machine is started and run on the new surface with a gradually increasing load until about 4000 to 6000 tons per yard of width have rolled over it; this is called the consolidation period. The test proper is then commenced, and the machine is run at a rate of about 2200 tons per yard of width per hour. In most cases with good materials a well-laid surface remains smooth and polished until about 200,000 tons per yard of width have rolled over it. About this stage wave-like markings begin to appear; these gradually extend until at 400,000 tons the surface becomes considerably waved and the vibration is excessive. The test is then considered complete. The results of four tests with mexphalte and aztecphalte are included, and are of interest as showing that considerable difference in the durability may be caused by the method of laying and by the workmen employed.

WE have received a booklet entitled "Economical Dishes for War-time," by Miss Florence A. George (Messrs. Cornish Bros., Birmingham, price 6*d*.). It contains a number of useful recipes for the preparation of economical meat and vegetable dishes and sweets. A brief introduction deals with the food requirements of the body, and at the end some hints are given on the management of gas-stoves.

THE following books are in the press for inclusion in the "Cambridge Technical Series" of the Cambridge University Press:—"Experimental Building Science," vol. i., J. Leask Manson; "Alternating Currents," W. H. N. James; "Development of English Building Construction," C. F. Innocent; "Naval Architecture," J. E. Steele; "Chemistry and Technology of Oils and Fats," F. E. Weston and P. J. Fryer; "Physics for Engineers," J. Paley Yorke; "Chemistry of Dyeing," Dr. L. L. Lloyd and M. Fort.

OUR ASTRONOMICAL COLUMN.

BRIGHT DISPLAY OF AURORA BOREALIS ON AUGUST 27.—A fine exhibition of Aurora Borealis was observed by Mr. W. F. Denning at Bristol in the early morning of Sunday, August 27, between the hours of 2 and 4 G.M.T. Shafts of light were first observed at about 2h. 15m. ascending amongst the stars of Ursa Major and Draco, and reaching considerable altitudes. Changes affected the appearances at short intervals, the streamers would fade away and new ones form, while the invariable disposition of the whole was to move quickly from the west to the east side of the north point. Some of the more conspicuous streamers were particularly recorded as they passed over certain stars, and the mean rate of motion across Ursa Major was found to be 15° in three minutes.

The active region seemed to extend from as nearly as possible N.W. to N.E., but the N.W. and N. showed the greatest abundance of streamers; in the N.N.E. there was a succession of faint bands of light rising upwards to the left of Auriga. Many of the rays observed in the N. region could be faintly traced to altitudes of 70°. The phenomenon was watched until 3.45, when the sky had regained its normal appearance, and twilight had become strong in the north-east.

DISTRIBUTION OF THE POLES OF PLANETARY ORBITS.—Prof. H. C. Plummer recently found that the mean pole of the orbits of the minor planets was situated at a distance of 53′ from the pole of the ecliptic, in longitude 16·7°, and he was led to investigate its relation to the poles of the major planets (*Monthly Notices*, R.A.S., vol. lxxvi., p. 378). A diagram showing the relative positions of the poles revealed several features of interest, to which no special attention had previously been directed. It thus appeared: (1) that the poles lie three by three on five lines; (2) that the pole of each orbit, with the exception of Neptune, lies on two of these five lines; (3) that each line contains the orbital poles of two adjacent major planets. Prof. Plummer found it difficult to believe that this was merely a chance arrangement. Prof. J. B. Dale has since directed attention to further interesting features of the polar diagram (Roy. Ast. Soc., June). On measuring the inclinations of the five lines to the line drawn from the pole of the ecliptic in the direction 315°, he obtained the following results:—

(1)	Earth—Mars—Mercury,	$3° = 82° - 79°$.
(2)	Earth—Uranus—Venus,	$31° = 82° - 51°$.
(3)	Uranus—Jupiter—Saturn,	$82° = 82°$.
(4)	Mars—Jupiter—Neptune,	$136° = 82° + 54°$.
(5)	Mercury—Venus—Saturn,	$161° = 82° + 79°$.

The directions of the five lines can thus be expressed very closely by the formulæ, α, $\alpha \pm 2\beta$, $\alpha \pm 3\beta$, where $\alpha = 82°$ and $\beta = 26\frac{1}{3}°$.

The diagram also shows that there are several pairs of lines joining poles which are nearly parallel. There is apparently nothing in the theory of the secular perturbations of the nodes and inclinations of the planetary orbits which would lead to the expectation of such definite relations, or to the continuance of these relations if they did exist at a given time, but Prof. Dale considers it almost incredible that the should be purely accidental. He inclines to the view that these remarkable relations may indicate the action of other forces, such as might be due to a resisting medium, in addition to the gravitational forces.

SOLAR VARIABILITY.—For the more precise study of the distribution of radiation of different wave-lengths across the sun's disc, the observing station of the Smithsonian Institution at Mount Wilson has been provided with a tower telescope having a concave mirror of 12-in. aperture and 75-ft. focal length. A description of this instrument, together with some of the observational results for 1913 and 1914, has been given by Messrs. Abbot, Fowle, and Aldrich (Smithsonian Miscell. Collections, vol. lxvi., No. 5). Spectrobolometric measurements were made at seven different wave-lengths, namely, 3737, 4265, 5062, 5955, 6702, 8580, and 10,080. The new results agree closely with those obtained at Washington in 1907, so far as the two series are comparable, and the curves of intensity distribution show in a very striking way the greater uniformity of the light across the disc as the wave-length increases. There were, however, slight, but significant, differences between the mean results for different years, a greater contrast of brightness between the centre and edge occurring in 1907 and 1914, as compared with 1913, taken as a standard; that is, in years when the solar constant was high the solar contrast was greater than usual. Besides the long-period change, there were small changes of contrast from day to day, correlated with short-period fluctuations of solar radiation; for this type of variation increase of solar radiation was attended by *decrease* in the contrast between the edge and centre of the disc. The authors are thus led to consider that there are two causes of change existing in the sun: (1) the increased effective solar temperature accompanying high solar activity, producing increased radiation and increased contrast; (2) the varying transparency of the outer solar envelopes from day to day, increased transparency resulting in increased radiation but decreased contrast.