SCIENCE

VOL. 86 FRIDAY, DECEMBER 17, 1937 No. 2242

Words and Sentences in Science and Industry: E. J. CRANE 549

Obituary:
George E. Osterhout: DR. AVEN NELSON. *Recent Deaths* 553

Scientific Events:
Study of the Gulf Stream; The Harvard University Collection of Glass Flowers; The Pittsburgh Award; The American Academy of Tropical Medicine; The Third International Congress for Microbiology 555

Scientific Notes and News 557

Discussion:
Man and Plants in Alaska: DR. ALEŠ HRDLIČKA. *Nutrition vs. Growth:* DR. FREDERICK S. HAMMETT. *Wolffia in Flower:* H. WALTON CLARK. *More Fresh-water Medusae:* DR. B. E. QUICK and D. C. MATTHEWS 559

Special Correspondence:
Biological Abstracts: COMMITTEE ON ARRANGEMENTS. *The Annual Meeting of the Union of American Biological Societies:* DR. GEORGE W. HUNTER, III 561

Societies and Meetings:
The Indiana Academy of Science: DR. M. W. LYON, JR. *The Utah Academy of Sciences, Arts and Letters:* DR. VASCO M. TANNER 563

Special Articles:
The Relation between Visual Acuity and the Optic Projection Centers of the Brain: DR. KARL U. SMITH. *Induction of Polyploidy in Nicotiana:* WALTER H. GREENLEAF. *Adenomatous Lesion in Stomach of Strain I Mice:* DR. H. B. ANDERVONT and DR. HAROLD L. STEWART 564

Scientific Apparatus and Laboratory Methods:
An Improved Instrument for the Intracerebral Inoculation of Experimental Animals: JEROME T. SYVERTON and DR. GEORGE PACKER BERRY. *Filter-Method for Clean Isolation of Trichinella Larvae:* M. HOBMAIER and K. F. MEYER 567

Science News 8

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

New York City: Grand Central Terminal
Lancaster, Pa. Garrison, N. Y.

Annual Subscription, $6.00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

WORDS AND SENTENCES IN SCIENCE AND INDUSTRY[1]

By E. J. CRANE

EDITOR, CHEMICAL ABSTRACTS, THE OHIO STATE UNIVERSITY

COOPERATION is the main highway of human progress. The use of words and sentences is the commonest vehicle traveling this highway. Too often this vehicle of cooperation shows the need of lubrication. Too often it breaks down. Its utility is none too good at best, for the indefiniteness of words, as used and as understood, limits communication tyrannically. The failure of our communication vehicle continuously to function smoothly is not surprising; the imparting of information and ideas by the enunciation or writing of words and sentences is really a most complicated procedure. An ordered and modulated series of sounds is made in a well-nigh infinite variety of combinations, and listeners frequently understand. Marks are rapidly made one after the other on some surface, and readers find meaning in them. Because the ability to talk or write and to gain information by listening or reading is common the remarkability of this distinctive human attribute is not generally realized. Because the use of words and sentences is universal, adequate capability in their use tends to be taken for granted.

Science is exact. Industry is exacting. Men in science and industry therefore have special need for skill in clear and accurate communication one with another.

Mathematics is a language. Like a sentence a mathematical equation conveys a complete thought. So does a chemical equation. Scientists work with these languages and in these distinctly scientific modes of expression they recognize the necessity for the use of correct symbols and for proper balancing of equations.

Words are symbols, too, and sentences, like equa-

[1] Address delivered in New York, on November 5, by the recipient of the Chemical Industry Medal for 1937 presented by the American Section of the Society of Chemical Industry.

tions, require balancing. Many workers in science are less careful to be exact in their use of words and sentences than they are in writing equations or in making graphs or drawings. This carelessness is a source of some weakness in scientific progress. Chemical and other scientific nomenclature is often confusing, and English in science too frequently lacks clearness.

