Letters

A Scientist by Several Other Names

During the first week of an introductory course in psychology, I asked my students (47 of them, mostly new college freshmen) to write down the names of ten scientists. They were given about 5 minutes to perform the task. I asked them to carry out this chore because, with the lists prepared, I hoped to go on and have the students indicate, in a general discussion, what the individuals they named had in common, and by doing this to lead them to an understanding of the nature and coherence of all scientific activity and eventually to an examination of the question whether or not psychologists belonged in this company.

The lists made interesting reading, and when all the nominations were tabulated they seemed to accommodate several speculations. The results of the tally are given here. The original spellings have been preserved, and the number of times each name (and spelling) was offered appears in parentheses.

Einstein (29), Eienstein (2), Einsteine (1), Einstien (2), Enstein (1), Inestine (1).

Pasteur (22), Pastuer (5), Pastuere (1), Pasture (3).

Newton (19), Neuton (1).

Salk (15), Saulk (2), Sulk (1), Bernard Salk (1).

Galileo (7), Galilao (1), Galilio (1), Gallaleo (1), Galleo (1), Gallileo (3).

Edison (13), Franklin (11), Freud (11), Darwin (10).

Curie, Marie (10), Curie, Pierre (4), Curie, (9), Currey (1), Currie (3), Cury (1).

Schweitzer (5), Scheitzer (1), Schwitzer (2), Schyzer (1), Swicher (1), Switcher (2), Switzer (1).

Von Braun (8), Van Braun (2), von Bron (1), Von Brawn (1).

Copernicus (2), Capericus (1), Cornepincus (2).

Da Vinci (3), De Vinchi (1), Divinshie (1).

Gottlib (3), Gootlieb (1), Gottlif (1) (*1*).

Leeuenholk (1), Leevenhope (1), Leuwenhook (1), Lewenhook (1), Lewinhook (1).

Sabin (3), Sabien (1), Sabine (1).

Bell (3).

Lavoisier (1), Lauversior (1), Lavasoir (1).

Marconi (3), Reed (3), Watt (3), Aristotle (2), Ferme (2), Goddard (2), Needham (2), Neilson (2), Morse (2), Pouchet (2), Redi (2).

Pavlov (1), Pavloff (1).

Spallanzani (1), Spallzani (1).

Each of the following names was mentioned once:

Archimedes, Martin Arrowsmith (*1*), Bacon, Boar, Burbank, Charles, Carlton. Coons, Crutchfield, De Krebs, Dornberger, Farraday, Fleming, Galton, Gauss, Howe, Kelsey, Koch, Kratzmer, Laurance, Lay, Linnearus, Dr. Ludwig (*2*), Malthus, Mendel, Mendelsohn, Mosier, Ohm, Oppenheimer, Pauling, Petri, Priestly, Rorshack, Sarnoff, Adam Smith, Vesalius, Voltz, Werner, Dr. Norman Welsh, Mr. Wizard.

The data suggest that even a reasonably well-informed adult is likely to know the names of only those who work in the physical or biological sciences.

Moreover, he probably believes (i) that women are not scientists; (ii) that inventors are scientists, mathematicians may be scientists; and (iii) that very few eminent scientists are alive today, and if they are, they are quite likely to be on television, in the Sunday supplements, or working in space technology or atomics.

The failure of social scientists to dent the list is not surprising, but the absence of many important names is; Descartes, Helmholtz, Leibnitz, Loeb, Mead, Poincaré, Watson, Meitner, Boltzmann, Kepler, Maxwell, Carson, Harvey, and Planck are some of the more obvious omissions.

The data do hold out a small ray of hope to the humanist. The cavalier renditions of the names may be taken (psychoanalytically) to indicate a deep-seated and general hostility toward scientists which, if channeled appropriately, would provide an effective safeguard against the looming threat of a scientific takeover.

