebrates | 592 | 592 | GL | K1 |
| Arthropods | 595.2 | 595.2 | GP | K8 |
| Insects | 595.7 | 595.7 | GQ | K86 |
| Diptera | 595.77 | 595.77 | GQV | K871 |
| Mosquitoes | <595.771 | - | <GQVC | - |
| Anopheles | - | - | " | - |
| 5) Bacteria | 589.9 | 576.85 | FLD | <I21 |
| Actinomycetales | 589.92 | 576.852 | FLDN | - |
| Mycobacterium | <589.92 | 576.852.21 | HQJ | - |
| M.tuberculosis | - | 576.852.211 | HQK | - |
| 6) Infectious diseases | 616.91/.96 | 616.9 | HQ | - |
| Virus diseases | <616.92 | 616.988 | HQQ | L:423 |
| Myxovirus | - | - | - | |
| Influenza | 616.203 | 616.921.5 | HQTB | L4:4241 |
| Asian | <616.203 | - | - | - |
| 7) Hypersensitivity | - | 616.056.3 | <HQAP | - |
| H, immediate | - | - | " | - |
| Anaphylaxis | 616.97 | 612.017.3 | " | - |
| Drug h. | <616.975 | - | - | - |
| Dermatitis medicamentosa | - | 616.5.056.3 | - | - |
| Epidermal necrolysis | - | - | - | - |

Summary of comparisons with MESH

Table 17

| Hierarchy | Length | Dewey | Bliss | Colon | UDC | Comments |
|---|---|---|---|---|---|---|
| Taste buds | 6 | 6 | 5 | 4* | 5 | B,C,D,U scattered |
| Elbow joint | 6 | 6 | 5 | 3* | 5 | B,C scattered |
| Anus | 6 | 5 | 6 | 5 | 5 | U scattered |
| Cochlear vein | 5 | 4* | 4* | 4* | 5 | E,C,D scattered |
| Ribosomes | 5 | 2* | 2* | 2* | 2* | |
| Anopheles | 7 | 6* | 7 | 5* | 5* | |
| Mycobacterium tuberculosis | 4 | 3* | 4 | 1* | 4 | B scattered |
| Asian influenza | 5 | 4 | 3* | 2* | 3* | C,D,U scattered |
| Melorheostosis | 4 | 2* | 2* | 1* | 3* | |
| Ochronosis | 5 | 1* | 1* | 1* | 3 | U scattered |
| Epidermal necrolysis | 6 | 2* | 3* | 0* | 3* | U scattered |
| Calcium phosphates | 5 | 4* | 2* | 5 | 5 | C scattered |
| Uropepsin | 6 | 2* | 2* | 2* | 4* | |
| Glucosamine | 4 | 1* | 1* | 1* | 4 | |
| Splenoportography | 5 | 2* | 2* | 2* | 3* | |
| Totals | 79 | 50 | 49 | 38 | 59 | |
| Asterisks | - | 11 | 10 | 13 | 7 | |

* lowest term not found in classification

Summary of comparisons with Euratom

Table 18

| Chart No. | Name | Keywords Eur. | Keywords UDC. | Non-keywords Eur. | Non-keywords UDC. | UDC core | Keywords + terms Class distribution |
|---|---|---|---|---|---|---|---|
| 44 | Energy & matter | 24 | 9 | 152 | 8 | 13 | 539.1 541.5 |
| 45 | Nuclear reactions | 23 | 16 | 134 | 9 | 12 | 539.17 539.16<br>539.12 539.18<br>539.19 623.45<br>535.34 |
| 46 | Radiations | 26 | 21 | 80 | 7 | 8 | 539.12 539.17<br>537.5 538.56<br>535 621.3<br>616 |
| 47 | Particles | 20 | 13 | 101 | 4 | 9 | 539.12 539.18<br>539.19 537.5 |
| 48 | Protons and neutrons | 21 | 15 | 51 | 1 | 13 | 539.125 539.17<br>621.039 |
| 49 | Leptons and hyperons | 19 | 12 | 75 | 15 | 8 | 539.126 539.124<br>539.123 539.18<br>539.16 537.5<br>621.384 |
| 50 | Reactor types | 5 | 4 | 13 | 8 | 7 | 621.039.52<br>621.039.57<br>621.039.51 |
| 51 | Reactor materials | 23 | 22 | 8 | 3 | 23 | 621.039.53<br>621.039.54<br>621.039.52<br>621.039.51<br>546,212 |
| 52 | Reactor parts | 13 | 10 | 14 | 4 | 10 | 621.039.53<br>621.039.54<br>621.039.55<br>621.039.56<br>621.039.51 |
| 53 | Reactor operation | 26 | 22 | 41 | 10 | 8 | 621.039.56<br>621.039.55<br>621.039.54<br>621.039.58<br>621.03951<br>621.398 62-519<br>614.8 697.9<br>542.1 004 |
| 54 | Radiation detectors | 23 | 18 | 26 | 2 | 12 | 539.1.074<br>539.1.073 539.12<br>539.073 |
| 55 | Plasma physics | 14 | 10 | 66 | 8 | 4 | 533.9 537.5<br>538.4 621.039.6 |
| 56 | Accelerators | 10 | 9 | 23 | 5 | 12 | 621.384.6 539.1 |
| | Totals | 247 | 181 | 784 | 84 | 139 | |

Table 19

Biochemistry in MESH and TEST

MESH

- Biochemistry
  - Blood coagulation
    - B.c. factors
      - Calcium
      - Fibrin
      - Fibrinogen
      - Prothrombin
      - Thrombin
      - Thromboplastin
    - B.c. Tests
      - Thromboelastography
    - Fibrinolysis
    - Prothrombin time
  - Metabolism
    - Basal m.
    - Body temperature
      - B.t. regulation
        - Sweating
      - Hypothermia
    - Calcification
      - Dentition
      - Ossification
    - Carbohydrate m.
      - Krebs cycle
    - Energy m.
    - Hematopoiesis
      - Erythropoesis
    - Lipid m.
    - Mineral m.
      - Iron m.
    - Photosynthesis
    - Pigmentation
    - Protein m.
    - Tissue m.
    - Water-electrolyte balance
  - Nitrogen fixation
  - Nutrition
    - Digestion
      - Defecation
      - Deglutition
      - Eructation
      - Mastication
      - Salivation
      - Urination
        - Diuresis
        - Natruresis
    - Infant n.
      - Breast feeding
      - Lactation
    - N.surveys
  - Respiration
    - Pulmonary circulation

TEST

- Biochemistry
  - Cytochemistry
    - RT Cytology
  - RT Bacteriology
  - Metabolism
    - Carbohydrat. m.
    - Lipid m.
    - Mineral m.
    - Nitrogen m.
    - Oxygen consumption
    - Protein m.
  - Nutrition
    - Animal n.
    - Human n.
      - Infant n.
    - Plant n.
  - Pharmacology
    - Psychoneuropharmacology
  - Physiology
    - Animal p.
    - Comparative p.
    - Electro p.
    - Patho p.
    - Physiological psychology
    - Plant metabolism
    - Plant
    - Plant reproduction
  - Biochemical cycles
    - Carbon dioxide c.
    - Iodine c.
    - Nitrogen c.
    - Phosphorus c.
    - Silicon c.
  - Biochemical oxygen demand

Table 20

Physiology in TEST and MESH

TEST

Physiology
- Animal
- Comparative p.
- Electro p.
- Patho p.
- Physiological psychology
- Plant metabolism
- Plant p.
  - Plant reproduction
- RT Biochemistry (q.v.)
  - Endocrinology
  - Homeostatis
  - Hormones
    - Adrenal cortex h.
      - Aldosterone
      - Corticosterone
      - Cortisone
      - etc
    - Androgens
      - Androsterone
      - Testosterone
    - Corpus luteum h.
      - Progesterone
      - Relaxin
    - Estrogens
      - Estradiol
      - Estriol
      - Estrone
    - Gastrointestinal h.
      - Gastrin
      - Secretin
    - Gonadotropins
      - Prolactin
    - Pituitary h.
      - Corticotropin
      - Intermedin
      - Oxytocin
      - etc
    - Plant h.
      - Gibberellins
    - Progestational h.
      - Pregnanediol
      - etc
    - Thyroid h.
      - Thyroxine
      - etc.
  - Metabolism (see Biochemistry)
  - Neurology
  - Nutrition (see Biochemistry)
  - Pathology
    - Plant p.
  - Peristalsis
  - Physical anthropology
  - Psychology

Continued overleaf

Abnormal psychology
Clinical p.
Criminal p.
etc.
Regeneration
Responses
Avoidance r.
Conditioned r.
Dynamic r.
etc.
Stress
Heat stress

MESH

Physiology
Adaptation
Acclimatisation
Accommodation, ocular
Hibernation
Weightlessness
Aging
Adolescence
Puberty
Geriatrics
Growth
Body constitution
Body height
Body weight
Longevity
Life expectancy
Middle age
Climacteric
Menopause
Pediatrics
Child
Infant
Newborn
Premature
Rejuvenation
Blood circulation
B. pressure
B. viscosity
B. volume
Capillary permeability
Capillary resistance
Maternal-foetal interchange
Pulmonary
Pulse
Plethysmography
Blood coagulation (see Biochemistry)
Death
Cadaver
Sudden d.
Drowning
Fetal d.

