Nagpur District (forming part of the well-known Sausar series of Dr. Fermor) Mr. W. D. West (*Trans. Nat. Inst. Sci., India*, I, No. 6, pp. 93-102) has put forward some evidence to show that in this area, the folding of the rocks reached the highest degree possible, and that a large body of rock, covering many square miles, was forced horizontally over a considerable distance, the *Nappe* thus produced coming to rest discordantly upon another portion of the same series of rocks. After giving a detailed account of the geology of this area, Mr. West has followed two main lines of argument, in support of his inferring a *Nappe* structure. One argument is based on the fact that a definite plane of discordance in the succession of rocks has been determined of such a nature as to suggest horizontal rather than vertical movement. The other argument is based on the sudden change in the lithology of the Bichua stage, so strikingly seen just east of Deolapar, which suggests that the two outcrops of the Bichua stage found here were not originally deposited as close together as they are now found.

While it is true that the evidence for a *Nappe* structure in this area is not by any means indisputable, it is obviously difficult to offer any other explanation of the facts mentioned in the paper; and though the conclusion reached by Mr. West has been based on the study of a comparatively small area, there is no doubt that the recognition of the existence of the *Nappe* structure in the Archæan rocks, involving the horizontal displacement of large rock masses, will help to explain some of the metamorphic anomalies and difficulties of correlation which are so puzzling in these very ancient rocks.

Attrition Tests on Stone used as Road Metal in India.

DR. M. S. KRISHNAN in an interesting paper (*Rec. Geol. Sur. India*, 1935, **69,** Pt. 3, 361–383), has given an account of the tests on road-making stones carried on for about a decade past in the Engineering section of the Government Test House at Alipore, Calcutta. After outlining briefly the method of experimentation, the results of tests carried on a very large number of samples covering a variety of Indian rocks, have been arranged suitably in tabular form. A discussion of the test results has also been included and Dr. Krishnan states, "the best stones for road-making purposes are the medium to fine-grained, compact, basic rocks like dolerite, basalts and epidiorites. The coarser grained rocks, acid types and compact gneisses come next. Granulites and hornfelses also occupy a high place amidst road-stones. The markedly prophyritic rocks are liable to be crushed under load. The soft rocks like the limestones, shales, laterites and the weaker types of sandstones are not suitable for any but light traffic, while vein quartz and quartzite (except perhaps some highly ferruginous types) are generally to be avoided."

M. B. R.

Industrial Outlook.

Modern Sewage Pumping : The Latest Scientific Principles.

DURING recent years great advances have been made in the pumping of sewage and a good example is the extensive additions and alterations that have recently been carried out in England at the Reading Corporation sewage works, Manor Farm (Berks).

In general the additions comprise two new concrete pre-sedimentation tanks, each 160′ 0″ × 52′ 6″ with a depth of 8′ 0″, together with all the necessary mains and connections. Also there are three new pump houses, nine new sludge drying beds having a total area of about five acres, six large solid digestion tanks with a total capacity of over 3,000,000 gallons, new filters with an area of approximately two acres, and a depth of 10′ 0″, and six new concrete humus tanks each 100′ 0″ × 50′ 0″.

Much other accessory plant and equipment is included, as well as two 24″ diameter concrete mains having a total length of about two-thirds of a mile, which connect the filters to the main works. Operations were commenced in May 1934 and the scheme has now just been completed.

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* Contributed by David Brownlie, 46, Grange Road, Ealing, London, W. 5.

The pumping plant is being supplied by the Pulsometer Engineering Co., Ltd., Reading, and the full equipment, operating in the three pump houses, includes six "Stereophagus" pumps and one "A. V. 4." and one "F.W.4. (Fullway)" centrifugal pump, all direct driven by slip ring A/C motors (3-phase, 50 cycles, 220 volts). Two of the "Stereophagus" pumps are 5″ diameter with horizontal drive, each with a capacity of 475 gallons per minute of unscreened sewage, while another of the pumps, 5″ diameter with horizontal drive, has a duty of 300 gallons of crude sludge per minute.