The value of good English is pretty generally recognized. English is universally a required course in our universities. "An extensive knowledge of the exact meanings of English words accompanies outstanding success in this country more than any other single characteristic." This quoted conclusion was reached by Johnson O'Connor,[2] director of the Human Engineering Laboratories at Stevens Institute of Technology, after an extensive investigation. The value of good nomenclature and good English in science and industry is not without recognition. Yet my constant work with chemical publications leads me to feel that emphasis is needed. If this emphasis could be made so strong as to stimulate effort for improvement by students, by writers and by editors and so graphic as to get the half-convinced over the fence and assiduously at work, the complexion of scientific and technical literature would clear and brighten. A good many people still think of a study of English as purely cultural. Skill in the use of English is a mark of culture, but it is also a very practical matter.

Perhaps I have been stating obvious facts; yet the obvious, fundamental, everyday consideration is sometimes taken for granted and therefore neglected. Taking things for granted is unscientific. The care, the skill and the scientific attitude of the laboratory, where scientific and technical results are obtained, are appropriate in reporting these results. Exactitude in reporting lags behind exactitude in discovering.

WORDS

All branches of science naturally have nomenclature faults and needs just as all have accepted standards. The need for names springs up ahead of the acquisition of thorough knowledge of the substances, properties, phenomena or processes brought to light in research. Names are, therefore, coined with insufficient information and frequently by investigators unskilled in nomenclature. They see only a partial picture of that which is being named and of the nomenclature of their fields. Indeed, many times so-called scientific names are coined on amateur night.

Needed information for naming is perhaps never complete. F. Richter, editor of Beilstein's Handbuch, said in a recent letter, "All reflections on nomenclature seem to be inevitably doomed to incompleteness because of the overwhelming variety of facts to be considered and the impossibility of duly taking into account all implications."

Frequently several names spring up where only one is needed. These cause confusion which at times seems endless, for once a name gets a reasonably good start it is headed off with difficulty. Multiple names in many instances have persisted for many years.

An excellent example of early cooperation to avoid multiple names is to be found in a recent occurrence. In 1935 a new alkaloid from ergot was independently isolated within a relatively short period in four different laboratories. At first there was some doubt as to the identity of the four products. Four names were proposed: ergometrine (by Dudley and Moir), ergotocin (by Kharasch and Legault), ergobasine (by Stoll and Burckhardt) and ergostetrine (by Thompson). The discoverers exchanged samples and decided they had identical products. Then the Council on Pharmacy of the American Medical Association adopted "ergonovine" as an acceptable non-proprietary substitute name. The council selected this name because of a rule against the recognition of names which are therapeutically suggestive.

The effort to systematize and to standardize is a continuous one. It is properly, in most instances, an international problem. The work is usually done by committees. As these committees are made up of busy men, widely scattered, progress is slow. Advances in science and industry would be distinctly helped if a more practicable and speedier method of word standardization could be found. Words are everyday tools. There would be adequate work in most branches of science for one or more nomenclature experts, employed as such, who could spend their full time in the name tool shop. They could help to solve the nomenclature problems of individual scientists and could assemble the considerable information needed by committees when more general decisions are necessary.

Editors have an opportunity to help make nomenclature in published papers conform with most generally accepted usage. Many endeavor to do this; others are lax. Authors who are rugged individualists, who are nationalists or who are too old to make changes sometimes handicap the efforts of editors.

Bacteriology presents a good example of the nomenclature difficulties which arise when knowledge is inadequate. Bacteriology is a comparatively young science. The general factors considered in classifying microorganisms are morphology, biochemical properties and pathogenicity. Many of the numerous classifications of bacteria which have been proposed are based on meager information compared to that obtainable from the large number of tests routinely applied to-day. Bacteriological literature is accordingly far from being in a satisfactory condition, and the workers

[2] *Atlantic Monthly*, 153: 160–6, 1934.

in this field are struggling with their nomenclature problems.

"In mineralogy it would take a book to discuss the problems of nomenclature," Edgar T. Wherry said to me recently. This field serves as an example of the difficulty in obtaining agreement. Some want to follow priority, others to follow usage when a mineral has more than one name, as many minerals do. Some want Dana's suggested *-ite* ending to be used as fully as practicable and others like the use, as well, of *-ine, -ote,* etc. There is wide divergence of opinion in usage as regards isomorphous series in spite of the strenuous efforts of the Nomenclature Committee of the Mineralogical Society of America to get general agreement.

