chemical methods are obviously essential, and the applications of physics to biology are likewise highly important—*e.g.*, in studies of the form and development of organisms and of skeletal structures. Without entering into the vexed question as to whether all responses to stimuli are capable of explanation in terms of chemistry and physics, it is very evident that modern developments have led to the increasing application of chemical and physical methods to biological investigation, and consequently to a closer union between biology, chemistry and physics. It is clear also that the association of zoology with medicine is in more than one respect becoming progressively closer—comparative anatomy and embryology, cytology, neurology, genetics, entomology and parasitology, all have their bearing on human welfare.

J. H. ASHWORTH

BIOLOGICAL ABSTRACTS

ON April 22, 1922, a meeting was held of representatives of 18 national biological organizations to consider the advisability of forming a federation,[1] and a year later, on April 26, 1923, the Union of American Biological Societies was formally inaugurated by the organization of a Council composed of accredited representatives of 15 member societies.

At the 1922 meeting, a publication committee of four was appointed to function jointly with a similar committee of the Division of Biology and Agriculture of the National Research Council. This committee presented a report to the Council of the Union at the latter's organization meeting, April 26, 1923. The report was adopted and the Council of the Union took the following actions:

(1) The Council of the Union of American Biological Societies considers that a single comprehensive system of biological abstracts is urgently needed.

(2) That the present Publications Committee be continued and given power to add to its membership subject to the approval of the Executive Committee of the Union of American Biological Societies and of the Executive Committee of the Division of Biology and Agriculture of the National Research Council.

(3) That the Council empower the Publications Committee (a) to formulate detailed plans for putting into effect a comprehensive system of biological abstracts for presentation to the Executive Committee of the Council of the Union and to the Executive Committee of the Division of Biology and Agriculture of the National Research Council; (b) to cooperate with the National Research Council in the continuation of its efforts to gain support for publication, abstracting and bibliography.

[1] SCIENCE, 56, 184–185, 1922.

(4) That the Executive Committee of the Union be empowered to pass, jointly with the Executive Committee of the Division of Biology and Agriculture of the National Research Council, finally upon such plans presented by the Joint Publications Committee, it being understood that such plans do not involve other than voluntary financial commitments of societies or constituent members thereof.

(5) That the Publications Committee be authorized to determine the probable support from members of constituent societies for a comprehensive system of biological abstracts.

The substance of the Joint Publication Committee's report, with some additions, follows.

While the Joint Committee is one on publication and bibliography, the discussions which led up to its appointment centered about the need and desire for abstracting and indexing services. So, while recognizing the fundamental need for improved publication facilities, the committee has up to the present confined its attention largely to the problem of a comprehensive integrated system of biological abstracts.

It is considered unnecessary to present extended evidence of, or arguments for, the importance of adequate informational aids to the investigator and teacher. Very early, even when the output of scientific literature was an insignificant fraction of its present volume, the need for aids was felt, and bibliographies, either unclassified or classified only as to certain major subdivisions, were developed. As the situation grew more complex, more detailed aids were needed, and there evolved from the relatively simple bibliographies the more highly classified and indexed ones which have reached a high state of development, though in different ways, in such agencies as the Concilium Bibliographicum, International Catalogue of Scientific Literature, etc.

Then, in the second half, and especially in the closing quarter of the last century, with natural science largely emancipated from traditional restraints, scientific publication increased by leaps and bounds, and the impossibility of thorough search of the original sources, because of limited library facilities and insufficient time, necessitated still more detailed aids. So, especially in the last two or three decades of the last century, began the conspicuous development of abstracts. These abstracts furnished at the same time classified bibliographies and brief accounts of current work. But the modern, detailed, searching subject index was not at first a feature of the abstracting journal, at least not of the biological ones; this indexing represents a still later development. Literature aids have thus undergone an extensive evolution, and are destined to develop still further to meet future changing conditions and demands.

