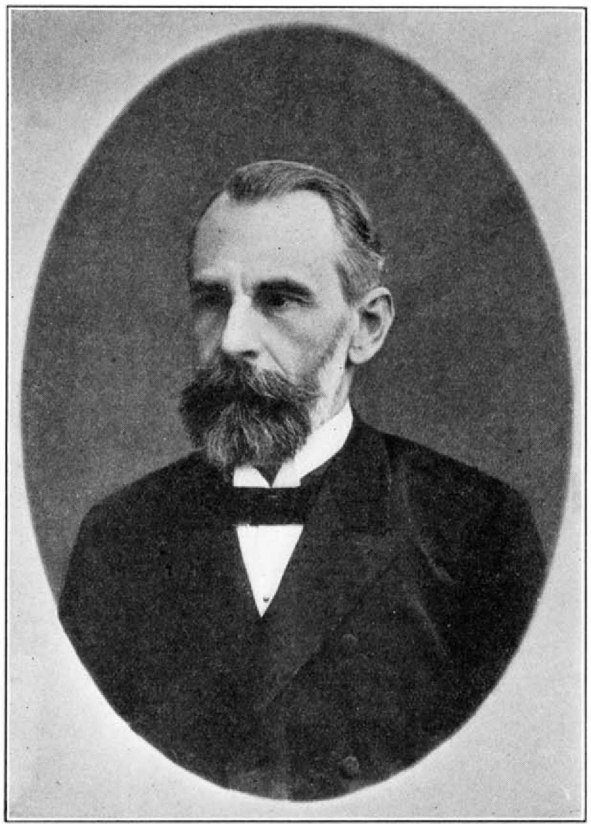
HOW BEILSTEIN IS MADE*

FRIEDRICH RICHTER

Editor of "Beilstein's Handbuch der organischen Chemie," Berlin, Germany

"OUR last recourse must be had to large Indexes and little Compendiums: Quotations must be plentifully gather'd and book'd in Alphabeth: To this end, the Authors need little be consulted, yet Criticks, and Commentators, and Lexicons carefully must."—How many books have not been written in accord with Swift's amusing prescription, but their fame was usually of short duration and today they moulder forgotten on dusty shelves. It is worth a moment's reflection that a comprehensive, scientific work like the Beilstein "Handbuch" has shown undiminished vitality through more than fifty years of our swiftly moving times, while the name of its founder sounds almost mythical to the present-day chemists. A short history of this work and the method of compiling it seems distinctly worth while.



BEILSTEIN IN 1892

The editors of chemical handbooks have always had worries. Perhaps one of the first to experience these was Diderot, who omitted most of the promised chemical articles from his encyclopedia. Macquer, the editor of the first alphabetical dictionary of chemistry, in 1776 wrote concerning the second edition to Guyton de Morveau, "You know what the condition of chemistry is today: Only a child two days ago, it suddenly finds itself in an incredible state of growth, and is changing into a colossus." Few references to the literature were given in this work and only the patient diligence of the German translator, Leonhardi, converted it into the invaluable source from which the chemical historian still derives much information. Ten years later, when Guyton de Morveau attempted in the "Encyclopédie méthodique" to give a complete presentation of the chemical knowledge of his time, he had to insert a new preface in the middle of the work to announce his conversion to the Lavoisierian theories and defend himself against the charge that he had made a "hurried compilation." In 1841 Wöhler wrote to Berzelius concerning Leopold Gmelin, who in 1819 brought out the first handbook of organic chemistry, "He is in despair as to what system he ought to use for organic chemistry." Gmelin died in 1853 in the midst of preparing the fourth edition of his organic chemistry. This was so hopelessly outmoded within ten years that it survived no further editions.

The history of science knows no standstills and famous textbooks mark its course like milestones. When (1881–83), scarcely thirty years after Gmelin's death, Friedrich Konrad Beilstein (1838–1906) put out the first parts of his "Handbuch der organischen Chemie," he could not have foretold that this modest attempt, as he called it, would make his name immortal. From the two small volumes of the first edition it could not have been foreseen that eventually forty volumes would not suffice to house the total treasure trove of organic chemistry.

