In the wall and column units, the load is applied to the specimen by mounting it in a heavy, built-up steel frame designed so that an upward thrust can be given to the bottom beam of the frame by means of hydraulic rams. The rams are operated on a maximum oil pressure of two tons per square inch, the oil being supplied by an electric pump and the load being recorded by a pendulum dynamometer in the control room. These loading frames have a maximum capacity of 500 tons. They stand in pits in the floor of the building, and the furnaces used in conjunction with them are built on wheels so that they can be moved away for the water test. In the floor testing unit, the furnace is fixed and the specimen is lifted away for the water test by a 30-ton travelling electric crane.

The essential aim of the Station is to provide the means of carrying out tests, as rapidly and economically as possible, on the basis of the standard specification. A considerable amount of work upon traditional materials is required, but tests of new types will be run concurrently.

Arrangements have been made whereby the facilities of the Station will be available to the Department of Scientific and Industrial Research, through its Building Research Station, both for carrying out a general programme of research into the fire resistance of traditional materials, and for conducting tests on behalf of manufacturers in accordance with a fixed schedule of charges, when a certificate of performance is required. It is hoped that the industry will take full advantage of the opportunity which now occurs to have the fire-resisting properties of its products assessed on a proper basis.

Scientific Research in Transport

NEW LABORATORY OF THE LONDON, MIDLAND AND SCOTTISH RAILWAY

LORD RUTHERFORD opened the new research laboratory at Derby of the L.M.S. Railway on December 10 (see NATURE, December 14, p. 949).

A distinguished party of guests travelled from St. Pancras by special train, the engine of which was named "Lord Rutherford of Nelson" by Lord Rutherford's small grandson, Pat Fowler, and at Derby luncheon was served on the train. Speeches made during luncheon by Sir Josiah Stamp and Lord Rutherford were relayed to the various cars, and everyone heard excellently. In his speech, the former specially welcomed Sir William Bragg and Sir James Jeans. He recalled that when he was president of the Institute of Transport, he devoted his presidential address to the subject of scientific research in transport and expressed his gratification that some of his dreams have now come true. The days of haphazard and rule of thumb tests are over; the days of controlled and directed experiment under arranged conditions have fully arrived. At the same time, he said, "I would like to stress the fact that we are not trying in this new laboratory to supersede or to rival scientific effort in all directions". The company is still extending its use of outside facilities in connexion with the Department of Scientific and Industrial Research.

Lord Rutherford, in declaring the new laboratory open, said that the L.M.S. is described as a public utility company; but it is more like a State within a State, as it has a gross revenue of nearly seventy millions and its own sea, land and air forces all organised for the most efficient service to the community. On the map, the railway appears to be not merely the backbone but rather the whole vertebrate system of Great Britain. Lord Rutherford said he is convinced that there is scarcely a single unit, whether of machinery or lay-out or even of organisation, that cannot be improved for its purpose by the application of scientific research. But even when valuable results are obtained, there still remains the serious difficulty of introducing them into this great organisation, which has developed over long years a successful routine. To obtain the best results from a laboratory such as the one at Derby, it is essential to develop mutual respect and understanding between the scientific man and the practical man. He expressed the hope that the officers and staff of the Railway will take the greatest interest in the new laboratory and utilise its services to help solve their problems.

Lord Rutherford then declared the laboratory open, and the staff and visitors were divided into groups and shown over it, some of them also inspecting the wagon and locomotive works.

The L.M.S. Railway is probably the largest commercial undertaking in the world. It has an authorised capital of 439 million pounds and gives employment to 223,000 persons. In addition to 7,000 miles of line open to traffic, it possesses 8,000 locomotives, hundreds of thousands of vehicles, 45 steamers and 31 hotels. In addition, it conducts several extensive manufacturing undertakings in connexion with its transport business. In 1930, Sir Harold Hartley was appointed vice-president and director of scientific research. In 1932, the chemical, paint, metallurgical and textile laboratories were formed into a research department. The effect of the completion of the new laboratory is to concentrate in one building the various research sections. In addition to possessing a large staff of specialists to deal with the various problems which are continually arising, the department utilises to the fullest extent the research organisation of the Department of Scientific and Industrial Research. It is also a member of six research associations, and allocates certain problems to research laboratories at the universities.

