field in particular have been reflected in the increased amount of work on the 'newer' metals, and uranium, titanium, zirconium, hafnium, niobium and vanadium all figure prominently in the current work of the Institute. A number of research programmes are concerned with the physical metallurgy of uranium and its alloys, and they include the determination of constitutional diagrams for certain binary alloys, the study of phase transformations, and determination of the crystal structure of uranium compounds. A metallographic study of the allotropic transformation in binary titanium zirconium alloys has recently been concluded.

In the work on materials for possible application at high temperatures, comprehensive investigations on binary and ternary chromium-based alloys have been followed more recently by an examination of the pure metal. Experimental and pilot-plant work on electrolytic processes has been concerned with identifying and controlling commonly occurring impurities and this has been coupled with an examination of the effects of these impurities on mechanical properties. Results of impact tests obtained on material which has been obtained by the lubricated extrusion of sheathed compacts have shown that this extrusion method has an effect of increasing the ductility and lowering the ductile/brittle transition temperature in chromium. A new retractable hearth argon-arc melting furnace for the production of chromium and chromium alloy ingots has recently been built.

Further attention has been paid to the low alloy oxidation-resistant steels. A recently published report (Fulmer Research Institute: Special Report No. 2. "Oxidation Resistant Silicon–Aluminium Steels") describes fully the properties of these low-carbon steels containing silicon and aluminium developed at the Institute, which in air at temperatures up to about 950° C. exhibit a degree of scaling resistance comparable with the well-known austenitic stainless steels. Other work in the field of ferrous metallurgy has included an examination of the causes of failure of high-speed steels with special attention to the susceptibility of this complex material to overheating. Some short-term programmes have been concerned with nodular cast iron.

Long-term corrosion and stress corrosion tests are in progress on the various aluminium alloys, and particular attention has been paid to the effect of directionality of metallurgical structure on the initiation and rate of corrosion attack. Fundamental aspects of stress corrosion cracking and layer corrosion are under investigation and more recently a research programme to determine the effect of various metal coatings on the fatigue and corrosion fatigue properties of high-strength aluminium alloys has begun. The development of corrosion-resistant aluminium-base structural alloys, the development of oxidation and shock-resistant coatings for high-temperature materials, the assessment of a new material for domestic hot-water boilers, and an examination of coatings for the protection of high-strength aluminium alloys are other subjects under active investigation. The high-temperature corrosion of zirconium, a matter of importance for the application of that metal in nuclear reactors, is also the subject of a major research programme.

The primary interests of the engineering and mechanical testing laboratories lie in the fields of creep and fatigue. Fundamental programmes are concerned, for example, with assessing the importance of rest periods and cumulative damage on fatigue life. A specially designed high-temperature fatigue machine has proved particularly useful in studying the effect of various heat-resisting coatings on the high-temperature fatigue properties of the basis metal. High temperature and corrosion fatigue studies are also being made using alternating tension and compression machines of the Haigh or 'slipping clutch' type.

Apart from the more usual tensile creep testing, small compression creep machines have proved particularly useful for the study of uranium and other highly reactive metals. A comprehensive investigation of the creep characteristics of certain binary alloy systems is also in progress to ascertain the effect on creep properties associated with changes in the solid state occurring at or near phase boundaries. Titanium alloys, aluminium alloys, magnesium alloys (for 'canning' uranium fuel elements), structural steels and cast iron are other materials on which creep-testing programmes have been carried out.

Facilities for mechanical testing have been adapted so that tests can be carried out at very low or high temperatures. Results have been obtained, for example, for sponsors interested in designing for low-temperature applications, such as the transport of liquid methane. The mechanical and thermal properties of various insulating materials have also been examined and another investigation has been concerned with the determination of the characteristics of oil filters by measurement of the pressure drop at various flow-rates of fluids of varying viscosities.

