– people are engaged in the activities of the field,
– literature is produced in the field.

An information source may be distinguished as one of the following:

– supporting or sponsoring organization
– abstracting and indexing services (or periodicals)
– information collections or data-banks
– chairs of universities
– teaching of subject-fields

4. Structure and Notation

It was agreed that BSO will be a 3-level scheme including 5000–6000 subject-fields with a simpler structure and more shallow hierarchy than in existing universal classifications.

The selection of notation can be made only after establishing the structure of SRC. Nethertheless from the existing alternatives the numerical notation (with Arabic numericals) was deemed to have more advantages.

5. Forms of display

The threefold presentation of the collection of subject-fields was envisaged as follows:

1. classified arrangement, i. e. a systematic table with subject-fields arranged according to their code numbers
2. associative arrangement, i. e. in form of graphic sheets with arrows indicating relationship of terms.
3. an alphabetical arrangement, i. e. in form of a thesaurus, being the index

6. Use of existing experience

It should be underlined that while developing the first outline of SRC the WG took largely into account existing international experience in the field of classification. The first outline of SRC is based on such documents as:

– main subjects of the Colon Classification
– OECD macrothesaurus of terms on economic and social development
– classification of Bureau of Terminology of European Communities
– INSPEC classification in physics, etc.

7. Future work

The main directions of effort of the WG in 1974 were defined as follows:

– establishment of agreed 1st, 2nd and 3rd level lists of subject-fields for SRC
– consultations with subject-field specialists for completeness of coverage
– development of structure and notation for SRC
– exploring possibilities of practical testing of SRC in the World Inventory of A & I services in machine-readable form
– presentation of SRC scheme at Bombay conference on Universal Systems of Ordering in Janary 1975 for comments and criticism.

Ejnar Wåhlin
Konsultbyrå, Stockholm

A Common Classification for Swedish Research Projects

Wåhlin, E.: **A Common Classification for Swedish Research Projects.**
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Proposal for a universal classification system on the level of subject-fields based on the observation of a continuous interdisciplinary combination of former single subject-fields. The multitude of possible combinations is shown in a "discipline matrix" of the natural sciences and technology. For the interdisciplinary field of ecology a "geometrical display" is used, showing possible combinations of natural objects with each other and in relation to their respective fields. Concludingly the difficulty in indexing research projects is pointed out. (I. C.)

1. Objectives and basic principles

A study is currently being conducted in Stockholm for the purpose of creating a central, common classification system for all research projects sponsored by Swedish governmental research councils. This project is intended to a) provide a means for improving the flow of information to persons actively engaged or otherwise interested in a particular scientific area, b) create a background for research statistics. For each of these purposes it was found necessary to present the research projects concerned from various aspects, i. e. under different entries.

The investigation concerned was initiated by the Swedish Natural Sciences Research Council and is directed by the chairman of that Council, Dr. Martin Fehrm. The present author was requested to work out, in cooperation with Dr. Fehrm and experts from various fields, a proposal for a classification system.

So far, our studies have been devoted primarily to general aspects and systematic principles as well as to systematization within the natural sciences, agriculture, and certain fields of technology. The intention is to extend this work to all other areas as well with the help of experts chosen by the research councils. While hoping to arrive in this manner at a system which these councils and the researchers consider acceptable, we are well aware of the difficulties involved. The present paper is an attempt to evoke comment and criticism from individuals and groups in other countries where the theory of classification has been studied more thoroughly than in Sweden. The opinions presented here should not be regarded as the official point of view of the Swedish re-

search councils: even if at this stage there might seem to be substantial agreement on many a fundamental question there is no doubt that continued study in Sweden and, who knows, divergent opinions expressed from abroad may well lead to a pronounced diversification of views.

In drawing up the structure of our classifications we have let ourselves be guided primarily by the following factors:

1. Selection of a number of representative "fields of knowledge" generally accepted as scientific units or as units in research and development. The system now being tested is therefore called the "field system" (FS).
2. Striving for a certain extent of agreement with some established systems of universal scope now used for research statistics and research policy.
3. Consideration of interdisciplinary combinations at the "disciplinary level". Disciplines with a pronounced combinatory character, e. g. biophysics, biochemistry, physiological psychology, medical technology etc. should not be represented by only one of the two equivalent components (see Section 3).
4. Use of combinations even between concepts at lower levels, both within a field and between different fields. This is realized parallel to the use of hierarchies (specific divisions) within each field (see Section 4).
5. Consideration of existing, modern specialized systems. Of particular interest are systems which have a certain international status, thus facilitating any future attempts at greater unity, to the extent that some measure of agreement can be reached with existing universal library systems without harming the main result and the demand for a modern and logical system, to be sought also.

