According to the authors "the thermal decomposition of petroleum into aromatic compounds occurs at temperatures considerably in excess of those needed for simple cracking, and in consequence much more serious losses occur in the shape of carbon and fixed gases. Paraffin hydrocarbons at these temperatures are almost completely decomposed. The desired products are not the primary results of cracking; they are obtained from them by further decompositions and synthesis. Accompanying them are other characteristic bodies, usually classed under the heading of unsaturated hydrocarbons, but which are far more reactive than the simple olefines. . . . Summing up, therefore, the effects of temperature on petroleum may be said to be: (1) temperatures up to 500°–600° yield in the main mixtures of olefines and paraffins; (2) temperatures about 700° yield a mixture of olefines, diolefines (*e.g.* butadiene), and aromatic hydrocarbons, with little paraffins; (3) temperatures about 1000° yield mainly permanent gases and a tar similar to coal-tar, in that they both contain aromatic hydrocarbons."

The effect of pressure on cracking appears in general terms to be that increased pressure favours synthesis, whilst diminished pressure promotes dissociation.

A very interesting development in the thermal decomposition of hydrocarbons is the effect of catalysts. Moissan first observed the production of liquid hydrocarbons (among them being benzene) by the contact of acetylene with metals, and in the well-known method of reduction of Sabatier and Senderens finely divided nickel, cobalt, iron, and other metals have been employed with and without hydrogen with very noteworthy results. Acetylene on reduction in presence of nickel yields both paraffins and cycloparaffins in proportion resembling Baku, Galician, and Pennsylvanian petroleum. Coke also behaves as a catalyst.

At the end of this very informing paper the authors give a summary of the mechanism of pyrogenesis, which does not admit of abbreviation, and is too long for reproduction. Those who are interested in the subject will feel that the authors have accomplished an important service to the coal-tar and petroleum industry in presenting to the public at such an opportune moment this valuable and exhaustive memoir.

J. B. C.

METALLIC TUNGSTEN POWDER AND HIGH-SPEED STEEL.

ONE of the most successful of the manufactures which have been established in this country by reason of the war is that of metallic tungsten. This metal occurs naturally in the form of oxide, together with the oxides of iron, manganese, and calcium. Pure tungsten powder is obtained by first isolating the tungstic oxide and then reducing it, whilst ferro-tungsten is obtained by reducing the mixed oxides. For the production of the best high-speed steel metallic tungsten powder is necessary, because ferro-tungsten contains impurities which are eliminated only when the process of separating the tungstic oxide from the ore is employed. Before the war almost all the pure tungsten powder was supplied by Germany, whilst ferro-tungsten was manufactured in France and, on a small scale, in this country. On the declaration of war only a limited stock of tungsten existed in this country, whilst the necessity for a large output of high-speed steel was urgent. The way in which it was supplied is described in an article in the *Chemical Trade Journal* for December 9.

An inquiry instituted by the Government showed that a factory for the production of metallic tungsten powder was essential. The Committee of High-Speed Steel-Makers, which took the matter in hand, recommended the engagement of the services of Mr. J. L. F. Vogel, and a company (High-Speed Steel Alloys, Ltd.) was formed, in which thirty firms manufacturing high-speed steel became shareholders. A site chosen at Widnes was taken over in November, 1914, and building was sufficiently advanced in July, 1915, for the commencement of production. The factory, which occupies a site of about six acres, is divided into eight departments. The first department comprises a warehouse for the storage of the ore, grinding and mixing plant, and the magnetic separator. The second department contains furnaces for roasting the mixed ore with soda, whereby all the tungsten is converted into sodium tungstate. In the third department the furnace product is broken up and conveyed automatically into the next department, where it is extracted with boiling water. The solution of sodium tungstate passes to the fifth department, where it is treated with acid. The resulting yellow tungstic oxide is dried in the next department, and prepared for reduction. The seventh department contains the furnaces for heating the crucibles to reduce the tungsten. The metal is washed and dried in the last department. The product has contained on an average 98·5 per cent. pure tungsten, which is one per cent. better than the German product.

The Government took control of all wolfram ore in the British Empire on September 1, 1915, but the amount being insufficient to meet the full demand, the High-Speed Steel Alloys Co., to improve the output, has purchased mines in Burma, and has sent out Dr. W. R. Jones, formerly of the Indian Survey, to take charge of operations.

EDUCATIONAL CONFERENCES.

AT the opening meeting of the Conference of Educational Associations, the chairman, Sir Henry Miers, directed attention to the wide interest aroused of late in educational questions, and laid down three lines of general agreement: continued education beyond fourteen, an improvement in the position and prospects of teachers, and a reorganisation of the scholarship system. We need to promote in young people a desire for further education and the power to carry it on, and to provide facilities for the exercise of that power. Mr. A. L. Smith, the Master of Balliol, in his inaugural lecture, struck a similar note. That all recently published programmes of reform should be working in the same direction, that so many suggestive experiments in the psychology and practice of education should be in progress, and that so wide an interest should have been aroused among workers, employers, and business men he regarded as very hopeful signs. As head of a great Oxford college he welcomed the controversy between classics and science, and expressed the opinion that much of the old curriculum should be discarded, that no one could be considered fully educated who was ignorant of the processes, standards, and history of natural science, and that it was possible to give a general scientific training which should provide useful equipment and valuable mental exercise for all. It would be both feasible and beneficial for science to enter into all early education, with specialisation later where aptitude was shown. Public opinion has not yet put the teacher in his right place, or rewarded him sufficiently, yet only so can we foster the power for development and heroism latent in the ordinary man. Educational methods have great influence on the efficiency and contentment of workers, and a great modern commonwealth needs at its centre a democracy which shall be intellectually, socially, and morally educated.