E. L. Klingelhofer
Sacramento State College,
Sacramento, California

Notes

1. These names appeared, no doubt, because the students were reading *Arrowsmith* in the course at the time.
2. A faculty member at the college at which I teach. I am somewhat miffed that nobody named *me*.

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Metric Question

Two pro-metric-system letters in a recent issue of *Science* [**140**, 1137 (1963)] presuppose the inevitability of an ultimate compulsory metric takeover in the United States and Great Britain. While there may have been some basis for such a belief during the latter half of the 19th century, a gradual shift in outlook, due to economic and technical changes, has been under way since then, especially since the congressional debates of 1902 (*1*).

Confusion and misunderstanding continue to bedevil the metric controversy, but the recent adoption of the wavelength of a line in the spectrum of krypton-86 as the basis for an international invariable standard of length should finally settle the question of which is "more" basic, the inch or the meter. By treaty, both these units have now achieved international recognition, along with other English and metric weights and measures. That there are two deeply rooted systems in the world today is increasingly being taken for granted by industry and commerce, except for those who have axes to grind or who have become irreversibly steeped in metric-system propaganda.

There is nothing scientific, sacrosanct, or immutable about the metric system, whose only claim to superiority lies in its decimalization and in its attempted relation between units by 10's only. In many respects it is inferior to the English system, a fact that Secretary of State John Quincy Adams demonstrated in his historic report to Congress in 1821, which laid the foundation for the continued use and standardization of the English units in the United States.

The 1960 British "Joint Report, on

Decimal Coinage and the Metric System" opens with a statement by a former president of the British Association for the Advancement of Science that uppermost in this study were questions of cost, practability, and "the possibility of a half-way house" centering upon accommodation and increased decimalization and simplification of the British units. In contrast to the 1951 British Hodgson Report, compulsory adoption of metricism was not recommended.

At the 1958 Washington meeting of the AAAS, Roy P. Trowbridge, director of General Motors Engineering Standards, presented a review of current attitudes of practicing engineers, scientists, and technicians in American manufacturing industry, which indicated a marked increase in support of the "inch" system. Concluding another critical analysis in 1963, Trowbridge took issue with the conventional belief that compulsory conversion to metricism in the United States is inevitable. "On the contrary," he stated, "a little well directed effort on the part of American industry might very well swing the conversion in the opposite direction."

Be that as it may, accumulating evidence indicates that further rationalization, accommodation, and cooperation between the English and the metric systems of weights and measures are the wave of the future (*2*).

JOSEPH MAYER
929 Chestnut Lane, Oxford, Ohio

Reference

1. J. Mayer, *Science* **137**, 1021 (1962); Fast, *J. Florida Assn. Sci. Teachers* (1963).
2. This letter is a digest of an article on "Metric System Developments," to be published early in 1964 in *School Science and Mathematics.*

The metric system evolved as a means to simplify and to unify measurements for all men. Its success is attested by its acceptance by most countries and about 90 percent of the world's population, without a single reversal. For almost a century it has been an official measurement system in the United States. But not until 1897 did England even permit the use of the metric system in trade. Such an insular attitude showed failure to recognize the technological and cultural advantages inherent in this simplified and unified system.

Letters in the 7 June issue of *Science* point to the advantages of the system and to certain logical steps to metric conversion. These letters elicited a response from Joseph Mayer, who concedes to the metric system only the value of decimalization and "its attempted relation between units by 10's only." If there is anything the system does, it is to interrelate units of measurement, not only by tens but by hundreds, thousands, and millions, and by their reciprocals as well. Thus, it uses two of man's great intellectual advances, the zero and the decimal point, to reach from the infinitely large to the infinitely small. Very small measures are expressed simply and precisely in the metric system, an impossibility in the English system.

Science is measurement, and numbers are its basic alphabet. In the numerical language of science the decimal system, and thus the metric system, take advantage of man's learned ability to count. In metrology, the basis of all other sciences and therefore the oldest, the metric system represents a historic advance in man's progress. The sense of "order and unity amid diversity," which is perhaps the ethical goal of both science and art, is finally achieved.

