Liquid Air Explosives.

AN Order in Council (1921, No. 1194) has been issued exempting explosives made by impregnating absorbent carbonaceous material with liquid air or oxygen from that provision of the Explosives Act which requires the manufacture of explosives to be carried out in licensed premises. This Order will, therefore, enable free competition between explosives of the usual type and mixtures of liquid oxygen with a fuel that can be made on the spot shortly before firing.

Liquid oxygen explosives originated in Germany, but before the war had no great vogue. During the war they were used on a fairly large scale by the Germans in non-gaseous coal mines, in iron mines, and for the destruction of machinery in French steel plants. This development was occasioned by the need for conserving Germany's supply of nitrates for the manufacture of military explosives.

The increasing cost of explosives and the improved methods of obtaining liquid oxygen make the problem of producing explosives by the simple method of saturating materials like wood-meal with liquid oxygen an attractive one. The explosives so produced also present certain advantages, especially as regards freedom from danger in transport, storage, and handling, but they have certain inherent disadvantages: thus, the rapid evaporation of the liquid oxygen necessitates rapid firing and so limits the number of shots that can be fired in one blast; it is necessary to have a liquefying plant close at hand; and the explosive cannot be used in fiery mines.

The plant required for liquefaction must be capable of turning out a product containing at least 85 per cent. of liquid oxygen. This is conveyed in Dewar vessels to the proximity of the rock face, where it is poured over a paper cartridge containing carbonaceous matter of different kinds, such as carbonised cork, or wood-meal, with or without the addition of petroleum. The impregnation of this cartridge with the liquid oxygen is carried out in a cylindrical vacuum-jacketed vessel, care being taken that the impregnated cartridge contains sufficient oxygen to ensure the total combustion of the carbonaceous filling and of its paper envelope. The impregnated cartridges are then pushed into the bore hole, where they are detonated by means of the usual detonator, or in some cases simply by a gunpowder fuze. According to another method the cartridges are impregnated in the bore-hole itself. The violence of this explosive is comparable with that of the more intense blasting agents, but much depends upon the manipulative skill of the workers.

For industrial purposes, since the war, there has been a general reversion to explosives based on nitrates, but it is understood that liquid air explosives are still used in Germany to a limited extent, and that experiments are being made with them in certain French Departments. Their investigation is also being carried on by the United States Bureau of Mines, which has issued a preliminary bulletin on the subject.

Obituary.

PROF. F. A. BAINBRIDGE, F.R.S.

PROF. FRANCIS ARTHUR BAINBRIDGE passed away on October 27. His friends knew he was not well enough to carry on his usual busy life of teaching and research, but none foresaw that his life would be suddenly cut short by heart failure. He was only forty-seven years old and in the prime of his career. Our deep sympathy goes out to his widow and little daughter.

Prof. Bainbridge had for years been a man of poor physique, and it was a wonder to his friends how, in spite of frequent attacks of illness, he contrived to do so much useful work. He was modest and retiring, but his catholic interest in scientific work and in things in general made him a delightful and lovable companion. He was a skilful experimenter, a clear writer, and an excellent teacher. Such men we can ill spare. The book ("Essentials of Physiology") he wrote with the late Prof. Menzies is highly esteemed, and illustrates to the full the power he had of interesting his readers and of making crooked paths straight.

Prof. Bainbridge was born at Stockton-on-Tees, educated at the Leys School, and then at Trinity College, Cambridge. His medical studies were carried out at St. Bartholomew's, and after a brilliant academic career he filled several minor posts in that hospital. His early researches were carried out at University College. Among the positions he held were British Medical Research Scholar, demonstrator in pharmacology at St. Bartholomew's, Gordon lecturer on pathology at Guy's, Jenner Memorial student and assistant bacteriologist at the Lister Institute, later the professorship of physiology at Newcastle (1911), and finally, 1915, he returned to his old school, St. Bartholomew's, as university professor of physiology. At the outbreak of war he at once offered his services, received a temporary commission in the R.A.M.C., and had charge of a military hospital at Newcastle; he worked also on the action of poison gases at Millbank, and gave lectures on that subject in cadet training schools throughout the country; but the stress of work was too great, and his health broke down, so that he had to resign his commission. His devotion to duty of all kinds made him an

example to us all. His honours included the F.R.C.P. and F.R.S.