With its quarter of a million known compounds and potentially many more, chemistry has one of the biggest nomenclature problems in science. Chemical nomenclature does not lag behind that of other sciences on this account, but there are pressing problems.

In organic chemistry the need for standardization in ring numbering is great. In an effort to bring system out of chaos Austin M. Patterson, American representative on the Committee for the Reform of Organic Nomenclature of the International Union of Chemistry, has worked out some systematic rules for position designation in cyclic compounds. These have been tentatively approved by the International Committee and, beginning in 1937, *Chemical Abstracts* will follow the rules in making index entries. Dr. Patterson and Leonard T. Capell have in course of compilation a catalogue of rings systems (there will be about four thousand of these) which will show the systematic numberings as well as other numberings in use. The publication of this catalogue in the near future is very desirable. Such undertakings are difficult to finance, but as they have fundamental significance, a way should be found.

In inorganic chemistry special difficulty is being encountered in naming coordination compounds and like complexes which are now being prepared in numbers. A wholly satisfactory naming system has not been found, but progress is being made (the German Commission for Nomenclature has recently made a valuable contribution[3]). The use of chemical formulas without an effort to coin names is a tendency in this field.

In the biochemical field the nomenclature of the proteins is fairly well established. The efforts of the International Union of Chemistry to establish a biochemical classification for fats, fat-like substances, carbohydrates and enzymes have not been effective. Carbohydrates and enzymes in particular are troublesome, carbohydrates to the organic chemist as well as to the biochemist. The hormones and vitamins present further examples of the chaos likely to arise in a new field of investigation. The chemical identification of some of these substances is beginning to help. Exclusive of the names of innumerable commercial preparations, some two dozen names have been used for the three principal estrogenic hormones, and even though the chemical structures have been determined and chemically correct names adopted by the Council on Pharmacy and Chemistry, some of these ambiguous names continue to be used.

In physical chemistry and chemical physics, words and symbols have been hard-pressed to keep up with the rapid strides made by investigators in recent years. Atomic disintegration and the separation of numerous isotopes have added one complication after another. The comparatively recent separation in quantity of the hydrogen isotope of mass 2, an advance of far-reaching significance, presented a nomenclature problem which will serve to illustrate some of the considerations properly kept in mind when names are coined. In deciding to recommend names for deuterium compounds which would differ as little as possible from those of the corresponding hydrogen compounds, the Nomenclature Committee of the American Chemical Society took into consideration such matters as (*a*) the existence of isotopes of many of the elements, (*b*) the fact that the isotopes of hydrogen are still forms of hydrogen and not new elements, (*c*) the effect of names and symbols on ease of thinking, (*d*) the teacher's view-point, (*e*) established nomenclature, (*f*) convenience and (*g*) indexing (this includes the use of indexes). If more of the haphazard naming in science and industry could be made to fit in with such general considerations, our nomenclature cart would not bump along so roughly and so slowly.

Trade names—of these there is no end. They multiply and they linger. If they are an evil they are no doubt a necessary evil; I do not gainsay their usefulness in trade. They are, however, the bugbear of scientific record keepers. Frequently they get into technical literature without definition or analysis. Editors have the lead and trumps and should work a squeeze play on undefined trade names—should refuse papers until lacking trade-name definitions are provided. Technical literature is not fiction. I mean it should not be. If in a story Edna Ferber wishes to name a mysterious character "Esmeralda" it is all right. Without an unmasked picture of the heroine, Esmeralda's activity in a pharmacological paper by John Scientist is much less exciting. Again, Taking Things For Granted is likely to be the villain.

Alloys, dyes and pharmaceutical preparations provide fertile trade-name fields. There are probably more than 10,000 alloy trade names in use. Each of

[3] *Chem. Weekblad,* 33: 722–30, 1936. (In English.)

the many producers is likely to have a long list of named alloys. Identical manufactured products with different trade names are not uncommon. In the Colour Index there are as many as 20 different names for some of the approximately 1,200 coal-tar dyes listed. When one encounters such names as Calite BL-28 or Buffalo Black 10B his hopes may mount that the numbers and letters are a clue to the discovery of systematic naming, but in so far as system exists it is limited and not generally helpful.