Continued overleaf

Digestion (see Biochemistry)
Electrophysiology
Endocrinology
Metabolism (see Biochemistry)
Movement
Exertion
Sweating
Gait
Kinesthesis
Locomotion
Nutrition (see Biochemistry)
Comparative physiology
Psychophysiology
Adaptation
Homeostasis
Orientation
Laterality
Mental processes
Cognition
Learning
(subdivisions)
Perception
Body image
Equilibrium
Hearing
Illusions
Sensations
(subdivisions)
Smell
Taste
Touch
Visual
(subdivisions)
Thinking
(subdivisions)
Emotions
(subdivisions)
Volition
Reflex
(subdivisions)
Stress
Regeneration
Convalescence
Wound healing
Reproduction
Biogenesis
Breeding
Fertilization
Insemination
Artificial
Cell division
Coitus
Ejaculation
Embryology
Metamorphosis

Continued overleaf

Estrus
Fertility
Labor
Delivery
Menstruation
Ovulation
Parthenogenesis
Pregnancy
(subdivisions)
Puerperium
Lactation
Sterility
Respiration
Sneezing
Vision
Visual fields
Perimetry

Viruses in MESH and TEST

Table 21

MESH

Viruses
- Animal v.
  - Adeno v.
  - Arbor v.
    - Encephalitic v.
    - Yellow fever v.
  - Entero v.
    - Coxsackie v.
    - Echo v.
    - Polio v.
  - Herpes v.
    - H.hominis v.
    - Varicella v.
  - Myxo v.
    - Fowl plague v.
    - Influenza v.
    - Mumps v.
    - Newcastle v.
    - Para-influenza v.
  - Pox v.
    - Ectromelia v.
    - Smallpox v.
    - Vaccina v.
  - Tumor v.
    - Avian leukosis v.
    - Myxoma v.
    - Papilloma v.
    - Polyoma v.
    - Rous sarcoma v.

- Bacteriophage
  - Coli p.
  - Mycobacterio p.
  - Salmonella p.
  - Staphylococcal p.
- Insect v.
- Plant v.
  - Tobacco mosaic v.
- Common cold v.
- Distemper v.
- Equine v.
- Foot-and-mouth v.
- Hepatitis v.
- Measles v.
- Rabies v.
- Vesicular stomatitis v.

TEST

Viruses
- Adeno v.
  - Oncogenic v.
  - Polyoma v.
  - Acute respiratory disease v.
- Arbo v.
  - Apen v.
  - Chikungunya V.
  - Colorado tick fever v.
  - Dengue v.
  - Equene encephalo v.
  - Japanese encephalitis v.
  - Kyasanur forest v.
  - Louping ill v.
  - Marituba v.
  - Mayaro v.
  - Omsk v.
  - Oriboca v.
  - Rift Valley v.
  - Semliki forest v.
  - West Nile v.
  - Yellow fever v.
- Bacteriophages
  - Coli p.
- Measles v.
  - Rubella v.
- Myxo v.
  - Influenza v.
  - Mumps v.
  - Newcastle v.
  - Para-influenza v.
  - Sendai v.
  - Swine influenza v.
- Popova v.
  - Papilloma v.
- Picorna v.
  - Entero v.
    - Coxsackie v.
    - Echo v.
    - Polio v.
  - Foot-and-mouth v.
  - Rhino v.
  - Pox v.
    - Vaccina v.
    - variola v.
  - Colorado tick fever v.

Continued overleaf

TEST

Hepatitis v.
Herpetic v.
Hog cholera v.
Miyagawanella v.
Monkey B v.
Plant v.
Rabies v.
Reo v.
Rividerpest v.
Vesicular v.

Table 22

Outline of Farradane's facets

Entities
- Physical
  - Elementary particles
  - Atomic
  - Molecular
  - Molecular assemblage (e.g. liquid)
  - Ordered assembly (e.g.Mineral)
  - Complex aggregate (e.g. Rock)
- Chemical
  - Elements
  - Radicals, ions
  - Compounds
  - Complexes (e.g. Resin)
  - Aggregates (e.g. Milk)
- Living
  - Self-reproducing compounds or complexes (e.g.Virus)
  - Cell components (e.g. Chromosome)
  - Cells (e.g. Cell, Amoeba)
  - Tissues (e.g. Blood)
  - Organs (e.g. Lung)
  - Organ system (e.g. Digestive)
  - Living entity (e.g.Cat)
  - Living group (e.g. Lichen)
- Artefacts
  - Separated natural materials (e.g. Cane juice)
  - Derived single products (e.g. Screw, Sugar)
  - Assemblies (e.g. Machine)
  - Complex assemblies (e.g. Factory)

Activities
- Physical
  - Simple (e.g. Vibrating)
  - Complex (e.g. Grinding)
  - Complex series (e.g. Manufacturing)
- Living
  - Simple physiological (e.g. Breathing)
  - Complex physiological (e.g. Digesting)
  - Combined complex (e.g. Reproducing)
  - Physiological with mental (e.g. Remembering)
- Physical abstract
  - Simple (e.g. Increasing)
  - Complex (e.g. Deteriorating)
  - Combined complex
- Mental abstract
  - Simple (e.g. Counting)
  - Combined (e.g. Calculating)
  - Complex (e.g. Planning)

Abstracts
- Physical (e.g. Light)
- Symbolic
  - Unit level (e.g. Number)
  - Combination (e.g. Formula)
  - Complex (e.g. Circle)
  - Higher level (e.g. Mechanism)

Continued overleaf

- Behavioural
- Space
- Time

Properties

- Pre-concept
  - Physical
    - Simple (e.g. Viscous)
    - Comparative (e.g. Hot)
    - Interactive (e.g. Acid)
    - Interactive with change (e.g. Soluble)
  - Behavioural and physiological
  - Abstract
- Measurable
  - Physical
    - Simple (e.g. Viscosity)
    - Comparative (e.g.Temperature)
    - Interactive (e.g.Acidity)
    - Interactive with change (e.g.Solubility)
  - Behavioural and physiological
  - Abstract

Objects and phenomena in Physics (A.I.P.) Table 23

Objects

1 Mathematical entities
11 Numerical computational and conceptual aid
12 Geometrical entities
13 Algebraic entities
14 State functions and equations
15 Transition matrices and equations
2 Particles, fields, nuclei, atoms and molecules
21 Particles and fields in general
22 Gravitational fields
23 Electromagnetic fields
24 Leptons
25 Hadrons
26 Cosmic rays and fields
27 Complex nuclei
28 Atoms and molecules
3 Chemical elements and their compounds
4 Ensembles and aggregate matter (see Table 25)
5 Astrophysical and geophysical objects
51 Solar system
52 Stars, clusters
53 Interstellar medium
54 Milky Way
55 Galaxies
56 Quasars, pulsars
57 Universe
59 Other extraterrestrial objects
6 Organisms, biological systems, organs
7 Artifacts, devices, instruments, systems
71 Sources
72 Transmission-handling
73 Detection
74 Containment and control
75 Measuring
76 Computing
77 Energy conversion
78 Environmental probes
79 Architectural
8 Conditions of object
e.g. Low temperature

Phenomena and associated properties

1 Mathematical
e.g. Solution of equations
2 Particle, field, etc
21 Mass, energy, frequency, wavelength
22 Velocity, momentum
23 Polarisation
24 Quantum numbers
25 Functions
26 Chemical bond type
27 Geometrical structure
28 Level structure, spectra
29 Interactions

Continued overleaf

Table 23 (continued)

| | |
|---|---|
| 3 | Chemical |
| 4 | Ensemble (see Table 25) |
| 5 | Astrophysical and geophysical |
| 6 | Psychological and physiological |
| 7 | Artifacts |
| 71 | Precision, resolution, noise level, signal/noise ratio |
| 72 | Sensitivity, dynamic range |
| 73 | Output level, intensity, power, gain |
| 74 | Accuracy, stability, etc. |
| 75 | Feasibility, efficiency, cost |
| 76 | Safety, |
| 77 | Design, fabrication |
| 78 | Testing |
| 79 | Operating instructions and parameters |

Ensembles and associated phenomena in Physics (A.I.P.)

Ensembles and aggregate matter

41 Ensembles of particles, molecules, etc
411 Obeying non-quantum statistics
412 Obeying quantum statistics
42 Excitations in aggregate matter
421 Heat
422 Mechanical, elastic and acoustic waves and oscillations
423 Spin waves
424 Quasiparticles
425 Carriers
43 Imperfections
432 Impurities
433 Point defects
434 Dislocations
435 Stacking faults
436 Associated defects
437 Color centers
44 Fluids
441 Plasmas
442 Gases
443 Liquids
446 Quantum fluids
447 Disperse systems
448 Fluid surfaces and interfaces
45 Fluid/solid systems
451 Condensed phases in general
452 Solid/gas
453 Solid/liquid
46 Solids
461 Crystals
462 Films, membranes
463 Amorphous, vitreous, fibrous
464 Solid/solid
47 Phenomenological descriptions of materials
471 Elastic
472 Plastic
473 Viscous
474 Optical
e.g. Luminiscent, photoconductive, laser
475 Electric and magnetic
e.g. Semiconductors, ferromagnetic
476 Alloys
477 Solutions
478 Technological (e.g. refractory)

Phenomena associated with ensembles

41 Structure-related
411 Size, shape, etc
412 Crystal structure
413 Electronic structure
414 Potential barriers, work functions
42 Thermal, thermodynamic and statistical
421 Thermodynamic (e.g. temperature, entropy)
422 Specific heats, heat capacities

Continued overleaf

Table 24 (continued)

| | |
|---|---|
| 423 | Correlation and collective phenomena |
| 4231 | Order parameters, coherence lengths |
| 4232 | Stability, instability |
| 424 | Heat flow, conduction |
| 425 | Diffusion |
| 426 | Phase and state |
| 4261 | Solubility, miscibility |
| 4262 | Phase transitions |
| 4263 | Thermal expansion |
| 4264 | Equation of state parameters |
| 43 | Mechanical and rheological |
| 431 | Density |
| 432 | Elasticity, compression, expansion |
| 433 | Hardness, fracture |
| 434 | Strength, fatigue, aging |
| 435 | Friction, abrasion, wear |
| 436 | Flow, creep, viscosity |
| 437 | Plasticity, deformation |
| 438 | Technological (e.g. ductility) |
| 44 | Electrical and magnetic |
| 441 | Charge density, etc |
| 442 | Electrical polarization, dielectric constant |
| 443 | Magnetization, etc |
| 444 | Electromagnetic transport |
| 450 | Interaction of particles and waves |
| 451 | Wave propagation<br>e.g. Refraction, dispersion, diffraction |
| 452 | Resonances and relaxation |
| 453 | Fluorescence, etc. |
| 455 | Transmission, absorption, etc |
| 46 | Emission |
| 461 | Spontaneous |
| 462 | Stimulated or induced |

Table 25

Properties, processes and phenomena in chemical physics (A.I.P.)

