employed as a plural). The two meanings of *response,* one might add, are as unrelated as those of the word *freedom* in "freedom (meaning exemption) from thought" and in "freedom (meaning liberty) of thought."

Thus, from all aspects one arrives at the conclusion that graded response and quantal response are by no means essentially equivalent and that they are not mutually interchangeable approaches to the determination of the *D,E* relation. The single isobol, which is all that can be established by a quantal response, depicts the *D,T* relation at one (and only one) level of *E* and gives no information whatever on the *D,E* relation. Whereas a plurality of *D,T* isobols from different *E* levels serves as a tool in determining the *D,E* relationship, due regard being given to the variation of *T,* a solitary *D,T* isobol signifies, so to speak, only one out of many necessary manipulations with this tool.

Potency, a "Many-Headed Multitude"

Since the ratio D/E is a major determinant of potency, a broader view of the *D,E* relationship is liable to throw more light on the problems of potency as well. Neither *D,E* nor *D,T* curves can be expected to be rectilinear, nor can the *D,T,E* structure be a (mathematically) regular surface. Hence, "the potency of a drug" is *never a singular.* Even for the same quality of effect, potency varies with *E* as well as with *T*. A satisfactory image of the potency of a drug is as composite and as pluridimensional as the image of the *D,E* relationship. No formula is yet available by which this infinite multitude of potency values can be compressed into a single figure.

Whenever the potency of a drug is presented in the form of a single value, this signifies that the value is valid only for a narrow section of the large field of varying potencies and has been obtained by keeping some determinant variables constant and thus disregarding them. In this way, for instance, quantal-response procedure unassumingly pin-points its attention on establishing a value $1/P$ called "*ED*50." In this expression, "50" indicates that the $1/P$ value offered is valid only for *T*50—that is, for subjects exhibiting the median tolerance of the "normal" or "probit 5" individual. *E* in "*ED*50" is usually said to stand for "effective"; the meaning is clearer if it is interpreted as standing for "endpoint" —namely, for the particular level of *E* on which the isobolic *D,T* relation of the quantal-response study takes its course.

Fortunately, as discussed above, a quantal-response study, in order to arrive at the *ED*50 value by biostatistical interpolation, must first establish a number of *D* values for other tolerances in the course of the *D,T* isobol and can thus increase, though still only on the same constant *E* level, the amount of information considerably by adding data on the "error" (error due to the variation of *T*)—for example, the *ED*16 and *ED*84 values. These fiducial limits are often determined by admirably intricate biostatistical calculations; however, such intricacy must not mislead one into believing that the *ED*50 marks more than a single point on the *D,T,E* surface, that the *P* value derived from it marks more than one out of many different *P* values of the drug, or that the three *ED* values presented yield more than a still rather crude estimate of the tolerance distribution on the one particular *E* level. Nor must it divert attention from the fact that not even a much more exhaustively established *D,T* curve could give any information on potencies at other *E* levels. It is not necessary to emphasize that all these fallacies are avoided when the aforementioned graded-response studies of the real *D,E* relations, aided by studies of *D,T* relations at several *E* levels, are employed as the basis of multiple $1/P$ and *P* determinations.

References and Notes

1. This study was supported by a research grant (B-381) from the National Institutes of Neurological Diseases and Blindness, National Institutes of Health, U.S. Public Health Service.
2. M. Wertheimer, *Productive Thinking* (New York and London, 1945); S. Loewe, *Arzneimittel-Forsch.* 3, 285 (1953).
3. L. Hogben, as quoted in A. L. Bacharach, M. E. Coates, T. R. Middleton, *Biochem. J.* 36, 407 (1942).
4. J. H. Gaddum, *Pharmacol. Revs.* 5, 87 (1953).
5. If some biostatisticians and even biologists tend to attribute to dose the dimension of weight, they forget what the derivation of the word (Greek: *dosis,* a giving) implies—namely, that the weight of the drug powder does not per se constitute a stimulus but only "in dependency on circumstances of person and organ" [E. von Weizsaecker, in Bethe's *Handbuch der Physiologie* (Berlin, 1926), vol. 11, p. 14],—that is, in appropriate contact with the excitable substrate.
6. The term *tolerance* is employed here in preference to the closely related term *threshold.* Both are reciprocal functions of sensitivity; however, tolerance can be characterized as referring to the step from negative to positive response at any of a wide range of *E* levels, whereas the word *threshold* may be understood to refer only to the doorsill between lack of any response and the minimal perceptible *E* level.
7. S. Loewe, *Ergeb. Physiol.* 27, 47 (1928).
8. D. J. Finney, *Statistical Method in Biological Assay* (Griffin, London, 1952), p. 437.

News of Science

AAAS Library Program Releases Book List: Elementary-School Traveling Library Launched

The AAAS Library Program, with support from the National Science Foundation, has this year issued a new catalog, *The AAAS Science Book List,* containing 900 titles. The new 140-page publication is a guide to recreational and collateral reading and to basic reference works in the sciences and mathematics for junior and senior high-school students, college undergraduates, and nonspecialist adults. It also serves as an acquisition guide for school and public libraries. The list has been prepared specifically as an aid in purchasing books (other than textbooks for class use) under the provisions of Title III of the National Defense Education Act of 1958.

Initially, United States book publishers provided complimentary copies of books on a preliminary list, which was then circulated for review and evaluation to members of the AAAS Council. Not only have all of the books listed been suggested by specialists, but, to assure their suitability, they have been read and evaluated by senior high-school students and college undergraduates already well grounded in the various fields of science and mathematics.