Also two of the "Stereophagus" pumps are of the vertical drive type, one being a 6″ unit with a duty of 550/650 gallons per minute for the main sludge, and the other 4″ diameter, operating the sludge return with a duty of 200 gallons per minute. Finally there is a 4″ horizontal pump of this type with a duty of 260 gallons per minute of effluent. As regards the "A.V." 4″ centrifugal pump this also has a horizontal drive and takes the top water and the humus, with a duty of 317 gallons per minute.

Essentially the "Stereophagus", it will be remembered, is a modified form of centrifugal pump with a conical impeller and a special internal cutting knife of hardened steel so that it can deal with unscreened sewage cutting up the solid matter in suspension to a size which facilitates subsequent handling. The impeller revolves in a volute casing and in normal running the liquid is passed by the impeller alone and the knife which is fixed parallel to the face of the impeller vanes, does not come into action until some solid material enters which is too large to pass between the vanes. When this happens it is immediately cut by the scissor-like action given by the stationary knife and the moving plates, the solid passing the knife again and again until sufficiently small to pass through.

Further with regard to the Reading Corporation it may be stated that two "Stereophagus" installations of this kind are already operating, one at the Whitely Road pumping station, consisting of two 5″ horizontal spindle pumps, each of 355/465 gallons per minute capacity, and the other at the Kidmore End pumping station, which has two 3″ vertical spindle pumps, each of 100 gallons per minute capacity.

Carbon Dioxide for Fire Fighting.*

Latest Designs in Portable Equipment.

A VALUABLE method of fire protection at electricity stations and industrial establishments now being more and more employed is the use of a permanently installed battery of high pressure cylinders filled with liquid carbon dioxide, situated in some central position, and connected up by narrow bore pipe in the danger points. By opening valves automatically or by hand on a control panel a vast volume of carbon dioxide gas can be poured into the flames, which are thereby smothered immediately because of the dilution of the oxygen of the air below the limit necessary for combustion. Thus an atmosphere containing only about 17 per cent. carbon dioxide will extinguish a fire, and this method is of great value for dangerous fires such as resulting from petrol, benzol, oil, turpentine, paint, varnish and tar.

Well-known specialists in this field of fire fighting by carbon dioxide gas are Foamite Firefoam Ltd., of London (55–57, Great Marlborough Street, W.1.) and considerable interest attaches to the latest designs of their "Alfite" portable equipment which operates on the same principle as the permanent plant, and is suitable for a wide range of conditions. For example, the small hand machine, easily carried by one person, consists of a cylinder containing 7 lbs. weight of liquid carbon dioxide, corresponding to about 60 cubic feet of gas. Included is a short flexible pipe and a wide "spray" head for directing the gas upon the flames, whilst the top of the cylinder has a small valve which on operating allows the gas to escape with great force in the form of a stream.

A larger size containing 12 lbs. of liquid carbon dioxide gas is also available, while another standard "Alfite" portable equipment consists of a large cylinder containing 50 lbs. of liquid gas, fixed in a horizontal position, on two wheels, propelled however to the scene of the fire and operated by one person.

The total weight of the machine is 380 lbs. and 12 feet of flexible hose is provided for directing the 450 cubic feet of gas represented by the above amount of liquid.

It will be remembered that a number of different methods are available for fire fighting

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* Contributed by David Brownlie, 46, Grange Road, Ealing, London, W. 5.

including water, acid-alkali extinguishers, carbon dioxide gas from cylinders, foam, and inert heavy vapours, such as carbon tetrachloride. Two separate principles are concerned, cooling the material to below the temperature necessary for combustion (combination with the oxygen of the air) or diluting the oxygen to the point when it will not support active combustion. As already stated, carbon dioxide acts in this way, and the same applies to carbon tetrachloride, used for motor car extinguishers, whilst water depends almost entirely on the first principle, reducing the local temperature. The firm make equipment using all the above methods, and foam for example, extremely valuable for many conditions, consists of a close aggregation of bubbles formed of a resistant film or skin filled with carbon dioxide gas made by mixing a special alkaline and acid solution. What is the best method to adopt depends upon the exact circumstances, and efficient fire fighting to-day is of course a highly complicated business using a great assortment of fast motor vehicles and rescue apparatus of different types.