Acoustic and ultrasonic
Bond Structure
Charge distribution
Chemical
Collision processes and scattering
Scattering
Colloidal
Detonation and shock wave
Electric and dielectric
Electron
Electronic states
Energy transfer
Energy and potentials
Fluid
Ionic
Isotope effects
Laser and maser
Liquid crystal
Luminescence
Macromolecular
Magnetic
Mass spectra
Mossbauer spectra
Molecular structure
Nuclear
Nuclide
Optical
Quantum mechanical
Radiation effects
Radiochemical
Relaxation
Rotational
Solid state
Solutions
Spin
Surface and film
Thermodynamic and thermal
Vibrational
X-Ray

Thermodynamic and thermal properties (A.I.P.)
- Accomodation Coefficients
- Activity
- Compressibility
- Critical Properties
  - Critical Point
- Density
- Energy
  - Configurational Energy
  - Energy of Activation
  - Energy of Formation and Dissociation
  - Energy of Fusion
  - Energy of Hydration
  - Energy of Mixing
    - Energy of Solution
  - Energy of Transition
  - Energy of Vaporisation
    - Energy of Evaporation
    - Energy of Sublimation
  - Zero-point Energy
- Enthalpy
  - Enthalpy of Activation
  - Enthalpy of Formation and Dissociation
  - Enthalpy of Fusion
  - Enthalpy of Hydration
  - Enthalpy of Mixing
    - Enthalpy of solution
  - Enthalpy of Transition
  - Enthalpy of Vaporisation
    - Enthalpy of Evaporation
    - Enthalpy of Sublimation
- Enthropy
  - Entropy of Activation
  - Entropy of Formation and Dissociation
  - Entropy of Fusion
  - Entropy of Hydration
  - Entropy of Mixing
    - Entropy of Solution
  - Entropy of Transition
  - Entropy of Vaporisation
    - Entropy of Evaporation
    - Entropy of Sublimation
- Equation of State
  - Virial Coefficients
- Formation Constant; Association Constant
- Free Energy
  - Free Energy of Activation
  - Free Energy of Formation and Dissociation
  - Free Energy of Fusion
  - Free Energy of Hydration
  - Free Energy of Mixing
    - Free Energy of Solution
  - Free Energy of Transition
  - Free Energy of Vaporization
    - Free Energy of Evaporation
    - Free Energy of Sublimation

Continued overleaf

Table 26 (continued)

Heat Capacity
Partition Functions
Phase Transition
Phase Diagram
Pressure
    Partial Pressure
    Vapor Pressure
Temperature
Thermal conductivity
Thermal Diffusion
Thermal Expansion Coefficient
Volume
    Free Volume
    Partial Molar Volume
Work Function

Table 27

| Classification of fundamental sciences (Auger) | Dewey |
|---|---|
| Mathematics: Pure and applied | 510 |
| Mathematics | 510 |
| Algebra | 512 |
| Topology | 514.83 |
| Differential geometry | 516.7 |
| Theory of functions and functional analysis | 517.5 |
| Probability and statistics | 519 |
| Automatics | 510.78 |
| Analogue computers | 510.782 |
| Digital computing | 510.783 |
| The physical sciences | 530 |
| Theoretical physics | 530.1 |
| Asymptotic behaviour as starting point of the theory | - |
| The non-linear spinor theory | - |
| Mathematical methods and quantum field theory | 530.143 |
| Possibilities of a geometric theory of pure field | 530.14 |
| Recent Research on the gravitational field | 521.12 |
| Atomic physics | 539.1 |
| Quantum mechanics of the atom | 530.123 |
| Atomic and physical constants | 539.14 |
| Elementary atomic particles | 539.721 |
| Simple atomic systems | <539.14 |
| Complex composite atomic systems | <539.14 |
| Externally perturbed atoms | <539.14 |
| Internally perturbed complex atomic systems | <539.14 |
| Collisions of atomic particles | - |
| Plasma | 537.16 |
| Radiation and its interaction with matter | <535/537 |
| Nuclear physics and high energy particle physics | 539.7 |
| High energy particle physics | <539.7 |
| Medium and low energy nuclear physics | - |
| Experimental technique | 539.73+.77 |
| Radiant energy | 535/537 |
| Optics | 535 |
| Image formation | - |
| Optical materials | <535.33 |
| Optical receptors | - |
| Electronics | 537.5 |
| Vacuum tubes | <537.53* |
| Gas discharge tubes | <537.53 |
| Electron microscopy | <537.56 |
| Solid state devices | 621.38152 |
| Masers | <537.5344 |
| Parametric amplifiers | <621.381535 |
| Principles of circuity | 537.5353 |
| Electronic instruments | 621.38133 |
| Computers | 621.38195 |
| Telecommunications | <621.38 |
| Radar | 621.3848 |
| Heat transfer and low temperatures | <536 |

* or 621.381512

Table 27 (continued)

| | Dewey |
|---|---|
| Heat transfer and insulators | 536.2 |
| Very low temperature physics | 536.56 |
| Magnetism and electricity | 537/538 |
| Electrostatics | 537.2 |
| Magnetism | 538 |
| Electrodynamics | 537.64 |
| The states of matter | 530.4 |
| Fluid mechanics | 532 |
| Mechanics of conventional fluids | <532 |
| Mechanics of non-conventional fluids | - |
| High pressures | - |
| Thermodynamic properties - The molecular theory of dense fluids | <536.71 |
| The physics of solids at high pressures | - |
| Dynamics of crystal lattices | - |
| The physics of solids at very high pressures- Allotropic transformations | <541.7 |
| Electronic transformations and ionization by compression at extremely high pressures | - |
| Very high dynamic pressures in shock waves | - |
| Chemical reactions at high pressures | - |
| Low pressures | 533.5 |
| Production of the vacuum | 533.54 |
| Measurement of low pressures | - |
| Composition of gases. Leaks | 544.4 |
| Solid state physics | 530.41 |
| Experimental methods | - |
| Structure analysis | 548.8 |
| Mechanical properties | 548.84 |
| Optical properties | 548.9 |
| Semiconductors | 537.622 |
| Work on germanium and silicon | <546.68 |
| Fundamental devices | 621.381.52 |
| Alloys | 546.37 |
| Superconductors | 537.623 |
| Superconductivity | <537.623 |
| Quantum theory of the conductivity of crystals | <548.85 |
| The chemical sciences | 540 |
| General chemistry | 541 |
| Thermochemistry and chemical thermodynamics | 541.36 |
| Electrochemistry | <541.37 |
| Chemical kinetics and combustion | 541.39 |
| Catalysis and catalysts | 541.395 |
| Analytical chemistry | 543/545 |
| Nuclear chemistry | 541.38 |
| Chemical effects of radiation | ditto |
| Radiochemistry | ditto |
| Inorganic chemistry | 546 |
| Inorganic macromolecules | <541.2254 |
| Compounds of the transition metals | 546.62/64 |
| Fluorine derivatives | 546.731 |
| Compounds for the electronics industry | - |
| Non-metallic materials for astronautical purposes | - |

Continued overleaf

Table 27 (continued)

| | Dewey |
|---|---|
| Metallurgical chemistry | 669.92 |
| The vitreous state | - |
| Organic chemistry | 547 |
| Organo-metallic chemistry | 547.05 |
| Silicon compounds | 547.08 |
| Organic fluorine compounds | <547.02 |
| The biological sciences | 570/590 |
| Biochemistry and biophysics | 574.19 |
| Intermediary metabolism | - |
| Photosynthesis | 581.13342 |
| Enzyme biocatalysis (enzymology) | 574.1925 |
| Chromosome biochemistry | <574.8732 |
| Cell biology | 574.87 |
| Ultra-microscopic structure | - |
| Transport through membranes | <574.875 |
| Excitability and contractility | - |
| Differentiation and ageing | 574.8765 |
| General physiology | 574.1 or 612 |
| Microphysiology | 574.876 |
| Renal physiology | 612.463 |
| Synthetic physiology | - |
| Neurophysiology | 612.8 |
| Plant biology | 580 |
| The organization of the plant cell | 581.872 |
| Growth and development | 581.3 |
| Genetics and taxonomy | 581.15 |
| Animal biology | 590 |
| Invertebrates | 592/595 |
| Vertebrates | 596/599 |
| Radiobiology | 574.1915 |
| The cytobiology of radiation | - |
| Somatic effects of whole-body irradiation on multicellular organisms | 612.01448 |
| Genetic effects of radiation | 575.131 |
| The earth and space sciences | 52+55 |
| The land mass | 551.1/.2 |
| The earth crust | 551.13/.14 |
| The internal structures | 551.11/.12 |
| The hydrosphere | <551.4 |
| The oceans | 551.46/.47 |
| Hydrology | 551.48/.49 |
| The atmosphere. Meteorology | 551.5/.6 |
| The very high atmosphere and outer space | |
| Aeronomics | - |
| Space | 523.111 |
| Astronomy - Astrophysics | 520 |
| Stars | 523.8 |
| Galaxies | 523.112 |

