leave the countries of their origin in very limited numbers.

The literature catalogues, together with microfilm copying, would fulfill in a highly efficient manner the needs of international scientific documentation. They would provide the means by which more complete reviews, digests, and compilations of literature on special subjects could be made and enable everyone engaged in research or in scientific bibliographic work to collect all pertinent publications on a given subject. Finally, they might be expected to reduce the chances that exceptional and important contributions to science might remain hidden and unused for shorter or longer periods of time.

The plans discussed above are based on the principle of cooperatively distributing the work itself among competent persons in the several countries. The possibility of organizing a single scientific documentation center for the entire world may also be considered. It has been suggested that the buildings constructed for the League of Nations in Geneva, Switzerland, would serve admirably for this purpose. These would also furnish the assembly halls and other facilities for holding international scientific meetings. In this case, the cooperation would be limited to supplying the funds required to pay the staff and provision for the collection of the scientific publications of all countries for transmission to the documentation center.

A single center would, of course, have certain advantages, but the organization of the work on the gigantic scale which would be required would undoubtedly be a very serious problem. Also, questions would be raised as to the prestige and advantages conferred upon the country in which the center is located. Although these imputations would be less in the case of Switzerland than in that of any other country which might be chosen, they would, nevertheless, be made, since scientists are not entirely free of chauvinism even though they recognize the international character of science. The suggestion of a single center of documentation for the world is one deserving of careful consideration in conjunction with the plans involving distribution of the work among the participating nations. Certainly, some kind of international cooperation in scientific documentation is desirable, and its attainment is worthy of the earnest efforts of all who are interested in the advancement of science and human welfare.

Scientific Publication as Affected by War and Politics

Samuel W. Fernberger
Department of Psychology, University of Pennsylvania

MANY YEARS AGO, THE WRITER BEGAN an analysis of the number of titles published in the different languages each year in the field of psychology. A number of reports have appeared in the *American Journal of Psychology* and in the *Psychological Bulletin*. This work was originally undertaken to impress on graduate students and professional psychologists the necessity of an adequate reading knowledge of English and German, no matter what their native tongue. The first article, published in 1917, indicated certain interesting and important language trends, and hence the writer has made three supplementary reports, each covering an additional 10-year period. By 1938 these trends seemed of such importance that the data from 1894 through 1935 were gathered together in a single article which covered the early development of psychology, World War I, and certain earlier years of the period of economic depression. This latter period covered, as well, certain political changes, especially in Italy and in Germany. Results are now available for the whole midwar years and for World War II.

It must be frankly admitted that the material here presented is limited in scope. Psychology, as a science, has been extremely fortunate in having a bibliographic service from a relatively early date. From 1894 to 1935 the *Psychological Index* merely listed titles in psychology or in neighboring fields of professional interest to psychologists. Since 1935 the writer has utilized the *Psychological Abstracts,* which supplies abstract service for psychologists.

The materials for the present paper are derived from these two sources. For the present purpose a title is a title, and no attempt has been made to evaluate it, be it a two-volume work or a single page in a journal. Certain sources of error are self-evident. Each title is listed as of the year in which it is mentioned in the *Index* or *Abstracts* rather than as of the actual year of publication. Although there are therefore certain lags, particularly toward the ends of the years, this error is subsequently self-corrective. It is also obvious that such bibliographic services can never be totally complete. Furthermore, the titles listed, particularly in neighboring fields, may vary somewhat from year to year as a result of changes in editorial policy. Finally, the present study deals only with the materials of a single science. However, the writer has been informed by colleagues

in other sciences that the picture presented would probably be true in other and very different fields of scientific endeavor.

Between the years 1894 and 1945, both inclusive, a total of 204,774 titles were listed in these two bibliographic sources, and it is upon this large body of material that the present study is based. The results will be found in Fig. 1. In order to smooth the curves somewhat, the average number of titles for each three-year period is given, except in the cases of the final values for 1945, when the number for the single year is reported. Also, in order to simplify the chart, only three curves are shown—one each for English and German language titles and a third for all of the other languages.

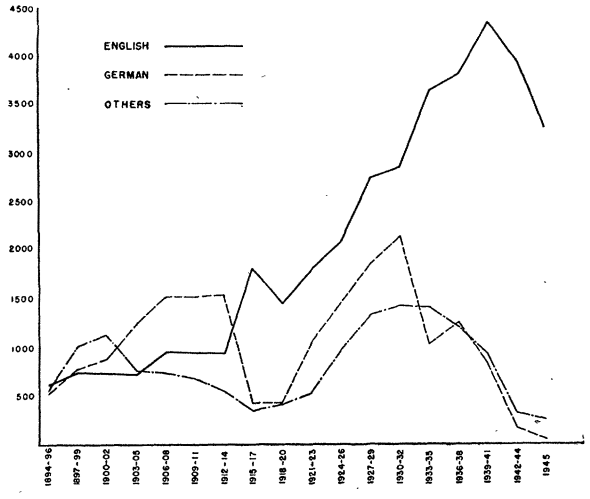

FIG. 1

In the early days of scientific psychology, up to 1905, approximately an equal number of titles was represented in each of the three curves. The "All Others" curve is made up almost entirely of French and Italian titles—a situation which remains true until after 1923. It will be remembered that the turn of the century was the heyday of French abnormal psychology.

