on storage and they show increased gum and peroxide formation, accompanied by decrease in the highest useful compression ratio (H.U.C.R.). The report suggests the need for caution in assessing the value of low temperature processes as sources of motor fuel.

The pioneers of low temperature carbonisation seemed to take it for granted that the tars and oils produced would find markets ready for their absorption. Even now, this idea is still widespread. Experience brought disillusion, and it became clear that only after long research could one expect to develop uses for these novel products. Among other institutions the Fuel Research Station has studied systematically the influence of conditions on the general character of the tars and liquors. A more detailed chemical study of the tars was undertaken by the National Chemical Laboratory at Teddington with the view of discovering, if possible, new industrial applications for these products.

Much of this work has been published in periodicals and is now included in a Fuel Research Technical Paper No. 32, entitled "A Study of the Tars and Oils Produced from Coal" (H.M.S.O., 2*s*. net). This is in four parts: statistics, the treatment of low temperature tars from a commercial retort, the carbonisation of three British coals at varying temperatures, and the influence of temperature on the properties of tars. Perusal leads to the conclusion that in the development of low temperature processes too much capital has been spent on large scale plant, and too little on laboratory investigation of the chemistry of the processes and their products.

One branch of the work of the Fuel Research Board is the physical and chemical survey of national coal resources, which now covers practically the whole of the British coalfields. The reports hitherto published have dealt with the detailed survey of seams of coal. Paper No. 20, which has just appeared (H.M.S.O., 1*s*. 3*d*. net), entitled "The Yorkshire, Nottinghamshire and Derbyshire Coalfield, Analysis of Commercial Grades of Coal, Part I.", breaks new ground by giving the analyses of the commercial products of about forty important collieries in the district. It can scarcely be doubted that the information will be of great use to those concerned with the selection and purchase of coal, whether at home or abroad. The report should also be of great value to the collieries concerned, and will excite envy in other industries not so fortunate as to have their products so examined and certified. Perhaps the most striking impression which the reader can gain from the figures is the high quality of the fuel marketed in this area. Most of the samples contain less than five per cent of ash.

High Speed Flying.

AT an evening discourse delivered before members of the British Association on Sept. 29, Mr. H. E. Wimperis, Director of Scientific Research to the Air Ministry, gave an interesting résumé of accomplishments, and speculations as to future advances, in high speed flying. The very high accelerations set up have given rise to various problems, both structural in the aircraft and physiological in the occupant. A rate of three times that of gravity can be obtained in starting by the use of catap lts. These are necessary for obtaining the minimum speed for flight for fast machines in a reasonable space. It is interesting to note that this rate of increase of speed is about a hundred times that of a steam-engined railway train. Even greater accelerations are experienced in curved flight—up to five times gravity—and as the machine is only designed to withstand a load of 8*g*, care has to be exercised, in making rapid turns of small radius, not to approach this. The centrifugal force on the pilot in such turns drives the blood from his brain to the more distensible parts of his body, and this is accompanied by a loss of sight, although not of mental clarity.

Such high speed machines are necessarily built as seaplanes, as it is impossible to make aerodromes with sufficiently flat surfaces, or large enough, to allow of reaching the very high minimum flying speed with safety. Even on smooth water, handling requires considerable skill, as the angle at which the floats will leave the water due to hydro-planing is greater than the machine can maintain when it becomes air borne. Another peculiar trouble arises from the fact that at speeds of above 360 m.p.h. the rush of air actually heats a body passing through it, instead of cooling it. This complicates the question of cooling both the engine and the pilot's cockpit.

With regard to future progress, while there is no theoretical limit to speeds higher than 407·5 m.p.h., the present record, there are many practical difficulties to be overcome. Better streamlining would give up to another 60 m.p.h. for the same power, but some excrescences which spoil this, such as the undercarriage, tail, etc., appear to be inevitable. At the velocity of sound, namely, about 700 m.p.h., there is a doubling of the head resistance, which would appear to be an insurmountable barrier to aircraft of the present form, but with other aerodynamic outlooks this may be passed.

Another method of reducing resistance would be to fly at altitudes of, say, 100,000 feet, where the reduced density of the air would offer less resistance to motion. This would probably need some form of rocket propulsion, as the present-day engine would not function without a sufficient supply of oxygen, neither would the propeller have enough bite on the thin air to transmit the necessary thrust.

Hardening of Metals in a Magnetic Field.

MR. E. G. HERBERT, of Manchester, contributed a paper to the Royal Society in January 1931 and two articles to *Metallurgia* in May and June of last year on the hardening of metals in a magnetic field. The Royal Society paper describes the fluctuations in the hardness of steel, duralumin, and brass caused by rotation in a magnetic field. Mr. Herbert shows that the time element is an important factor in the hardening produced magnetically. He has found that the hardness changes are sometimes very rapid, and in hard steel, freshly treated, changes may sometimes be observed from minute to minute.

Later research has shown that the effect produced in steel by the magnetic treatment is periodic in character, generally extending over many hours subsequent to treatment. In some experiments there were a sequence of six alternate increases and decreases of hardness occupying gradually lengthening periods of time. It was found that when a rotary magnetic field was used the maximum hardening effect could be produced by a single turn in the magnetic field at a suitable temperature followed by a period of ageing. The cloud-burst process of hardening by steel ball bombardment could be superimposed on the

rotating field method, the processes being apparently independent of one another.

