Some space is devoted to the importance of inventions and research in connection with war munitions, and it is interesting to note that Sir Robert's firm is now in a position to manufacture a heavy calibre naval shell which, for range and piercing power, will far outstrip anything previously accomplished. Invention should be stimulated and every effort made to discover fresh inventors, and, once they are discovered, to encourage them to give their ideas to the world so that everyone may benefit from them.

CONSIDERABLE interest is attached to the description in *Engineering* for October 10 of the geared turbines supplied by the De Laval Steam Turbine Co. to the Swedish destroyers *Wrangel* and *Wachtmeister*. The high- and low-pressure turbines occupy separate casings, and drive pinions engaging on opposite sides of the main gear wheel. The high-pressure turbine casing accommodates a cruising element, and the low-pressure turbine an astern turbine. The wheels of both high- and low-pressure turbines are designed to make 3600 revs. per min. at full power, and the maximum peripheral speed is 180 metres per second. The cruising element consists of one velocity-compounded wheel, followed by a simple impulse wheel. The main turbine has four wheels. The astern turbine has one velocity-compounded wheel with two rows of blading, followed by a simple impulse wheel. The aggregate shaft horse-power at full power is 11,000, with the propellers running at 450; the astern shaft horse-power is 4400, with propellers running at 250. With steam 97 per cent. dry, the turbines were guaranteed to consume not more than 5.2 kg. of steam per shaft horse-power hour at full load. Double helical gear wheels are used for speed reduction, and the pinions are rigidly mounted. The pitch line speed at full power is 35 metres per second. Michel thrust-blocks have been fitted, and their remarkable qualities confirmed by the tests.

OUR ASTRONOMICAL COLUMN.

NOVÆ.—Yet another nova has been found on the Harvard plates, this time by Miss Woods (Harvard Bulletin 693). Position for 1875: R.A. 18h. 24m. 6.2s., S. declination 29° 28'9". Its former magnitude was 14, but it rose temporarily to 11 in 1901. On April 24, 1919, it rose to 7, and has now sunk again to 12, its image appearing nebulous. The magnitudes are photographic.

Pubs. Ast. Soc. Pac., August, 1919, contains a paper by Dr. Shapley on a nova of another kind that was discovered by Prof. Wolf two years ago, and independently by Prof. Barnard in the present year. Its place for 1917.0 is R.A. 17h. 35m. 13.45s., S. declination 11° 53' 57.6"; its photographic magnitude is 11 (Harvard scale); spectral type, FO; radial velocity large and positive. All plates exposed before 1909 fail to show it; all since 1910 show it. Three interpretations are suggested:—(1) That it is really just beginning its stellar career, in which case it is of unique interest; (2) that it is a long-period or irregular variable, somewhat like η Argus; and (3) that it has just emerged from behind an obscuring nebula. To test this last suggestion, Dr. Shapley took a long exposure with the 60-in. reflector and studied the distribution of faint stars. The results, given in the paper, while not inconsistent with the hypothesis, give no decisive evidence in its favour; there is no distinct line of demarcation of stellar density, as in some of Prof. Barnard's dark nebular regions. However, a much smaller cloud than these would suffice in this case.

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Mr. Joy has made an estimate of the star's distance by the Adams spectroscopic method, finding 500 parsecs. A Harvard plate of 1909 July 9 shows it of magnitude 14.4; 1910 March 21, 11.3. Since 1915 it has been 11.

Both Mr. C. P. Olivier (*Ast. Journ.*, No. 757) and Messrs. Van Maanen and Sanford (Pubs. Ast. Soc. Pac., August, 1919) publish preliminary values of the parallax of Nova Aquilæ 1918. Their values (absolute parallax) are 0.060" and 0.009". The latter, which implies a distance of 362 light-years, is close to the values found for Nova Persei, both by direct measures and by the expanding nebular illumination. All the observers contemplate further measures when the brightness of the nova has sunk nearly to that of the comparison stars.