It is not certain when Beilstein conceived the idea of publishing his work. It is only known that it was the fruit of more than twenty years of collecting memoranda for his own use. This activity can doubtless be ascribed to the motives so well expressed by Berzelius in his letter of March 5, 1831, to Wöhler, "The professor complains of excessive writing. Of course this is boring, but we must admit that without this writing one never attains his potentialities. If, for instance, Davy in his youth had been forced to write, as the professor now is, I am convinced that he would have advanced chemistry by a whole century: but under the

* Translated by Ralph E. Oesper, Associate Professor of Chemistry, University of Cincinnati.

circumstances it became nothing more than 'brilliant fragments,' just because, from the beginning, he was not forced to diligently familiarize himself with all parts of the science as though it were a unit."

The first edition of Beilstein's "Handbuch" was sold out almost immediately—clear testimony that his personal need for an ordered collection of the facts was shared by many others and that the time was ripe for a work of this kind. The second edition followed quickly in 1885, the third in 1892. When Beilstein, with the third edition, closed his participation in the "Handbuch," he left "a stupendous monument of industrious, intelligent compilation" (Bolton). He wrote to a friend, "If in quiet I now review the achievements of my last forty years, it occurs to me how fortunate I was to have been born at a time and to have lived in a period when such an undertaking as my Chemistry could be accomplished. By chance, all the favorable conditions coincided. A delay of only a few years, and all would have been in vain."

What were these favorable circumstances? The first, his untiring diligence, he modestly did not mention. Hjelt, in his biography of Beilstein,[1] tells that Beilstein did not allow vacations to interrupt the work on his "Handbuch." This unceasing concern for his work is illustrated by an amusing experience related by his assistant, Wihtol. On high feast days and similar occasions, Beilstein sat well behaved with his relations in the church pew. However, a glance over his shoulder revealed on his opened hymn book a very long chemical formula: the book concealed a proof sheet of the "Handbuch." In this way, he provided, as the Russians say, that "the wolves were sated and the sheep remained whole." More important is a second circumstance through which the "Handbuch" became a memorial of a special kind. A glance at its forerunner, Gmelin's "Handbuch der organischen Chemie," suffices to show the far-reaching change that had occurred in organic chemistry between 1860 and 1880. This change was primarily the work of Kekulé, who had laid the firm foundation of the modern science with his structure and benzene theories. Until then the multiplicity of organic compounds had been a rather confused mass of empirical results: now appeared the first contours of a newly ordered world. Hardly more than ten years were necessary for the almost general adoption of the method of writing formulas still used today.[2]

Beilstein's work was the first complete compendium of organic compounds written in the spirit of this new viewpoint. It was a test of Kekulé's ideas and the fact that it could be carried up to the present without essential alteration argues for the solidity of these theoretical bases. This is the second favorable circumstance leading to the continuance of the "Handbuch."

Beilstein also made some experimental contribution to the development of Kekulé's teachings. He wrote, "My critics reproach me with having accomplished little of real significance along this line, but it was necessary to show beforehand that there is only *one* benzoic acid, that benzyl chloride and chlorotoluene are different, and so forth, before these could bring to your theory that range and that significance which it had from the beginning." Kekulé readily acknowledged this aid.

Today Beilstein's literary accomplishment appears incomparably greater than his experimental studies. It is really astounding that he compiled three editions of his work with practically no assistance. In May, 1895, he wrote to one of his German friends, "Obviously I could write my 'Handbuch' only in Russia, and therefore I declined all calls to Germany.[3] At a Russian polytechnical school the professors need not be scientifically active because even the students arouse no such impulse, but in Germany I would have been viewed askance."