Parallel to the scientific systematization work, different ways of formulating and specifying the research objectives are being studied along lines laid down by pertinent Unesco, OECD and EEC publications.

2. The fields of knowledge

The main structure of FS consists of a number of fields of knowledge selected so as to be in agreement with generally accepted areas of science, e. g. as these appear in certain international systems used for science statistics and science policy. There is today rather good agreement among the research institutes in different countries regarding the main sequence of these fields. This order, based on the natural sciences, does not, however, agree with the traditional disciplinary order generally used in library systems (e. g. UDC).

Every field in FS is denoted with a capital letter indicating the subject (B for biology, H for history, etc.). These letters have no ordering function; a certain sequence is proposed (Table 1) according to the above mentioned principles. However, everyone is free to change this sequence. A division of certain fields (e. g. C and S) or a joining of fields may also be justified. Especially in the human and social sciences there is a lack of agreement on the composition of a set of disciplines forming together a satisfactory system. This question is under study by Unesco and OECD in connection with their activities for international statistics of scientific research.

Compared with traditional classification schemes, this structure is freer and there may be reason to consider whether a sequence of the fields standardized for all purposes is at all necessary.

As the fields are rather independent areas of science their internal classification can be discussed with scientists as units for their own sake.

This does not imply that a common survey would not be necessary. On the contrary, the idea of combinations (see Sect. 3) necessitates thorough study of the relations between each field and other fields. Also central steering is needed so that the structure obtained will be consistent from field to field. The field series in its current shape is shown in Table 1.

Table 1: The Field Series
Indicated in brackets are the corresponding Swedish research councils.

D Mathematics. Data	
R Mechanics	
F Physics	
K Chemistry	(Natural
G Geo-Sciences	Science)
U Astronomy	
B Biology	
M Medicine	(Medicine)
L Bioproduction[1]	(Agric.)
T Technology. Material Culture	(Technology)
P Psychology	(Social)
E Individuals and people	(Social)
S Society	(Social)
Q Linguistics	(Humanistic)
C Spiritual areas	
H History	(Humanistic)
W Geography	(Social)

1 Bioproduction (= agriculture, forestry, animal husbandry, fishery, etc.) has in most universal systems an independent position (cf. UDC 63). These areas may alternatively be considered as applied biology and included in field B.

Of the internationally known systems used for research policy we studied, among others the following: The Unesco-Frascati system (Classification of scientific fields according to the Frascati manual), Unesco's "provisional list of scientific disciplines 1972", the US National Science Foundation's fields of science, etc., as well as certain national systems dealing with the social sciences and humanities.

The first three systems mentioned above are subdivided into a few large blocks:

Frascati:	Natural Sciences
	Engineering
	Medical sciences
	Agriculture
	Social sciences
	Humanities
Unesco 1972:	Exact sciences
	Physical and natural sciences
	Applied sciences
	Human and social sciences
NSF (USA):	Physical sciences
	Environmental sciences
	Engineering
	Life sciences
	Psychology
	Social sciences

We found it more expedient to skip the large-block stage and instead went down directly to a larger number (ca. 15–18) of fields of knowledge (see Table 1).

3. Combined fields of knowledge

Research and teaching are in an increasing degree concerned with areas composed of two different sciences. These combinations can lie on a high level, as is the case with the following sciences, coded here according to the field system.

Bio-physics	(FB)
Geo-physics	(FG)
Physical chemistry	(KF
Bio-chemistry	(KB)
Geo-chemistry	(KG)

They can also lie on a lower level:
Plant genetics (B15–B3)
Soil microbiology (B2–G3)

It seems, however, that it is not possible to bring about general agreement as to what field is the dominant one in a combined science. Is geo-physics a branch of physics or a geo-science? Therefore, as a general rule, the codes my be changed around as follows: FB = BF, FG = GF, B3–B15 = B15–B3.

There is reason, however, to take into consideration the existence of "science pairs" and ask what the differences are between, e. g., biological chemistry (KB) and chemical biology (BK), between physical chemistry (KF) and chemical physics (FK), between social psychology (PS) and psychological sociology (SP). In a number of cases one finds that such differentiation is accepted by certain scientific circles, but this varies from country to country and as a whole it seems that these questions have not been sufficiently studied. Often it was perhaps mere chance which enabled a certain combination of sciences to be expressed in a certain order and to attain the rank of an independent position possibly even worthy of a special chair. Science statistics and science policy can hardly function well without these questions being analyzed and a uniform nomenclature introduced.

