a hybrid-type pattern, one with a *rivularis*-type pattern, and a third with an intermediate pattern. Other characters, such as the presence and size of the balancer and the size of the dorsal fin, also segregate in the backcrosses, and they segregate independently of one another and of pigment pattern. The ratios of segregation indicate that the numbers of genes that differentiate the species with respect to these characters are not very large.

There is not space to deal with the corresponding results of backcrosses involving other species combinations.

These are elementary genetic experiments, but since they involve my California newts, and since I have been for years uncertain of the feasibility of making any type of genetic analysis at all with these animals, the results are of special interest to me personally.

### Conclusion

In presenting this account I am well aware that developmental biologists will possibly react with the feeling, "there goes another embryologist down the drain," and animal behaviorists will point with gratification, on the other hand, to the evidence that here is an embryologist who has finally seen the true light—even though he sees it dimly and is still an amateur. In any case, the reader in whose mind problems of speciation are uppermost, especially during this much celebrated Darwin Centennial year, can consider himself fortunate that he is not using experimental animals that yield genetic information as slowly as do California newts.

#### Notes

1. I wish to thank Mr. and Mrs. T. L. Hedgpeth and more recent owners of the ranch, particularly Mr. and Mrs. Stanley Richardson, Jr., for the facilities and courtesies they have generously extended to me. The project has been supported in part by grants from the National Science Foundation.
2. The genus was formerly designated *Triturus*.

# Analysis of References in Critical Tables

## National origin of physicochemical data is determined from literature citations in two research projects.

Bruno J. Zwolinski and Frederick D. Rossini

In recent years, particularly in the past decade, the advances and activities in the political, economic, and scientific areas of human endeavor have been examined from several points of view, in an attempt to delineate progress, major trends and their causes and interactions, and interrelationships with respect to future prospects and predictions in these areas, on both a national and an international level. In every analysis we are confronted with perennial questions as to the authenticity of the information or facts analyzed and their interpretation. Recently a thought-provoking article by Crane and Heumann was published entitled "*Chemical Abstracts* measures a nation's research" (*1*). Their thesis is that, since *Chemical Abstracts* has been working for over 50 years to cover the world's chemical literature as completely as possible, and since chemistry is a fundamental science closely integrated with a number of areas in the general field of physical, engineering, and biological sciences, the number of articles published in a particular country and abstracted in *Chemical Abstracts* should be a relative measure of national scientific activity.

As was to have been expected, the timely article by Crane and Heumann and the statistics which they gave elicited responses from readers which were both laudatory and critical in nature, particularly with respect to the total scientific activity—past, present, and future—of the United States and the U.S.S.R. In his brief comments on the letters received regarding the implications of the scientific information given in his article, Crane (*2*) pointed out specifically that the *Chemical Abstracts* statistics do not measure quality. He also doubted the availability of an effective measure of quality that would have general applicability.

A few months prior to the appearance of the article by Crane and Heumann, an independent study was undertaken in the Chemical and Petroleum Research Laboratory of the Carnegie Institute of Technology on the problem of national scientific activity and contributions. In this study the references by country of origin in the "General list of references" in the critical tables of the American Petroleum Institute Research Project 44 on "Data on Hydrocarbons and Related Compounds" and in the critical tables of the Manufacturing Chemists Association Research Project on "Properties of Chemical Compounds" were subjected to analysis.

### Continuing Critical Tables

A few brief comments on the history of these two projects and on the nature of the selected values of physicochemical data with which they are concerned may be in order. Both of these projects on the compilation of continuing critical tables of basic scientific data are research projects of the chemical and petroleum research laboratory of the department of chemistry at the Carnegie Institute of Technology. The American Petroleum Institute Research Project 44 began work in September 1942, at the National Bureau of Standards, under the direction of Frederick D. Rossini. In June 1950 this project was moved to the Carnegie Institute of Technology. The purpose of the project is to compile and keep up to date a complete and self-consistent set of tables of critically se-