Appendix 4

# Survey of UDC Editions*

## authorized by the Fédération Internationale de Documentation [FID]

### FULL EDITIONS

**English**

Universal Decimal Classification (Fourth International Edition) (FID No. 179). London, British Standards Institution.
Each part contains an alphabetical subject index unless otherwise stated.

| | |
|---|---|
| BS 1000: Vol. 1, Part 1: 1943 | General introduction. Auxiliary tables.<br>UDC 0 Generalities.<br>60 pp. 4to. 15/–.<br>Without alphabetical subject index. |
| BS 1000: Vol. 2, Part 1: 1943 | UDC 50 General works on pure science.<br>UDC 51 Mathematics.<br>UDC 52 Astronomy, geodesy.<br>UDC 53 Physics.<br>104 pp. 4to. 15/–. |
| BS 1000: Vol. 2, Part 2: 1943 | UDC 54 Chemistry [crystallography, mineralogy]. |
| BS 1000: Vol. 2, Part 3: 1943 | UDC 55 Geology, geophysics.<br>UDC 56 Palaeontology.<br>UDC 57 Biology.<br>UDC 58 Botany.<br>UDC 59 Zoology.<br>124 pp. 4to. 15/–.<br>Alphabetical subject index also available separately if required, 3/6. |

Since sections of BS 1000 are not issued in consecutive UDC order, the use of volume and part numbers was abandoned after 1943 and replaced by the UDC number itself in brackets after the designation BS 1000.

| | |
|---|---|
| BS 1000 [611]: 1968 | UDC 611 Anatomy.<br>26 pp. A4. 20/–. |
| BS 1000 [612]: 1968 | UDC 612 Physiology.<br>40 pp. A4. 25/–. |
| BS 1000 [613]: 1968 | UDC 613 Hygiene.<br>16 pp. A4. 15/–. |
| BS 1000 [615]: 1968 | UDC 615 Pharmaceutics. Therapeutics. Toxicology.<br>20 pp. 4to. 15/–. |
| BS 1000 [617]: 1968 | UDC 617 Orthopaedics. Surgery. Ophthalmology.<br>20 pp. A4. 15/–. |
| BS 1000 [621.3]: 1964 | UDC 621.3 Electrical engineering.<br>68 pp. A4. 40/–. |
| BS 1000 [622/623]: 1955 | UDC 622 Mining and mineral dressing.<br>UDC 623 Military and naval engineering, ordnance, arms production.<br>52 pp. 4to. 15/–. |
| BS 1000 [624]: 1968 | UDC 624 Civil and structural engineering in general.<br>24 pp. A4. 20/–. |
| BS 1000 [65/651+657/659]: 1968 | UDC 65/651 Business and industrial organization and management. Communication.<br>39 pp. A4. *Price to be determined.* |
| BS 1000 [669]: 1949 | UDC 669 Metallurgy.<br>44 pp. 4to. 15/–. |
| BS 1000 [678/679]: 1954 | UDC 678 Macromolecular materials (rubbers and plastics).<br>UDC 679 Industries based on stone and other processable materials.<br>36 pp. 4to. 15/–. |
| BS 1000 [681.3]: 1968 | UDC 681.3 Data processing machines, etc.<br>12 pp. A4. 15/–. |
| BS 1000 [684]: 1968 | UDC 684 Furniture and allied trades.<br>11 pp. A4. 15/–. |
| BS 1000 [69]: 1958 | UDC 69 Building. Materials, construction, trades.<br>40 pp. 4to. 15/–. Amendment PD 5996, March 1967. |
| BS 1000 [73/76]: 1968 | UDC 73/76 Fine and applied arts.<br>16 pp. A4. 15/–. |
| BS 1000 [77]: 1968 | UDC 77 Photography.<br>33 pp. A4. 20/–. |

**French** (3rd edition)

Classification Décimale Universelle. (5e édition internationale.) Brussels, Editiones Mundaneum.

| | |
|---|---|
| UDC 0: 1951 (*out of print*). | UDC 61: 1940 (*out of print*). |
| UDC 2: 1951 (*out of print*). | UDC 62: 1941 (*out of print*). |
| UDC 3: 1952 (*out of print*). | UDC 65: 1942 (*out of print*). |

**German** (1st and 2nd editions)

DK Dezimalklassifikation. Deutsche Gesamtausgabe. (Dritte und achte Internationale Ausgabe).
Berlin, Deutscher Normenausschuss.

| | |
|---|---|
| UDC 0/2: 1934 (repr. 1948). | UDC 62: 1964 2nd, loose leaf ed. |
| UDC 3/4: 1935 (repr. 1948) (*out of print*). | UDC 63/65: 1965 2nd, loose leaf ed. |
| UDC 5: 1958 2nd ed., (repr. 1964). | UDC 66: 1965 2nd, loose leaf ed. |
| UDC 6/61: 1951 (repr. 1964). | UDC 67/9: 1948 (*out of print*). |

Supplement sheets incorporating latest extensions are published in 'DK Mitteilungen' (FID No. 304).

**Japanese**

Kokusai Zyussin Bunruihô (FID No. 253).
Tokyo, Nippon Dokumentêsyon Kyôkai.

| | |
|---|---|
| UDC 5: 1951. | UDC 63: 1957. |
| UDC 6/61: 1955. | UDC 66: 1952. |
| UDC 62: 1952. | |

**Polish**

Uniwersalna Klasyfikacja Dziesiętna. Pełne Wydanie Polskie Dziesiąte Wydanie Międzynarodowe (FID No. 327).
Warsaw, Centralny Instytut Informacji Naukowo-technicznej Ekonomicznej.

| | |
|---|---|
| UDC 0: 1962. | UDC 623: 1964. |
| UDC 51: 1965. | UDC 624/628: 1964. |
| UDC 528/529: 1964. | UDC 669: 1965. |
| UDC 53: 1959. | UDC 671/676: 1965. |
| UDC 541/547: 1965. | UDC 677: 1964. |
| UDC 55: 1966. | UDC 678/679: 1964. |
| UDC 56/57: 1965. | UDC 681: 1963. |
| UDC 58: 1966. | UDC 682/685: 1964. |
| UDC 59: 1965. | UDC 686/689: 1963. |
| UDC 620/621: 1966. | UDC 69: 1963. |
| UDC 622: 1965. | |

**Portuguese**

Classificação Decimal Universal. Edição Desenvolvida em Língua Portuguesa (FID No. 342). Lisbon, Centro de Documentação Científica do Instituto de Alta Cultura (CDC).
*and*
Rio de Janeiro, Instituto Brasileiro de Bibliografia e Documentação (IBBD).

| | | |
|---|---|---|
| UDC 0: 1961. | UDC 1: 1963. | UDC 2: 1963. |

**Spanish**

Clasificación Decimal Universal. Tablas Completas. Edición en español (UNE 50 002) (FID No. 243).
Madrid, Instituto Nacional de Racionalización del Trabajo.

| | |
|---|---|
| UDC 0: 1955. | UDC 61: 1958 (*out of print*). |
| UDC 1: 1964. | UDC 62/621.398: 1959. (*out of print*) (*2nd ed. in* preparation). |
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* For residents in the U.K. *only*, obtainable through BSI, 101 Pentonville Road, London, N.1. For residents in other countries, obtainable through FID, 7 Hofweg, The Hague, Netherlands.

A example Archive Figure 1

D

MACHINES AND SYSTEMS

MECHANICAL AND THERMAL PLANT AND MACHINES (cont'd.)

Dk Nuclear Reactors* (cont'd.)

Dkb/v Heterogeneous Reactors (cont'd.)

Dkb/g Thermal (cont'd.)

*By moderator:*

| | |
|---|---|
| Dkc | Graphite |
| Dkcb | Beryllium |
| Dkd | Water, light |
| Dkdb | Boiling water |
| Dkdd | Pressurised water |
| Dke | Water, heavy |
| Dkeb | Boiling water |
| Dked | Pressurised water |
| Dkf | Hydrogen, hydrides |
| Dkg | Organic compounds |

*By coolant:*

| | |
|---|---|
| m | Gas |
| n | Air |
| p | Hydrogen |
| q | Carbon dioxide |
| r | Helium |
| rn | Nitrogen and other gases |
| s | Water, light |
| sb | Boiling, steam |
| sd | Pressurised |
| t | Water, heavy |
| tb | Boiling, steam |
| td | Pressurised |
| u | Organic |
| v | Liquid metals |
| vb | Bismuth |
| vl | Lithium |
| vm | Mercury |
| vp | Potassium |
| vs | Sodium |

| | |
|---|---|
| *Dkeqb* | *Advanced gas cooled reactors* |
| *Dker* | *High temperature reactor* |



cont'd. . . .