Figure 1 shows – as a basis for discussion – a scientific combinative matrix using as elements the fields, D, F, K, U, G, B, M and T. Since only the part under the diagonal is used, corresponding "science pairs" such as GB and BG can be shown in the same square.

The squares on the diagonal show the pure sciences, which can be connected either horizontally to the fields preceding them in the field system or vertically to the fields following them. We get a two-dimensional, matrix-type structure instead of a one-dimensional series.

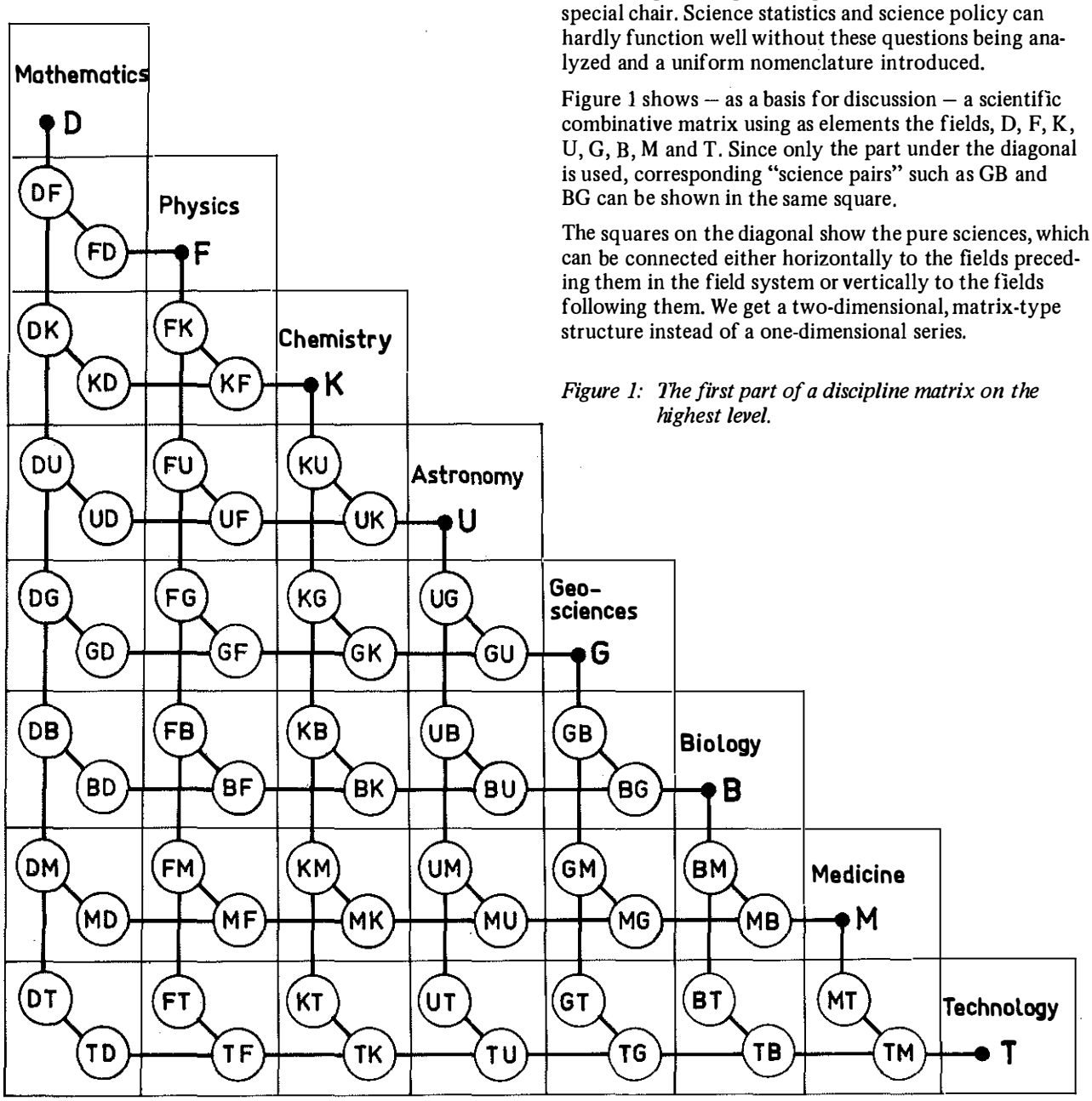


Figure 1: The first part of a discipline matrix on the highest level.