Instead of attempting to give a list of Prof. Bainbridge's published researches, I will quote from a document drawn up by Prof. Starling which admirably gives the main features of his work; he has allowed me to use it:—

"A very large proportion of Prof. Bainbridge's work represents important additions to knowledge which have found a permanent place in the record of scientific discovery. In pathology his most important work was in the differentiation of the different types of para-typhoid bacilli, a study which has been carried very far in later years. It was, however, on the physiological side that his work was of most importance. In his researches on lymph formation he took up the question of the tissue lymph and defined for the first time the part played in lymph formation by the metabolism of cells. Working on the sub-maxillary gland and the liver, he pointed out the defects in the secretory theory and showed that all the results obtained might be explained as due to the production of metabolites in the cells and the consequent rise of osmotic tension in the tissue fluid which had the effect of attracting fluid from the blood vessels and adding to the lymph flow from the part. The question of the mechanism of urinary secretion was one which occupied him frequently through his scientific career. His earliest work, carried out with Beddard, consisted in a repetition of Nussbaum's experiments, avoiding many of the sources of fallacy which these contained. At first he was inclined to ascribe a secretory function both to glomeruli and to tubules, but later, in experiments carried out at Newcastle, he was led to adopt Cushny's view, in the support of which he brought forward many new and ingenious experiments. His work with Evans on the functions of the mammalian kidney fed with blood from a heart–lung preparation was, unfortunately, only in the nature of a preliminary communication, but the method promises to be of considerable value for the elucidation of many problems connected with urinary secretion. His work on the gall-bladder with Dale was a useful contribution to a department of physiology in which knowledge is very deficient.

"Most interest, however, attaches to his latest work on the circulation, and especially to the discovery of the relationship which holds between pressure on the venous side of the heart and the rate of the heart beat. Many attempts had been made to explain the acceleration of the pulse which occurs in exercise. The pace-maker itself is unaffected by the pressure in the auricular cavity, though a quickening of the pulse is one of the methods adopted by the organism for enabling the heart to deal with the greater inflow of blood into this organ which accompanies muscular exercise. Bainbridge showed that any rise of pressure on the venous side of the heart caused a quickening of the beat, partly by inhibition of the vagal tone, partly by reflex excitation of the accelerator mechanism. This condition is the converse of that which is expressed as Marey's law, a rise of pressure on the ventricular side tending to cause reflex slowing of the heart, and it is therefore described as 'Bainbridge's law.' The review of the whole subject of the physiology of exercise, which he undertook in writing a comprehensive monograph on the subject, suggested many new problems for work on the circulation, and he was making plans to attack these problems, partly alone, partly in conjunction with other physiologists, when his work was brought to a sudden and premature close; but he was happy in his work and in the planning of new researches, and he would be content that others should build on the foundations which he has laid down."

Prof. Bainbridge married in 1905 Hilda Winifred, daughter of the Rev. E. Thornton Smith. In his wife he found a companion keenly interested in his work, who, by her constant co-operation and care, enabled him to utilise his talents to the full, in spite of the disability of ill-health from which he suffered. W. D. H.

Dr. W. S. Bruce.

THE untimely death on October 29, at the age of fifty-four, of William Speirs Bruce removes a leading oceanographer and the foremost British authority of his time on Polar regions. From the age of twenty-five Bruce had devoted practically his whole life to the exploration of Polar lands and seas, and had to his credit no less than twelve Arctic and two Antarctic expeditions. On the eve of completing his medical course at Edinburgh he sailed for the Antarctic in the Dundee whaler *Balaena* in 1892. The visit of this and other whalers was of course a commercial venture, and though Bruce was mainly occupied in assisting the crew in sealing, he found time to make many valuable observations in the north-western part of the Weddell Sea, the first scientific observations made in those regions for half a century. Returning home the following year, he became an assistant in the *Challenger* office, and later was in charge of the observatory on the summit of Ben Nevis until 1896, when at a few hours' notice he sailed in the *Windward* to Franz Josef Land with the Jackson-Harmsworth Polar expedition. For a year he assisted in the survey of the archipelago and made valuable collections, and he was present at the historic meeting with Dr. F. Nansen on his return from the Polar ocean. In 1898 Bruce sailed with Major A. Coats to Novaya Zemlya, Kolguev, and Hope Island, and later in the same summer with the Prince of Monaco to Spitsbergen. This was the first of many cruises with the Prince of Monaco, and laid the foundation of Bruce's wide and authoritative knowledge of Spitsbergen and its natural history.

Since his return from the Antarctic Bruce had