While much of the Institute's work remains confidential to the sponsors, more than one hundred papers and technical articles (in addition to a number of patents) have been published with the sponsors' permission. Reprints of most of these were available in the Institute's library, together with a large number of translations of foreign scientific papers, including many translated from the original Russian. A recently published booklet which was issued to visitors (and which is now available from the Institute) gives details of the organization and current activities of the laboratories.

COAL SCIENCE

THE Second International Conference on Coal Science was held during May 1–4 at Valkenburg, a holiday centre in Limburg, The Netherlands. In keeping with the atmosphere, meetings were held in a conference hall attached to one of the newer hotels, and members were entertained by the Burgomaster, F. A. A. H. Breekpot, at a reception in the Municipal Grotto. The purpose and background of the present biennial series of conferences have already been set out in *Nature* (176, 103; 1955).

The response to the requests for contributions showed that interest in the subject is still increasing. Ten countries were represented as compared with eight on the previous occasion, including the first from the Eastern bloc, namely, Poland, which sent four delegates headed by Prof. Roga, of Glowny Instytut Gornictwa, Katowice. Dr. M. Samec, director of the Kemični Inštitut "Borisa Kidriča", Ljubljana, attended as official delegate of the Slovene

Academy of Arts and Sciences. Coal scientists from Czechoslovakia had also intended to participate but were unable to obtain visas in time. The United States (both Government and industry) was directly represented for the first time. The great majority of conference members, however, were drawn from Germany, France, The Netherlands and Great Britain. Despite efforts on the score of efficiency to limit the numbers attending, the total was about 30 per cent higher than that at the previous conference.

On this occasion changes were made in the arrangements. Meetings took place in the morning and evening, leaving the afternoon free for informal contacts and excursions. All papers were concerned with experimental advances and none attempted to survey a whole field of research. Papers were photocopied in their language of origin, and sent to participants some weeks before the meeting; submission of written summaries of contributions to the discussion in advance was encouraged, so that some indication of the degree of interest in each paper was available to those planning the time-table. Authors were encouraged, on the whole with success, to present their papers in fifteen minutes on the assumption that they had been read in detail by those interested. These arrangements minimized the language difficulties which, however, were still noticeable when the time came for spontaneous discussion and authors' replies.

As on the previous occasion, members of the organizing committee took the chair in turn at the six sessions that followed the address of welcome by the president, Prof. D. W. van Krevelen. The subjects discussed were grouped under four headings: (*A*) chemical methods of coal research (chairman, E. H. Grand'ry); (*B*) new physical techniques in coal research (Dr. M. Th. Mackowsky); (*C*) physico-chemical studies of coal macerals (two sessions, Dr. I. G. C. Dryden and Prof. W. Fuchs); (*D*) fundamentals of coal carbonization (two sessions, R. Loison and Dr. D. C. Rhys-Jones).

The proceedings, including discussion, will be published in *Brennstoff-Chemie*, and in view of this it will be sufficient here to direct attention to selected points of novelty or special significance. A notable feature of the Conference was the increased proportion of work based on new approaches and departing from traditional lines of coal research. This healthy sign was the subject of comment, and it was felt by many that the Conference was one of the most satisfying of its kind in recent years.

A contribution by P. H. Given (British Coal Utilisation Research Association) was aimed at elucidating some of the factors controlling the reactions of coal with chemical reagents; he was able to show that the molecular-sieve properties of coals were of secondary importance in hindering reaction, and that where an expected change failed to take place, plausible chemical reasons could be suggested. Using some reagents, in particular bromine, the rate was as high with coal as with simple compounds thought to resemble it in structure. Perhaps the most significant of the results cited in a paper by J. J. Th. M. Geerards, D. W. van Krevelen and H. I. Waterman (Delft) was the production from cellulose in good yield of an oil resembling perhydrophenanthrene in analysis and infra-red absorption; an observation which suggests that the study of primary hydrogenation products may throw but little light on the constitution of an unknown material.