The Metallurgical Section is concerned with investigations relating to the selection of metals and their manipulation by casting, forging, heat treatment and welding. It also examines materials which have failed to give a satisfactory performance in service. The Engineering Section deals with research on the design and performance of engineering details of machines and structures. It studies aerodynamical problems connected with the air resistance of trains, with wind pressures, ventilation systems and so on. The Textile Section is responsible for the inspection and testing of the various textile materials purchased by the Company, and for drawing up specifications

controlling their quality. This laboratory makes about eight thousand tests every year. The Paint Section specifies and tests all kind of paint materials. It is also concerned with the routine control of the manufacture of paint- and varnish-cleaning agents. In the constant-temperature and humidity room the nature of all textiles is closely examined. A humidity control apparatus maintains constant conditions of 75° F. and 66 per cent relative humidity. This is essential, as the properties of textiles vary largely with temperature and humidity.

In the workshop, special precautions have been taken to prevent the transmission of vibration. In some of the rooms accelerated tests are carried out. For example, in the paint exposure laboratory, by the use of the 'weatherometer', results can be obtained in five weeks which with outdoor exposure alone would have taken twelve months. At the moment, more than a thousand outdoor exposures are in progress. Visitors were impressed by the practical nature of the tests, and the great economic value of the results to the Company.

Energy-Output of the Coal-Miner

IN a paper read before the Institution of Civil Engineers on December 13, Prof. Kenneth N. Moss discussed the energy-output of the coal miner.

The object of the first part of the paper was to show that the performance of manual work necessitates a food-input in excess of the energy-output. Thus if it is required to maintain a high work-output from men engaged in manual work, the engineer in charge must satisfy himself that the calorie-value of their food-input is adequate for the purpose.

Some years ago, Prof. Moss determined the calorie-value of the daily food-input of sixty colliers, and found that the average was a little more than 4,700 Cal. The average oxygen consumption per minute throughout the working shift on the coal-face for twelve colliers was found to be 1,333 c.c., which, after deducting the average oxygen basal resting-rate of 235 c.c. of oxygen a minute, was found to be equivalent to 16,950 ft.-lb. of energy.

The total energy expended below ground during a 7½-hour shift is about 2,800 Cal., and the energy expended during 24 hours is estimated to be about 4,500 Cal. Thus the calorie-value of the daily food-input of a miner should be 4,750–5,000 Cal., to enable him to do his work without loss of body weight or coal-output. The actual average work-output, assuming the mechanical efficiency of the body to be 25 per cent, was 4,237 ft.-lb. per min. during the time spent on the coal-face.

If a miner has to work or walk in places where he has to stoop a good deal, his energy-output is greatly increased, or in other words, the mechanical efficiency of his body is seriously diminished. Thus if a miner has to work in a stooping position so that his body height is reduced by 40 per cent, his energy-output is increased by 65 per cent. If men have to walk a good distance along low roadways the energy expended may be so great as seriously to affect their work-output in the working place. Alternatively, if men are called upon to walk to their work under such conditions, their food-intake must be increased to enable the extra energy to be expended.

Referring to the physiological aspect of the problem, Prof. Moss said that a miner at work in air at a dry-bulb temperature of 98°–100° F., and a wet-bulb temperature of 85° F., can lose as much as 18·56 lb. of moisture through the sweat-glands and respiratory tract during 5½ hours work. If the work-output below ground is equal to 2,800 Cal., it is necessary, assuming that no heat is lost by radiation and conduction, to evaporate 10·6 lb. of water from the skin to neutralise the heat generated in the body during work. The significance of a high wet-bulb temperature is thus clear.

The drinking of water when at work is essential in order to keep the body-temperature normal, though excessive drinking of water is harmful. The significance of the chloride content of the blood points to an effective remedy for heat-cramp and fatigue ; the addition of 5–10 gm. of sodium chloride to 1 gallon of drinking water will prevent the cramp, and to a great extent the fatigue, which is caused by hard work under trying air-temperature conditions.

Archæological Research in South Africa

ONE of the biggest drawbacks to the proper study of prehistoric archæology in South Africa has been, and still is, the complete absence of a properly worked out and correlated geological background. The advances and recessions of ice sheets during the Quaternary provide this background in Europe, and broadly speaking, the existence of the geological canvas has not only created a great stimulus to research in prehistory generally, but has actually become an essential feature of the proper study of the subject. In South Africa there is unfortunately no such background. Prehistorians will therefore be interested to know that the Directors of the Geological Survey and the Bureau of Archæology of the Union of South Africa have arranged a joint and detailed geological and archæological survey of certain vital sections of the Vaal and Riet River Valleys and their tributaries, with special reference to climatic and other conditions during the Quaternary. These valleys hold the secrets of climatic fluctuations and earth movements that were experienced in post-Pliocene times in South Africa, secrets that may be found to be intimately interrelated with climatic fluctuations and movements in other parts of the world—in East Africa and Europe particularly. If correlation is possible and earth