Each citation in the AAAS catalog contains a brief descriptive note and a designation concerning degree of difficulty. To assist librarians with limited

budgets, the AAAS has marked approximately 100 entries with a double asterisk to indicate books that are considered indispensable; some 200 other books carry a single asterisk to indicate that they are recommended if resources permit.

While several well-known book lists for high-school libraries are available, none of those consulted by Hilary Deason, director of the AAAS Science Library Program, gave sufficient representation to the sciences and mathematics. Deason believes that in the average high-school library the titles in the pure and applied sciences should aggregate at least 20 percent of the total. However, a survey of the libraries of approximately 2600 representative high schools participating in the Science Library Program during the past 2 years shows that science titles constitute only 5.2 percent of their collections.

Primary-School Library Launched

On 7 September the National Science Foundation announced the award of a $500,000 grant to the AAAS to extend the successful Traveling High-School Science Library Program to include a Traveling Elementary-School Science Library. Five hundred sets of 160 books have been selected for the new program and, as schools reopen this month, students in 800 elementary schools throughout the nation will begin to enjoy science books of the kind heretofore circulated only in high schools.

The 160 books represent all major scientific disciplines, including mathematics. An accompanying catalog classifies the volumes at three levels of difficulty: *P*, primary or very simple; *I*, intermediate; and *A*, advanced. The AAAS plans to circulate 80 books at a time to each of the 800 schools, with an exchange at mid-year.

High-School and Paperback Programs

The Traveling High-School Science Library is now beginning its fifth year, having been instituted in 1955–56 with 11 sets of books that circulated to 55 schools. This year the library contains 465 200-book sets that will go to 1700 schools. Each of the current units consists of 165 books that were included in the library in previous years and 35 new selections, necessary because certain books included previously became unavailable.

Two years after the establishment of the first Traveling Library it became evident that the program was stimulating wide interest among adults; therefore, *An Inexpensive Science Library*, a selected list of paperbound science books, was prepared. A first edition of 24,000 copies issued in 1957 and a revised second edition of 50,000 copies issued in 1958 are both out of print. The present edition contains a brief descriptive note for each book and classification according to degree of difficulty. The edition lists 400 titles.

The AAAS publishes annotated catalogs of the two traveling school libraries mentioned above, which may be obtained at 25 cents each; *The AAAS Science Book List* is $1 a copy; and *An Inexpensive Science Library* costs 25 cents.

Senate Committee Reports Effects of Hypothetical Nuclear War

A "Summary-Analysis" of hearings on biological and environmental effects of nuclear war was released on 31 August by the Joint Congressional Committee on Atomic Energy. The publication reviews the major points developed during hearings that were held 22–26 June by the Special Subcommittee on Radiation, under the chairmanship of Representative Chet Holifield (D-Calif.).

The hearings covered by the 58-page analysis were for the purpose of establishing "a public record clearly setting forth the scientific facts concerning the probable physical and biological effects of such a war on man and his environment." The analysis noted that "this is the first time any comprehensive presentation of such facts has been made to the American people or to the people of any other nation."

The subcommittee assumed a hypothetical attack in which 263 nuclear weapons in 1-, 2-, 3-, 8-, and 10-megaton sizes, with a total yield of 1446 megatons, were detonated on 224 targets within the United States. An additional 2500 megatons were assumed to have been detonated elsewhere in the Northern Hemisphere in attacks on overseas United States bases and in retaliation against the aggressor homeland. All weapons were arbitrarily designated as having a yield of 50 percent fission and 50 percent fusion.

The human casualty estimates and the probable damage to dwellings in the United States were described as follows:

"The expert testimony and supporting scientific data presented at the Subcommittee hearings indicate that under present conditions such an attack would have cost the lives of approximately 50 million Americans with some 20 million others sustaining serious injuries. More than one-fourth (11.8 million) of the dwellings in the United States would have been destroyed and nearly 10 million others would have been damaged. Some 13 million additional homes would have been severely contaminated by radioactive fallout. Altogether, approximately 50 percent of existing dwellings in the United States would have been destroyed or rendered unusable for a period of several months.

"Although the weapon detonations used in this exercise were designated as surface bursts which would maximize the local radioactive fallout hazard, nearly 75 percent of the deaths would have resulted from the blast and thermal effects combined with immediate radiation effects. Only 25 percent of all fatalities would have resulted from fallout. At the same time more than half of the surviving injured would have radiation injuries. Most of the damage sustained by dwellings would have resulted from the blast and thermal effects."

The analysis also points out that "probably the most significant finding presented to the Subcommittee was that civil defense preparedness could reduce the radiation casualties of the assumed attack on the United States from approximately 25 percent of the population to about 3 percent." It was the conclusion of expert witnesses that the United States must have a national radiological defense system. The report especially emphasizes the finding that a nuclear war of the magnitude considered would not, as many had previously believed, extinguish all human and animal life.

AAAS Oceanographic Congress Has Large Attendance

There were 41 scientists from the U.S.S.R. alone among the participants in the International Oceanographic Congress that closed at United Nations headquarters on 12 September. Nearly 1200 people, representing more than 40 countries, registered for the 13-day meeting, which was jointly sponsored by the AAAS, UNESCO's International Advisory Committee on Marine Sciences, and the Special Committee on Oceanic Research of the International Council of Scientific Unions.

There were 11 women in the Soviet group, which arrived on 28 August aboard the oceanographic ship *Mikhail*