The avalanche-like extension of the literature toward the end of the century rendered impossible the continued compilation of the "Handbuch" by a single individual. In 1883, shortly after the closure of the first edition, M. M. Richter estimated there were only 15,000 organic compounds. By 1910 this number had risen to 150,000. The figure for today is somewhat uncertain, but 350,000 cannot be far wrong. Consequently, it was a further happy circumstance in the history of the "Handbuch," that the German Chemical Society, under the active leadership of its Vice-President, Emil Fischer, in 1896 was ready to assume the responsibility for the work and to establish a separate editorial office for its continuance. This made possible the publication of the supplementary volumes to the third edition (1899–1906) and the issuance of a fourth edition (1918 on). Of course, even these beginnings were still quite modest because the entire editorial staff at first consisted of an editor and one assistant. However, everything was on a completely new basis in so far as the staff no longer needed to concern itself with culling the literature, that is, in a sense, with providing its "raw materials." This was due to the happy thought of entrusting this task to the abstractors of the *Chemisches Zentralblatt*, which had been taken over

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[1] HJELT, E., *Ber.*, **40**, 5041 (1907); for other biographical sketches see LUTZ, O., *Z. angew. Chem.*, **19**, 2058; WITT, O., *J. Chem. Soc.*, **1911T**, 1646; GAUTIER, A., *Bull. soc. chim. Fr.*, [3], **35**, 1 (1906).

[2] It is of historical interest to note that at first Kekulé did not know how to escape entirely from the type theory. "They (the type formulas) disclaim the ability of expressing the way in which the carbon atoms themselves and the atoms of other elements completely united with them are joined; the reason being that complete disintegration of the radicals leads to such complicated formulas that all clarity of arrangement is lost." (Kekulé, *Lehrbuch* II, 250.) On this occasion Beilstein proved himself the keen critic foreshadowing the future author of the "Handbuch." In a letter to Kekulé, Oct. 3, 1865, he writes, "Please, please, throw the types out. Remember the old saying: *formulae non agunt nisi solutae*—Dissolve them then more drastically than in the famed phthalic acid formula. Build in your atoms [= molecules] or nuclei: grottoes, caves, arbors and gardens, so that the imagination of the chemists can fill them with the loveliest H, Cl, or other spheres, and their minds can be set at rest."

[3] Munich, 1868, Halle, 1881, and so forth.

by the Chemical Society at the same time. Useless duplication was avoided by placing the preparation of the *Zentralblatt* abstracts and the summaries for Beilstein in one hand. The staff needed only to check against the originals the correctness and the completeness of the abstracts delivered to it. This task in itself was still voluminous enough, but this procedure had the advantage that the staff acted as a second control and, to a great extent, eliminated the possibilities of error. This arrangement proved excellent for more than twenty years and was the basis for the preparation of the first supplement to the fourth edition. However, when the great growth of the post-war literature brought corresponding increases in the number of the *Zentralblatt* abstractors and, in addition, a more frequent turnover in the abstracting staff made its disturbing effects noticeable, the disadvantages began to outweigh the advantages. When the second supplement to the fourth edition was projected in 1928, the editorial staff was forced to reassume the abstracting of the original literature and to prepare all the memoranda slips in its own offices.

The raw material, with which the editorial staff works, are the single "Beilstein slips." The originals of about forty of the most important chemical and physical chemical periodicals are abstracted completely. The *Chemisches Zentralblatt* is the source for the rest of the literature. The unavoidable brevity of its abstracts requires that here also the originals must often be consulted. Each slip, in principle, bears statements concerning one compound only. The data are set down in a definite order: occurrence, formation, preparation, physical properties, chemical and biochemical behavior, analytical, the salts. Since, for technical reasons, every original paper must be abstracted separately, each slip contains statements from a single paper only. For the fourth edition of the main volumes these slips numbered 250,000. The correct abstracting of the literature and the checking of the slips for accuracy by no means completes this phase of the editorial task. The next important step is the arrangement of the file of slips in the order in which the material will appear later in the "Handbuch." Accordingly, on each slip is written the System Number which definitely determines the position of the compound in the completed volume.

