of the trains to run equally well in either direction. The practically universal adoption of the multiple unit system for suburban traffic, where several coaches throughout the train are provided with motors, proves that the flexibility this gives to the make-up of the train is of great value in practice. It is usual to divide the trains into units, each unit consisting of one motor coach and several trailer coaches. In the new express service from London to Brighton, the trains are made up of six or twelve coaches, two or four of which are motor coaches, each being equipped with four 225 horse power motors. Over a new portion of an American railway where the stops are 1·55 miles apart, the average speed including stops is 31 miles per hour; on another portion of the line where the stops are 2·9 miles apart the average speed is 40 miles per hour. The increase over the speed of steam trains in Great Britain is about 50 per cent. This speed could be easily increased; it is merely a question of cost. Mr. Lydall considers that on main lines it would be found advisable to work not less than one third of the passenger train mileage by multiple unit stock. By electrification the average speed of passenger trains in Britain could be raised by 25 per cent. The combination of greater comfort, higher speed, and more frequent service would attract many more passengers, and the latter two would also enable the railways to recover much of their goods traffic which at present goes by road transport.

Motor Car Lights on the Road

WHEN motor cars pass each other at night time, there is often a blinding glare in the drivers' eyes. We learn from *Science Service* that, in the United States, the Bureau of Standards has been conducting an extended research on head-lights to discover how glare can be avoided. Dr. Dickinson of the Bureau of Standards concludes that the most important difficulty in obtaining safe head-lighting is the great disparity in brightness between beams from different lamps. One head-light beam is frequently ten times as intense as another. The driver with the dim lights experiences an almost complete lack of visibility when his car plunges into the bright light of the approaching car. Dr. Dickinson suggests that if the lights were kept so that no head-lamp was more than two or three times brighter than another, most of the glare problem would be solved. Most drivers rely on what they can see of the curb rather than what they see of the oncoming car. Hence the light is increased for a hundred feet in front of the car and the beam is widespread horizontally and slightly depressed. Few motorists realise that it is more dangerous to pass a car that is standing still than one that is running fairly fast. A driver in judging whether the road is clear relies on what he has seen during the past few seconds by the light of the oncoming car. But the road immediately at the back of a car at rest is not illuminated in this way and so danger may lurk there unseen. Exposed lights along the roads sometimes increase the risks of night driving. They often make objects almost invisible which could easily be seen by the head-lights alone.

Early Days of the Turbine

IN his inaugural address as chairman of the North-Eastern Centre of the Institution of Electrical Engineers, Mr. C. Turnbull gave interesting reminiscences of some of the initial difficulties Sir Charles Parsons met in perfecting the steam turbine. His experiments with early forms of the turbine were in entirely new and unexplored regions of engineering. Everything had to be found out. Steel discs were run under stresses that no one could calculate and no one knew whether they were safe or not. The early high-speed turbines ran at 4,800 revolutions a minute. But thanks to the wonderful care always taken at Parsons's works, accidents were very rare. When driving dynamos at high speeds, the armature reaction caused great difficulty. Several solutions were adopted for turbo-alternators. In one way the brushes were moved automatically with the load by steam pressure and the variation of the strength of the field was counteracted by special windings. A further difficulty was that owing to the springing of the shaft, the connexions between the armature and the commutator used to give trouble. This was overcome by the use of flexible connectors, a device first proposed by Parsons. It has proved of the greatest value. Details are given of the famous *Turbinia* and the heartbreaking experiences with the destroyers *Viper* and *Cobra*. Mr. Turnbull tells how Parsons refused to give up and how his perseverance ultimately led to success. Another great invention that came from Parsons's works was the invention of means for balancing high-speed machinery. The early days of the steam turbine were hard days and the labour expended seemed to lead to nothing. At one time it was doubtful if the steam turbine would ever become practical. The story of Parsons's life should prove very encouraging to young and old inventors.

The New Helm or Steering Orders

THROUGH the work of the International Safety at Sea and Load Line Convention, and the passing of the Merchant Shipping Act, 1932, and in accordance with the subsequent instructions of the Board of Trade, on January 1 the 'direct' system of helm orders came into use on all British vessels. For centuries the order to "Starboard the helm" or "Port the helm" has caused the ship's head to go in the opposite direction, the practice having come down through the centuries when tillers were in use. Under the new regulations the order "Starboard" will be given, when it is intended that the wheel, the rudder blade and the head of the ship should go to starboard, and the order "Port" will be given when it is intended that the wheel, the rudder blade and the ship's head should go to port. Though it is expected that little difficulty will be experienced in changing over from the 'indirect' system to the 'direct' system, for a time the orders will be given in the words "Wheel to Starboard" and "Wheel to Port", thus enabling the helmsman to adapt himself gradually to the new system. Like most innovations of the kind, the change in

established practice has not been introduced without considerable criticism and opposition, but it is probable that in a very short time it will be regarded as an eminently sensible and desirable alteration.