Trade names not infrequently come to be used so widely that they are taken over as public property and given official place in the English language, often to the dismay of manufacturers. Then of course definition in papers is no longer necessary.

Like college slang, "lab lingo" and industrial idiom are picturesque. I like them but not when used in wrong places, as in a printed scientific article. Some trade journals are full of such expressions and many readers are puzzled.

SENTENCES

This is no course in English and I could not pose as a teacher of English. The editorial blue pencil has grown stubby now, however, and perhaps there are one or two comments which can suitably be made.

Space limitations usually require that published papers be brief. Brevity is in many respects a virtue in itself, that is, down to the lowest point where clearness is retained. If in writing a paper the physical limitations are kept in mind from the beginning and the paper is built to fit, the product is usually better than the pared-down product of a longer paper. Abstracts are like papers in this respect.

A way in which brevity may be carried too far is to provide graphs and figures and say little more than "Here they are. Help yourself." Many an unbalanced meal has been eaten in a cafeteria-style restaurant. Statement of the author's interpretation of results is always of interest, often of value. Interpretation of the meanings of our accumulated data lags far behind anyhow.

In scientific writing the use of short sentences often helps. The fear of being misunderstood sometimes causes scientists to qualify and amplify until sentences become involved. Such sentences are like snowballs that have rolled down hill on a thawing day. They need to be broken up, and it is well to polish off sticks that have been picked up. Short sentences add emphasis. They wake up the reader lulled to a nap by a series of unrelieved long sentences. Too many short sentences, a staccato style, may be tiring, too, but a tendency in the direction of shorter sentences in scientific writing seems desirable. Clear-cut, lucid expression is helped.

Science calls for water-tight communication. May I try being a schoolmaster for a moment. Avoid loose construction. Avoid implied antecedents. A sentence should be so right that there can be no doubt as to its meaning. Join the minority and say "one tenth as large" instead of "ten times smaller." Be careful about hyphens. They can change the whole meaning of a phrase or sentence. Be precise. Say "sodium hydroxide" or "sodium carbonate" or "sodium bicarbonate" or "sodium oxide," whichever you mean, instead of "soda"—unless you make it clear that you are thirsty. Remember the reader.

Possibly the atrocious language of patents influences technical writing in general. Patent language is a law unto itself. I sometimes think a vigilance committee should take this law in hand. It is a menace. Dangling participles deserve their sentence less than that often assigned patents by puzzled patent perusers.

"CHEMICAL ABSTRACTS"

Chemical Abstracts, a key to the world's chemical literature, is built chiefly of words and sentences. It is encouraging to think of the 1937 award of the Chemical Industry Medal as a token of the usefulness of *Chemical Abstracts* to chemical industry. In a full sense *Chemical Abstracts* is a product of cooperation as well as a tool of cooperation. May I take this occasion to point with gratitude and with admiration to the fine spirit of helpfulness among American and other chemists which has been so big a factor in the production of *Chemical Abstracts.* There has never been a time when to obtain abstracting and editorial help has been difficult. A truly enormous amount of work has been accomplished by the faithful group of C.A. workers during the thirty years of the existence of *Chemical Abstracts,* and the work continues. I ask the privilege of sharing with them the implications of this medal. They deserve to share.

During the thirty years just mentioned *Chemical Abstracts* has grown from the publication of approximately 9,000 abstracts in a year to over 60,000 abstracts per year. The total abstracts for 1937 will be approximately 65,000. Of these about one third will be abstracts of patents. The number of abstracts of papers published is a pretty good measure of chemical activity. The total abstracts of papers for 1913, the year which preceded the year of the opening of the World War, was 19,025. The total dropped during the war to a low mark of 9,283 in 1918. It was not until 1923 that the total abstracts of papers returned to the 1913 level, the figure for 1923 being 19,507 abstracts. Since the total number of abstracts of papers in 1936 was 41,927, chemical activity throughout the world, thus reflected, can in one sense be said to have doubled during the past fourteen years and in another sense,

owing to the effects of the World War, to have required twenty-four years to double.