The Headmasters' Conference, which is held

annually at some school or college, met at Rugby School on December 21–22. About 110 schools—including all the great public schools—are represented by the Conference. Among the conditions under which a school may be represented are that it contains 100 boys, counts at least ten among the undergraduates of Oxford and Cambridge, and sends to these universities an average of five or six boys each year. Particulars of the schools admitted to representation are given in the "Public Schools Year Book." At the recent meeting of the Conference held at Rugby the following resolutions were passed, among others:—

1. That this Conference welcomes the letter with regard to war memorials sent to headmasters in the early autumn by H.R.H. the Prince of Wales, as the chairman of the Statutory Committee, and endorses the suggestion that provision of scholarships and exhibitions should form part of the measures taken at public schools to commemorate the fallen.

2. (*a*) That it is essential to a boy's general education that he should have some knowledge of the natural laws underlying the phenomena of daily life, and some training in their experimental investigation. (*b*) That, in the opinion of this Conference, this can best be ensured by giving to all boys adequate courses of generalised science work which would normally be completed for the ordinary boy at the age of sixteen. (*c*) That, after this stage, boys who require it should take up science work of a more specialised type, while the others should for some time continue to do some science work of a more general character.

3. That, while desirous of improving the teaching of science and making it a reality in all public schools, this Conference deprecates the present proposals of the Oxford Hebdomadal Council for making the passing of an examination in science an essential qualification for an Oxford degree.

4. Board of Education Circulars 849, 933, and 956. That this Conference approves the general educational policy indicated by these circulars, and in particular the principles:—(*a*) That all boys in secondary schools should pursue a normal course of education up to the age of about sixteen, unimpaired by premature specialisation and unimpeded by the varying demands of external examinations. (*b*) That the universities should continue to be the responsible examining authorities in secondary schools, but holds that no further compulsion or restriction of any kind can be usefully applied to schools until a general acceptance of an approved "first examination" by universities and professional bodies has been secured. If in any case acceptance is only conditional, the conditions must be of the simplest kind, and a clean sweep must be made of the present absurd complexities. In the details of the proposed first and second examinations there are many points calling for further discussion, and two only will be mentioned in the present resolution:—(i) The Conference holds that natural science and mathematics should count as two "groups," not as one only; (ii) it adheres to the view expressed in Circular 849, section VI., regarding such subjects as music, drawing, manual work, and housecraft, to which may be added physical exercises. It is as far as possible from undervaluing such subjects as essential parts of a good education, but believes that their adequate inclusion can be better secured in other ways than by formal examination at the age of sixteen.

5. That this Conference reaffirms its conviction that Greek ought no longer to be retained as a compulsory subject in the Entrance Examinations to the Universities of Oxford and Cambridge. In urging this, the Conference in no way wishes to deny that for those boys who are fit for it there is no finer educational instrument than Greek, nor that there are other compulsory subjects which are open to grave objections.

THE U.S. NATIONAL RESEARCH COUNCIL.

IN the Proceedings of the National Academy of Sciences for October a report is given of the first meeting of the National Research Council, held in New York City on September 20 last. Dr. G. E. Hale was unanimously elected permanent chairman.

Dr. Hale, as chairman of the organising committee of the council, announced an agreement between the National Academy of Sciences and the Engineering Foundation by which the foundation has placed its funds at the disposal of the council for a period of one year, and has given the services of its secretary, Dr. Cary T. Hutchinson, to the National Research Council, to serve as its secretary. Dr. Hale announced that in accordance with this agreement the National Academy of Sciences has appointed Dr. Hutchinson secretary of the National Research Council.

Later in the meeting Dr. Pupin emphasised the great value of co-operation in industrial research, as evidenced by the work of the Research Laboratory of the General Electric Company, and spoke of the difficulty in securing men adequately trained. Dr. Noyes urged the need that universities and colleges should interest more men in research work and train them more effectively. Dr. Carty pointed out that industrial research has as its objective commercial development, and that scientific research has no such immediate purpose. Dr. Vaughan believed that much good could be done by the council in stimulating the Congress of the United States to make larger grants to help pure science. Mr. Manning explained the assistance given to the U.S. Bureau of Mines by the great chemical and smelting companies, and suggested similar assistance for pure scientific research.

After an adjournment for dinner, Mr. Rand dwelt upon the essential need of co-operation with the great industrial research organisations, instanced the assistance that the research laboratories of the U.S. Steel Corporation had rendered to the Institute of Mining Engineers, and expressed the belief that the co-operation of the U.S. Steel Corporation with the Research Council could be secured. Mr. Herschel pledged the support of the American Society of Civil Engineers, and Mr. Dunn explained the relations of the Engineering Foundation with the council.

Two meetings of the Executive Committee were held in New York on September 21 and 29. At the first meeting it was resolved that the efforts of the Research Council shall be uniformly directed to the encouragement of individual initiative in research work, and that co-operation and organisation, as understood by the Research Council, shall not be deemed to involve restrictions or limitations of any kind to be placed upon research workers.

The following resolution was adopted, inviting the American Association for the Advancement of Science to co-operate with the Research Council:—"That the American Association for the Advancement of Science be informed that the National Research Council has been organised by the National Academy of Sciences at the request of the President of the United States for the purpose of bringing into co-operation existing governmental, educational, industrial, and other research organisations, with the object of encouraging the investigation of natural phenomena, the increased use of scientific research in the development of American industries, the employment of scientific methods in strengthening the national defence, and such other applications of science as will promote the national security and welfare, and that the association, which has itself established the Committee of One Hundred on Research, be invited to co-operate with the Research Council in the promotion of research, and that to this end it be asked to appoint a committee of three