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371 : 221—Ver
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Figure 4



## 550 Earth sciences

.1 Philosophy and theory

Class geologic time [*formerly* 550.1] in 551.701

## 551 Physical and dynamic geology

Scope: geophysics and geochemistry of lithosphere, hydrosphere, atmosphere

*For astronomical geography, see* 525

### SUMMARY

| | |
|---|---|
| 551.1 | Gross structure and properties of the earth |
| .2 | Plutonic phenomena |
| .3 | Exogenous processes and their agents |
| .4 | Geomorphology |
| .5 | Descriptive and dynamic meteorology |
| .6 | Climatology and weather |
| .7 | Historical geology (Stratigraphy) |
| .8 | Structural geology (Tectonophysics) |
| .9 | Geochemistry |

.1 Gross structure and properties of the earth

*For geomagnetism, see* 538.7

551.11–551.12 Earth's interior

.11 Structure

Core, mantle, mohorovicic discontinuity

.12 Properties

Heat, temperature ranges, isostasy

551.13–551.14 Earth's crust

.13 Structure

.14 Properties

Heat, temperature ranges, thermal conductivity, elasticity, deformation

.2 Plutonic phenomena

.21 Volcanoes

.22 Earthquakes

.23 Fumaroles, hot springs, geysers

Figure 5

Dewey Decimal Classification

*Earth sciences*

| | |
|---|---|
| 551.460 7 | Deep-sea surveys and explorations |
| .460 8 | Submarine geology |
| .460 83 | Deposits and sedimentation |
| .460 84 | Topography |
| | Ridges, canyons, mountains of ocean floor |
| .460 9 | Special oceanographic forms |
| | Salt-water lagoons, inland seas, coastal pools |
| | 551.461–551.469 Specific oceanic bodies |
| .461 | North Atlantic Ocean |
| .462 | Mediterranean and Black Seas |
| .463 | Caribbean Sea and Gulf of Mexico |
| .464 | South Atlantic Ocean |
| .465 | West Pacific Ocean |
| .466 | East Pacific Ocean |
| .467 | Indian Ocean |
| .468 | Arctic Ocean |
| .469 | Antarctic waters |
| .47 | Dynamics of the sea |
| | Use 551.470 01 – 551.470 09 for standard subdivisions |
| .470 1 | Ocean currents |
| | Theories, circulation, observational methods |
| | Class specific ocean currents in 551.471–551.479 |
| .470 2 | Waves |
| .470 22 | Ocean waves |
| .470 23 | Seiches |
| .470 24 | Tidal waves |
| .470 8 | Tides [*formerly* 551.46] and tidal currents |
| .471–.479 | Specific ocean currents |
| | Divide like 551.461–551.469, e.g., Gulf Stream 551.471 |
| .48 | Surface waters |
| .482 | Lakes, ponds, fresh-water lagoons |

*555*

66-2/-8 *As 621-2/-8 plant, process, product details*
-4 Shape and form of products
-5 Plant operation and control
-7 Plant servicing, safety, etc.
-9 Process and plant characteristics
-932 Continuous processes
-934 Discontinuous, intermittent, batch
-944 Counterflow processes
-951 Simple (one-stage) processes
-954 Complex (multi-stage) processes
-97 Thermal: temperature level or range
-973/-974 Very low. Low temperature
-975-/976 Normal (atmospheric). Moderate temp.
-977/-978 High temperature. Very high
-98 Pressure level or range. *As* -97
-982 Vacuum

66.0 CHEMICAL ENGINEERING
Operations, (unit) processes and plant

66.01 Engineering, processing, plant and services
.011 Process design
.012 Process control and efficiency. *Cf.* 658.5
.2 Consumption of raw and auxiliary materials
.3 Heat and power consumption
.4 Capacity. Throughput
.5 Yield. Output
.7 Process efficiency, engineering economics
.013 Chemical works: plant, power, services
.6/.7 Power supply. Processing services
.017 Material properties. *Cf.* 620.1/.2
.019 Material defects, spoilage, etc. *As* 620.19

66.02 Chemical processes and plant generally
.022 Pre-treatment, preparation. *By* :621.9
.023 Containers. Reaction vessels. *By* :621.642
.024 Mountings. Stands. Supports, etc.
.025 Fittings for vessels. Closures and seals. Manholes and windows. Inlets. Outlets
.026 Pipes, valves, connections. *By* :621.64
.028 Introduction of material. Correct quantities

66.03 Plant, processes for specific industries (*at* 664, 666, 667, *etc.*)

66.04 Heat transfer treatments. Furnaces. *Cf.* 662.9
.041 Furnaces
.042 Furnace operation and equipment. Charging
.043 Furnace materials. Linings
.044 Furnace upkeep and repair
.045 Heat transfer, exchangers and coolers

66.046 Thermal processing and plant
.3 Cooling processes. *Cf.* 621-71
.4 Heating of solids. Roasting, calcination
.5 Fusion. Melting. Smelting
.8 Pressure heating. Autoclave treatment
.047 Drying: air (vacuum, freeze) drying
.3 High-temp. drying (heat alone)
.35 Radiation (high-frequency, infra-red)
.8 Chemical drying. Desiccation
.048 Distillation, fractionation: stills, columns
.3 Fractional distillation. Fractionation
.5 Vacuum distillation or evaporation
.6 Steam distillation
.7 Pressure distillation
.8 Molecular distillation
.9 Products, stages: tops, middles, bottoms
.049 Other thermal methods of separation
.1 Concentration by evaporation
.2 Solid separation by distillation of solution
.4 Phase separation by partial fusion.
.5 Solid/liquid separation. Sweating
.6 Sublimation

66.05 Plant, processes for specific industries (*at* 664, 666, 667, *etc.*)

66.06 Working with liquids: handling, treatment
.061 Solution. Extraction
.4 From solids
.5 From liquids. Liquid-liquid extraction
.062 Solvents. *By* :546 *and* :547
.063 Mixing. Maceration. Homogenization
.6 Dispersions: Emulsification, etc.
.72 Softening, plasticizers, etc.
.93 Dilution and diluents
.064 Dialysis. Dialysers
.065 Solidification. Precipitation. Crystallization
.5 Crystallization
.066 Clarification. Decantation. Separation
.067 Refining. Purification. Filtration
.3 Filter apparatus: papers, funnels, etc.
.4 Pressure filtration. Filter presses
.5 Centrifuging. Centrifuges
.7 Decolorizing. Deodorizing
.068 Expressing. Presses
.069.1 Washing
.82 Treatment of liquids with gases. Gasification
.84 Degassing of liquids. Degasification

Figure 7

669 METALLURGY. *Cf.* 622.7; 661.8

..5/..8 Specific metal alloys, etc.
*As* 669.2/.8...5/8
–1 State and form of the metal(s)
–11 Natural state
–12/–13 Rolled, drawn, extruded. Forged, pressed
–14/–15 Cast. Heat treated, hardened
–4 Shape and form of metal products. *As* 621–4
–9 Process and plant characteristics. *As* 66–9

669.01 General and theoretical metallurgy
.014 Reactions. Behaviour of elements, etc.
.015 Products (intermediate, crude, pure)
.017 Physical metallurgy generally. *Cf.* 620.18
.018 Alloys. Metals according to properties.
*Cf.* 669.2/.8..5
.2 Mechanical: machinable, deformable
.25 Extra-hard metals, hard metals
.29 Structural, constructional
.4 Thermal: m.pt., expansion, etc.
.5 Electrical and magnetic properties
.6 Acoustic, optical, density properties
.7/.8 Chemical. Corrosion-resistant
.9 Pseudo-alloys generally. Cer(a)mets

669.04 Heating processes, equipment. *As* 66.04, *e.g.*
.041 Metallurgical furnaces. *Cf.* 669.162.2
.042 Furnace accessories, charging devices, etc.
.046 Heating processes
.5 Melting: oxidation, carburization, etc.

669.05 General, fundamental metallurgical processes
.051 Combined studies on ores and metallurgy
.052 Treatment of mixed ores. *Cf.* 622.7
.053 Metal extraction. *Cf.* 669.2/.8..3
.054 Metal refining generally. *Cf.* 669.2/.8...4
.8 Recovery from scrap and waste products
.056 Metal fabrication generally. *By* :621.7/.9
*Specific metals, use* 669...6
.9 Coating, finishes on metal. *Cf.* 669...69
.058 Metal plating(s) generally. *Cf.* 669...8
• .083 Pressure treatments, vacuum metallurgy: *use* 669–98 •
669.09 Various metallurgical processes. *As* 66.09

669.1 FERROUS METALS. IRON. STEEL
.11 Iron and iron–carbon alloys
.12 Pure iron (chemically and technically pure)

669.13 Cast iron
.018 According to properties. *As* 669.018
.138 Coating(s). *As* 669.2/.8...8

669.14 Steel generally. Carbon steels
.018 According to properties. *As* 669.018
.148 Coating(s). *As* 669.2/.8...8

669.15 Alloys of iron (except with carbon).
Alloy steels (–194). Ferro-alloys (–198)
*Elements by* '2/'8 *as* 669.2/.8, *e.g.*
669.15'24–194 Nickel steel–
–198 Ferro-nickel
'24'26 Nickel–chromium steel

Bliss Classification

Figure 5

CLASS D

ASTRONOMY, GEOLOGY, GEOGRAPHY, AND NATURAL HISTORY

---

SECTIONS

*D1 – D9, assigned to Astronomy, are consistent with Schedule 1.*

D General, Elementary.
DA General, Descriptive, and Spherical Astronomy.
DB Practical, and Observational, Astronomy.
DC Theoretical Astronomy.
Celestial Mechanics.
DD Cosmology, Astrophysics, and the Stars.
Nebulae, Meteors, and Comets.
DE The Sun.
DF Planets, the Solar System.

DG Geology, General:
Elementary, Astronomical relations, Geognosy.
DH Physical Geology:
Geochemistry.
Dynamical Geology.
DI Historical Geology:
Paleontological Geology.
Stratigraphical Geology.
DJ Mesozoic and Cenozoic Eras.
DK Physiographical Geology.
DL Geographical Geology.
DM Geology of the United States.
DN Petrology and Petrography.
DO Economic Geology.
DP Economic Geology of the United States (or of America).

DQ Geography, General.
Mathematical and Cartographical.
DR Physical Geography (Physiography).
DS Meteorology.
DT Regional Geography.