Research at the Port Erin Biological Station

A SEPARATE report on the work of the Port Erin Biological Station has been discontinued and a survey of the research done is now published in the "Report for 1931 (No. 40) on the Lancashire Sea-Fisheries Laboratory at the University of Liverpool and the Annual Report of the Marine Biological Station (No. 45) at Port Erin, Isle of Man", 1932, edited by the late Prof. James Johnstone and Dr. R. J. Daniel. In this report a large amount of original work is also published. This covers a wide field and deals with the abdominal musculature of Crustacea, herring investigations, hydrography and the fauna and flora of the Isle of Man. The Port Erin Station has recently (1931–32) had a new laboratory added, fully equipped for practical teaching and with about thirty work places. New engines and pumps have been installed. The plaice hatchery and lobster culture are still continued. Besides liberating lobsterlings hatched and reared in the laboratory, a number were placed singly in glass rearing jars and fed on crab, boiled and ground to a fine meal. Nearly half of the number survived and cast their shells four or five times, making eight or nine casts between the period of hatching and the end of the first year. The newly hatched young are fed on fresh plankton; after the fourth moult (lobsterling) they are fed on crushed crab, small pieces of fish being added after the fifth month. These interesting experiments are to be continued on a larger scale next year. Dr. R. J. Daniel has completed his comparative work on the abdominal muscles of the Malacostraca and has drawn up an elaborate phylogenetic table to express the relationships that exist between the main ventral system of musculature.

A New Source of Rubber

IN order to avoid the necessity of importing rubber from tropical countries, the Soviet Government has organised investigations of native plants likely to contain this valuable product in their latex. Amongst various plants studied, several species of *Chondrilla* (Compositæ) occurring mainly in the southern sandy regions, proved to be very promising and their cultivation is being carried out on an extensive scale. Green parts of the plant are cut and rubber prepared from the latex. The quantities obtained must be rather small, since only up to 2 per cent of the green mass represents rubber. Recently, however, it was found that certain insects feeding on roots of *Chondrilla* can be utilised for extracting rubber from the latex (Veltischev and Luppova, *Priroda*, No. 10, 1932). One of these is a caterpillar of a pyralid moth, *Bradyrrhoa gilveolella* Tr., which feeds on the roots and constructs round its body a tube formed of condensed latex and sand grains. Up to thirty and more such tubes can be found on the roots of a single plant, and the tubes contain 9–17 per cent of rubber. Another useful insect is the larva of a buprestid beetle, *Sphenoptera foveola* Gebl., which also feeds on roots of *Chondrilla* and causes a large outflow of latex solidifying round the root. These swellings contain up to 4 per cent of rubber. Neither insect produces any serious effect on the infested plant, and healthy plants can be infested artificially in order to increase their productivity. Experiments are being made to test the practical and economic side of this method of obtaining rubber.

Cultivation of Green Crops

BULLETIN No. 53 of the Ministry of Agriculture and Fisheries ("Cabbages and Related Green Crops". London: H.M. Stationery Office, Price 9d.) has recently been published. It traces the botanical origin of the various green crops, and deals in detail with the soils, rotation, manuring, harvesting and marketing most suitable for cabbages, savoys, Brussels sprouts, cauliflowers and several miscellaneous green crops. A very interesting section deals with the saving of seed in the counties the climate of which is most suitable for this purpose. Pests and diseases are not mentioned in the present pamphlet, since they have been described very fully in other publications of the Ministry.

Astrolabes and Their History

ASTROLABES are not as generally available for study in the museums of the world as their scientific importance and artistic qualities would merit, but all who may desire to become better acquainted with this instrument in its various forms are now given the opportunity. Subscribers are invited for a comprehensive work, entitled "The Astrolabes of the World", based upon the series of instruments in the Lewis Evans Collection in the Old Ashmolean Museum at Oxford, in the Science Museum at South Kensington, and in several other public and private collections in Europe and America. The early Greek treatise on the astrolabe, by Philopon, and the Syriac treatise by Sabokt—both dating from the seventh century—will appear in English for the first time. Illustrations are given of Chaucer's astrolabe, now clearly identified by the character of the rete as depicted in MSS. and many instruments contemporary with Columbus and Drake, are figured. The subject is of fundamental importance to all students of the history of astronomy, geography and surveying, and indeed to the history of science generally, for it may truly be said that the astrolabe kept alight the torch of the scientific method of observation and of computation of results, in many countries, and through many dark ages, when larger instruments and well equipped observatories did not exist. It is hoped that the principal reference libraries may obtain copies of this monumental work, which it is proposed to issue in two quarto volumes, containing more than 600 pages and 155 plates, of which 12 are in collotype, and 216 text figures. The price to subscribers is ten guineas. Subscription forms may be obtained from Dr. R. T. Gunther, Curator of the Lewis Evans Collection, in the Old Ashmolean, Broad Street, Oxford.