Mr. Herbert adopts as a provisional theory that the rotating magnetic field gives rise to a fluctuation of a periodic character in the systems of electrons, which in turn causes periodic fluctuations in molecular cohesion. A very interesting possibility of a practical nature follows from these investigations, namely, the stabilisation of the metal at a selected phase in the fluctuations set up mechanically, magnetically, or otherwise. For example, the stabilisation of steel wire in a condition characterised by greatly increased ductility with undiminished tensile strength.

In *World Power* for October, Mr. Herbert describes some work in connexion with high-speed tools. At present the results obtained seem very anomalous; in some cases the magnetic field has a hardening effect on the metals experimented on, and in other cases it softens them. The results suggest that the magnetic effects have been merely superimposed on the normal age-hardening process. They may be quite different in character. A softening magnetic process added to age hardening might be expected to slow down the hardening process, while a hardening magnetic treatment added to the normal hardening might be expected to accelerate it. It was observed that an increase of hardness equivalent to an increase of 13 per cent on the Brinell scale was induced in high-speed steel by a single turn of the magnetic field, occupying about a minute and applied at a temperature of only 100° C. Such a treatment could easily be given to finished tools of the most complicated character as well as to drills, sawblades, and dies in which a high degree of hardness is desirable. It is probable that further experiments, especially as to what is the best temperature to employ, will give even better results. As no metal hitherto subjected to magnetic treatment has failed to react, it is possible that these effects are common to all metals. In the non-magnetic metals the hardness changes hitherto produced have been relatively slight, but research in this direction seems very promising. It has been suggested that these changes may not be confined to metallic or even to inorganic substances.

University and Educational Intelligence.

LONDON.—Dr. F. A. von Hayek has been appointed for the session 1931–32 to the Tooke chair of economic science and statistics tenable at the London School of Economics.

The following titles have been conferred in respect of posts held at the Colleges indicated: *Professor*:—Dr. Charles Singer (history of medicine, University College); Mr. E. F. D. Witchell (mechanical engineering, Imperial College—City and Guilds College). *Reader*:—Mr. R. J. Tabor (botany, Imperial College—Royal College of Science); Dr. W. G. Bickley (mathematics, Imperial College—City and Guilds College); Dr. G. F. J. Temple (mathematics, Imperial College—Royal College of Science); Mr. B. W. Holman (mining, Imperial College—Royal School of Mines); Dr. Herbert Dingle (physics, Imperial College—Royal College of Science); Dr. H. S. Gregory (physics, Imperial College—Royal College of Science); Dr. S. G. Paine (plant bacteriology, Imperial College—Royal College of Science); Mr. J. P. Ross (surgery, St. Bartholomew's Hospital Medical College); Dr. L. C. Martin (technical optics, Imperial College—Royal College of Science); Dr. Elizabeth A. Fraser (zoology, University College).

The title of emeritus professor in the University has been conferred on the following:—Prof. E. J Garwood, on his retirement from the Yates-Goldsmid chair of geology at University College; Prof. C. Spearman, on his retirement from the chair of psychology at University College; Prof. W. E. Dalby, on his retirement from the chair of civil and mechanical engineering at the Imperial College—City and Guilds College.

The degree of D.Sc. in biochemistry has been conferred on Bireschandra Guha for a thesis entitled "Investigations on the Factors of the Vitamin B Complex and on the Newer Factors necessary for the Normal Nutrition of the Rat" (*Brit. Med. Jour.*, 1931, and *Biochem. Jour.*, 1931).

FOR the session 1931–32, the Department of Coal Gas and Fuel Industries with Metallurgy of the University of Leeds has arranged a series of evening courses, with practical work. The courses comprise studies in the manufacture of coal gas, refractory materials, the coke fire, and metallurgy. Further information can be obtained from the Registrar, University, Leeds.

THE professional education of teachers in the United States of America during the past ten years is reviewed in *Bulletin*, No. 30, 1931, of the Office of Education, Washington. One of the most striking changes brought to notice is in the relationship between the demand for and supply of certificated teachers. The number of students in training for teaching increased from 135,435 in 1919–20 to 274,348 in 1927–28; the number of students completing one-, two-, and three-year curricula during the same time increased from 21,012 to 49,627, whilst those graduating after a four-year course increased from 1296 to 8179. The over-supply of teachers in many places and the over-crowding in a few teachers' training institutions have led to the raising of the standard of requirements for admission to teacher-training courses. There has been also rapid progress in raising standards of certification. The average number of students per training institution has grown from 439 to 877, necessitating better facilities for their social and physical welfare. Of the strictly professional courses, student teaching is coming to be recognised as one of the most important, and it is much more frequently provided than formerly, but probably fifty per cent of teachers enter upon their duties without having been through such a course. Training colleges are increasingly concerning themselves with the careers of their graduates, and recognising an obligation not only to see them placed but also to help them in overcoming their inevitable difficulties during the first year or two of teaching.

COMMONWEALTH Fund fellowships will be available early in 1932 for British students who desire to continue their studies in American universities. Last year there were 121 candidates (99 men and 22 women) for ordinary and Dominion fellowships, and 29 fellowships were granted; 56 candidates applied for service fellowships (open to those in government service only), and 6 appointments were made. Of the 35 fellows appointed, 20 came from faculties of science. These fellowships are available to research graduates and also to students who have just taken their first degree. There is no fixed stipend attached to a fellowship, but each is of the approximate annual value of 3000 dollars. Each fellowship includes provision for an equipment allowance of 200 dollars, and a travel allowance, tuition fees, etc., 150 dollars per month for living expenses, allowance for travel during the Christmas recess, and allowance for three months' travel (which is compulsory) at the end of the first academic year. A fellowship is tenable for two years, with possible extension to a third year. There is very little limitation to the subject of study which a fellow may choose. Applications for fellowships must be