sects, $83,900; stored products insects, $71,900; taxonomy of insects, $145,000; bee culture, $54,400.

Bureau of Biological Survey, $1,424,166, including: Administration, $73,280; maintenance of mammal and bird reservations, $75,000; food habits of birds and animals, $628,273; production of fur-bearing animals, $51,200; biological investigations, $56,800; protection of migratory birds, $173,013; animal breeding and protection in Alaska, $101,000; upper Mississippi River refuge, $190,600; Bear River, migratory bird refuge, $75,000.

Bureau of Public Roads, $495,400, including: Administration, $70,500; road management, $65,000; investigating road building, etc., $72,900; farm irrigation, drainage and engineering, $287,000.

Bureau of Agricultural Economics, $6,056,433, including: Administration, $286,000; farm management, $409,000; marketing and distributing farm products, $765,933; crop and livestock estimates, $845,000; market inspection of perishable foods, $420,000; market news service on fruits and vegetables, $1,227,000; cooperative marketing, $290,000; cotton statistics, $420,000; cotton futures and standards acts, enforcement, $219,500; enforcement of the United States Grain Standards Act, $820,000; administration of the United States Warehouse Act, $256,000; enforcement of Standard Container and Produce Agency Acts, $40,000; salaries and expenses, wool division, $8,000; wool marketing studies, $50,000. Operation of Center Market, Washington, D. C.

Bureau of Home Economics, $167,500, including: Administration, $18,500; general expenses, $149,000.

Plant Quarantine and Control Administration, $2,618,500, including: Administration, $73,000; plant quarantine enforcement, $550,000; parlatoria date scale control, $86,700; Thurberia weevil control, $34,300; gypsy and brown-tail moth control, $567,500; European corn borer control, $898,000; Japanese and Asiatic beetle control, $267,000; white-pine blister-rust control, $27,000; Mexican fruit worm control, $85,000; export inspection and certification, $30,000; Grain Futures Act, enforcement of, $110,000.

Food, Drug and Insecticide Administration, $1,537,300, including: Administration, $104,000; collaboration with other departments, $16,300; Pure Food and Drugs Act, enforcement, $1,030,000; Tea Importation Act, enforcement, $43,800; Naval Stores Act, enforcement, $39,500; Insecticide Act, enforcement, $224,000; Milk Importation Act, $53,000; Caustic Acid Act, enforcement, $26,700.

Experiments in livestock production in southern United States, $43,500.

Experiments in dairying and livestock production in western United States, $60,500.

Farmers' seed-grain loans collection, $10,000.

Cooperative investigations, South Carolina Experiment Station, $40,000.

Forest roads and trails, $8,000,000.

Federal-aid highway system, $74,000,000.

SPECIAL ARTICLES

ON THE VARIATION OF LATITUDE WITH THE MOON'S POSITION

RECENT investigations at this laboratory have suggested a possible connection between the variation in latitude of a given place on the earth's surface and the position of the moon in the sky at the time observations for latitude are made. An analysis of the whole series of the latitude observations, which were made by Ross at Gaithersburg from 1911 to 1914, has revealed a striking correlation between the moon's hour angle and the value of the latitude obtained. The data were restricted to results obtained with the photographic zenith telescope, thus eliminating all personal equation. For convenience the observations were divided into two periods, one from 1911 to 1913, the other from 1913 to 1914. According to Ross's estimates, the 1913 to 1914 observations were considerably superior to those of the earlier years, as is evidenced by the smaller probable error.

In conducting the analysis, a card catalogue was made of the results of the observations of latitude for each night and each group of stars. The mean right ascensions of the group give the necessary data for ascertaining the moon's hour angle at the time of observation. From the mean curve of latitude variation at Gaithersburg extending over the period 1911 to 1914 and published by Ross, corrections were obtained to reduce each night's data to the mean latitude of Gaithersburg, determined from the observations of the whole period. The resultant values of latitude were then tabulated against the mean value of the moon's hour angle for each group of stars, and the running mean taking three at a time gave the results graphically shown in Fig. 1.

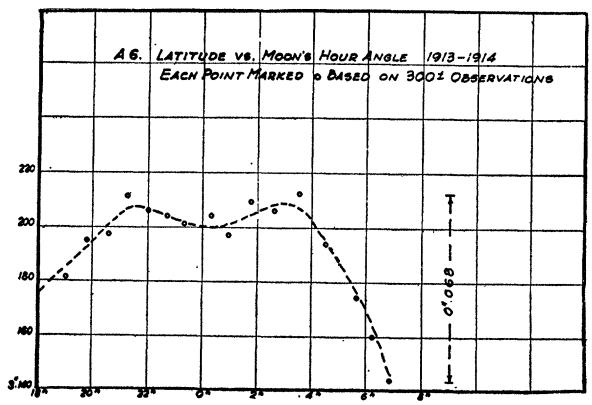

FIG. 1

Since the declination of the moon and hence the observer's distance from the sublunar point may vary greatly even for the same values of the hour angles, the hour angle and declination were transformed into altitude and bearing by suitable tables. Again the observations were divided into two series, one including those made when the moon was above the horizon and the other when it was below the horizon.

