15,000 lb. to the square inch being developed and communicated to the pistons. Since the hole in the coal has been drilled as a snug fit for the bar and steel liner which goes beneath it, the forcing out of the pistons involves the disrupting and breaking down of the coal. After the burster has been placed in the hole, the miner retires to the pump some 10–20 ft. away and operates the hand pump to generate the pressure required to burst down the coal. As a rule, the coal comes down within two or three minutes of commencing to operate the pump, and several tons of coal are brought down at each operation.

One advantage of this technique is obvious—there is no possible risk of an explosion. Moreover, very little coal dust is produced, so that conditions predisposing towards an explosion are absent, and, of course, the mine atmosphere is much pleasanter and healthier for the workmen. Again, round coal of maximum market value is produced and it is not shattered or rendered 'tender' by an explosion; therefore it does not suffer from disintegration in transport. Finally, but not least important, the roof is in general not disturbed. Should any change in conditions take place, however, the fact that the men are present all the time, and not withdrawn as in shot-firing, means that there is a very much better chance of detecting changes in roof conditions.

It is found in practice that the coalburster has very few limitations, that it will operate successfully on all types of coal, hard or soft, in stalls as in wide-work, and will function well under a variety of conditions. One colliery in Great Britain has for some years now been getting its whole output (8,000 tons per week) by means of coalbursters, shot-firing being completely eliminated. The device must be looked upon as a notable contribution to the safer working of coal mines and to the production of coal of higher market value than has been possible by the use of explosives.

A. Harvey.

SCIENTIFIC AND INDUSTRIAL RESEARCH IN NEW ZEALAND*

THE thirteenth annual report of the Department of Scientific and Industrial Research, New Zealand, which covers the year 1938–39, refers to the initiation of a number of new research activities. One of the most important of these is the formation of a Timber Protection Research Committee of the Council to direct and co-ordinate research on the preservation of timber from the attacks of wood-boring insects and fungi. The depreciation of building securities from the attacks of these pests presents a serious problem in New Zealand, and the research programme planned by the committee contemplates work by the Entomological Division and Plant Diseases Division of the Plant Research Bureau, including biological studies of wood-infesting insects, penetration tests for wood preservatives, and toxicity tests with insects and fungi, as well as further work in the Dominion Laboratory on the analysis of wood preservatives and the chemical aspects of penetration tests.

The serious effects of uncontrolled soil erosion have led to the establishment of an expert technical committee on soil erosion and land deterioration, to report on the measures necessary to maintain vegetative cover in New Zealand and prevent irreparable damage. The report of this committee is in process of publication and indicates that in few cases is the damage beyond repair, although in many areas soil erosion has reached a serious state, and a programme to handle the problems that are now apparent is outlined.

In addition to its intensive studies on cheese starters, the Dairy Research Institute has carried out a number of investigations on butter-making, including the oxidation of the fat of butter in cold storage, starters for butter, and the factors affecting hardness of butter. Other work has been concerned with the chemistry of incipient oxidation defects in butter, and the control of mould in dairy products, including the resistance to mould attack offered by different pigments, and the effect of various paint vehicles and driers. The Plant Diseases Division of the Plant Research Bureau has continued its investigations on the control of dry rot in swedes and turnips, the control of club-root, and the use of arsenate, derris and nicotine sprays and dusts for the control of diamond-back moth. Other work of this Division has been concerned with timber preservation and the testing of seed disinfectants; a fourth list of certified sprays has been issued. The Entomological Division has continued its work on the introduction of parasites for the control of the diamond-back moth, on the sheep maggot fly problem, and on timber borers. Animal research at Massey College has been concerned with the application of accurate scientific methods for measuring wool characteristics to the grading of individual stud sheep, and arrangements are being made with the Wool Manufacturers Research Association at Dunedin for the commercial processing of wool with known and accurately measured characteristics.

Fruit research has covered fertilizer, rootstock and pruning experiments on apples, and studies for the chemical control of bronze-beetle and red-mite, physiological studies of internal cork of apples, spraying experiments and the testing of certified sprays. The Fruit Cold Storage Committee has investigated the use of copper-treated wraps for the control of the spread of grey mould in winter cole pears, as well as the effect of fertilizer treatment on the keeping quality of Cox's Orange Pippins and other varieties of apples. Storage trials have been continued with Ballerat and Washington apples. Experimental work on boron in relation to physiological diseases has been directed towards the persistence of boron dressings in soil.

The Tobacco Research Advisory Committee has been concerned with seed-bed experiments, seed germination studies and investigations on mosaic disease. The plant selection work has yielded a natural Italian perennial rye grass cross ecotype,

* Thirteenth Annual Report of the Department of Scientific and Industrial Research. Pp. 134. (Wellington, N.Z.: Government Printer, 1939.) 2s. 9d.