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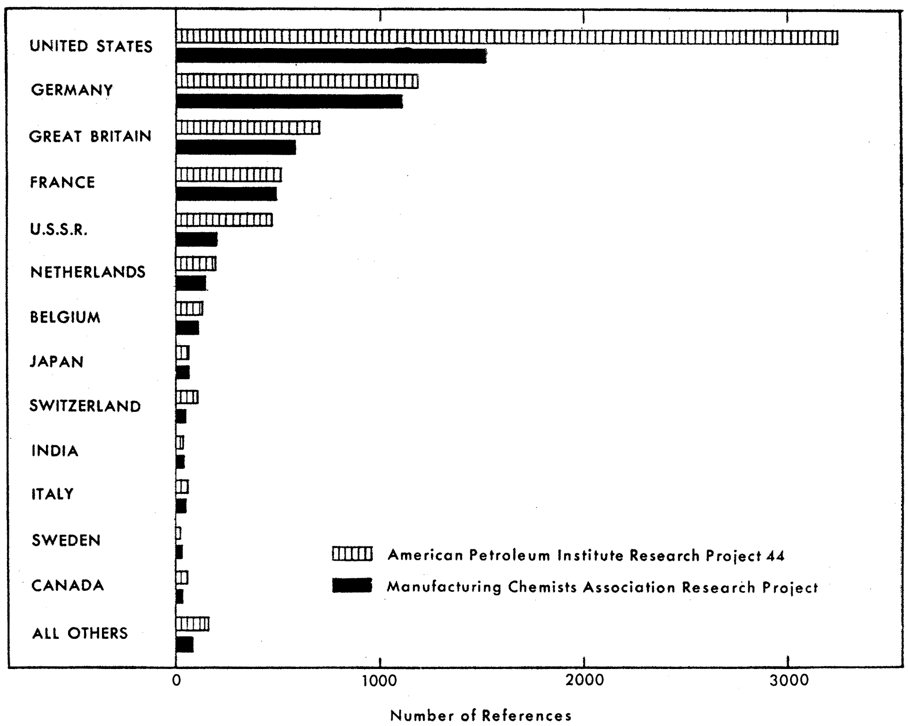


Fig. 1. Sources, by country, in the "General list of references" of the critical tables of the American Petroleum Institute Research Project 44 and the Manufacturing Chemists Association Research Project.

Table 1. Sources by country in the general list of references of the critical tables of the American Petroleum Institute Research Project 44 and the Manufacturing Chemists Association Research Project, at the Carnegie Institute of Technology, as of 30 June 1958.

| Country of origin of the journals | API Research Project 44 | | MCA Research Project | |
|---|---|---|---|---|
| | No. | % | No. | % |
| Australia | 5 | 0.07 | 0 | 0 |
| Austria | 50 | 0.73 | 9 | 0.21 |
| Argentina | 0 | 0 | 2 | 0.04 |
| Armenia | 0 | 0 | 1 | 0.02 |
| Belgium | 125 | 1.82 | 98 | 2.23 |
| Brazil | 0 | 0 | 3 | 0.07 |
| Canada | 57 | 0.83 | 27 | 0.62 |
| China | 0 | 0 | 6 | 0.14 |
| Czechoslovakia | 49 | 0.71 | 6 | 0.14 |
| Denmark | 14 | 0.20 | 8 | 0.18 |
| Finland | 6 | 0.09 | 4 | 0.09 |
| France | 521 | 7.57 | 493 | 11.22 |
| Germany | 1180 | 17.14 | 1104 | 25.13 |
| Great Britain | 698 | 10.14 | 570 | 12.97 |
| Hungary | 0 | 0 | 1 | 0.02 |
| India | 30 | 0.43 | 36 | 0.82 |
| Italy | 60 | 0.87 | 32 | 0.73 |
| Japan | 53 | 0.77 | 52 | 1.18 |
| Mexico | 0 | 0 | 1 | 0.02 |
| Netherlands | 186 | 2.70 | 131 | 2.98 |
| Norway | 0 | 0 | 4 | 0.09 |
| Poland | 12 | 0.17 | 7 | 0.16 |
| Rumania | 2 | 0.03 | 2 | 0.04 |
| Spain | 8 | 0.12 | 20 | 0.45 |
| Sweden | 14 | 0.20 | 28 | 0.64 |
| Switzerland | 97 | 1.41 | 43 | 0.98 |
| U.S.S.R. | 471 | 6.84 | 192 | 4.37 |
| United States | 3246 | 47.15 | 1514 | 34.46 |
| Yugoslavia | 1 | 0.01 | 0 | 0 |
| Total | 6885 | 100.00 | 4394 | 100.00 |

