has its days of discouragement and depression. But do not believe that defeatist and hopeless saying that "opportunity knocks but once," for opportunity herself has said, in the words of Walter Malone:

They do me wrong who say I come no more,
When once I knock and fail to find you in;
For every day I stand before your door
And bid you wake and rise to fight and win.

CONSPICUOUS ASTRONOMICAL ADVANCES OF THE YEAR[1]

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A SURVEY of some of the most important or most interesting events in the astronomical world during the past year includes stories about the solar system, the galaxy of stars and nebulae and extragalactic objects. Some of these events were predicted, such as the total solar eclipse; others, like the epidemic of new stars, were unexpected.

(1) A new theory of the origin of the solar system —or perhaps it would be better to say a variation and extension of older theories—has been proposed by Dr. R. A. Lyttleton, an advanced student of astronomy at Princeton University. Dr. Lyttleton's hypothesis, which is born out of suggestions by Professor H. N. Russell, makes a decided advance in our speculation concerning the origin of the planets; for he has shown a way in which at least one of the most troublesome objections to earlier theories may be avoided. His theory, in brief, suggests that formerly the sun had a companion star. This companion, after being partially disrupted by the close passage of a third star, long ago deserted the neighborhood, leaving in the sun's gravitational care the debris of the creative encounter. The present planets, formed from the erupted filaments in much the manner described in earlier tidal evolution theories, are endowed with momentum derived from the parent star. The failure to account for the large angular momentum (velocity times distance times mass) of the individual planets has been the principal difficulty in earlier theories. Lyttleton's hypothesis is a step forward, but we must still admit that a completely satisfactory theory of the origin of the solar system does not exist.

In speaking of this problem, we should also point out that Professor Russell's new book on the origin of the solar system certainly can be considered one of the most important publications of the year.

(2) The total solar eclipse of June 19, observed from the Grecian Isles, through Russia and Siberia to the northern Japanese Islands, was the usual mixture of success and sadness. The Harvard–M. I. T. eclipse expedition to Ak Bulak was uncommonly successful, and hundreds of spectrograms were brought back. It will take years to discuss results fully, but preliminary examinations by Dr. Menzel and Dr. Boyce, the leaders of the expedition, show several new coronal lines, and indicate a close connection between high excitation in the chromosphere and the strength of the as yet unsolved coronal radiation. From his infrared eclipse plates Mr. Hemmendinger, of the Harvard expedition, finds a new strong coronal radiation at approximately λ 9800—much farther to the red than any coronal line heretofore known. The new information on coronal lines will greatly assist in the interpretation of the corona and the identification of its material.

(3) Two important additions to the powerful astronomical equipment of the western observatories have been announced. One is a twenty-inch astrophotographic telescope for the Lick Observatory; its four component lens system is designed by Dr. Frank Ross, and is now in the process of manufacture by J. W. Fecker at Pittsburgh. An eighteen-inch Schmidt type camera has been made in Pasadena for installation on Mount Palomar, near the site where the building is now under construction for the 200-inch reflector. The Schmidt camera, the largest of its kind now in America, combines the advantages of speed and achromatism characteristic of reflectors with the large flat star field characteristic of refractors.

(4) The discovery and exploration by Dr. Otto Struve and his colleagues at the Yerkes Observatory of a "red" nebulosity around the bright star Antares was announced at Harvard's Tercentenary Conferences. Nebulae which reflect light of blue stars, such as the Pleiades, have long been known. But this is an important advance in indicating the power of nebulosity to reflect light from red stars. A small Schmidt camera was useful in this research, which was carried on chiefly at the McDonald Observatory on Mount Locke in Texas.

(5) The past year has been conspicuous for a wave of bright novae appearing in the Milky Way. The records of astronomy show no similar frequency. Astronomers were still intent upon the peculiar Nova Herculis that appeared in 1934 when a dozen different observers, on the nights before and after the total solar eclipse, independently discovered the naked-eye Nova

[1] Remarks at the dinner of the American Association of Variable Star Observers, October 17, 1936.