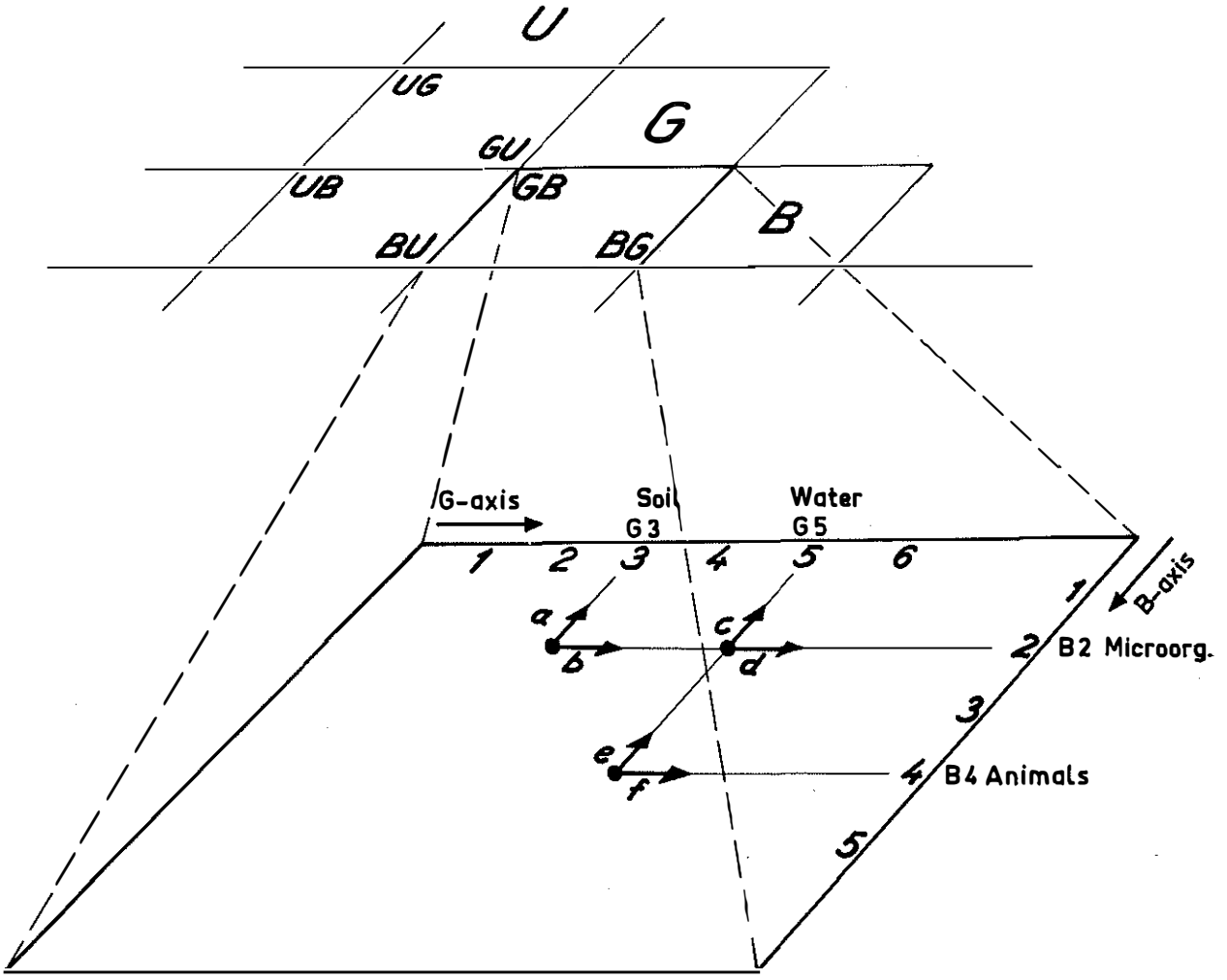
Within these squares, combinations of sub-areas can be indicated as points. This is shown in Figure 2, where the BG-square is enlarged and provided with a G-axis and a B-axis; the G-axis faces the G-square and the B-axis the B-square.

As an example, G3–B2 (or B2–G3) is marked here by a point. Arrow *a*, which is directed toward the G-axis, can be interpreted as G3–B2 and arrow *b* as B2–G3.

The text under the figure shows various possible interpretations of the codes. Thus, into this net of squares one can in principle insert any research project which can be characterized by two system concepts.

