read more and more about less and less. We are specialists.

But, even in our specialized narrow fields, the literature has expanded till one can keep pace with it, if at all, only by dint of considerable sacrifice of time that other people spend in some respite from the daily grind. This pressure of the literature is the direct result of a general expansion of research activities during the past fifteen years. It indicates in some measure the rapidity of the forward march of science, and is therefore to be welcomed. The deplorable thing is that the scientist must waste a certain portion of the all-too-short time available for reading in covering a literature unnecessarily cluttered up with inconclusive progress reports and with material re-hashed under two or three different titles and published with variously modified trimmings in as many different journals.

The first line of defense against the rising tide of literature is established by the abstracting journals. Though they provide no substitutes for the original papers, they do guide the research worker to the literature in his field. The more quickly and efficiently they do so, the more is the time available for actual research and the less is the waste of effort from unnecessary duplication of research. The difficulties faced by the abstracting journals are obviously matters of concern to all who use them. The following discussion of some of those difficulties in a recent editorial in *Nutrition Abstracts and Reviews*[2] is so pertinent that it might well be brought to the attention of workers in all fields of science:

> In many cases essentially the same material is published in two or more journals. When the papers, including the titles, are identical, no confusion is caused. In many cases, however, the results of the same experiments are published under slightly different headings, and even published separately by the different authors who have collaborated in the research. This increases the already almost impossible task of readers who try to read the original papers on their subject. As far as this journal is concerned, it involves duplication of abstracting, which increases the work and cost of producing the journal, without adding to its value. It is suggested that duplicate publication is usually unnecessary, and should be avoided. In cases where it is considered justifiable to write up the same material twice, it should be made clear at the beginning of the article, or in a footnote to the title, that the results have already been communicated and the original reference should be given.
>
> Another cause contributing to the present enormous output of literature is premature publication of results. This frequently leads to the appearance of a series of papers while the work is still in progress, involving considerable repetition in the description of procedure and the statement of partial findings. This custom is of no lasting advantage to the worker, and from the point of view of the advancement of knowledge it is to be deprecated. The premature publication of undigested data and hastily reached conclusions, which require subsequent revision, results in the confusion rather than the clarification of knowledge. The reputation of workers and the convenience of readers would be better served if authors could be persuaded to defer publication until the work was reasonably complete and ample time had been given to the study of data. The Editors venture to suggest that senior workers, who they are confident share these opinions, should take the opportunity of impressing them upon those working under their supervision.

Apart from relief for the abstracting journals, it is obvious that elimination of unnecessary publication would simplify the literature problem for the individual worker, for the libraries that aid him and for persons and departments attempting to compile card indices covering special fields. Equally important is the fact that any reduction in the flood of manuscripts now entering nearly every editorial office in the country would automatically shorten the periods of imprisonment for papers now waiting from six months to a year or more for their release.

The paragraphs quoted above happened to meet the writer's eye at a time when he had just finished reading the third of three papers presenting the same data under three different titles. The present outburst is the result. It is in no sense directed at the volume of research but solely at the unnecessary and expensive publication which makes a difficult task almost impossible. The editors of *Nutrition Abstracts and Reviews* render a valuable service in pointing out that relief from this undesirable situation lies in the hands of scientific workers themselves.

F. B. H.

[2] Vol. III, No. 1, 1933.

THE NEED OF ADEQUATE PROVISION FOR THE QUANTITY PRODUCTION OF DEUTERIUM WATER

THE recent work of G. N. Lewis,[1] of Crist and Dalin,[2] of Bonhoeffer and Brown[3] and of Oliphant[4] has shown that metathetical reactions involving the two isotopes of hydrogen must be of very general occurrence. This of course means that the preparation of many chemical compounds containing deuterium substituted for all or part of the hydrogen atoms will be comparatively simple as soon as pure deuterium water is available in quantity. To transform an ordinary hydrogen compound into the corresponding deuterium compound, one has evidently only to bring the compound into metathetical equilibrium with successive portions of pure deuterium water. Its replace-

[1] *Jour. Am. Chem. Soc.*, 55: 3502, 1933.
[2] *Jour. Chem. Phys.*, 1: 677, 1933.
[3] *Z. physik. Chem.*, 23: 171, 1933.
[4] *Nature*, 132: 675, 1933.

able hydrogens will then all be exchanged for deuterium.