THE SUN-SPOT CURVE.—Mr. Seth B. Nicholson gives an interesting curve of sun-spot activity in Pubs. Ast. Soc. Pac., August, 1919. It is constructed simply from the number of spots, regardless of area. Mr. Nicholson places the late maximum in September, 1917, and the curve since then shows a notable decline. The previous maximum is placed in May, 1905, and is both flatter and lower than the recent one. The minimum is shown in June, 1913. There are also curves of the mean latitude of spots, which show that the fall in latitude since the last minimum has been much steeper than in the preceding cycle.

Mr. Nicholson directs attention once more to the resemblance of the spot-activity curve with the light-curve of Cepheid variables. The sun's surface is certainly not pulsating, as those of the Cepheids are believed to be; if the resemblance of curve means anything, it suggests that there may still be remnants of pulsation in the sun's interior.

SOLAR RADIATION.—Mr. C. G. Abbot (Proc. Nat. Acad. Sci., U.S.A., September, 1919) gives an account of the simultaneous measures of solar radiation made in 1918 at Mount Wilson and Calama, Chile. The results give still stronger support to the hypothesis that the short-period variations in the radiation are in the sun itself than did those at Mount Wilson and Algeria in 1911–12. Mr. Abbot states that the Calama results are telegraphed to Argentina, and successful predictions of temperature are based upon them. He suggests additional radiation stations at various cloudless regions, which he anticipates would be of great utility in weather prediction.

NEW SOURCES OF ALUMINIUM IN NORWAY.

DURING the war neutral as well as belligerent countries had to search within their own borders for those raw materials which formerly they were content to import; new occurrences of well-known ores have been discovered, and new methods devised for winning important products from rocks which hitherto have possessed no commercial value. Norway was particularly hard hit by the curtailment of international trade, and, amongst other problems, that of finding a home source of aluminium presented itself, and seems to have received a promising solution.

The metal aluminium can be obtained by electrolytic means from its oxide, and nearly all the suggested methods of manufacture depend upon this as a final stage, the main difficulty being the preparation of a sufficiently pure oxide, free from iron and silica. The ore commonly used is bauxite, after a rather costly preliminary purification by the Baeyer process. At the outbreak of war the Central Powers

utilised their available bauxite, including the small deposits of poor quality in Germany; but the necessity of finding a more widespread source was felt, and a process was discovered and successfully put into operation by Dr. Buchner, of Heidelberg, for winning the metal from kaolin and kaolin-rich clays. Clay is extracted with sulphuric acid, and, after removal of the iron, the alumina is precipitated from the solution with ammonia, four tons of a clay with an alumina content of 30 per cent. yielding one ton of the oxide. This process seems to have a considerable future before it, and plans are laid for its introduction on a large scale into Sweden.

There is no bauxite in Norway, and it was first proposed to work the clays after the Buchner and other suggested methods. This, however, has for the most part proved impracticable owing to the unfavourable character of the clays, which are relatively unweathered glacial deposits, not only poor in alumina, 16-20 per cent., but with part of it bound in alkali felspar, and therefore unavailable. In 1917 Prof. V. M. Goldschmidt, of the Mineralogical Institute, Kristiania, conceived the idea of using labrador-stone as a source of aluminium.¹ Labrador-stone is a white rock extensively developed in south-western Norway, and especially in the inner Sognefjord district, where it builds the huge laccolitic mountain masses so familiar to tourists, by whom it is commonly mistaken for marble. The main constituent of this rock is a plagioclase felspar of the labrador group, the more feldspathic varieties containing only a very small amount of iron-bearing pyroxenes, and with an alumina content of 30 per cent. Prof. Goldschmidt has found that the felspar is surprisingly soluble in dilute acids, so that it can be dissolved out, leaving a residue of insoluble ferromagnesian minerals and silica. The calcium and sodium oxides of the felspar, 13 per cent. and 5 per cent. in amount respectively, go into solution with the alumina, and, using sulphuric acid, there is thus a considerable loss in the form of a useless by-product. This method is rejected for the manufacture of alumina, although it is used in the preparation of sufficient quantities of aluminium sulphate to satisfy Norwegian needs. By using nitric acid as a solvent, not only is a waste of acid avoided, but the precipitation with ammonia can be dispensed with—a valuable consideration in Norway, where ammonia cannot be obtained cheaply in quantity.

