

## ASTRONOMY

# Planet Paths Calculated

Positions have been found for the five outer planets for the next hundred years. Calculations requiring 40 hours per week for 80 years by desk machine, done in few weeks.

➤ NAVIGATORS may feel secure in the announcement made at Haverford, Pa., that the positions of the five outer planets for the next hundred years have already been calculated.

G. M. Clemence of the U. S. Naval Observatory, Dr. Dirk Brouwer of Yale University Observatory and Dr. W. J. Eckert of the International Business Machines' Watson Scientific Computing laboratory stated that the paths of Jupiter, Saturn, Uranus, Neptune and Pluto have been traced out for over 400 years, from 1653 to 2060.

The actual positions of these planets have been calculated at 40-day intervals, they told those attending the meeting of the American Astronomical Society.

Navigators use the actual positions of Jupiter and Saturn to determine their location at sea or in the air. Through study of the motions of celestial bodies, astronomers hope to learn more about how the universe operates.

Basic theories of motion in all sciences depend upon the action of these planets in space. The same laws that govern the motions of planets also govern the motions of man-made devices such as airplanes and tractors, of natural phenomena such as weather and tides.

These five outer planets contain over 99% of the mass of all the planets. Thus their influence on comets and satellites is of the greatest importance.

The position of these planets had previously been calculated for only the next decade or so. Due to the cumulation of errors over the years some of the estimated positions were a few seconds of arc off, that is, 5,000 to 10,000 miles out of line.

The computations reported are by far the most extensive ever made. For the first time the actions of the planets on one another have been calculated each time the actual position of the planet was determined.

Each of the 3,600 separate calculations involved 800 multiplications of 14-digit numbers, 100 divisions, 1,200 additions and subtractions, and the recording of 3,200 digits.

These calculations would have occupied an operator with a desk machine, working 40 hours a week, about 80 years if he had made no mistakes. Actually, the large volume of calculation was done within a few weeks by the IBM Selective Sequence Electronic Calculator, made available without cost to the project by Thomas J. Watson, chairman of IBM's Board. This was the first electronic calculator built with "mem-

ory" enough to do the job, Dr. Eckert pointed out.

The computing machine gave the planet's coordinates directly, eliminating the need for further time-consuming figuring. It made all of the calculations, in duplicate, for a single 40-day step in less than three minutes.

At each step the machine automatically compared the two independent results, and in case of disagreement automatically repeated the calculation. The machine was found able to correct most of its mistakes on the second attempt; in case of disagreement on the second trial it stopped, indicating need for servicing.

About 15,000 observations of Jupiter and Saturn were used to determine the basic material fed into the electronic computer for the work. The paths were extended backward to 1653 because data from observations of an eclipse of Jupiter at that time are still of value.

For Uranus and Neptune fewer observations were available. This is because Uranus was not discovered until 1781 and Neptune not until 1846. There are, however, two precious pre-discovery observations of Nep-

tune in 1795 when the planet was recorded as a ninth magnitude star. For Pluto the number of observations was comparatively small, this planet being found only two decades ago.

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## CHEMISTRY

## Clinical Chemists To Be Certified

➤ PATIENTS and their doctors will benefit from the establishment of a new certifying board, the American Board of Clinical Chemistry, Inc.

Tests for detecting and diagnosing disease and development of new chemicals or new ways of using chemicals for treatment of disease are among the kinds of chemistry involved in this new specialty.

The new certifying board, like the American Board of Internal Medicine, the American Board of Surgery and other medical specialty boards, will establish standards and qualifications for persons wishing to practice the specialty.

Representatives of three leading organizations of chemists, the American Chemical Society, the American Institute of Chemists and the American Society of Biological Chemists, joined in establishing the new board. Officers are: president, Dr. Otto A. Bessey of the University of Illinois College of Medicine; vice-president, Dr. Donald D. Van Slyke of Brookhaven National Laboratory; secretary-treasurer, Dr. Jos. W. E. Harrison, pharmaceutical chemist of Philadelphia.

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**ROBOT BRAIN**—With this electronic calculator, the positions of the five outer planets were calculated for the next hundred years.