The curve for German titles rises steadily through 1908 to a maximum of an average of more than 1,500 titles a year. This level is maintained up to the beginning of World War I. Then, from 1915 through 1920, the curve drops sharply to a minimum of less than one-third of this number. But almost immediately after the war, the curve for German titles rises very sharply to an all-time maximum of over 2,000 titles a year for the period which ends in 1932. This was the year in which Hitler came to power in Germany, and the effect of this political change is immediately obvious with a drop to less than one-half of the just-previous maximum in the following three years (1933–35). In the next three-year period, ending in 1938, there is evidence of a slight recovery in the German curve, but with the beginning of World War II the German curve drops very rapidly—almost to the point of extinction—with only 187 titles listed in 1945. In Germany the effect of World War II was far more devastating on the volume of psychological publication than was that of World War I. This is particularly true because of the disastrous effects of the previous change of political pattern, which led to the suppression or emigration of so many of the productive scientists in Germany.

The curve of English language titles, most of which are of American origin, has a somewhat different form from the German. Psychology in America developed much more slowly than in Germany. The English curve runs along on more or less of a dead level, of less than an average of 1,000 titles per year, until 1914. In the next three-year period (1914–17) there is a sudden and marked increase in English language psychological publication to an average of over 1,600 a year. The American entrance into World War I has the effect of interrupting this increase, a small but definite regression appearing during the three years, 1918–20. The American participation in World War I was of relatively short duration, and hence the effect was not great. From 1920 until 1941, the English language curve rises rapidly and steadily to an all-time maximum average in any language of over 4,300 titles a year. Then came the American entry into World War II, with a decrease in the volume of published productivity, appreciable from 1942 to 1944 and much more marked for the final year of 1945. It is interesting to note that the slopes of the German and English language curves are very similar for the period of World War II.

The curve for all languages, other than English and German, has a form quite different from that of the other two. It rises to an initial maximum of over 1,100 titles during 1900–02. Indeed, for the six-year period, 1897–1902, more titles appeared in French and Italian combined than in either English or German. After 1902, the "All Others" curve, which, as has been indicated, is comprised very largely of French and Italian titles until about 1924, drops steadily to a minimum of 350 titles for the years of the beginning of World War I (1915–17). Curiously, this decline is only slightly hastened by the advent of war—partly because the decline was already so great. During the next six years (1918–23) the curve indicates a slight increase in publication in languages other than German and English.

From 1924 through 1932 there is a steady increase in the number of titles other than English and Ger-

man. This is especially marked during the first six years of this period. The maximum is reached in 1930–32, with over 1,400 such titles. The reasons for this increase are complex. In the beginning it is due to a very marked increase of titles in Russian, but part of this increase, and indeed a considerable part, is due to a rise in national feeling in the smaller countries. Finns felt that they must write in Finnish and Czechoslovakians in Czech. The languages run the gamut from Arabic to Turkish. Before this time, scientists in the smaller countries wrote for the most part in English, German, French, or Italian. These four languages were usually the only ones officially recognized at international scientific congresses. Toward the end of this period an increase in the number of titles in Spanish and Portuguese can be noted, most of which were of South American origin.

The "All Others" curve starts to decline after 1935 and, with the beginning of World War II, declines almost as rapidly as that for German publication, reaching a minimum of slightly over 300 titles in 1945. Of these, nearly one-third are of South American origin.

It would seem that these results have a story to tell. It is true that during the years of the recent war many psychological reports were issued which never reached publication. This is certainly true in the United States, where so much "classified" material was prepared by psychologists within the Services or under contracts with the National Defense Research Committee, the National Research Council, and other agencies. The writer doubts if much of this material will ever be published, partly because of continued classification and partly because the research problems were of a special character which made them useful during the war but frequently of no great scientific or systematic interest after the war is over.

One can only conclude that systematic science cannot flourish during wartime or in a political situation in which the scientists do not have freedom of thought and in which there are continued elements of uncertainty.

A New Classification System for Chemical Compounds[1]

D. E. H. Frear, E. J. Seiferle, and H. L. King[2]
The Pennsylvania State College, State College, Pennsylvania

IN THE COURSE OF SOME RESEARCH INVESTIGATIONS in which the authors have been engaged for the past several years, a simple system for classifying chemical compounds was required. For the purposes of this investigation it was necessary to (a) order the compounds in such a way that an individual compound could be located in a file containing several thousand other compounds with a minimum of effort and possibility for error; (b) arrange the compounds, in so far as possible, so that related compounds would be grouped together in the file; and (c) make possible the collection and statistical study of data on the frequency of occurrence of all chemical groupings appearing in the compounds under study.

After a number of trials with existing classification and indexing systems, including molecular formulas, alphabetical arrangements, and several others, it became apparent that each of these failed, in one way or another, to fulfill the requirements of this investigation. Accordingly, a classification system was devised especially for the work at hand, using an approach which the authors believe to be unique. This system was first applied in substantially its present form in 1943, and since that time it has been used successfully on approximately 8,000 different chemical compounds. These compounds comprise a group on which insecticidal and fungicidal tests had been recorded and cover a wide range of composition. Both organic and inorganic compounds are included.

Briefly, the present classification is based on "code numbers" assigned to each chemical compound. The code number for a particular compound consists of one or more group numbers, depending upon its type and complexity. These group numbers are assigned by referring to a prearranged list in which constituent chemical groupings (not necessarily functional groups) are given numerical designations. *The groups are listed in decreasing order of complexity.* This is probably the most important feature of the present classification system and, in the opinion of the authors, is the greatest single factor contributing to its workability.

The list of major families is given in Table 1, with one or more examples under each.

Parenthetically it should be noted that the presence of the elements O, N, S, or X (halogen) in the constituent group determines into which family the group falls and is thus the criterion of the complexity of the group. The carbon atom may or may not occur in

[1] Authorized for publication on 22 June 1946 as Paper No. 1334 in the Journal Series of the Pennsylvania Agricultural Experiment Station.
[2] The second-named author is grateful to the General Aniline and Film Corporation for approving devotion of part of his time to this project.