The editors expended much labor in bringing this System of organic compounds to its present form. Of course, it was not devised from the ground up; it is the product of a long historical development. The fundamental ideas of homologous series, of parent nuclei, and functional groups have existed since about 1840; the distinction between cyclic and acyclic compounds was added in the sixties. These were the basic elements which sufficed Beilstein for the arrangement of the 15,000 compounds included in his first edition. When, however, about in the eighties, the number of heterocyclic compounds also began to increase considerably, Beilstein's original principles of arrangement were no longer adequate. He himself recognized that the invention of a new system would be one of the most urgent problems of the future. After laborious preliminaries the new system was finally ready in 1907. It has fully proved its merit in the succeeding thirty years, and, in all likelihood, will suffice for a long time.

The basic ideas, as the writer has shown elsewhere,[4] are by no means as complex as many still consider them. The division into acyclic, isocyclic, and heterocyclic compounds, and the arrangement according to homologous series and the degree of saturation is traditional and requires no further explanation. New and fundamental, however, is the idea that only the unbroken carbon chain[5] and the ring are regarded as significant with respect to the systematic viewpoint. The System deals primarily only with compounds of which this is true. These are the "index compounds." All others appear as their derivatives, which can be considered as arising by substitution, or by the loss of water from two or more index compounds. The loss of water or "anhydro synthesis" thus becomes the "systematically" most important reaction of organic chemistry. Those parts of the index compounds on which it occurs are the functioning groups. The exact definition of these (OH, CO_2H, NH_2, etc.) and their limitation to a not too large number (about twenty) is the real basis of the new system. If for a given compound the index compound has been determined, and the decisive functioning group and the degree of saturation fixed, then the System Number giving the place of the compound in the "Handbuch" can be found. Without exaggeration, these simple principles make it possible to arrange easily, or find, 70–80 per cent. of all organic compounds. Real difficulties are encountered only when the basic structural formula does not give the necessary precise single picture as, for example, when a choice must be made between numerous desmotropic formulas. This choice can only be schematic. The number of thoroughly investigated cases of desmotropism is exceedingly small in comparison with the possible cases, and the method of deciding by analogy is nowhere so questionable as here. Therefore, numerous cross references to the other possible forms are necessary. This places an undesirable burden on the reader and the editorial staff, but it is due to the present state of chemistry rather than to a fault in the System. The System is not deficient, but the present method of expressing formulas lacks the necessary preciseness. Similar quandaries arise with many dyestuffs and related compounds for which, as yet, admittedly no satisfactory structural expressions have been found.

This detailed discussion of the questions involved in systematizing this vast array of compounds is distinctly pertinent because it will become increasingly significant as their number grows, since nomenclature

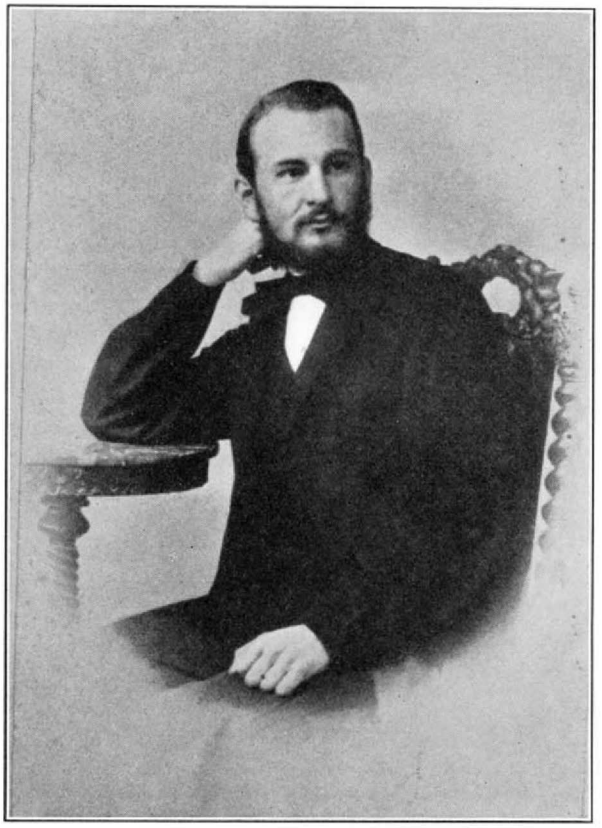
[4] RICHTER, FR., "Kurze Anleitung zur Orientierung in Beilstein's Handbuch der organischen Chemie," Julius Springer, Berlin; **1936.** See also E. H. HUNTRESS, "A brief introduction to the use of Beilstein's Handbuch der organischen Chemie," John Wiley and Sons, Inc., New York City, **1938.**