Lacertae. On September 18 Mr. Tamm in Sweden discovered a nova of the slow-rising kind in Aquila; an examination of older plates at Harvard and in Germany showed the nova to have appeared before the end of July, and Miss Harwood's plates at Nantucket first recorded it, below the fifteenth magnitude, on July 17. Nova Aquilae did not attain naked-eye visibility, but an unnamed Japanese observer first reported a fifth magnitude nova in Sagittarius on October 4. Confirmation came from the Cape of Good Hope; this object, Nova number 16 in Sagittarius, has faded rapidly to the eighth magnitude.

To the list of novae in the Milky Way can be added a supernova just found on a Harvard photograph of the southern external galaxy I.C. 4719. This extremely remote object apparently exceeded in brightness the total light of its million-star galaxy. At its brightest the object was of the fourteenth magnitude, but it has now faded hopelessly away.

(6) The misbehavior of the bright northern star Gamma Cassiopeiae has monopolized the attention of astronomers during the past few weeks. Since 1932, according to the University of Michigan, the spectrum of Gamma Cassiopeiae has shown peculiar and numerous changes. Apparently these changes, like rumblings before a volcanic eruption, were preliminary to a general outburst. Abnormal brightness of the star was noted in July by the French observer, P. Baize, but Dr. Marshall's photographs in August showed that it had subsided. Suddenly on the morning of October 5 the star increased about 60 per cent. in its radiation, a change detected by Dr. Cherrington at Delaware, Ohio. The preceding evening Mr. Peltier's observations at Delphos, Ohio, had shown the star in normal light. During the past two weeks Gamma Cassiopeiae has been slowly returning from its maximum magnitude of 1.6 toward normal brightness at 2.25, but it is unlikely that the troubles are over. Both light and spectrum should be carefully watched.

(7) The development of a method for rapid measurement of the velocities of faint stars has been completed during the past year by Dr. B. J. Bok and Dr. S. W. McCuskey, and the first results have been announced. The continuation of the work with northern and southern telescopes will contribute new material during the next two years for the determination of the rotation of the Milky Way and the interpretation of galactic structure.

(8) The granulation of the sun's surface has been analyzed, observationally and theoretically, by Professor Harry H. Plaskett in an important investigation of the brightness, dimensions and meaning of the granulations or "rice grains" which cover nearly uniformly about one half of the sun's surface. Although the granules average more than two thousand miles in diameter, they come and go rapidly, with an average lifetime of only a minute or so. At maximum they are about 10 per cent. more luminous than the intergranular areas, and are indicative of the continual turbulence of the solar atmosphere. Plaskett's results are based on an exceedingly skilful technique in making and analyzing the spectrograms obtained by him with telescopes at Victoria, B. C., and at Oxford.

(9) A new member of the family of the Trojan planets has been discovered by Reinmuth at the Heidelberg Observatory. These distant asteroids move around the sun in the same average period as Jupiter. They are, in fact, managed by that planet. The total number of Trojans now known is eleven. All bear names of the heroes, Greek or Trojan, of the ancient battles before Troy. Number eleven has not yet been named.

(10) The most thorough investigation of the masses of the stars has been completed by Professor Henry Norris Russell. He has studied mainly double stars. He finds that the masses and luminosities are closely related, in confirmation of the well-known theoretical deduction by Eddington.

SCIENTIFIC EVENTS

THE NEW ULTRA-CENTRIFUGE PLANT AT THE LISTER INSTITUTE, LONDON

ACCORDING to an article in *Nature*, the governing body and the director of the Lister Institute entertained on September 29 Professor The Svedberg, of Upsala, and a number of interested physicists, biochemists and biologists on the occasion of the completion of the new ultra-centrifuge plant. In welcoming the guests, Professor J. C. G. Ledingham explained that, in anticipation of Professor Svedberg's visit to London on his way home from the Harvard celebrations, every effort had been made to put the finishing touches to the new installation. Dr. Macfarlane, Lister Institute fellow in biophysics and a former pupil of Professor Svedberg, had been almost entirely responsible not only for the design of the building to accommodate the new plant, but also for the supervision of the lay-out and assembly of all the accessory connections, electrical, optical, refrigerating, etc., carried out by the institute's engineering staff. Throughout the whole work, he had enjoyed the constant advice and cooperation of Professor Svedberg. The total cost of the installation, including the new building, was about £7,000, of which sum the Rockefeller Foundation had contributed £3,400 toward defraying the cost of the new machines.