lected numerical data on the physical and thermodynamic properties of hydrocarbons and related compounds, such as certain oxygen, nitrogen, and sulfur derivatives of hydrocarbons. The companion or sister project, the Manufacturing Chemists Association Research Project, began work in May 1955, at the Carnegie Institute of Technology, also under the direction of Frederick D. Rossini. The aims of this project are similar in nature and scope to those of the API research project, except that the critical tables of the MCA research project on the physicochemical properties of chemical compounds will cover in time all known inorganic and organic substances with the exception of the hydrocarbons and certain related compounds.

The term *continuing critical tables* means tables of critically selected "best" values of properties and physicochemical constants, kept essentially up to date by revision at appropriate intervals. The selection of a "best" value involves various activities, such as appraisal and scrutiny of the data, of the method and procedure of measurement, and of the purity of the substance measured; weighting and mathematical analysis of the original data of each investigator; and theoretical, semi-empirical, and empirical correlation with molecular structure and with the variables of temperature, pressure, and so on. In many cases, new values are created, including values for many compounds never prepared by man. Such basic data on physical and thermodynamic properties are found scattered throughout the entire world literature of scientific journals in the general areas of physics, chemistry, and engineering. The staff has the responsibility to find such data wherever they may be published and no matter how obscure the journal. Only in rare cases are the data not obtained directly from published articles.

## Analysis

It was the consideration of the quality of contribution that prompted us to analyze the "General list of references" in the critical tables of both the API and the MCA research projects. Our purpose was to ascertain the relative contribution of each country, as measured by the number of original journal publications used in the compilation and cited alphabetically by author's name in the "General list of references" of the two projects. Since at the present time over 11,000 journal references are given in these two publications, it was felt that such an analysis would be meaningful. If we accept the authenticity and reliability of the data compiled in these tables of critical data, the analysis given below should give some measure of the quality of certain national scientific activities. Furthermore, since precise and accurate scientific data are the foundation for basic research and theoretical advances in all fields, this analysis may serve to indicate the national trends in fundamental research, as contrasted with applied research and development.

For this analysis, an actual count of the individual references was made. The recent "List of Periodicals Abstracted by *Chemical Abstracts*," together with the *Chemische Zentralblatt*, served as a guide for determining the origin by country of each specific scientific journal, where this was not obvious. Only in a very small number of cases, involving journals for which there had been a change of title or of place of publication or both, was it not possible to establish firmly the country of origin for a reference. If errors were made in these instances, these would have had no significant effect on the figures for the relative contributions of the largest contributors, which is the most meaningful information presented.

The following ground rules were adhered to in the preparation of the analysis: (i) All primary sources, such as journals, are enumerated; (ii) patents by each country of origin are tabulated as primary sources; (iii) a few secondary publications, such as treatises, compilations of data, and textbooks, are included (these represent only 2 percent or less of the total number of references); (iv) in the tabulation, "Great Britain" includes England, Wales, and Scotland; (v) "U.S.S.R." implies only Russia proper, all Soviet satellites, with the exception of East Germany, being regarded as separate countries; East and West Germany are counted as one country (*3*).

## Results

The results of the analysis are summarized in Table 1 in terms of the absolute number and the percentage contribution by country for each of the two sets of critical tables. In Table 2 are listed, with their percentage contributions, the countries whose journals provided the largest number of references for the critical tables of the two projects, together with a comparison of the information from *Chemical Abstracts* by Crane and Heumann (*1*). It is seen that the figures from the "General list of references" of the API Research Project 44 and of the MCA Research Project are in substantial accord qualitatively, and that these figures agree reasonably well with those of Crane and Heumann for the period 1909 to 1956.

Figure 1 shows graphically the information reported in Tables 1 and 2.