[5] Consequently ethers, sulfides, azo-compounds do not appear as special classes in the System.

and formula index can never be more than secondary aides.[6] The dislike of the practicing chemist for the System is understandable, even though he handicaps himself by this attitude. It is dangerous to foster the illusion that a better system may be devised in the future. Every conceivable system, of which there are many, will bring its own complications. Every system necessarily must depart from the simple ones used in the smaller traditional texts to which the practicing chemist is accustomed.

The System makes it possible to assign an unequivocal place to all organic compounds. This is of great moment, not only to the user, but it is also of the greatest importance to the editors. Many years intervene between the collection and the systematic arrangement of the material, but it must be possible at any given time to find immediately any given compound. Of course, it happens frequently that a recent publication may justify a new view of the constitution of a long known compound. If the reasons advanced appear convincing to the editors, new formulas must be entered on the slips at hand, and these must be arranged under the corresponding new System Number. Often this necessitates the reformulation of a large series of reaction products and a consequent transfer to other places in the System. This labor of Penelope would never end if a halt was not called by setting a time limit. Publications that have appeared after this date are, in general, not considered, but are held over for the subsequent supplementary volume. However, exceptions are made in special cases, particularly in the discarding of constitutional formulas recognized to be incorrect.

As soon as all the abstracts of a literature period are arranged systematically in the file, the work of the editorial staff enters a new phase: the assembling of the actual manuscript begins. This task varies considerably. Sometimes it consists in no more than slight stylistic changes, if the compound has been described only once and by a single author. When there is a more extensive literature which perhaps will fill one or more pages of the "Handbuch," the assembling of the individual statements into the finished article is anything but a mechanical task. Often it is found that the statements of different authors cannot be brought into satisfactory accord and the originals are carefully rechecked. Sometimes the disagreement is explained by slight differences in the experimental conditions. Such cases may arise easily because the abstractor, when preparing the slip, has merely the isolated fact in view, and so regards as unessential certain details which later prove significant when the total literature is under review. Frequently the literature contains actual contradictions: these require the Beilstein collaborator to take a critical stand. Such points have occasioned more than a thousand inquiries from the editorial board to the authors themselves. This correspondence has, in many cases, cleared up the incongruity, or sometimes further experimental studies are initiated. If the authors are dead the problem must be examined to determine whether one of the statements appears incredible in the light of present knowledge. Often it turns out that the statement is outmoded and that the method and discussion can no longer be accepted as conclusive. Sometimes it is possible to explain the true course of the reaction from parallel examples involving compounds of analogous structure. If all these measures fail, nothing remains but to present the conflicting statements side by side. The