DU Natural History.
DV Natural History of the Several Countries.
DW Microscopy.

DY Geology and Biology.

Bibliography

Figure 9

SCHEDULE 11

FOR SUB-CLASSIFICATION UNDER ANY BOTANIC CLASS, ORDER, FAMILY, OR GENUS, THIS SPECIAL AUXILIARY SCHEDULE

*may be requisite, entire or in part, more often under the higher taxonomic classes, to which its specifications are more readily applicable, than under the lower classes, to which, however, some of its subdivisions may be adapted. The letters for the specifications of this schedule, whether applied under sections or under sub-sections, should be prefixed by the component comma, to distinguish these from ordinary subdivisions of sub-sections, as is done elsewhere to indicate specification from a relevant systematic schedule. This composite sub-classification would be antecedent to the taxonomic subdivisions.*

*The numeral subdivisions would be consistent with Schedule 1.*

,A Morphology, Anatomy, and Histology.

,B Special, Distinctive, Peculiar Organs, Structures, or Tissues. Transformations.

,C Roots, Root-systems, of Cormophytes (vascular plants);
or Mycelium of Thallophyta.

,D Stems, or analogous, or homologous, structures.

,E Leaves, Foliage, Venation, Phyllotaxis.
Modified Leaves,
Fronds, Thallus, or analogous, or homologous, structures.

,F Reproduction, Reproductive Organs, Sexual, or Asexual.
Flowers, Floral Parts, Inflorescence.
Antheridia, Oögonia, Archegonia; or analogous, or homologous structures.

,G Fruits, and Seeds;
or Spores, and Sporangia.

,H Embryology of the class, or order, etc.

,I Physiology " " " " "
Chemical composition, properties, actions, etc.
Metabolism, Growth, Duration of life, etc.

,J Food, Assimilates, Commensalism, etc.

,K Special Physiology: special Processes, Functions, Reactions;
Habits, Tropisms, etc.

,L Secretions, Excretions, Extracts, Special substances, or Products.

,M Ecology of the class, or order, etc.

,N Special Ecological subjects: Photographic studies.
Relations to Humidity, to Light, etc.
Temperature-range, and other Relations to Temperature.

,O Ecological Adaptation, Variation, and Isolation.
See also Geographical Adaptation, Isolation, ,S.

Basic Classification

Figure 10

EN Genetics: Inheritance (Heredity) and Variation.

*The science of inheritance and variation in organisms, Genetics, is distinct, tho rooted in Cytology (EC), which is basic not only to Genetics but also to Histology, Development, and Embryology, and not only to those branches of Morphology, but to the interrelated branches of Physiology. Genetics on the other hand extends into Phylogeny, EO. Cytology and Genetics, or Genetics with especial regard to Cytology, may be placed in EN, or in END. Genetics and Phylogeny would be distinct in ENY. Ontogeny is in EDE, Morphogenesis in EDH.*

*EN1 - EN9 should be consistent with Schedule 1.*

EN8 Problems of, or in, Genetics.

ENA Theoretical, Comprehensive works and general discussions.

Principles, Theories, Laws of Inheritance and Variation.

Inheritance and Variation in relation to Development.

See also Ontogeny, EDE, and Variation, ENG.

ENB Experimental studies:

Methods,

Laboratories, Stations.

ENC Statistical and Biometrical studies.
Mathematical treatment. See also Biometrics, EBR;
Probability in. Statistical Biophysics, EAR.
and Statistical Methods in Biology, EBB.

END Genetics including Cytology. *(If this is to be distinguished from the general subject)*

ENE Cytological Basis of Genetics.
Germ-cells, Gametes, Sexual cells.
Germ-plasm,
Continuity of; See the alternative under Cytology, ECO - ECR.
Weismann's theory of, Weismannism.
Genotypes.
Fertilization.
Spermatogenesis, and Oögenesis; Zygotes.
Nucleus, Karyology;
Maturation. See also Reproduction and Sex, EKR and EKS, under Physiology.

ENF Chromosomes, Chromosomology.
Chromotin, Chromomeres;
Chromosome Changes: Inversion, Translocations, Deficiency.
Chromosome theory of Inheritance;
Genes, The;
Chromosome numbers:
Haploid, Diploid, Triploid, Tetraploid;
Ploidy, Polyploidy, Heteroploidy.

ENG Variation, Genetic; Diversity. See also FAD, FKB, GKB.
Causes, Factors; Ecological, Adaptive Variations see under Adaptation, ELT and EMJ.
Hereditary Differences;
Autogenous Variations in Gametes, in Somatic Tissues.
Gene Mutations.
But for Gene Mutations see rather ENP.
Racial Variability, Races:
Racial Genotypes, See also EOG.
Genetic Equilibrium, Extinction of Races.
Hardy's Formula.

ENH Isolation, Genetic.
Phylogenetic Isolation see in EOI,
Sexual Selection,
Physiological, and Psychological, Incompatibility.
Isolating Mechanisms.
Ecological Isolation in EML.

Figure 11

Class Classification

## CHAPTER C

### PHYSICS

*Canonical divisions*

C1 Fundamentals
C2 Properties of matter
C3 Sound
C4 Heat
C5 Light. Radiation
C6 Electricity
C7 Magnetism
C8 Cosmic hypothes

**C1 Fundamentals**

C13 Matter
C11 Weight
C18 Gravitation
C14 Energy
C15 Space
C166 Time

**C2 Properties of Matter**

C2 [P], [P2]

*Foci in* [P]

1 Solid
15 Glass
16 Crystal
5 Liquid
8 Gas

*Foci in* [P2]

13 Density
2 Elasticity
21 Linear
22 Areal
23 Volume
25 Shape
251 Bending
4 Surface tension
47 Capillarity
6 Plasticity
91 Friction
92 Viscosity
93 Diffusion
7 Pressure
76 Vacuum
8 Structure

**C3 Sound**

C3 [P]: [2] [2P]

*Foci in* [P]

1 Audible sound
2 Infra sound
5 Ultra sound

*Foci in* [2] *cum* [2P]

1 Generation
2 Propagation
21 Velocity
22 Reflection
23 Refraction
28 Intensity
3 Frequency
31 Pitch
33 Musical scale
35 Resonance
358 Resonator
38 Analysis
5 Interference (beat. diffraction)
7 Acoustics
71 Absorption
8 Nature

**C4 Heat**

C4: [2] [2P]

*Foci in* [2] *cum* [2P]

1 Generation
2 Transference
23 Convection
24 Conduction
25 Radiation
27 Absorption
28 Calorimetry etc.
281 Calorimetry
282 Quantity of heat
283 Specific heat
3 Thermometry
4 Expansion of body

2·37

Subject heading list Figure 12

AVIATION SUBJECT HEADINGS

**Aerodynamics, Hypersonic**
*sa* Aerodynamics, Supersonic
*xx* Aerodynamics, Supersonic

**Aerodynamics, Supersonic**
*sa* Aerodynamics, Hypersonic
Aerodynamics, Transonic
Shock waves
*xx* Aerodynamics, Hypersonic
Aerodynamics, Transonic

**Aerodynamics, Transonic**
*sa* Aerodynamics, Supersonic
*xx* Aerodynamics, Supersonic

**Aerolasticity**
—Electromechanical analogies
*xx* Electromechanical analogies

Aerographs. *See* **Meteorographs.**

Aeronautical Center. *See* **U.S. Federal Aviation Agency. Aeronautical Center.**

Aeronautical charts. *See* **Cartography; Maps and charts.**

**Aeronautical engineering**
*xx* Engineering

**Aeronautical engineers**
*sa* Flight engineers
*xx* Engineers
Flight engineers
—Training
*xx* Training

Aeronautical instruments. *See* **Instruments.**

Aeronautical research. *See* **Aeronautics—Research.**

**Aeronautics** [For general material on the science of aeronautics]
*sa* Aerodynamics
Airplanes
Civil aviation
Flight
Rockets
*xx* Aviation
*x* High-speed aeronautics
—Abbreviations. *See* **Abbreviations.**
—Addresses, essays, etc.
—Alaska
—Bibliog. *See* **Bibliography.**
—Biog. *See* **Biography.**

**Aeronautics** *(Continued)*
—Canada
—Competions. *See* **Competitions.**
—Directories
—Education. *See* **Study and teaching.**
—Examinations, question, etc.
—Exhibitions. *See* **Exhibitions.**
—Fiction
*x* Fiction
Military aviation—Fiction
Military aviation—Korean War—Fiction
Military aviation—World War, 2d—Fiction
—Gt. Brit.
—Handbooks, manuals, etc. *See* **Handbooks, manuals, etc.**
—History. *See* **History.**
—Manuals
—Nomenclature. *See* **Terminology.**
—Outlines, syllabi, etc.
—Pictorial works
—Periodicals
*xx* Periodicals
—Bibliography
—Indexes
*xx* Indexes
—Poetry
—Research
*xx* Research
*x* Aeronautical research
—Societies. *See* **Organizations.**
—Statistics
—Terminology. *See* **Terminology.**
—Textbooks
*xx* Education
*x* Textbooks
—U.S.