D. E. G. Austen and D. J. E. Ingram (Southampton) discussed recent work on the stable or trapped free radicals detected by electron resonance in coals and carbonized coals. These are few in number (about one to several thousand carbon atoms), and the proportion depends chiefly on the type of coal and temperature of carbonization. Their place in the chemical picture of coal and their influence on its properties are not yet clear. A paper by C. L. M. Bell, R. E. Richards and R. W. Yorke (Oxford) was also presented by Dr. Ingram. Interpretation of nuclear magnetic resonance measurements in terms of the linkages of hydrogen in coal is limited since the forms that can be distinguished are not grouped in the most convenient manner to answer key chemical questions, such as the ratio of aromatic to non-aromatic hydrogen. The preliminary results given did not agree closely with those deduced from comparisons of the intensities of infra-red bands, but in view of the uncertainties in both methods of deduction the discrepancy is more apparent than real. R. Westrik, of the Netherlands State Mines, contributed a study of coals by electron diffraction, which indicated in all samples an unexplained hexagonal spacing twice as large as that of graphite.

Historically there has been a tendency for the coal petrologist and the coal chemist to think on quite different lines and to work in separate compartments. In the papers of Session *C* substantial attempts were made to relate the two fields of inquiry more closely. The long-standing question of the relative merits of the use of polished surfaces and thin sections in the microscopic examination of coal was again discussed and some agreement was evident; it is clear that the methods are to some extent alternative, but also in some measure complementary to one another. Another noticeable tendency was the change in emphasis from discussion of the properties of rock types (the visible banded components of a coal seam) to those of the more fundamental macerals (microscopic components that may be compared with inorganic minerals). D. G. Murchison (Durham) described some well-planned experiments designed to settle a controversy that has long thwarted the effective use of reflectance measurements in the classification of coals: he concluded that variation of the reflectance of the basic microscopic constituents, vitrinites, as a function of their carbon content or rank, was probably not discontinuous.

Papers by A. Ladam, P. Iselin and B. Alpern (Centre d'Etudes et Recherches des Charbonnages de France), by C. Kröger (Technische Hochschule, Aachen), and by F. J. Huntjens, H. N. M. Dormans and D. W. van Krevelen (Netherlands State Mines) were all concerned with the properties, or the thermal decomposition products, of maceral concentrates. A measure of agreement is now apparent and one can indicate in semi-quantitative terms the relations between the chemical properties of a coal and the relative proportions of macerals in it. There are one or two surprising discrepancies between different investigators, but the difficulties are many: if separation is to be at all complete the coal has to be finely sub-divided, and it is then more difficult to express the microscopic analysis in terms of the normally recognized constituents because characteristic shapes and opacities have been modified. The authors of the last two papers mentioned have made especially comprehensive studies.

B. Lavrenčič (Kemični Inštitut "Borisa Kidriča," Ljubljana) gave an interesting account of the rheological properties developed when the unusual Yugoslav coals containing about 10 per cent of organic sulphur are heated; these coals have properties quite abnormal in comparison with classifications based on low-sulphur coals. D. W. van Krevelen, H. A. G. Chermin, H. N. M. Dormans and F. J. Huntjens described the dilatation of various blends of coals and coke on heating and its prediction from that of the components. Two papers, given by I. G. C. Dryden and K. S. Pankhurst (British Coal Utilisation Research Association), and by G. J. Pitt (National Coal Board), are usefully considered together, since the method of extracting, with chloroform, fusible material developed by coking coals on heating was common to both investigations, though in the second investigation scavenging by gas during the heating was considerable and in the first was eliminated as far as possible. A comparison of the two sets of results is of interest: for example, the rate of development of plasticity on heating at constant temperature (Pitt) is much smaller than that of the development of chloroform-soluble material by thermal decomposition. This indicates that the chloroform extract, though known to be associated with the development of plasticity, is by no means the only factor involved.