The striking rise in the value of the latitude with the increasing altitude of the moon is shown in the altitude-latitude curve, Fig. 2, which again was

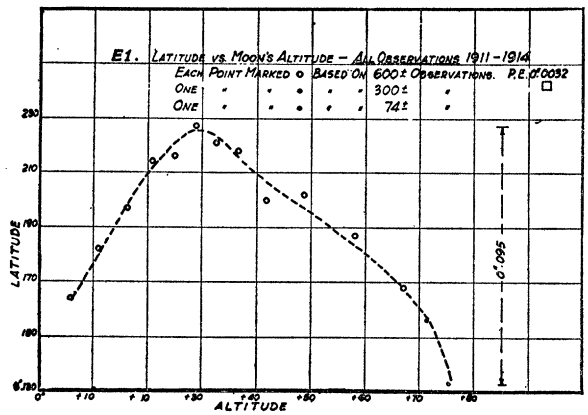

FIG. 2

plotted from the running means. The maximum latitude occurs at altitude 30°, or when the observer was 60° from the sublunar point. It should be stated that the extreme range of variation of latitude due to this lunar effect was 0."08 for the 1913–1914 series and about 0."09 for the whole series 1911–1914. On account of the relatively greater degree of precision obtained in the 1913–1914 series and the larger number of observations included, double weight was given this series in plotting the final graph as exhibited in Fig. 2. The fact that the total variation is about twenty times the probable error of each point on the curves leaves little ground for interpreting the curve as a chance phenomenon. The curve of observations for the moon below the horizon is radically different. A marked fall in the value of latitude follows the negative altitude of 30°.

In seeking an explanation for this extraordinary relationship one is at a loss to account for the fluctuation on the grounds of any deflection of the vertical due to a theoretical tide in the earth's crust.

Meteorological causes, unless a function of the lunar hour angle, should have been practically eliminated in the averaging of between two and three thousand observations. The possibility, however, of the effect of an atmospheric tide may need some consideration.

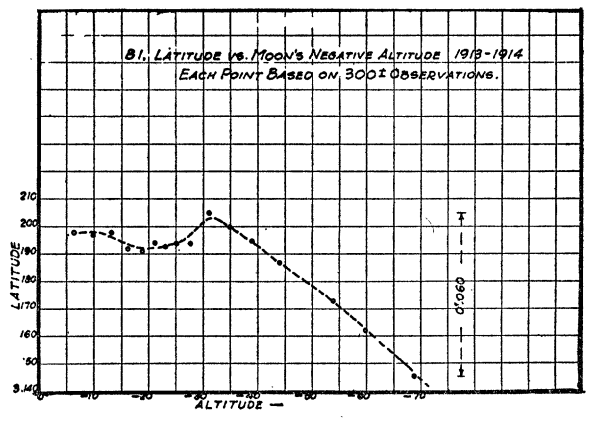

FIG. 3

It should be noted that a change in refraction systematically introduced by the passing of an atmospheric tide is of the correct sign for the observed effect, but the magnitude of the variation seems too large to be accounted for on such a hypothesis.

One is led to interpret the result as a change in the direction of the earth's instantaneous axis of rotation, unless the more fanciful hypothesis of an actual displacement of the earth's crust is to be entertained. It is to be emphasized that various attempts to detect deflections in the direction of gravity by the plumb line, horizontal pendulum or a pipe experiment such as that of Michelson and Gale refer all changes to the position of the earth's crust, whereas the location of the zenith as in the Talcott method for latitude determination refers the vertical to the direction of the earth's axis in space.

Whatever may be the causes involved, the importance of the consequences of such an observed effect scarcely needs to be emphasized, as it vitally concerns the fundamental determination of star positions. It is suggested that a possible explanation of the notable discrepancies in stellar coordinates from star catalogues of widely distributed observatories may, at least in part, be traceable to this lunar effect.

The investigation is now being continued in an analysis of the latitude observations made with the same instrument after its removal to the Naval Observatory at Washington. This latter investigation has now so far progressed as to completely confirm the correlation of the change in latitude with the lunar hour angle discovered in the Gaithersburg series of observations. In the preparation of the data for the analysis, I have had the invaluable assistance of Miss Margaret Olmsted, a graduate student at Radcliffe College.

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