Here however we have no diagonal separation of BG and GB. The separation is indicated by the direction of the arrows, which may even be interpreted as two separate layers in each square.

Figure 2: Combinations of specific areas inserted in an enlarged square



Arrow	*Code*	*Concept Combination*	*Combinative discipline (Interpretation)*
a	G3–B2	Soil – Microorganisms	Microbiological geology (= influence of microorg. on soil?)
b	B2–G3	Microorg. – Soil	Geological microbiology (= microorg. living in soil?)
c	G5–B2	Water – Microorganisms	Microbiological hydrology (= influence of microorg. on water?)
d	B2–G5	Microorg. – Water	Hydrological microbiology (= microorg. living in water?)
e	G5–B4	Water – Animals	Zoological hydrology (= influence of animals in water?)
f	B4–G5	Animals – Water	Hydrological zoology (= animals living in water?)

(Water here = Inland water)

In Figure 3 the points have been replaced by squares and the network of squares has been extended to squares G, B, and BG. Analogous with Figure 1, section areas G1, G2, G3, etc. are to be found as small squares alongside the diagonal. If we proceed from the square "animals" (B4–B4) horizontally to the left, we come to combinations of animals with plants (B3), microorganisms (B2), water (G5), earth surface (G4), soil (G3), etc. Thus we cover here the area for animals in relation to other organisms and in their natural environment. This corresponds to the discipline animal ecology. Note that square B4–B1 does not belong here; it belongs to the discipline zoology (animal physiology, genetics, etc.). If we proceed vertically from the square (G5–G5) water to the square BG, we find aquatic ecology (G5–B2/B4), also called limnology. Square B4–G5 is common to animals and water and corresponds to animal aquatic ecology.

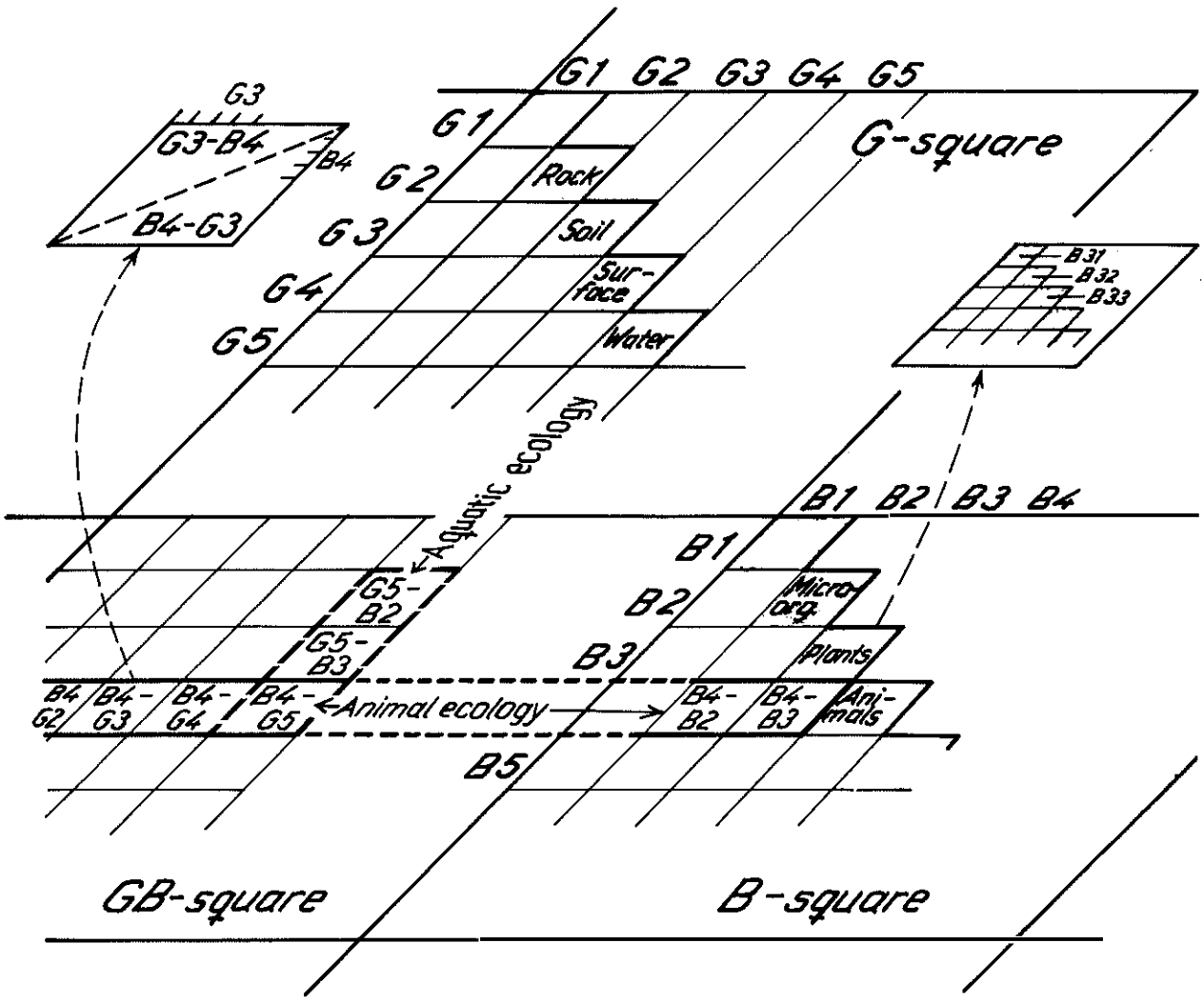
Thus we can illustrate that ecology is an area of knowledge that cannot be introduced independently, e. g. as a particular class within biology, so that it would be represented twice. Other cases which are similar to this one, do indeed exist, e. e., new sciences which are representatives of combinations of older sciences with quite new names.

