form a new and powerful instrument for determining the shallower, as well as the deeper, structure of the earth's crust.

Pendulum Observations. The normal way of comparing gravity at a number of points is the timing of an 'invariable' pendulum. E. C. Bullard (*Proc. Roy. Soc.*, A., July) has devised a method of recording swings of the pendulum and wireless signals simultaneously on a drum covered with photographic paper. The wireless signals may be special time signals, but for the comparison of pendulums at two stations the author adopts the ingenious expedient of recording the swings at the two stations, together with a portion of an ordinary commercial message from a high power transmitter. The message serves to provide simultaneous marks at the two stations. Using a time of observation of one hour, the errors in timing are small compared with other uncertainties, the accuracy attained being of the order of one part in a million.

Detecting Cracks in Metal Surfaces by Magnetism. A description of apparatus for detecting cracks, otherwise invisible, in machined metal surfaces is given in the *Metropolitan-Vickers Gazette* for July. The method is first to magnetise the part inspected, then immerse it in a fluid carrying finely divided iron particles in suspension. If there is a crack, the iron particles will line up along the crack or cracks owing to the disturbance of the magnetic field caused by them. When the cracks are located, the part is demagnetised. The apparatus provides for the magnetisation of the surface, for its immersion or the pouring of fluid over it, for inspection and finally for demagnetisation. When the objects to be inspected are small and conveniently shaped, a number of parts can be magnetised and inspected simultaneously, thus saving considerable time. A circulating device is used for agitating the fluid in the immersion tanks so as to keep the iron particles uniformly distributed. As it is undesirable to leave parts in a magnetised state, means are provided for demagnetising them before use. This is done by passing the parts slowly through an alternating current solenoid, either by means of a moving conveyor or trolley. In the Company's own factory, the method is extensively used for the inspection not only of large forgings such as turbo-alternator rotors, but also of smaller products such as gear pinions and milling cutters. The most suitable apparatus for routine inspection tests depends on the number of objects to be inspected and on their size, shape and material.

Astronomical Topics

The Planetary Nebulæ. Prof. H. N. Russell has published an article on these nebulæ in the *Scientific American* for July. He complains that the name planetary is unsuitable, but, it seems, without sufficient reason. The photograph of the Owl nebula that is reproduced bears a decided resemblance to Mars when slightly gibbous.

One of the first problems is to determine the distances and sizes of these nebulæ. Dr. van Maanen tried several years ago to obtain direct measures of parallax at Mount Wilson; the objects measured gave a mean parallax of 0·012″, but the fact that the mean proper motions were only twice the parallaxes, whereas the radial velocities indicated that they ought to be seven times as great, led to the conclusion that the parallaxes were too large. An explanation was found in the nebular light being bluer than that of the comparison stars, which caused unequal refraction. A new method of attack was to determine the proper motions by plates extending over an interval of 15 years. They were small; but just large enough to use for comparison with the radial velocities. The average distance of the nebulæ observed came out as 4,500 light-years, and the diameter of the nebulæ nearly a light-year. The photographic magnitude of the central star came out as fifteen times that of the sun, but the visual only ten times that of the sun; this difference arises from the blueness of the nebular light.

It appears that the central stars must be white dwarfs, with diameter one-fifth of the sun's, and density not less than a thousand times the sun's.

As to the chemical composition of the nebulæ, our familiar atmospheric gases oxygen and nitrogen were identified several years ago, and Boyce, Menzel and Miss Payne have just identified the strongest two remaining lines as those of doubly ionised neon.

The distance of the Ring Nebula in Lyra is given as 1,500 light-years; its diameter two-thirds of a light-year. Prof. Russell makes a slip in describing it as spherical, for its outline is an ellipse, with axes in the ratio seven to ten.

The "Nautical Almanac". The *Nautical Magazine* for July contains an article on the "Nautical Almanac" by its superintendent, Dr. L. J. Comrie. He gives a sketch of the state of navigation before the Almanac existed, and then briefly traces the various changes that have been introduced in it. The following quotation emphasises the startling nature of the changes that have been made in the last seven years: "Up till about 1926 the work of computing was done, with slight exceptions, by hand. Highly skilled computers, who lived on 7-figure logarithms, were the order of the day. In that year the work of mechanising the calculations was begun, and to-day no logarithms are used. . . . About one-third of the staff are astronomers, the rest are computers. This mechanisation has resulted in great economy, and has rendered the routine portions of the work much less fatiguing."

The article then describes in detail the methods of using the machines. Differencing has always been used for checking values that are calculated for uniform time-intervals; this differencing is now done mechanically by the National accounting machine, which prints both the function and its differences. Actually two copies of the function are printed, one being kept for reference, the other sent to the printers; the differencing secures that the copy for press is free from errors. Two other machines are described, one of which builds up a function from the calculated second differences, and the Hollerith machine, by which a large part of the calculation of the positions of the moon, as given by Brown's tables, has been carried out up to the year 2000; the cost was £1,500, as compared with £6,000 by the old methods. The workers have to depress keys, instead of writing down figures; this is both much quicker and freer from errors.