Table 3 gives some facts and figures regarding the critical tables of the American Petroleum Institute Research Project 44 and the Manufacturing Chemists Association Research Project.

Table 2. The countries whose journals provided the largest number of references for the critical tables of the American Petroleum Institute Research Project 44 and of the Manufacturing Chemists Association Research Project and for *Chemical Abstracts* (*1*).

| Country* of origin of the journal | API Research Project 44 (%) | MCA Research Project (%) | *Chemical Abstracts* 1909–1956† (%) | *Chemical Abstracts* 1956 (%) |
|---|---|---|---|---|
| United States | 47.15 | 34.46 | 32.2 | 28.4 |
| Germany | 17.14 | 25.13 | 20.2 | 8.4 |
| Great Britain | 10.14 | 12.97 | 11.9‡ | 9.2‡ |
| France | 7.57 | 11.22 | 8.4 | 6.0 |
| U.S.S.R. | 6.84 | 4.37 | 6.5 | 13.5 |
| Netherlands | 2.70 | 2.98 | 2.0 | 1.3 |
| Belgium | 1.82 | 2.23 | 0 | 0 |
| Japan | 0.77 | 1.18 | 3.7 | 10.4 |
| Switzerland | 1.41 | 0.98 | 1.4 | 1.9 |
| India | 0.43 | 0.82 | 2.0 | 2.4 |
| Italy | 0.87 | 0.73 | 3.2 | 4.1 |
| Sweden | 0.20 | 0.64 | 0 | 0 |
| Canada | 0.83 | 0.62 | 0 | 0 |
| All others | 2.23 | 1.67 | 8.5 | 14.4 |
| Total | 100.00 | 100.00 | 100.0 | 100.0 |

* Arranged in order of the number of references in the critical tables of the Manufacturing Chemists Association Research Project. † Mean of the figures given by Crane and Heumann (*1*). ‡ Obtained from the figures reported for the British Commonwealth and the factor 0.84 quoted by Crane and Heumann (*1*).

## Discussion

One must keep in mind that the figures presented in Tables 1 and 2, and in Fig. 1, represent a special kind of compound averages—averages for different classes of compounds, with different kinds of properties, in different

Table 3. Facts and figures regarding the critical tables of the American Petroleum Institute Research Project 44 and the Manufacturing Chemists Association Research Project, at the Carnegie Institute of Technology, as of 30 June 1958.

| Item | API Research Project 44 | MCA Research Project |
|---|---|---|
| No. of chemical compounds listed | 2,138 | 1,451 |
| No. of individual numerical entries | 227,293 | 12,214 |
| No. of references | 6,885 | 4,394 |
| No. of valid sheets in a complete set of tables | 1,807 | 393 |
| Oldest reference cited (date) | 1822 | 1826 |
| Longevity of the project (yr) | 15.5 | 3 |
| No. of recipients of the data sheets: | | |
| in the United States | 842 | 1,028 |
| abroad | 332 | 153 |
| Total | 1,174 | 1,181 |
| Total No. of countries receiving data sheets | 34 | 30 |
| No. of countries* represented in the "General list of references" | 22 | 27 |

* For comparison with these figures, consider the following: No. of countries in the world having one or more institutions of higher learning (*4*), 80; No. of countries who are members of the United Nations, 81; total No. of countries in the world (*5*), 115.

scientific areas, taken over different periods of time and influenced by different economic and political factors and by advances in scientific theory and practice, with their associated fads and prejudices. In view of this fact, one is tempted to say that any kind of agreement or disagreement is rather fortuitous and perhaps meaningless.

As to whether this analysis of the references in the two sets of continuing critical tables constitutes a sound basis for delineating the quality of basic physicochemical research on an international level, only time will tell. One fairly obvious and not unexpected result of this study is the finding that the principal countries of the world—those in which there is the greatest scientific activity—are the largest contributors of such basic scientific physicochemical data.