The main features of the process, which has been worked out by Prof. H. Goldschmidt, are as follows:—The labrador-stone is extracted with dilute nitric acid, the 30 per cent. acid, first raw product of the electrical air-industry, serving for this purpose. The silica and greater proportion of the iron minerals remain insoluble, aluminium, calcium, and sodium going into solution together with a little iron. After removal of this iron the solution is evaporated down and the residue heated to a certain temperature at which the aluminium salt alone is decomposed, the nitric acid driven off being collected as a valuable concentrate. By washing with water the nitrates of calcium and sodium are removed, to be recovered and used in agriculture, the alumina remaining.

This process seems to be full of promise for Norway—a country with such abundant water-power, a flourishing nitric acid industry, and an unlimited quantity of a raw material which few other countries possess; and hopes are entertained that a product will be obtained which will not only suffice for local needs, but also win a footing in the world's rapidly expanding aluminium market.

L. HAWKES.

¹ "Om Aluminiumfremstilling av Norske Raastoffer." By V. M. Goldschmidt. Særtryk av Tidsskrift for Kemi, No. 2, 1919.

HYDRO-ELECTRIC DEVELOPMENT WORKS.¹

AN extremely able and informative paper has recently been contributed to the Institution of Electrical Engineers by Mr. J. W. Meares, chief engineer of the Hydroelectric Service of India, dealing with the general principles of the development and storage of water for electrical purposes—a subject which is of the greatest interest at the present time from an industrial and economic point of view. Mr. Meares's paper is a general survey of the various problems connected with the inception of hydroelectric installations; it outlines the conditions essential to the satisfactory development of any scheme of water-power, for it must, of course, be borne in mind that it is quite possible for a country to have considerable water resources, say, in the form of rivers, which are incapable of economical development. The paper treats of all the preliminary considerations relating to the gathering of supplies, flow and storage; the lay-out and efficiency of hydroelectric plant, and the principles underlying the design of headworks, canals, and delivery mains.

Supplies of water at different heads entail distinct methods of treatment. The heads may be broadly grouped as high, medium, and low, in which, without too rigidly defining the boundary lines, high heads are taken at from 300 ft. or 400 ft. to a possible 5000 ft., low heads from 3 ft. as a minimum to, say, 80 ft. or 100 ft., with medium heads between these limits. A high head is associated with small volumetric flow, and a low head with a large flow; the former is adapted to jet-impulse wheels of the Pelton type, and the latter to pressure, or reaction, turbines.

In areas dependent on the collection of rainfall for supplies, the amount of fall and the run-off are important considerations. The following empirical table devised by Mr. G. T. Barlow, formerly Chief Engineer of the United Provinces, India, gives a working hypothesis for preliminary calculations which, while perhaps inapplicable to many parts of Europe or America, affords a clear indication of the nature of the variations to be met with in a particular locality:—

	Percentage run-off				
	A	B	C	D	E
Light falls, say under $1\frac{1}{2}$ " in 24 hours	1	3	5	10	15
Medium falls, say from $1\frac{1}{2}$ " to 3" in 24 hours	10	15	20	25	33
Heavy falls, say above 3"	20	33	40	55	70

A is flat, cultivated and black cotton soil catchment.

B is flat, partly cultivated and stiff soils.

C is average catchment.

D is hills and plains, with little cultivation.

E is very hilly, steep, and rocky, with very little cultivation.

The paper also contains a table giving the over-all commercial efficiency of hydro-electric plant as follows:—

For 500 kilowatts	74 per cent.
" 1000 "	76 " "
" 1500 "	78 " "
" 2000 "	80 " "
" 3000 " and over	82 " "

As a rough approximation, the capacity of plant in kilowatts may be obtained by dividing by 15 the product of the quantity of water in cubic feet per

¹ "The General Principles of the Development and Storage of Water for Electrical Purposes." By J. W. Meares.