Aeronautics, Commercial. *See* **Commercial aviation.**

Aeronautics, Military. *See* **Military aviation.**

**Aeronautics and civilization**

**Aeronautics and state**
*sa* Administrative and political divisions
State aeronautics
—U.S.

Aeronautics as a profession. *See* **Occupations.**

Aeronautics in agriculture. *See* **Agriculture.**

**Chemical detection (Con.)**
*excludes Chemical agent detection*
BT Detection
RT Naval mine detection
—Ordnance detectors
Sea surface effects detection
—Submarine detection

***Chemical determination***
USE Chemical analysis

**Chemical dosimeters 0616**
BT Dosimeters
Measuring instruments
Radiation measuring instruments
RT Luminescent dosimeters

***Chemical element 104***
USE Element 104

**Chemical elements 0702**
*Use of a more specific term is recommended; consult the terms listed below*
Actinide series
Alkali metals
Alkaline earth metals
Atoms
Halogens
Ions
Isotopes
Metalloids
Metals
Nonmetals
Precious metals
Rare earth elements
Rare gases
Refractory metals
Trace elements
Transition metals
Transuranium elements
Valence

**Chemical engineering 0701**
UF Unit operations
RT Agricultural chemistry
Chemurgy
Colloid chemistry
Electrochemistry
—Material handling
Organic chemistry
—Physical chemistry
Thermochemistry

**Chemical engineers 0509**
BT Engineers
Personnel
Professional personnel

**Chemical equilibrium 0704**
UF Equilibrium constants
NT Acid-base equilibrium
RT—Chemical reactions
Chemical reactivity
Fugacity
Irreversible processes
Phase rule
Reaction kinetics
Thermodynamic equilibrium

**Chemical etching 1308 0701**
BT Chemical finishing
Etching
Metal finishing

**Chemical exchange isotope separation 1802**
BT Isotope separation
Separation
NT Isotope exchange
RT—Centrifuging
—Distillation
Thermal diffusion

**Chemical finishing 1308 0701**
UF Chemical coating
BT Metal finishing
NT Chemical etching
—Chemical polishing
Electropolishing
RT Conversion coating
—Corrosion prevention

**Chemical hydroforming 0701**
BT Chemical reactions
Hydrogenation
RT—Cyclization
Dehydrogenation
—Oxidation

**Chemical indicators 1103**
UF Indicators (chemical)
Phenolphthalein
RT Carminic acid
Congo red
Hematoxylin
Methylene blue
Methyl violet
Phloroglucinol

**Chemical industry 0503 0701**
BT Industries
NT Drug industry
RT Munitions industry

***Chemical kinetics***
USE Reaction kinetics

**Chemical laboratories 1402**
UF †CBR laboratories
BT Laboratories

**Chemical lasers 2005**
BT Lasers
Stimulated emission devices

**Chemical machining 1308 0701**
UF Chemical milling

**Chemical marking agents 1502**
RT—Dyes

***Chemical milling***
USE Chemical machining

**Chemical plants 0701**
BT Industrial plants

**Chemical polishing 1308 0701**
BT Chemical finishing
Metal finishing
Polishing
NT Electropolishing
RT—Chemical cleaning

**Chemical porcelain 1102**
BT Porcelain
Refractory materials
Vitreous whitewares
Whitewares
RT—Electrical porcelain
Refractory porcelain

**Chemical projectiles 1502**
BT Chemical ammunition
Projectiles
RT Chemical warheads

**Chemical properties 0704**
NT Acidity
Alkalinity
Calorific value
Chemical reactivity
Chlorinity
Heat of ablation
Heat of absorption
Heat of activation
Heat of adsorption
Heat of combustion
Heat of crystallization
Heat of dissociation
—Heat of formation
Heat of fusion
Heat of hydration
Heat of mixing
—Heat of reaction
Heat of solution
Heat of sublimation
Heat of transformation
Heat of vaporization
—Latent heat
pH
Salinity
—Thermochemical properties
Valence
RT Adsorptivity
—Atomic properties
—Chemical bonds
—Chemical tests
Chromaticity
Hygroscopicity
—Mechanical properties
Molecular weight
Optical activity
Passivity
—Physical chemistry
Physicochemical properties
—Soil properties
Solubility
—Thermodynamic properties
Toxicity

**Chemical propulsion 2108**
RT Hybrid propulsion
Jet propulsion
—Marine propulsion
Missile propulsion
Rocket propulsion
Spacecraft propulsion

**Chemical pulping 0701 1308**
BT Pulping
NT Continuous pulping
Sulfate pulping
Sulfite pulping
RT—Cooking liquors (pulping)
Digestion (decomposition)

**Chemical pulps 1112 1107**
BT Pulps
NT Dissolving pulps
Rag pulp
Sulfate pulps
Sulfite pulps
RT Cellulose
Wood pulp

**Chemical radicals 0704**
NT Complex ions
—Free radicals
RT—Ions
—Molecules
Valence

**Chemical reactions 0704**
UF Chemical synthesis
NT Acetylation
Acidolysis
—Acylation
Addition polymerization
—Addition reactions
Alcoholysis
Alkali aggregate reactions
—Alkylation
Amidation
Amination
Ammonolysis
Bromination
Carbonylation
Carboxylation
—Cement aggregate reactions
Chelation
Chemical hydroforming
—Chlorination
Condensation polymerization
—Condensation reactions
—Cyclization
Dealkylation
Decarboxylation
Dechlorination
—Decomposition reactions
Defluorination
Dehydrohalogenation
Denitration
Depolymerization
Desulfurization
Diazotization
Diels–Alder reactions
Diene synthesis
Dimerization
Displacement reactions
Dissociation
Electrolysis
Electrophilic reactions
Elimination reactions
Endothermic reactions
Esterification
Etherification
Ethylation
Exchange reactions
Exothermic reactions
Fermentation
—Fluorination
Gas ionization
Glycolysis
Graft polymerization
Grignard reactions
—Halogenation
Hydration
Hydrochlorination
Hydrofluorination
—Hydrogenation
—Hydrolysis
Internal oxidation
Iodination
—Ionization
Isomerization
Metalation
Methylation
Nitration
Nitrification
Nitrogen fixation
Nucleophilic reactions
—Oxidation
Oxidation reduction reactions
Ozonization
Phosphorylation
—Photochemical reactions
Photochromism
Photolysis
Photosynthesis
—Polymerization
Pyrohydrolysis
Pyrolysis
Radiolysis
Rearrangement reactions
Recombination reactions
Reduction (chemistry)
Saponification
—Solvolysis
—Substitution reactions
Sulfation
Sulfonation
Sulfuration
Xanthation
RT Accelerating (chemistry)
Activity coefficients
Arresting (process)
Carbonization
Catalysis
—Chemical equilibrium
Chemical reactivity
Chemical reactors
Chemical stabilization
Conversion
—Cracking process
Dehydration
Deuteration
Disproportionation
Heat of activation
—Heat of reaction
Inorganic chemistry
Neutralizing
Organic chemistry
—Particle interactions
—Physical chemistry
Reaction kinetics
Sieking
Stoichiometry
Sulfidization
Thermochemistry

**Chemical reactivity 0704**
BT Chemical properties
Reactivity
RT Atomic structure
—Chemical equilibrium
—Chemical reactions
Free energy
Heat of activation
—Heat of reaction
Molecular structure
Reaction kinetics
Thermochemistry
Valence

**Chemical reactors 0701**
RT Autoclaves
Beds (process engineering)
—Burners
—Chemical reactions
Chlorinators
Columns (process engineering)
Contactors
—Containers
Copper converters
Digesters
Fluidized bed processors
—Furnaces
Kettles
Kilns
Retorts (reactors)
Roasters
—Steel converters
—Tanks (containers)

***Chemical reducing***
USE Reduction (chemistry)

**Chemical removal (sewage treatment) 1302**
BT Sewage treatment
Waste treatment
RT Activated carbon treatment
Activated sludge process
Aerobic processes
Anaerobic processes
Clarification
—Filtration
Microorganism control (sewage)
—Odor control
—Sedimentation

**Chemical removal (water treatment) 1302**
BT Water treatment
RT Activated carbon treatment
Adsorption
—Chlorination
Clarification
Deaeration
Demineralizing
—Filtration
—Ion exchanging
Lime–soda ash process
—Water softening

**Chemical resistance 1113**
NT Acid resistance
RT—Corrosion resistance
Oil resistance
Solvent resistance

**Chemical resistant coatings 1103**
BT Coatings
Protective coatings

## 2000 Physics

Medical Subject Headings Figure 16

PRUE (C13)
X MALABSORPTION SYNDROME (C13)
X STEATORRHEA (C13)

PRUE, TROPICAL (C13)

PUTUM (A12)

QUALENE (D2)

*quamous Bone see under TEMPORAL BONE (A2)*

QUILL (B6, D4)
XU SCILLAREN (B6, D4)

*quint see STRABISMUS (C11)*

*able Factor see FACTOR VII (D6)*

TAINS AND STAINING (E5, G1)
see also related:
DYES (D8)
XR DYES (D8)

*ammering see under STUTTERING (C10, F)*

*annum see TIN (D1)*

TANOLONE (D5)
X NEODROL (D5)

*apes see under EAR OSSICLES (A9)*

TAPES MOBILIZATION (E4)
XR OTOSCLEROSIS (C11)

*aphylocoagulase see under HYDROLASES (D5)*

TAPHYLOCOCCAL INFECTIONS (C1)
see also related:
CROSS INFECTION (C1, G3)

TAPHYLOCOCCAL INFECTIONS, GASTROINTESTINAL (C1, C4)

TAPHYLOCOCCAL INFECTIONS, RESPIRATORY (C1, C5)

TAPHYLOCOCCAL PHAGES (B4)

TAPHYLOCOCCUS (B3)
XU MICROCOCCUS PYOGENES (B3)

TARCH (D6)

TARVATION (C13)
see also related:
FASTING (E2)
HUNGER (F)
XR FASTING (E2)
XR HUNGER (F)

TATE MEDICINE (G2)
X SOCIALIZED MEDICINE (G2)
XU MEDICAL CARE PLANS (G2)
XU NATIONAL HEALTH PROGRAMS (G2)