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showing definite promise for short-rotation arable lye, such as occurs in the South Island. Interesting work has been carried out by the Plant Chemistry Laboratory on plant growth-substances and their effect in promoting the rooting of cuttings, and particularly effective results have been obtained with β-indolylbutyric acid.

The report also refers to the work of the Leather and Shoe Research Association, the Wool Manufacturers Research Association, which has continued the study of the raw wool scouring process, to radio research, the activities of the Social Science Research Bureau and of the Dominion Laboratory and Geological Survey.

THE CRAB NEBULA: A PROBABLE SUPER-NOVA

THE Crab Nebula in Taurus, which has the distinction of being No. 1 in Messier's Catalogue, is of peculiar interest, as is shown by articles published respectively in *L'Astronomie* (August 1939) and in the *Telescope* (September 1939). These articles summarize the results of several technical papers published on this subject during the past few years. It seems likely that the Crab Nebula was first recorded by John Bevis, an English physician, in 1731. It was rediscovered in 1758 by the French astronomer, Charles Messier, and was later the subject of careful scrutiny by Sir William Herschel. It was observed with the great reflector at Parsonstown, Ireland, by Lord Rosse, whose drawing of the nebula, published in 1844, probably suggested its name. It remained, however, for astronomical photography to show, first in 1892 by Isaac Roberts and later by the American astronomers (Keeler, Curtis and Ritchey), its peculiar filamentary structure and afterwards to provide data for measuring its linear rate of expansion of about 0·18″ per annum.

Using this value and the present angular dimensions of the nebula and extrapolating backwards, an interval of about 800 years is obtained for the nebula to expand from a point of origin. A similar time interval (900 years) was obtained by Hubble. Spectra of the Crab Nebula, first obtained in 1913–15 at the Lowell Observatory, showed a bowing of the emission lines, when the slit of the spectrograph crossed the whole extent of the nebula (major axis 6′). Interpreting this feature as a differential Doppler effect due to the approaching nearer side of a shell of gas and the receding further side, Mayall in 1937 derived a velocity of expansion of about 1,300 km./sec. from Lick spectrograms. Assuming a constant rate of expansion, he concluded from the available data that the epoch of the outburst was about A.D. 1100. Meanwhile, Lundmark had pointed out that the Crab Nebula was near the position of the bright object recorded in Chinese and Japanese annals as having been seen for six months in A.D. 1054. In 1934, a translation by Y. Iba of the Japanese records gave the position of the object as near the star ζ Tauri and its brightness as equalling that of Jupiter. By combining the apparent linear expansion in seconds of arc per annum with the absolute expansion in km./sec., the order of distance was derived as 1,500 parsecs, equivalent to nearly 5,000 light years. Using this distance and the apparent magnitude of Jupiter (− 2·2 m.), the absolute magnitude of − 13·1 is obtained for the nova, which must have been at least one hundred times as bright as an ordinary nova.

In *Contributions* from the Mount Wilson Observatory No. 600, W. Baade assembles the evidence for the existence of two classes of novæ, common novæ and super-novæ, which differ in luminosity by a factor of about 10,000. Typical of the former class is the nova which appeared in the Andromeda nebula in 1885 and reached a maximum apparent visual magnitude of 7·2, equivalent to an absolute magnitude of − 15·0. To this recently recognized class of super-novæ, so the evidence suggests, the nova of 1054 may have belonged, and the expanding shell of gas originating with the cosmic explosion is still visible as the Crab Nebula.

TREATMENT FOR ROT-PROOFING SANDBAG REVETMENTS

SANDBAG revetments exposed to the weather tend to break up, due to rotting of the sandbags, and inquiries have been made about preservatives. Two types of preservative are suitable. They are respectively a creosote or tar distillate, used as a water emulsion, or a solution of an organic copper salt in creosote made up into an emulsion. The former is more widely available than the latter and is suitable for treatment of revetments in position which have already deteriorated by being exposed to the weather for some time. The latter is more potent but is also more expensive, and its use will not generally be justified unless the bags are in good condition and unless it is desirable to take down the whole revetment, treat all the bags and then re-pile them.

The application of the preservatives should conform with the following specification:

(1) A creosote or tar distillate of medium creosote type applied as a water emulsion in such a quantity as to give on the exposed portion of the bag a coating of creosote not less than one fifth of the normal dry weight of the fabric exposed. This is given approximately by a 25 per cent creosote emulsion when sprayed on the bags to give a thorough coating, completely satisfying the absorption of the fibres. The creosote should comply with British Standard Specification No. 144/1936, 'Creosote for preservation of timber'.

Any normal emulsifying agent may be used and the following is given as an example of the process of emulsification.

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