unstable. Thus if the hypothesis of liquid stars is true, stars ought to be observed to occur only in those parts of the diagram where the curves are drawn thick.

The background of Fig. 2, taken from the Report of Mount Wilson Observatory (1921), shows the observed distribution of 2100 stars; the thick lines are curves I have drawn to divide the diagram into regions occupied by, and avoided by, stars. The general agreement with the theoretical diagram shown in Fig. 1 is so good that we need scarcely hesitate to identify corresponding areas in the two diagrams.

The belt of stars which runs diagonally across the whole diagram is called the 'main-sequence'; it contains stars of ordinary radius, such as the sun, Sirius, and Procyon. In the stars which occupy the upper reaches of the main-sequence we see that the atoms are ionised down to their *K*-rings, but the less luminous stars such as the sun must contain all sorts of atoms mixed. Observation shows that the left-hand edge of this sequence is very clearly defined; the stars seem to press against it like flies against a window-pane. This sharp left-hand edge is determined by the condition that the atoms are jammed together almost as tightly as they can be packed; in the configurations there represented the density is the maximum possible, short of the final ionisation of the *K*-ring. The "white-dwarfs," such as the companion of Sirius, with diameters only about a fiftieth of that of the sun, and densities of about a hundred thousand times that of water, consist mainly of atoms stripped bare to their nuclei, although enough *K*-rings must survive to build up a firm liquid base at the centre of the star. Stars of huge diameter, such as Betelgeuse (α Orionis), with diameters hundreds of times that of the sun, and mean densities only about a thousandth that of atmospheric air, must have three rings of electrons (*K*, *L*, *M*) left on their atoms.

The upper part of the diagram forms a macrocosm of the atom itself, the great difference between the diameters of the nucleus and the k-ring being reflected particularly clearly in the big empty gulf between the white-dwarfs and the main-sequence. Thus the structure of the atom is blazoned across the heavens, and if the physicists had failed to unravel it, the astronomers might have succeeded—in time. Theory does not fix absolute values for the co-ordinates in Fig. 1 until the atomic weights and atomic numbers of the atoms are given. I have found that the best agreement with the observational material shown in Fig. 2 is secured by taking the atomic number to be about 94. Atoms of lower atomic number would lose their electrons at too low temperatures, while those of higher atomic numbers would grip them too tightly. Thus the main mass of the central liquid regions of the stars appears to consist of a sort of "supra-radioactive" atoms, with atomic numbers just above those of the ordinary radioactive elements such as radium (88) and uranium (92). We are driven back to Newton's conception of the stars as being formed of a special 'lucid' type of matter, and this lucid matter appears to come next in complexity after our terrestrial semi-lucid radioactive elements, of which the lucid elements may well be the parents.

Power Alcohol in Australia.

By Prof. JOHN READ.

THE main sources of organic energy which are at present being utilised in Australia are black coal and brown coal. The Australian deposits of black coal form about 2·2 per cent. of the total coal reserves of the world, being thus only slightly less extensive than the deposits of Great Britain. The chief deposits of black and brown coal occupy very favourable locations in New South Wales and Victoria, respectively; and, in addition, the eastern coastal zone of Australia (including Tasmania) affords considerable opportunities for the development of hydro-electric power. In comparison with Great Britain, therefore, Australia is well endowed with natural sources of energy. At present, however, both these countries are almost wholly dependent upon outside sources for their supplies of liquid fuels, particularly for fuels fulfilling the requirements of the internal combustion engine. A very similar state of affairs exists in South Africa and in various other parts of the Empire; so that a problem of wide significance and extreme economic importance is here manifest.

In Great Britain, as in Europe generally, a good deal of attention is being paid to the Bergius process and the low temperature distillation of coal. Any such investigations directed towards the economic manufacture of liquid fuels from black or brown coal are patently of considerable interest to Australia, particularly as the processes would also furnish lubricating oils. Climatically, however, Australia differs so widely from Great Britain and northern Europe that it is not surprising to find the Australian more disposed than the European to draw upon his lavish current supplies of solar energy and less inclined to encroach unduly upon his limited capital of 'fossil sunshine.' This tendency is noticeable in a report issued recently by the Council for Scientific and Industrial Research of the Commonwealth of Australia, entitled "The Possibilities of Power Alcohol and certain other Fuels in Australia" (*Bulletin* No. 33. By G. A. Cook. Melbourne, 1927). The Australian imports of petrol and other petroleum products are increasing rapidly, the value of imported petrol alone being more than £6,500,000 per annum at the present time. Such a position is characterised as "very unsatisfactory even in times of peace, but in times of emergency it becomes positively dangerous." In 1925, the Joint Parliamentary Committee on Public Accounts took evidence on all phases of the Australian liquid fuel problem, and came to the conclusion that "the consensus of geological opinion concerning the prospects of flow oil being discovered in commercial quantities in Australia is unfortunately not very favorable." Apart from oils obtainable from coal and shale, power alcohol and related synthetic fuels are recognised in the report under notice as the most likely substitutes for natural petroleum in Australia.