E. A. Depp and M. B. Neuworth (Pittsburgh Consolidation Coal Co.) discussed the pyrolysis of model compounds thought to embody the type of chemical structure that exists in coals. Interesting results were obtained, but the work is laborious and more variants of structure are needed before drawing firm conclusions; moreover, the existence of a few specially weak linkages in coal may determine the temperature and course of decomposition and to some extent invalidate comparisons with simple pure compounds (compare the different behaviour of synthetic polymers from that of their monomers). Prof. M. Letort (Nancy) presented a most interesting paper on a new type of adsorption isotherm (methane on graphite) which appears to show discontinuities corresponding to completion of successive molecular layers of adsorbate. Prof. Letort suggested that the necessary condition was a special correspondence between atomic spacings in the adsorbent and adsorbate, and that the method could be used to follow the development of graphitization in carbonaceous solids when heated.

Finally, those attending were privileged to see a remarkable colour film made by W. Spackman, W. F. Berry and A. H. Brisse in the United States which showed the behaviour of certain coal constituents on heating thin sections under the microscope. This was not only fascinating to watch but enlightening as to the different interactions between constituents that must occur prior to the formation of coke.

There was some private discussion as to the future value of conferences on coal science in view of the impact of atomic energy. There seems, however, little doubt that the use of coal will be maintained for several decades to come—in the United States it is expected to increase considerably—and that the emphasis will shift from combustion towards chemical conversion. The success and liveliness of this conference encouraged the view that further meetings were desirable at least in the immediate future. It is generally agreed that nowadays conferences proliferate too freely, and it is certainly necessary to examine carefully the reasons even for maintaining an existing series. There is room for much experiment in methods of organizing, particularly in order to reduce the work involved for both organizers and participants, and the amount of irrelevant and repetitive material that has sometimes to be read before the real points for discussion become apparent. This meeting was partly successful in these respects; it is hoped that further improvements can be made on the next occasion. I. G. C. DRYDEN

MUSEUMS ASSOCIATION

ANNUAL CONFERENCE

THE sixty-third annual Conference of the Museums Association was held in Bristol during July 8–12 under the presidency of Sir Philip Hendy, director of the National Gallery. Nearly four hundred delegates attended, and the Conference opened with a conducted tour of historic Bristol and an informal reception at the University, where members were received by the vice-chancellor, Sir Philip Morris. The official welcome by Alderman Percy W. Raymond (Lord Mayor of Bristol) was followed by a vigorous address from Sir Philip Hendy, who dealt with various activities within the museum movement during the past year. He referred to the successful outcome of the negotiations between the Durham County Council and the trustees of the Bowes Museum at Barnard Castle, and also to the slow progress of talks with the government officials regarding State aid to museums. The plight of some of the smaller museums was described as desperate, and although Sir Philip felt that the nation as a whole was far more museum-conscious than ever before, there was a lack of sympathy in Treasury circles. He felt that there should be a far more equitable distribution of cultural benefits among the organizations and institutions concerned.

The same theme was followed in an afternoon session under the chairmanship of Sir Mortimer Wheeler, who said that in spite of the Treasury's declaration to the contrary, the problem was not purely local, but a part of a general national educational problem. He recalled the scheme in Wales for mutual aid and affiliation between the National Museum of Wales and the museums of the Principality, and considered that it might serve as a model for other regions. Dr. Dilwyn John then outlined the Welsh scheme to which nineteen museums now belong, and Mr. S. D. Cleveland suggested a pilot survey in one part of Britain which might lead the way to a more general plan. Sir George Dyson, chairman of the Carnegie United Kingdom Trust, said that the first step must be to obtain common agreement between the various public and private authorities concerned. Mr. Philip James directed attention to the plight of many museums and art galleries owned by private trusts or societies, and emphasized the importance of ventilating these matters in the Press. Other speakers stressed the urgency of the situation, and in summing-up Sir Mortimer Wheeler said that he felt that a survey carried out in a relatively restricted area, such as south-west England, would yield information of value. Based on that experience, it would be possible to extend the survey to the whole country. As suggested by Mr. W. J. Deacon, it might be possible for