

ization's experience with course content improvement programmes.

*Commission on Engineering Education.* Members of this Commission include many leading representatives from industry, Government, and education. The Commission was formed at a meeting at Boulder, Colorado, in 1961.

The headquarters of the Commission in Washington function as a point of co-ordination for the members. The Commission is developing educational resources of particular relevance to fundamental fields of engineering, including all types of educational resources and procedures which involve both students and faculty in the areas of design, data processing and decision making.

*Semiconductor Electronics Education Committee.* The teaching programme of this Committee—now being used for the first time, in its preliminary form, at eleven universities in the United States and Great Britain—demonstrates introductory semiconductor physics, the principles of semiconductor devices, and the most important features of electronic circuit design and construction which use semiconductor devices. It is intended that the final material produced by the Committee will be used in either the junior or senior year of college.

The Committee's presentation includes text material in the form of a series of six paperback books on the principles and applications of semiconductors; the development of home laboratory experiments; take-home laboratory kits; a series of formal laboratory experiments;

and a set of films both complementary and supplementary to the texts.

*National Committee for Fluid Mechanics Films.* The films in fluid mechanics produced by this Committee are being used at more than sixty universities and Government institutions in improved teaching of aeronautical and astronautical engineering, and in chemical, civil, mechanical and marine engineering. The films are also being used in the instruction of meteorology, applied mathematics, and in medicine. The first two major films produced, *The Fluid Mechanics of Drag and Vorticity*, are being used at universities in the United States, Ghana, Great Britain, Australia, Canada, Israel and Holland.

*Social Studies and Humanities.* This programme evolved from a conference sponsored by Educational Services Incorporated at Dedham, Massachusetts, in the summer of 1962. Participants at the conference represented the humanities and the social sciences, including literature, history, art, music, Latin and Greek, as well as sociology and psychology. The consideration of the possible revision of the present social studies and humanities curricula is the aim of this programme, which is not yet fully implemented. Investigations are being made of the individual humanistic disciplines with the view of focusing the major ideas of the past and present into a presentable, coherent framework which may then, using some of the techniques developed by the behavioural scientists, be taught most effectively.

## SOLVENT EXTRACTION CHEMISTRY

A SYMPOSIUM on "Solvent Extraction Chemistry" was held at Gatlinburg, Tennessee, during October 23–26, by invitation of the Oak Ridge National Laboratory. The purpose of the symposium was to bring together persons engaged in investigating solvent extraction and to provide for the interchange of information, not merely through the papers presented, but also in an open session and by informal discussions.

The presentation of thirty-two papers submitted from laboratories in the United States, Great Britain, France, Sweden and Italy in a programme which filled four days is a measure of the expansion of work in this field since the one-day symposium (*Nature*, 172, 149; 1953), arranged by Atomic Energy Research Establishment, Harwell, in 1953. In the intervening period, the chemistry of solvent extraction has been included in conferences of wide scope, such as the International Conferences on the Peaceful Uses of Atomic Energy at Geneva in 1955 and 1958; in these, the chemical aspects have generally taken second place to flowsheets and processing problems.

Dr. F. L. Culler, head of the Chemical Technology Division, Oak Ridge National Laboratory, in his opening remarks pointed out that the progress achieved by research in the past decade had made solvent extraction an important and powerful technique for solving the separation, purification and recovery problems that occurred in the field of atomic energy. Solvent extraction had moved forward from the use of diethyl ether to separate uranium from contaminating metals to being a versatile technique applied to the separation of closely related inorganic compounds in a variety of acid media: separations could if necessary now be achieved in a matter of seconds rather than minutes. Dr. Culler foresaw the time when its use for separations of biological substances would be greatly extended.

Organo-phosphorus compounds, which were grouped as 'neutral' or 'acidic', formed the subject of several papers presented by the members of the Argonne National Laboratory, Atomic Energy Research Establishment, Harwell, Oak Ridge National Laboratory and the General

Electric Co. Laboratories at Hanford. The neutral class extract metals and acids: the former mainly by solvation  $\equiv P=O \rightarrow M$ , there being replacement of aquo groups from the co-ordination sphere; the latter by hydrogen bonding. The extractive power of these compounds has been correlated with their basicity, which is reflected in a number of properties such as the frequency of the infra-red stretching vibration of the PO group: the extraction order is phosphine oxides > phosphinates > phosphonates > phosphates.

The phosphates, though relatively weak as extractants, are ideal for many separation processes as recovery from the organic phase is usually easy: tributyl phosphate (TBP) has been extensively studied on account of its versatility, and the part played by ions and ion-pairs in TBP systems has been recognized. Increased attention has been paid to the influence of the polarity of the diluent, often a hydrocarbon, on the distribution coefficients. Among these neutral compounds, phenyl phosphonates have been found to have enhanced selectivity for the separation of certain metals, while phosphine oxides are suitable for small-scale laboratory separations and for analytical purposes. Other compounds included in the reviews were certain diphosphonates found to be very powerful extractants, and thiophosphates.

The main impression given by the papers dealing with the acidic organo-phosphorus compounds as extractants was the variety of mechanisms that have been found to occur. Thus the metal complexes obtained with the monoacidic phosphates, HX, may contain: (1) the unit  $X^-$  as a monodentate or as a bidentate group; (2) the group  $HX_2^-$  derived from the dimer of HX; (3) the neutral group, HX, co-ordinated through its phosphoryl oxygen; (4) the anion, for example,  $NO_3^-$ , present in the aqueous phase. In view of the interaction of the neutral compounds (for example, TBP) with HX and of their ability to form solvates, it is not surprising that the extracting power of a mixture of a neutral compound and HX is often considerably different from that of HX alone.