Different conditions with respect to temperature, time, presence of suitable surface catalysts, etc., will be needed in different cases, but the principle is evidently of very general application. An example would be the bubbling of NH_3 gas through a train of bubble-tubes containing deuterium water and with suitable provision for drying the gas between tubes. From the end of such a train, deuterammonia, $NH^2{}_3$, would be evolved.

Similarly, if benzoic acid be shaken with successive portions of pure deuterium water it will probably be quantitatively converted into the corresponding deuterium acid, probably benzodeuteric acid, $C_6H^1{}_5COOH^2$. To prepare deuterobenzoic acid, $C_6H^2{}_5COOH^2$, would probably require a higher temperature and a suitable catalyst. This acid, if shaken with successive portions of pure protium water, $(H^1{}_2O)$ would probably yield deuterobenzoprotic acid, $C_6H^2{}_5COOH^1$.

The comparative ease with which many new compounds can be prepared in this way gives further emphasis to the great need of provision for the large-scale production of heavy water. To equip a small plant having a capacity of 6 to 10 gallons of 95 per cent. deuterium water per year would cost something like $25,000. Labor costs would be about $5,000 per year, and power costs (40 KW) would depend upon location. Such a plant would be much more economical than the small-scale laboratory outfits now in use at a number of universities and would produce sufficient heavy water to allow many chemical and biological investigations to be carried out.

In contrast with the hundreds of millions which are being spent in new projects by the Federal Government and by private industry, the amount of money involved is almost infinitesimal. Yet probably in no other way could the expenditure of an equal amount of money be productive of greater advances in chemistry and possibly biology and medicine, not to mention physics, which requires only relatively small amounts of the heavy water.

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ALFALFA YELLOWS

FOLLOWING the publication of the abbreviated discussion on "alfalfa yellows" (SCIENCE, October 27, 1933) we have been informed by Professor E. M. Searls, of the Department of Economic Entomology of the University of Wisconsin, that he had secured data from the entomological view-point, which lead essentially to the same conclusions with reference to leafhopper populations and time of cutting alfalfa, as expressed by us. This lends much emphasis to the validity of the findings, and because Professor Searls has not yet published his results we take this opportunity to provide for a simultaneity of recognition for his contribution.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A PORTABLE VACUUM TUBE VOLTMETER FOR MEASUREMENT OF GLASS ELECTRODE POTENTIALS WITH EXAMPLES OF pH ESTIMATIONS[1]

SIMPLICITY of design, small cost, accuracy and stability of the zero point are factors which justify a brief description of an equipment which has been found extremely useful in measuring the pH of biological fluids, food products and the like. Any laboratory possessing a suitable potentiometer and galvanometer may be provided with equipment for measurements with a glass electrode for a sum not exceeding ten dollars. The necessary parts are: One R. C. A. tube No. 232, thirteen flashlight cells, four No. 6 dry cells, two single-pole single-throw switches, twenty-five feet of rubber insulated wire No. 16 B. and S. gauge, and a wide mouth bottle, with tight-fitting rubber stopper.

The vacuum-tube is kept in a dry atmosphere by mounting in the wide mouth bottle in the following manner: An eighteen-inch length of insulated wire is soldered to each of the four base prongs, and a twelve-inch length to the cap of the tube. The wires attached to the prongs are bent so that when the tube is in a vertical position the five wires may be passed through small holes in the rubber stopper, in which they should fit snugly. A dry atmosphere is maintained either by a thin layer of phosphorus pentoxide in the bottom of the bottle, or by means of phosphorus pentoxide contained in a side arm connecting through the rubber stopper.

The wiring diagram is shown in Fig. 1. The tube filament is supplied with 1.5 volts, four No. 6 dry cells connected in parallel to give sufficient capacity for the maintenance of a constant filament temperature. Seven flashlight cells, connected in series to the filament battery, furnish twelve volts to the screen or space charge grid. Four flashlight cells in series furnish six volts to the plate, acting through a galvanometer which has a sensitivity of 0.025 microamperes

[1] Food Research Division Contribution No. 176.