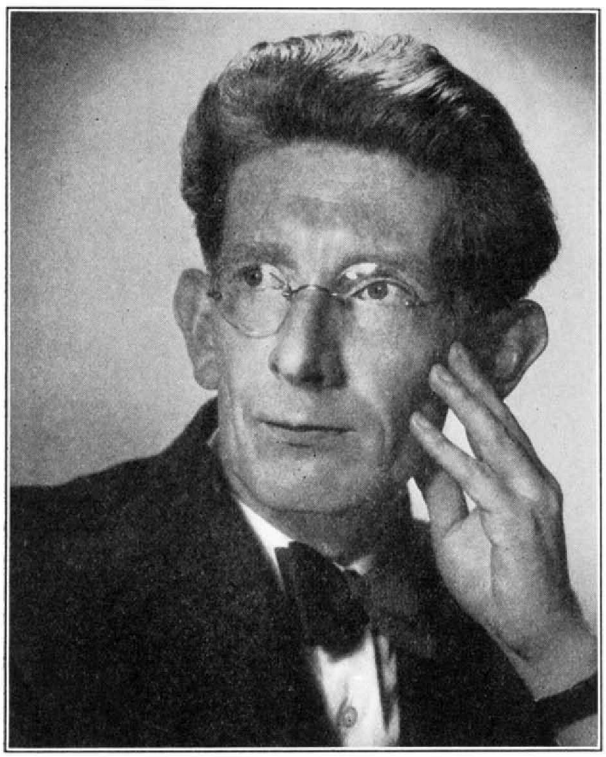
BEILSTEIN (AT GÖTTINGEN)

Beilstein collaborator is not allowed to exercise an arbitrary personal judgment.

The capabilities of the collaborator must measure up to high requirements in other respects. Although the "Handbuch" makes some claim to completeness, this does not signify that it includes every statement in the literature. In the older papers, especially, are given reactions which, considered from the present viewpoint, cannot succeed or which appear entirely without significance. The inclusion of such statements would merely clutter up the "Handbuch" and be of no value to the reader. In such cases, the collaborator, to a limited extent, must make a choice conditioned by the importance of the topic. For instance, obsolete methods must not be given in detail if it is now easier and cheaper to prepare the compound from other start-

[6] This was recognized quite some time ago. See EMIL FISCHER, "Aus meinem Leben," Julius Springer, Berlin, **1922**, p. 136.

ing materials and by more efficient procedures. So far as possible, only the best should be taken from the welter of available physical data. It is well known that the figures given by the organic chemists of the older school are often not above suspicion. The principles to be followed in such critical choices have been excellently laid down by Timmermans.[7] This selection requires a large mass of comparative material and there are perhaps not more than fifty to one hundred compounds in all organic chemistry for which good



DR. FRIEDRICH RICHTER, EDITOR OF BEILSTEIN'S HANDBUCH DER ORGANISCHEN CHEMIE

and bad physical data can be distinguished with certainty.

The critical presentation of the formation and reactions of a chemical compound, in general, involves complexities of which the layman has scarcely any conception. Every paper mentions, either as starting materials or reaction products, many compounds concerning whose constitution definite statements must be made. However, these compounds usually occur in widely separated parts of the "Handbuch" and can be subjected to an intimate, critical treatment only at a later time. This is possibly one of the most difficult tasks in the editing of the "Handbuch." At almost any instant the collaborator must be able to shift rapidly to another field, and, without spending too much time, make a provisional critical decision whether the starting material or reaction product under consideration will actually retain the formula assigned to it when this compound later is considered exhaustively.

The sciences bordering on chemistry, such as physics, medicine and technical chemistry, are considered in the "Handbuch" only in so far as they are of interest to the chemistry of the compound in question, and its use. Here, too, the collaborator often is faced with rather difficult choices.

These are but a few of the problems that must be solved by the editorial staff. The rules they must follow are exactly prescribed in numerous written directions, which fill many folders. Even so, the nature of this undertaking is such that a perfectly uniform editing of the manuscript is not attained. Consequently, several collaborators do nothing but subject the completed manuscript to another careful scrutiny to see that like chapters are treated alike, so that reactions mentioned under *Methyl Alcohol* are not omitted under *Ethyl Alcohol*, and so forth. Only after the manuscript has passed this stage does it come into the hands of the editor. He reads it carefully and verifies against the original literature anything which seems questionable to him.