There has probably never before been a time when

interest in making scientific information ascertainable has been so general throughout the rank and file of scientific workers. In the past, the problem has been mainly the business of a few—bibliographic experts or occasional men of science fired with the vision of the great service to be rendered to research and teaching by better mechanical aids in the literature. The man of science has, therefore, in a very large measure felt himself remote from such enterprises, which in consequence have not enjoyed his full support and active participation. Large numbers of scientific workers have thought of literature aids as necessary but hardly requiring their attention or participation. The dignity to which their importance entitles them has frequently not been accorded bibliographic efforts.

But the increasingly difficult problem faced by scientists due to the bewildering increase in the amount of literature has brought a gradual realization, earlier in some groups than in others, that the subject is of such vital importance that it demands their general support and participation. Only within the past few years has this sense of responsibility quickened generally among American biologists. This awakening is not entirely spontaneous. In large measure we have been aroused by the sudden collapse or serious impairment, during and since the war, of some of the most important of the aids on which we have relied in the past. This has helped us to realize how indispensable these are, and also that their production is a gigantic task requiring and deserving our best talent and efforts. It has awakened us, too, to the fact that, having so long accepted, without perhaps proper appreciation, the fruits of the efforts of our European colleagues, we can not now shirk those responsibilities which, because of our present more fortunate situation, are clearly ours. Whatever the contributing causes, it is a fact that these have led, within the past five years, to the establishment of four agencies in America which endeavor to abstract and index a large part of the world's literature in their respective fields—Endocrinology and Abstracts of Bacteriology in 1917, Botanical Abstracts in 1918, and the International Medical and Surgical Survey in 1919.

The committee has attempted to study the problem in a more or less fundamental way, giving especial attention to the organization, scope, completeness and adequacy of existing agencies, in order to discover if possible the shortcomings and causes thereof of the present procedure, and thereby be able, perhaps, to suggest ways and means of improvement.

A survey has been made by the Committee of the agencies which attempt to make a serious contribution to biological bibliography of international or national scope. (A brief résumé of this survey is appended to the minutes of the meeting of the Council of the Union of American Biological Societies held April 26, 1923.) This survey includes between 75 and 100 agencies devoted wholly or in considerable part to bibliography (abstracts, indexes, bibliographies, etc.) in the biological sciences, excluding psychology and anthropology. In this number are included many of those medical agencies in which the fundamental preclinical sciences as well as clinical medicine are extensively represented.

Of this large list, one has attempted to cover the whole of biology, indeed the whole of science. Several seek to cover botany and zoology, respectively, in a comprehensive way. Others have such large objectives as medicine and agriculture. But the great majority have a very restricted scope, so restricted as in many cases to deprive the user of adequate contact with important related fields of biology which contribute to his specialty.

In the judgment of the committee, a fundamental weakness in the present procedure is the multiplicity of uncorrelated and inadequately supported agencies. The majority of these reviewing, listing, indexing and abstracting organs more or less efficiently serve special interests, and till the part of the biological field selected more or less imperfectly and incompletely with the result that the abstracting, indexing and listing in these departments is diffusely distributed, incompletely done, and often treated from restricted points of view. Inevitable, too, under this procedure is an appalling amount of duplication.

The effect of this dispersive movement in the bibliographical and abstracting field as a whole in biology has some features of immediate service—condensation of references, esprit de corps within the subject and its immediate clientele, etc. Upon biology as a whole and upon synthesis, common progress, and upon a wider diffusion of interest in other fields than that of the biologist's immediate endeavor this segregation is less helpful to the progress of biology on sound and broad lines. It is believed that a complete, well-edited and well-organized system of biological abstracts would contribute fundamentally in the way of suggestion, stimulus and widening point of view and greater precision in attack upon our common problems. Such a system, too, would avoid the unnatural segregation of plant and animal material in such unified subjects as genetics, evolution and cytology, and the unfortunate separation of much plant and animal physiology, pathology, ecology, etc., which still occurs in many of our largest services, because confining their efforts to the plant or to the animal field.