STATISTICS (H, I)
see also related:
PSYCHOMETRICS (F)

*Status Lymphaticus see LYMPHATISM (C7)*

STEAM (G3)

STEARIC ACID (D6)

*Steatorrhea see SPRUE (C13)*

*Steatorrhea, Childhood see CELIAC DISEASE (C13)*

*Steel see under METALS (D1)*

STEIN-LEVENTHAL SYNDROME (C6)

STELANGIUM (B3)

*Stelazine see TRIFLUOPERAZINE (D4)*

STELLATE GANGLION (A8)

STERILITY (C6, G1)

STERILITY, FEMALE (C6)

STERILITY, MALE (C6)

STERILIZATION (G3)

STERILIZATION, SEXUAL (E4)

STERNOCLAVICULAR JOINT (A2)

*Sternocostal Joints see under RIBS (A2)*

STERNUM (A2)
XU ENSIFORM CARTILAGE (A2)
XU MANUBRIUM (A2)
XU XIPHOID BONE (A2)

STEROIDS (D2, D5, D6)

STEROLS (D6)

*Stethoscopy see under AUSCULTATION (E1)*

STEVENS-JOHNSON SYNDROME (C12)

STIGMATIZATION (K)

STILBAMIDINES (D2, D3)

STILBENES (D2, D5, D8)
XU BENZESTROL (D2, D5, D8)
XU MESTILBOL (D2, D5, D8)
XU PROMETHESTROL (D2, D5, D8)

*Stilbestrol see DIETHYLSTILBESTROL (D5)*

*Still's Disease see ARTHRITIS, JUVENILE RHEUMATOID (C3)*

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Medical Subject Headings

Figure 17

C - DISEASES

C8 - Cardiovascular Diseases

HEART DISEASES
HEMORRHAGE
VASCULAR DISEASES

NEURYSM
Aortic Aneurysm
Cerebral Aneurysm (C10)
Heart Aneurysm
NGINA PECTORIS
Coronary Disease
NGIOKERATOMA (C2)
NGIOMA, SCLEROSING (C2)
NGIOMATOSIS (C2)
NGIONEUROTIC EDEMA
C9,C14)
NGIOSARCOMA (C2)
ORTIC ANEURYSM
ORTIC COARCTATION
ORTIC DISEASES
Aortic Aneurysm
Aortic Coarctation
Aortic Rupture
Aortic Stenosis
Leriche's Syndrome
ORTIC RUPTURE
ORTIC STENOSIS
ORTIC VALVE DISEASES
Aortic Stenosis
RRHYTHMIA
Arrhythmia, Sinus
Auricular Fibrillation
Auricular Flutter
Bradycardia
Extrasystole
Heart Block
Tachycardia
Ventricular Fibrillation
RRHYTHMIA, SINUS
RTERIOSCLEROSIS
Arteriosclerosis Obliterans
Cerebral Arteriosclerosis (C10)
RTERIOSCLEROSIS OBLITERANS
RTERITIS
Endarteritis

ARTERITIS (Continued)
Periarteritis Nodosa (C3)
Temporal Arteritis (C3)
AURICULAR FIBRILLATION
AURICULAR FLUTTER
AYERZA'S SYNDROME
BRADYCARDIA
BUNDLE-BRANCH BLOCK
CARDIAC TAMPONADE
CARDIOVASCULAR DISEASES
CAROTID ARTERY DISEASES (C10)
CEREBRAL ANEURYSM (C10)
CEREBRAL ANOXIA (C10)
CEREBRAL ARTERIOSCLEROSIS (C10)
CEREBRAL ARTERY DISEASES (C10)
CEREBRAL EMBOLISM AND THROMBOSIS (C10)
Sinus Thrombosis (C10)
CEREBRAL HEMORRHAGE (C10)
Hematoma, Epidural (C10)
Hematoma, Subdural (C10)
Subarachnoid Hemorrhage (C10)
CEREBRAL ISCHEMIA TRANSIENT (C10)
CEREBROVASCULAR DISORDERS (C10)
Carotid Artery Diseases (C10)
Cerebral Aneurysm (C10)
Cerebral Anoxia (C10)
Cerebral Arteriosclerosis (C10)
Cerebral Artery Diseases (C10)
Cerebral Embolism and Thrombosis (C10)
Cerebral Hemorrhage (C10)
Cerebral Ischemia, Transient (C10)

CHOREA (C10)
CORONARY DISEASE
Angina Pectoris
Coronary Vessel Anoma lies
Myocardial Infarct
CORONARY VESSEL ANOMALIES
DEXTROCARDIA
DIABETIC ANGIOPATHIE (C7,C13)
Diabetic Retinopathy (C C11,C13)
DIABETIC RETINOPATHY (C7,C11,C13)
DYSPNEA, PAROXYSMAL (C5)
EBSTEIN'S ANOMALY
EISENMENGER COMPLE
EMBOLISM
Coronary Disease
Embolism, Air
Embolism, Amniotic Fluid (C6)
Embolism, Fat
Pulmonary Embolism
EMBOLISM, AIR
EMBOLISM, AMNIOTIC FLUID (C6)
EMBOLISM, FAT
ENDARTERITIS
ENDOCARDIAL FIBROELASTOSIS
ENDOCARDITIS
Endocarditis, Bacteria (C1)
Endocarditis, Subacute Bacterial (C1)
ENDOCARDITIS, BACTERIAL (C1)
ENDOCARDITIS, SUBACUTE BACTERIAL (C1)
EPISTAXIS (C5)

35 HEAT TRANSFER — 51 COOLANTS — 42 ANALOG SYSTEMS — 45 SHIELDING

34 FLUID FLOW

53 LEAKS

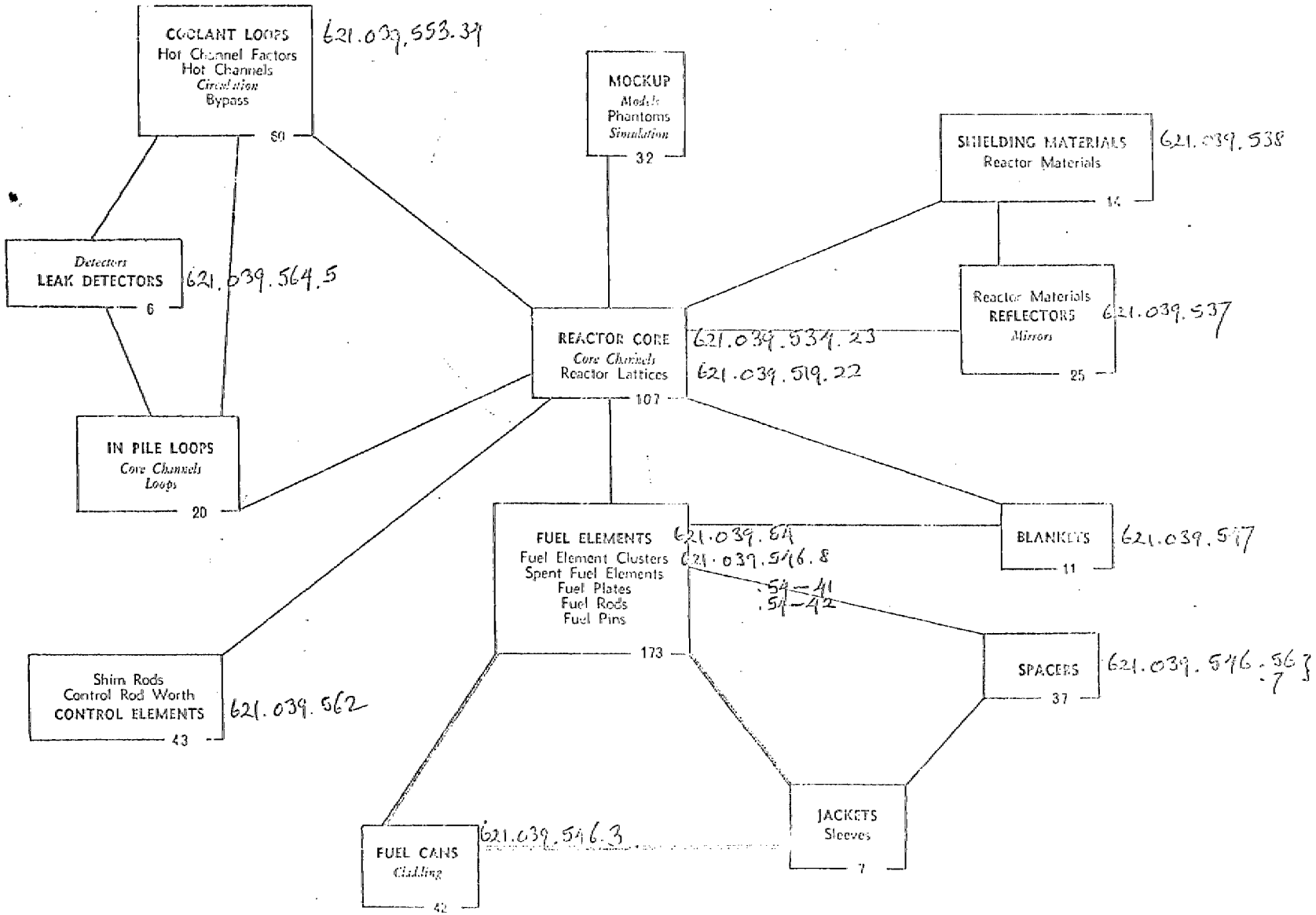
27 MATERIALS TESTING

53 CONTROL

51 FERTILE MATERIALS

51 FUELS

22 FINS




45 RELAXATION — 51 FERTILE MATERIALS — 0 RADIATION PROTECTION — 27 FAILURES