Publications of the character of the "Handbuch," by their very nature, are bridges between the past and the future. From this fact arise, in equal measure, the difficulties and the pleasure of editing them. Mere accurate rendition of the literature and systematic arrangement would be sufficient to meet the requirements ordinarily demanded of an archive. Science, however, is a living organism which is continually developing and the observations from the past included in the "Handbuch" must serve the needs of the present. This means that the setting of a limiting date for closing the edition is merely a technical expedient, and the editorial staff must keep in constant touch with the present progress of the science. Here, as elsewhere, ability of high order is necessary to know what to omit. The findings of the past must be evaluated for the present and this appraisal must not be influenced by the fads that run their course in every science. But withal, the bounds of the whole must be set with good judgment so that room is left for the developments of the future. This is the point where the apparently purely reportorial activity of the editors merges into the creative, and the revision of the text with both these functions in mind is the last phase through which the manuscript passes before it is sent to the printer.

The correction of the proof of the Beilstein "Handbuch" is exceptionally laborious. The galleys are carefully compared with the manuscript to eliminate, so far as possible, numerical errors, all empirical formulas are verified once more, the index is prepared, and, lastly, the whole text is subjected to a last scientific review before it is finally released to the printer.

If the material set forth in Beilstein is surveyed, it becomes apparent that, in general, the co-workers cannot function as narrow specialists. However, the editorial staff does include specialists for certain topics,

[7] TIMMERMANS, J., "La notion d'espéce en chimie," Gauthier-Villars et Cie, Paris, 1928.

ONE OF THE EDITORIAL OFFICES

such as sugars, alkaloids, and so forth. This is true also of another field which has not yet been discussed: nomenclature. All the advantages and disadvantages of the chemical language are exhibited in the wide variety of names that can be given to even simple compounds. It would be impracticable to give in the "Handbuch" all the conceivable names for every compound. An intelligent selection is necessary. The chemical language, to a great extent, is founded on conventions. Therefore, the editorial staff is faced with the problem of determining which of these usages has shown itself likely to endure and to be capable of generalization. Such names are usually considered "correct." From these, whose number is still far too large, must be chosen those which are nearest the usages of the literature. An important point in the selection of names is that an understanding of the systematic arrangement should be facilitated by the names themselves. As can be seen, this involves an extensive classification, whose importance is just as great as the development of the System of organic compounds. Chemical nomenclature is as capable of change as the structural formulas themselves. It is an essential medium of expression, whose use must be cultivated carefully. At present, nomenclature is still the most important means of orientation for the user of the "Handbuch." This orientation will be made much easier by the forthcoming "General Index," whose publication may be expected within a few years. It is the writer's personal belief that orientation by the System is simpler than orientation by nomenclature. The chemical name, by its nature, is merely a restatement of the structural formula, and the number of formulas is much smaller than the number of names. The difficulties that must arise from the limited interests of the individual and the abundance of the material are obvious, so perhaps it is well that there are available several methods (including the formula index) by which the user can find his way through the mazes of the "Handbuch." The individual can decide whether he wishes to use nomenclature or the System as a guide, but he will have to choose one or the other.

The main volumes and the first supplement now (end of 1937) only lack the Main Division IV. It includes those natural materials whose constitutions, by January 1, 1920, had not been sufficiently elucidated to permit the inclusion of these compounds among the substances of established constitution. The chemistry of this group of materials has made rapid progress in the last fifteen years and the editorial board found itself faced here with a particularly difficult problem. Some of these materials, for example, the sterols and chlorophyll, have in this period taken on an entirely different aspect; consequently, the treatment of all these compounds could not be terminated with 1920. The tremendous additional work which this has imposed on the

staff is balanced by the hope that this volume, because of the abundance of its recent material, will bring the reader comparatively up-to-date information.

Another long-expressed desire of the chemical public will soon be filled. As has been pointed out, all the literature that has appeared since 1920 has been continuously abstracted by the staff. This task will be completed shortly and the first volumes of the second supplement may be expected in a few years. Then, for the first time, there will be a departure from the principle of a definite limiting date and the attempt will be made to narrow the gap between the literature and the publication date of each volume. This will meet numerous complaints. In the comparatively near future there will be accessible an orderly presentation of the entire material of organic chemistry.