* * *

The wide scope of chemistry is reflected by the abstracts and their classification in *Chemical Abstracts*. It is surprising how many chemical papers abstracted are found in journals devoted primarily to other sciences. Perhaps three fourths of the papers appearing in the physics journals are found to be of chemical interest. Most of our basic industries are in large part chemical industries, as the contents of the journals devoted to them show.

The more than 2,800 periodicals now systematically examined in the preparation of *Chemical Abstracts* are printed in 31 languages. The English language—English words and sentences again—is the medium for the printing of two fifths of these (18.1 per cent. from the British Empire and 22.2 per cent. from the United States). German periodicals come next with 14.9 per cent., followed by Russian with 7.3 per cent., then French 6.2 per cent., Japanese 5.5 per cent. and Italian 4.8 per cent. Russian and Chinese chemical periodicals have shown the most rapid increase in number during the past five years. Russian papers vary a good deal in value, but some are excellent and improvement is apparent. Will the reading of the Russian language have to be added to the equipment of chemists? Here and there throughout the world, outside the British Empire and the United States, English is now used to a considerable extent in the printing of scientific papers. This fact and the predominant position of English at present in chemical publication encourage the hope, faint though it is, that English may some day gain recognition as the "universal language" of science.

Chemical Abstracts has long striven for completeness. Completeness in an abstract service involves not only the reporting of all publications in its field, but also adequate abstracting of individual papers and thorough indexing. *Chemical Abstracts* publishes nothing that is new and yet endeavors to publish everything that is new in chemistry.

The indexes are regarded as the most important part of an abstract journal. The purpose of an abstract journal is largely defeated if all the information concentrated between its covers is not made quickly and certainly available by a good key, the index. *Chemical Abstracts* is about one third index. This is properly so.

Subject indexing calls for great care in the use of words. Indexes which are mere compilations of words are not subject indexes. There is a wide difference between a true subject index and a word index. Word indexing leads to omissions, scattering and unnecessary entries. Subject indexes, sometimes called analytical indexes, bring like things together no matter what they may be called elsewhere and tie related things together with a thorough system of cross references. Such indexes utilize classification in so far as it is serviceable. Sometimes the effort to break away from word indexing has led to the substitution of classification for subject indexing. Classification is an indexing tool, not the objective; its use can be easily overdone. Scientific literature would be strengthened if more of its indexes were made scientifically. Taking things for granted is again to blame; poor indexes result from an assumption that a knowledge of the subject-matter of a publication is all the equipment needed for indexing. Indexing is an art and science in itself and a good knowledge of nomenclature is needed. Good indexes are likely to be more exact in word usage than are the papers or abstracts indexed.

Those of us responsible for *Chemical Abstracts* believe in the possibilities for its usefulness. This evening's happenings encourage the belief and I am grateful. *Chemical Abstracts* is a living record of the forward march of men who, along with their fellow scientists, are doing more for the world than is any other group. Great men are in these ranks, greater men than the warriors and statesmen or politicians who so often receive acclaim. It is a privilege to be an observer and a recorder of this advance.

Some men with nothing to say say it very well. These writers and their readers accomplish nothing very pleasantly. The scientist has something to say, perhaps more to say than has anyone else. Curiosity, ingenuity and carefully acquired skill continuously carry him into new places and his interest there is in fact instead of favor, truth instead of ideas acquired on the basis of their appeal. The world needs facts and truths. The scientist's fellow workers need his cooperation. This useful citizen, the scientist, extends his usefulness when words and sentences, like test-tubes and tadpoles, are effectively at his command.

OBITUARY

GEORGE E. OSTERHOUT

GEORGE E. OSTERHOUT was one of the twin boys born to George Osterhout, Sr., and Emma (Harding) Osterhout, at Tunkhannock, Pa., on March 31, 1858. In recent years, he had not been physically strong. He succumbed at the age of 79, on April 2, to an attack of influenza when coronary thrombosis set in.

Mr. Osterhout, at the age of 27, went West, pri-