But quite apart from these considerations this dispersive tendency involves serious practical difficulties. The narrower the scope of a service, the more limited its support. The literature in many if not

all special fields is so widely diffused in scientific publications that it becomes quite impossible for the relatively weak special services to approximate completeness or adequacy. The meager support which such agencies can command means, too, that they are carried on very largely by personal enthusiasm and sacrifice with the uncertainties and discontinuity which this procedure is likely to involve.

In striking contrast to this more or less chaotic situation in biology, the committee has been impressed with the well-ordered procedure in chemistry, which in comparison is so splendidly served in America by one strong, well-supported system of abstracting and indexing.

The type of bibliographic aid preferred varies with the character of the work and training and habits of the individual biologist. Classified indexed bibliographies in book or card form and abstracts in book form are the chief more highly developed types now in use. The systematist especially prefers a highly classified arrangement, which has been achieved both in indexed bibliographies (*e.g.*, Zoological Record (book form) and Concilium Bibliographicum (card form) and in abstracting journals (*e.g.*, Just's Botanischer Jahresbericht). But the committee is convinced from its inquiries that the type of service which most nearly meets the needs and desires of the great majority of workers is the abstracting journal with detailed carefully prepared indexes. It is believed that by adding to the monthly abstracting journal the feature of annually cumulated, classified, bound volumes the service in general would be improved and the needs of those especially requiring a detailed classified or indexed arrangement met. Such an arrangement, too, would more nearly meet the needs of libraries, which in general express a preference for classified or indexed bibliographies. Since limited support has so greatly handicapped bibliographic undertakings in biology it is felt that any new developments should be so conceived as to merit and command the widest possible support.

The success and efficiency which characterize the plan of the American chemists in making the subject of chemistry a unit for purposes of abstracting and indexing and the further important fact that this plan has the uniform automatic support of members of the American Chemical Society, has encouraged the committee to secure the facts necessary for an approximate picture of the proportions and feasibility of a similar plan for biological literature under the auspices of the Union of American Biological Societies.

The committee has attempted to ascertain the approximate volume of the world's biological literature as measured by the annual number of titles. Its studies in this direction lead to the conclusion that the annual number of titles approximates 40,000. These calculations include the literature in the biological sciences, including plant and animal industry and paleontology, but excluding clinical medicine and psychology.

To check the committee's estimates, Mr. Gunnell, of the United States Regional Bureau of the International Catalogue of Scientific Literature, was asked to tabulate the annual number of titles in the various parts of the International Catalogue of Scientific Literature concerned with the biological sciences. Mr. Gunnell's total for 1913, the last year for which all parts of the catalogue appeared unaffected by the war, is 37,779.

The number of pages required to cover this literature (40,000 titles) in one abstracting journal on the basis that 6.8 titles could be cared for per page (the approximate average in *Botanical Abstracts* and *Abstracts of Bacteriology*) is approximately six thousand.[3]

Cost of manufacture and distribution of twelve monthly numbers totalling 6,000 pages plus 500 pages of index (estimated) in an edition of 7,000 (the committee has secured bids from ten or twelve printing establishments, on one of which this estimate is based)	$52,144.00
Estimated annual income from 1,000 institutional subscriptions at $15.00	15,000.00
Balance of manufacturing and distributing cost to be met by individual support	$37,144.00
Probable cost of manufacture and distribution to the individual should each of the 6,000 individuals who are members of the societies invited to adhere to the Union support a unified system[4]	$ 6.20

[3] The question of bulk of such a service having been raised, the possibility has been considered of issuing it in parts individually obtainable. The committee is of the opinion that breaking up the publication would introduce complications and uncertainties which might involve an increase in the cost to the individual and a weakening of the undertaking, should it be entered upon.