The widening responsibilities of the editorial staff are best pictured by the constant growth in the number of collaborators. In his biography Hjelt wrote, "Many believed, as Beilstein often related with a certain satisfaction, that he had a special bureau with a staff of coworkers. This was anything but the case. His bureau consisted of his workroom where, surrounded by periodicals, manuscripts and proof, he sat at his writing table or typewriter. By himself he went through the whole literature, that is, all the chemical journals, and with the help of one assistant or secretary, he prepared all the editions of the great work." The changed conditions are apparent in the following Table:

	Editors	*Scientific collaborators*	*Technical collaborators*
1907	2	2	..
1918	2	6	..
1924	2	11	1
1928	2	24	2
1933	1	25	2
1937	1	27	3

It has been related of one of the great chemists (Wilhelm Ostwald?) that at the start of his career he made it a rule to read Liebig's *Annalen* from beginning to end, and he found this practice highly profitable for his scientific development. It is almost inconceivable that anyone might have the same idea with respect to "Beilstein." However, for about twenty years, the writer has found himself in the position of this imaginary "Beilstein reader." In closing, it may be of interest to learn something of the impressions of such a "Reader *malgré lui*." The "Handbuch" represents, to some degree, the microcosmos corresponding to the macrocosmos of living organic research. The attentive reader finds mirrored on every page the spirit of the science and its relation to human life. Two main endeavors are responsible for the abundance of organic compounds. From the needs of practical life arise the countless dyestuffs, medicinals, and other artificial products brought forth by the inventive genius of man. Among these are many compounds which have been studied little beyond the stage demanded by their practical application; they testify often enough to technical failures and fruitless wanderings into blind alleys. By the side of these materials stands a stately host of products which have been the subject of thorough scientific investigations. This pictures clearly the fact that pure science often is the child of technical empiricism, that it frequently then goes its own way along the path of purely academic research, and finally returns proffering its knowledge to service the needs of daily life. There is the equally numerous host of compounds that bear witness to the search of the inquiring human mind concerning the material foundations of natural phenomena and life processes. It would be hard to find a more impressive example of the essence of a science than the immense number of compounds which have been assembled as building blocks for the orderly erection of structural chemistry. Proof of structure was the incentive for the preparation of a very considerable fraction of the organic compounds. This edifice rises like a cathedral on which generations have labored. It is never finished; the plans are altered, each generation adds its bit, and perhaps under the foundations are discovered the remains of earlier and more primitive designs. One is almost tempted to carry the figure farther and to speak of "styles" of the various eras. The lack of homogeneity of the material in Beilstein speaks most eloquently. It shows the intimate interlacing of research and daily life, and demonstrates, at the same time, the deep-seated change that one hundred fifty years of organic chemistry have wrought in the concepts underlying proofs of structure. The Kekulé theory is the fundament of the present edifice; it is truly amazing that though our ideas have been considerably refined, all the progress of modern science, including physical-chemical methods, has not undermined this foundation. However, the discerning reader will be conscious of many compounds in which traces of the inadequate methodology of the earlier periods can be detected and, untouched by modern developments, these have, to a certain extent, fallen by the wayside. Not only unimportant compounds have suffered this fate. It would be a mistake to consider this material dead; even in the most unfavorable cases it will have value as a part of the great storehouse of empirical experimental findings. Who can say how soon theoretical or technical needs will bring about a reawakened interest in materials that now lie neglected? Perhaps among these blocks discarded by the architect are future cornerstones.

An attempt has been made to give the reader a glimpse into the workshop of the Beilstein editorial staff. Chemists can be justly proud of this great accomplishment. It is a practical reference work, but for him who reads between the lines it also is a living demonstration of the never-ending progress and the limits of science.