Amines and quaternary ammonium compounds have not yet been applied so extensively as organo-phosphorus compounds, but the five reviews devoted to them suggested they will be found increasingly useful for the extraction of acids and for the separation of the platinum group metals and of the transuranium elements. Other papers surveyed developments in the application of solvent extraction to analytical purposes and to the extraction of fission products from the waste liquors that occur from the treatment of irradiated fuels.

The final session was of particular interest to those concerned with the operation of tributyl phosphate processes for the separation of fissile material from irradiated reactor fuels. The papers and the discussion which followed dealt

with chemical aspects of the degradation (by thermal and radiolytic reactions) of tributyl phosphate itself and of the hydrocarbon diluent which form the bulk of the organic phase. Complementary studies at the Atomic Energy Research Establishment, Harwell, and at Windscale Technical Works have identified the class of compounds responsible for the retention of fission product zirconium in the organic solvent after it has been in use for several months; the compounds are certain hydroxamic acids, present at less than  $10^{-5}$  M and derived from the nitration of the diluent.

The symposium was organized by a committee under K. B. Brown as chairman. The papers are to be published in *Nuclear Science and Engineering*. J. M. FLETCHER

## HYDRAULICS AND FLUID MECHANICS

A CONFERENCE on "Hydraulics and Fluid Mechanics" was held at the University of Western Australia, Nedlands, during December 6-13. It was sponsored by the Faculty of Engineering and is to be the forerunner of a triennial series. These will be held initially in Australia or New Zealand and will be known as Australasian Conferences on Hydraulics and Fluid Mechanics.

The inclusion of both the terms was for the purpose of attracting a wide variety of papers. This aim was fulfilled and the conference assisted in bringing applied mathematicians, physicists and engineers closer together in a most co-operative atmosphere. It also helped to make the attendance sufficient for all activities associated with such conferences to be undertaken. This is a particular problem presented to conference conveners in Australia and New Zealand, where travel distances are so great and specialists in any field so few. In these circumstances, most attenders must be authors to warrant travel subsidy by an employer, and a wide variety of topics must be accepted so that the gathering warrants the outlay to attend.

The open invitation resulted in 57 papers being presented or tabled during the course of the five working days. In each session of one and a half hours three papers were generally presented. Each author had twenty minutes for presentation, which left half an hour for discussion of all papers. Some concurrent sessions were necessary.

The proceedings of the conference are to be published by Pergamon Press and should be available about May 1963. The volume will contain approximately half the papers submitted, together with the inaugural address delivered by Prof. Hunter Rouse, director of the Iowa Institute of Hydraulics Research. It was appropriate that Prof. Rouse should be guest at this first conference of a new series having been inaugurator of the renowned series of Iowa Hydraulics Conferences.

Reference was made to the Iowa series and the different approach made in it and the present conference. For example, the former had specific themes with solicited speakers while the latter covered a wide range of topics with unsolicited papers. Prof. Rouse recommended experimentation in the various facets of organizing the conference. As future gatherings are to be the sole responsibility of the university which chooses to hold it, such variations are likely. The only probable common denominators are the need for a wide variety of papers, for the reasons given here, and the desirability of having as many overseas visitors as possible.

Prof. Rouse's address was entitled "On the Art of Advancing the Science of Hydraulics", emphasis being placed on 'science' as distinct from applications, and 'hydraulics' which connoted a specific branch of fluid mechanics—the sturdy offspring which the original empirical experimentation of hydraulics begot. Speaking on the part played by the university, Prof. Rouse sub-

mitted that fundamental research was as essential to it as was higher education. He accepted that product or process development had its creative or instructive sides, but that routine testing, involving no new procedures or concepts, should be reserved for the commercial laboratory or the technical institute. Other requirements in the art of advancing any field of knowledge were free exchange of ideas among research workers and emphasis on good staff above all else—equipment, buildings, maintenance, funds, etc.

The conference papers of more direct interest to engineers have been summarized elsewhere<sup>1,2</sup> and hence only those of general scientific interest will be included here. The topics on which two or more papers were received included flow through porous media, the effect of vortices, waves and guided weapon research.

### Porous Media

R. A. Wooding (Applied Mathematics Laboratory of the Department of Scientific and Industrial Research, Wellington, New Zealand) presented a paper entitled "Mixing Layers in Flow Through Porous Media". It treated properties of steady vertical convection from a source of heat, or of heated fluid in a saturated porous medium, when the Rayleigh or Péclet number was very large. The effects of thermal diffusion were important only in zones of mixing between fluids at different temperatures. Flows of this type could be expected in geothermal regions.

J. de Yong (Commonwealth Scientific and Industrial Research Organization, Division of Forest Products, Melbourne) discussed the merits of applying capillary or drag models to flow through media of high porosity. The paper was aimed specifically at paper pulp pads, and emphasized consideration of rheological properties in evaluating permeability. Various theories were described and tests reported, from which it was concluded that the 'drag equations' described the permeability flow-rate relationship most accurately.

### Vortices

A paper entitled "Sink Vortices and Whirlwinds" was presented by E. K. Webb (Commonwealth Scientific and Industrial Research Organization, Meteorological Physics Division, Melbourne). Whirlwinds develop only over smooth ground when there is strong thermal convection (ground hotter than air) with a light wind. The criterion for the formation of a whirlwind was developed in terms of inflow and an effective turbulent viscosity. It was only when a significant portion of the inflow shrank into the molecular conduction boundary layer that this criterion was satisfied. The equation was derived which satisfied this latter condition. It corresponded to a wind