Analysis of the references in the continuing critical tables of the American Petroleum Institute Research Project 44 and the Manufacturing Chemists Association Research Project will be made at regular intervals, and appropriate reports will be issued. In particular, it is planned to evaluate the change in percentage of contributions with time for the several countries. This will be important in giving us a projection into the future. It is expected that such an analysis will show a high upward rate of change for the U.S.S.R., as was shown by the figures derived from *Chemical Abstracts.*

### References and Notes


1. E. J. Crane and K. F. Heumann, *Chem. Eng. News* **36**, 65 (1958).
2. E. J. Crane, *ibid.* **36**, 13 (1958).
3. Grateful acknowledgement is made to Harry J. Ries and James T. Kerr for assistance in the preparation of this information.
4. M. M. Chambers, *Universities of the World Outside the U.S.A.* (American Council on Education, Washington, D.C., 1950).
5. W. S. Woytinsky, *World Population and Production* (Twentieth Century Fund, New York, 1953).


# Eugene F. DuBois, Environmental Physiologist

Eugene F. DuBois died 12 February 1959, after distinguished service to science and to his country. He was born in West New Brighton, Staten Island, 4 June 1882. His father died when Eugene was nine. His mother, who attended opera in New York regularly from the age of 8 to 80, spoke French and German fluently and studied Spanish after she was 70. Eugene felt that he got the best part of his education at home during his first 12 years, thanks to his mother, a happy environment, a house full of books, and walks through the woods and fields. In 1897, at 15 he transferred from the Staten Island Academy to Milton Academy, where he learned from one of his teachers, James Hattraik Lee, that study could be good fun. He spent some summers in Europe, but in the summer of 1898 he and his brother Arthur, as volunteer orderlies, helped care for patients with typhoid fever and dysentery at the Army Hospital at Camp Wyckoff, Montauk Point. Eugene then decided to study medicine.

He rated his three years in the humanities at Harvard easy, despite the fact that he graduated *cum laude.* He arranged his courses so that he could row on the Charles River every afternoon. He later regretted having taken only the minimum requirement in chemistry and biology, commenting that he did not get a good education at Harvard but did get the desire and drive to educate himself, a stimulus that lasted throughout his life.

DuBois entered Columbia College of Physicians and Surgeons in 1902. At that time classes were large, standards were low, and instruction was didactic. Students supplemented their medical education by joining private quiz classes and by substituting as interns. Only in this way was it possible to pass the stiff examinations given by the hospitals to select interns. With Charles Lieb, DuBois was fortunate in being selected to serve as "clinical clerk" in the summer of 1905.

After graduation in 1906, DuBois spent six months with Hanke in Berlin studying pathology. He returned to residency at Presbyterian Hospital. This was in the era of transition, in New York, from the old traditions to the beginning of modern medicine. Leaders in the transition were Graham Lusk, Samuel Meltzer, Theodore Janeway, and Christian Herter. The Rockefeller Institute was making its influence felt, and the Harvey Society was founded. DuBois and several of his fellow interns mapped out careers in scientific medicine. After two years as intern and house officer, DuBois went, on the advice of John Howland, to Berlin to study metabolism for six months under Theodore Brugsch. As happens even today, the young scientist accumulated notebooks of data without adequate information on how to write a scientific paper. Graham Lusk came to his rescue during his stay in Berlin and in typical fashion was generous of his time in helping DuBois recalculate the data and write the paper. The two men became lifelong friends.

DuBois returned to Presbyterian Hospital in 1909, to begin work in pathology under Eugene Opie. There he was associated with Jonathan Meakins and Russell L. Cecil. He held various appointments at Cornell beginning in 1910. He was professor of medicine from 1930 until he became professor of physiology in 1941. In a sense he asked for the latter post. When Bronk, after a 1-year tenure, resigned as professor of physiology at Cornell to return to the Johnson Foundation, DuBois remarked that "it was a chair any professor of medicine would be glad to accept." Almost immediately he was offered the position and accepted it.

DuBois had hesitated about departing for his second period of European study in 1908 because he had just become engaged. However, his fiancee insisted that his career should come first. After he married Rebeckah Rutter in 1910, his small salary compelled him to open an office in their apartment and practice medicine a few hours a day. While never an athlete, DuBois enjoyed many forms of sport and throughout his life maintained a high degree of