The great French chemist Antoine-Laurent Lavoisier, one of the originators of the system, integrated the measures of length, weight, and volume, all on the basis of the unit volume and weight of water at maximum density. Ironically, Lavoisier's life was taken from him, during the French Revolution, on narrow ideological and political lines. It was not until years later that France came to realize what a stark tragedy this sacrifice of one of her greatest sons had been. We can say in all fairness that to speak of decimalization as the only advantage of the metric system does not suffice. The compounded advantages of decimalization and correlation between all three basic units of measure are one of Lavoisier's legacies to science. (For a brief history of the origins of the metric system, see *1*.)

In his letter, Mayer states, "the recent adoption of the wavelength of a line in the spectrum of krypton-86 as the basis for an international invariable standard of length should finally settle the question of which is "more" basic, the inch or the meter." How an improved standardization of length will help resolve a difference in attitudes is not made clear.

If English is to become the language of the free world, we and the British will have to reject the English system of weights and measures in favor of the metric system. And the longer the delay, the less chance there will be for this to come about. All else being equal, any civilization that uses only the metric system can progress faster than one that uses only the English system. Any nation handicapped by the necessity to use both systems interchangeably will be slowed in the process. British or American students, to be well educated, must be facile in both. They must cope with the extravagant memory requirements of the English system and must be able to make conversions between the two. To "go metric" is a needed step in the scientific manpower race.

Mayer implies that there has been a shift back toward the English system since 1902, "due to economic and technical changes," none of which he describes. In reality, metric conversion has progressed steadily in the United States on a purely voluntary basis. Entire industries and professions now use the metric system. Labels on food and other products have increasingly shown metric equivalents. Most scientific publications use only metric measurements. The *United States Pharmacopoeia,* serving the professions of pharmacy and medicine, now uses only metric units. Manufacture to metric specifications is increasingly important in international trade (*2*).

John Quincy Adams in 1821, contrary to Mayer, wrote eloquently of the beauty and simplicity of the metric system. But when Adams, as Secretary of State, wrote his extensive review to Congress, not even France had progressed to the point of enforcing the exclusive use of metric weights and measures in trade. This did not take place until 1840. Although Adams failed to advocate conversion to the metric system for the United States, he did recognize the promise of the system for the future. One need only quote the last part of his dissertation (*3*) to prove this. "UNIFORMITY of weights and measures, permanent, universal uniformity, adapted to the nature of things, to the physical organization, and to the moral improvement of man, would be a blessing of such transcendent magnitude, that, if there existed upon earth a combination of power and will adequate to accomplish the result by the energy of a single act, the being who should exercise it would be among the greatest of benefactors of the human race. But this stage of human perfectibility is yet far remote. The glory of the first attempt belongs to France. France first surveyed the subjects of weights and measures in all its extent and all its compass. France first beheld it as involving the interests, the comforts, and the morals, of all nations and of all after ages. In forming her system, she acted as the representative of the whole human race, present and to come. She has established it by law within her own territories; and she has offered it as a benefaction to the acceptance of all other nations. That it is worthy of their acceptance, is believed to be beyond a question. But *opinion* is the queen of the world; and the final prevalence of this system beyond the boundaries of France's power must await the time when the example of its benefits, long and practically enjoyed, shall acquire that ascendency over the opinions of other nations which gives motion to the springs and direction to the wheels of power." Clearly, the metric system has provided all nations the convenience and uniformity of measurement for which it was created.

Now France and all of Europe, except England, are in position to aid in the commercial and cultural development of Africa, a continent which rivals North America in potential for human welfare. That most of Africa will use the metric system is already established.

No period in history has been more critical than this one for conversion to the metric system by English-speaking countries. The active support of engineers, scientists, and educators is needed. Congress should provide the means (i) to thoroughly explore this important opportunity (*4*), (ii) to expedite increased use of the metric system, and (iii) to set deadlines for stepwise conversion. This is in the national interest. Such a government-sponsored transition, properly explained and motivated, will stimulate not only world trade but domestic business as well.