In reviewing possible Australian sources of power alcohol, it is pointed out that the starch-producing cereals are in general too important as foodstuffs to be utilised for other purposes; but in some Australian localities "the fermentation of certain varieties of tubers is by no means commercially unattractive even under present conditions and prices. Cassava, arrowroot, the sweet potato in the warmer climates, and perhaps beet in the milder, are at least worth consideration in this connexion. Some sugar-producing grasses, for example, sorghum, also have prospects." The nipa palm, which has been stated to provide a better source of sugar even than the sugar-cane, is a further raw material of considerable interest, since it grows abundantly in certain regions of Papua and the mandated territory of New Guinea.

Owing to the bulky nature of the raw materials, the conclusion is reached that at present it would be possible at the best to establish distilleries in favoured localities where the production of suitable high-grade materials presents no particular difficulty. In such districts imported petrol might be largely replaced by alcohol, but it appears that a complete replacement is incapable of achievement in the absence of a successful method for producing liquid fuels from raw celluloses. "From the point of view of the producer of power alcohol, Australia may be considered to be a favoured field of operation. . . . On the one hand, the local price of petrol is high, and on the other an ample and cheap supply of cellulosic raw materials is available. In view of the possibilities of ultimate success, and in view of the urgent national need, the chemists and bacteriologists of Australia might well cooperate and interest themselves in the problem, the former to develop the most suitable methods of producing large quantities of fermentable materials per ton of cellulose, and the latter to discover the organisms best suited for the subsequent fermentation."

As regards synthetic methods for the production of power alcohol, neither ethylene nor acetylene is held to offer promise as the basis of a satisfactory commercial process in Australia; but a comparison of the prices of petrol in the countries concerned makes it conceivable that some other synthetic process might be capable of successful operation in Australia although perhaps economically impracticable in Europe or the United States.

Technologically, the best raw material available in Australia for manufacturing power alcohol is molasses. In the record season of 1925–26, the total production of crude sugar in Australia exceeded 500,000 tons; of the accompanying 120,000 tons of molasses, however, a large proportion was either used as fuel, cattle food, etc., or wasted. If utilised wholly in the manufacture of power alcohol, this by-product would yield only about one-twentieth (7,800,000 gallons) of the current Australian demand for motor fuels.

The Australian investigations on power alcohol include experiments on the cultivation of sorghum, artichokes, sugar beet, cassava, sweet potatoes, arrowroot, etc.; the preparation of alcohol from the carbohydrates of zamia palms, grass-tree cores, and prickly pear; the hydrolysis and fermentation of common Australian hardwoods (NATURE, Oct. 8, 1927, p. 522); and the use of alcohol as an engine fuel under various conditions. Coming to actual commercial achievement, a power alcohol distillery with a capacity of about one million gallons per annum started production in February 1927, at the Plane Creek sugar mill, near Mackay, Queensland. The raw materials are molasses and certain starchy crops, including cassava and arrowroot. The fuel, consisting essentially of a mixture of alcohol and ether, is marketed under the name of 'powrac.' As an extension of this enterprise it is proposed to erect other distilleries in the Cairns district of Queensland.

Obituary.

PROF. C. DIENER.

CARL DIENER, who died in Vienna on Jan. 6, was born in that city on Dec. 11, 1862, there received the whole of his formal education, and there ran his professional career. As a student there was no need for him to go elsewhere, since he had as teachers some of the most eminent men of the age: in geography, F. Simonyi; in geology, E. Suess; and in palæontology, M. Neumayr. But when he had finished his student course in 1883, he at once turned for a wider experience to mountaineering in the Alps, in Dauphiné, and in the Pyrenees. He was among the first to introduce Alpine climbing into Austria itself, and was for seven years president of the Austrian Alpine Club; his membership of the English Alpine Club was, to his deep regret, broken by the War.

Naturally Diener did not leave his scientific interests behind when he sought the high mountains, and on the results he obtained in the Lebanon, Antilebanon, and the region of Palmyra, he habilitated as privat-docent for geography so early as 1886. Geology, however, claimed more and more of his attention, and the turning point of his career came when in 1892 he joined an expedition financed by the Government of India and the Vienna Academy, to examine the Trias of the Central Himalayas. In the first place, the valuable geological results obtained led him to extend his teaching to geology in 1893, and caused him in 1897 to be nominated professor extraordinarius of that science. Secondly, he was associated on the expedition with Griesbach and Middlemiss of the Indian Geological Survey, and this led to an