Science in the Service of Indian Agriculture.*

THE material results of scientific discoveries have, as elsewhere in the world, greatly benefited rural India and her agriculture. Better transport, better illumination, the rural electric supply, the telegraph and the wireless are all tending to raise the standard of comfort in the villages. An even greater service is the application of the scientific method in the solution of the problems of agriculture which is largely an art and perhaps primarily a business. The conscious application of the scientific method is barely a century old but an immense amount of agricultural lore, gained as the result of experience, has accumulated which is both important and deserves to be scientifically interpreted. In India, the first attempts at improving agriculture took the form of the opening of model farms for copying the methods in vogue in advanced countries. The appointment of American cotton growing experts, the importing of agricultural machinery including steam ploughs and the opening of model farms in Madras, Bengal and the U. P. belong to this phase. The next landmark is the report of the Famine Commission of 1880 and its successor of 1901 to which we owe not only the development of irrigation, communications, rural credit, etc., but also what eventually became the Provincial Departments of Agriculture. The visit of Dr. Voelcker and his most valuable report followed, as likewise successively the appointment of individual experts like Mr. Mollison, Dr. Leather, Dr. Barber and Dr. Butler. In 1904 Lord Curzon's Government made the next great advance which resulted in the creation of the Imperial Department of Agriculture, the opening of the Pusa Research Institute and the starting of properly equipped scientific Departments of Agriculture in the Provinces. Steady progress has followed and thanks to the wise and far-reaching recommendations of the Royal Commission on Agriculture research can now be organised and financed with a precision previously unknown. With the Universities and kindred institutions co-operating with the Agricultural departments the stage has now been set for a great advance in rural uplift.

With this somewhat familiar historical background we may now describe the contributions of the different sciences to the improvement of Indian agriculture using the term however in its narrower sense of mere crop production. This improvement in crop production has been along three directions, *viz.*, the improvement of the plant, its better nutrition and better protection against pests and diseases. More progress has been made in plant improvement than in improved plant nutrition in India for reasons partly economic and partly technical. The rapid advance in the science of genetics and its application to plant breeding has naturally led to much attention being paid to the improvement of the staple crops of the country. As a result, the area under improved wheats alone is well over 16 million acres, to take the case a most important crop. Wheat indeed was one of the first crops to be studied the names of the Howards, of Milne and of Evans being associated with this important work. The varieties originated are all of high merit, one of them Pusa 12 having given double the yield of the local, over a seven-year period of trial. All are also of high milling value and Pusa 12 combines with high yield, earliness, hardiness and good milling and baking quality. The Pusa improved tobacco is a cross between the Adcock and the Pusa 28 and combines the excellence for cigarette making with the valuable agricultural features of the local parent; the improved linseed of Pusa combines the root system and the agricultural habit of one type with the high oil content of another; and the types of *Cajanus indicus* evolved in Pusa are largely resistant to the wilt disease.

The work on sugarcane improvement at the Coimbatore Research Station has resulted in the production of highly satisfactory crosses between the wild cane and the noble or tropical cane, eminently suitable for cultivation in Northern India where they now occupy some 60% of the total cane area of India. In the improvement of the cotton crop, tests for the spinning quality of the various strains evolved by plant breeders are systematically carried out at the Cotton Technological Laboratory of the Indian Central Committee, so that improved cottons undergo a rigid test on this important requirement of quality before they are pronounced as really

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* Summary of a lecture delivered by Sir Boyce C. Burt, at the Twenty-third Annual Meeting of the Indian Science Congress, Indore, 1936, on 3rd January.