The policy of the American Chemists, now in successful operation for sixteen years, too, has impressed the committee with the desirability of keeping the service intact. The committee has, therefore, sought to meet the problem of size in another way, namely by searching for less bulky papers. Excellent papers are available which bulk less than one inch per thousand pages. Using such paper would reduce the linear shelf room, annually necessary for the volumes, to less than six inches, even should the journal report on approximately all the world's biological literature. For libraries and others desiring them, copies printed on heavier paper could be furnished.

[4] Since binding, probably in two volumes, would be necessary to make the journal thoroughly usable as a reference work, the subscriber would have an additional outlay of $4.00 or $5.00, or a total cost in the vicinity of $10.00 or $11.00.

Editorial overhead: These calculations do not include editorial, bibliographic and clerical overhead. The National Research Council is continuing its efforts to secure adequate support for international scientific bibliography and abstracting. If these efforts meet with further success such support may be expected, at least at the outset, largely to meet such overhead.

The above calculations are based on twelve monthly numbers annually, the abstracts classified in subject-matter sections with cross references, so that the material in a particular field can be consulted as conveniently as in a journal of more limited scope. In order, however, to provide a more highly classified instrument, especially for the systematist and others particularly served by such an arrangement, and also to bring all material for a given year and in a given category together, the committee has investigated the additional expense involved in cumulating the material at the end of the year and issuing it in one or more bound volumes, after which the monthly numbers, printed on less costly paper, can be discarded, used by the subscriber for making special bibliographies, or otherwise utilized. In the cumulated volume the material having appeared under a given section in the monthly numbers would be brought together and subjected to a more detailed classification than is practicable in the monthly issues—a classification as detailed as a careful consideration of the needs of the various groups may dictate. In addition to the more detailed classified cumulated arrangement, the annual volume or volumes would contain detailed alphabetical subject and author indexes, which have proved of such exceptional utility and supplement the classified arrangement in an important way, as instruments for locating desired information.

The committee is informed that the cumulated bound volumes would increase the estimated cost given above about 25 per cent., or a total for the monthly numbers and the annual cumulated volumes of $69,380.00.

Leaving the estimated annual income from 1,000 institutional subscribers the same, namely $15,000, the balance of $54,380 of the total manufacturing cost to be met by individual support, should each of the 6,000 individuals who are members of the societies invited to adhere to the Union support of a unified system, would be about $9.00 per individual. (This cost to the individual is well below that of the uncumulated journal bound by the subscriber; the large saving on wholesale binding more than offsets the added cost due to the cumulation.) It needs to be borne in mind that under a system of uniform support this sum would secure for the individual a monthly current abstracting journal and an annual classified and indexed master key to the world's biological literature, the latter bound in two volumes and fully ready for use without further expense of any kind.

The exigencies of the case require that the financial responsibility for such an enterprise be assumed initially largely by the workers in America, an obligation which can not well be shirked at this time, especially in view of the benefits which have for so long been reaped by American workers from the responsibilities carried in Europe. But assuming that there will be such assurances from American biologists as to make the venture financially possible, it is clear that the successful production of such a comprehensive service, *i.e.*, the prompt and adequate abstracting of approximately all the world's biological literature, presupposes the widest cooperation among biologists everywhere. In this cooperation the relation to the enterprise of all collaborating biologists would be the same, as now is the case in *Abstracts of Bacteriology, Botanical Abstracts,* and other services, European and American. If undertaken, the initial years of the service would constitute a trial period from which such readjustments, both as regards character of the journal and its direction, should come as experience and changed conditions may dictate. Indeed, this degree of plasticity should constantly characterize the service.

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THE INTERNATIONAL UNION OF PURE AND APPLIED CHEMISTRY

THE annual meeting of the Fourth International Congress of the Union of Pure and Applied Chemistry was held in Cambridge, England, on June 17, under the presidency of Sir William Pope, professor of chemistry of Cambridge University, and was attended by representatives from twenty-one countries, nearly four hundred members and guests being present at the annual banquet.

The meeting lasted four days and among the important decisions reached by the various committees were the following:

The Committee on the Reform of Nomenclature of