As a detail of Figure 3 on the left it is shown that the diagonal separation of discipline pairs can even be applied to this low level. On the right it is shown how a square like "plants" can be subdivided in the same way as the larger squares. Accordingly, internal combinations within zoology can be represented here.

The entire network of squares can be visualized as a large floor where books are arranged two-dimensionally in squares instead of one-dimensionally on shelves, a troublesome arrangement, if practiced. But just as in the case of a hierarchical system we may bring a tree figure into a straight line, we may here also establish a principle for the arrangement of squares in a one-dimensional sequence, e. g. for an index, a catalogue, or a shelf arrangement.

This use of squares is not merely a means to illustrate existing conditions. It even might be an auxiliary means for analyzing system structures on a broad scale. The connection between B and G seems to function well, but how would it be if we go a step down and analyze the M-

Figure 3: A geometrical display of ecology.



square? Perhaps the squares' mutual relationships can provide the impetus to such a restructuring of the field system that the totality, including the combination areas, becomes more harmonic. Perhaps one can let some field (e. g. history or technology) correspond to a third dimension. Perhaps one can find a limited number of dimensions that encompass the totality.

Each geometric illustration of our knowledge, however, should only be used as one way of deciphering relations, not, however, as an absolutely valid system.

The connection between specific areas can be illustrated according to Figure 4. No consideration has been taken to the inner sequence in a combination, rather GB is regarded as being equal to BG.

Certainly, disciplines or subject areas, which represent three components do occur, but the overwhehning majority on the discipline level seem to be pair combinations. It is a large step in itself to change from thinking in one dimension into two dimensions and here the interest is concentrated on combinations of two components. One can perhaps speak of a two dimensional classification or more exactly two dimensional universal classification.

The limitation to only two units has indeed formal advantages. The relations can be lucidly expressed in diagrams as above. Two components correspond to two entities (AB and BA) while three components give rise to six combinations. Subject areas with two concepts result in a moderate increase of volume in a systematic subject index compared with a one-dimensional representation.

4. Specific division versus combinative division

In every field there are at least two possibilities for subdivision of classes, namely the ordinary specific (hierarchical) division and the division by combination of elements.

In physics, e. g. there can be subdivisions according to Elementary particles, Nuclei, etc. There are, however, also fields of physics with a combinative character, which also may have the status of specific subclasses.

Cosmic rays, for example, consist of elementary particles but may at the same time be considered as astrophysical and geophysical phenomena.

	F	*Physics*	
	F1	Elementary particles	Pure physics
	F2	Nuclei	
	F3	Atoms. Molecules	
	F4	Fluids. Plasma	
Cosmic-rays			
	FK	(Physical Chemistry, see KF)	Combinative physics
	FG	Geophysics = GF in Geosciences	
	FU	Astrophysics = UF in Astronomy	
	FB	Biophysics = BF in Biology	

In classing research projects, a conflict may arise whether one should refer a project to a certain discipline or whether it should be indexed by combination of simple concepts. A solution for this conflict could not be given here, but it is not unimportant to know about this conflict.

Figure 4: Connections on different levels