DOUGLAS V. FROST
Abbott Laboratories,
North Chicago, Illinois

References

1. D. McKie, *Endeavor* **32**, 24 (1963).
2. *Iron Age* (Aug. 1962).
3. *The Metric System* (Barnes, New York, 1871), p. 295.
4. *Science* **136**, 1085 (1962).

I think working scientists will agree that it is far better for them to use one system of measurement than two, and it is easier for them to record data and compute in a decimal system than in a system having fractions like 1/12 or 1/64. The fact that the wavelength of a line in the spectrum of krypton-86 is a more precisely measured unit of length than is a metric or inch unit does not destroy the usefulness of the metric as a working system. It is the micron-to-kilometer orders of magnitude that are the concern of the majority of scientists in their daily work.

One does not expect industry and commerce to convert to the metric system unless they themselves choose to do so in their long-term interest, but since scientists depend in large part on scientific and technical discoveries for their advances, surely they are entitled to the system with which they prefer to work. What scientists prefer may be ascertained by anyone who picks up and looks into a few scientific journals in any library in any part of the world.

NEAL A. WEBER
Department of Biology, Swarthmore College, Swarthmore, Pennsylvania

Drive Decay and Differential Training

While Pliskoff and Hawkins (*1*) present some interesting evidence, there seems no essential contradiction between their results and the drive-decay hypothesis (*2*, *3*) of "extinction" in the Olds effect. They found that if rats were trained, by being repeatedly rewarded by electrical stimulation of the brain, to emit further responses in a Skinner box after the lever had been withdrawn and then reinserted, the number of responses up to extinction was greater than when no such training had been given. [In the latter condition the results of Howarth and Deutsch (*4*) were confirmed.] This is the only difference, in findings for the trained and untrained groups, for which Pliskoff and Hawkins claim statistical significance, and it is presumably mainly on the basis of this difference that they call in question the generality of the drive-decay hypothesis. However, this hypothesis does not state that drive level is the sole determiner of performance in the Olds phenomenon. It merely postulates that the differences between normal habits and habits formed through electrical stimulation can be understood if we assume that each electrical stimulus induces a drive for further stimulation (as well as a reward), and that this drive decays rapidly with time. The way this drive, in intracranial self-stimulation, enters into the determination of performance of a habit is not postulated to be different from the way drive operates in the determination of performance in normal habits. This being so, whether a given level of drive eventuates in performance depends on a multitude of factors which have already been shown to contribute to normal habits—for example, effortfulness of response (*3*). One such factor may be loosely termed the "learned probability of reward" (*5*). Where the learned probability is low, as it is when an animal has repeatedly found that response no longer produces reward, the animal will stop pressing the lever as soon as the intracranial stimulation is discontinued. This is the explanation of Herberg's results (*6*). On the other hand, in Pliskoff and Hawkins's experiment the learned probability of reward after the lever had been withdrawn and reinserted was much higher than the learned probability for the untrained group—the group in which the results of Howarth and Deutsch's (*3*) study were confirmed. As contrasted with the experimental conditions of Howarth and Deutsch's study and also of Pliskoff and Hawkins's first experiment, the animals in their later experiment had been highly trained and frequently rewarded for returning to the lever. It is to be expected that, as drive decays to an asymptote, lower levels of drive will continue to produce lever pressing in the group which has been trained in lever pressing.

Discussion of the other objections raised by Pliskoff and Hawkins appears unjustified, since they do not claim statistical significance for the data they present.

Since the generality of the phenomenon of drive decay has been called in question, it should be pointed out that many different experimental designs and situations have been used to verify its occurrence (*3*). For instance, it has been shown that an animal's speed of traversing an electrified grid decreases sharply as the investigator lengthens the interval between trials for brain stimulation, but that the speed increases