Scientific American.

ESTABLISHED 1845.

MUNN & CO., Editors and Proprietors.

PUBLISHED WEEKLY AT
NO. 37 PARK ROW, NEW YORK.

O. D. MUNN. A. E. BEACH.

TERMS FOR THE SCIENTIFIC AMERICAN.

One copy, one year, postage included..... **$3 20**
One copy, six months, postage included **1 60**

Clubs.—One extra copy of THE SCIENTIFIC AMERICAN will be supplied gratis for every club of five subscribers at $3.20 each; additional copies at same proportionate rate. Postage prepaid.

The Scientific American Supplement

is a distinct paper from the SCIENTIFIC AMERICAN. THE SUPPLEMENT is issued weekly; every number contains 16 octavo pages, with handsome cover, uniform in size with SCIENTIFIC AMERICAN. Terms of subscription for SUPPLEMENT, $5.00 a year, postage paid, to subscribers. Single copies 10 cents. Sold by all news dealers throughout the country.

Combined Rates.—The SCIENTIFIC AMERICAN and SUPPLEMENT will be sent for one year, postage free, on receipt of *seven dollars*. Both papers to one address or different addresses, as desired.

The safest way to remit is by draft, postal order, or registered letter.

Address MUNN & CO., 37 Park Row, N. Y.

☞ Subscriptions received and single copies of either paper sold by all the news agents.

Publishers' Notice to Mail Subscribers.

Mail subscribers will observe on the printed address of each paper the time for which they have prepaid. Before the time indicated expires, to insure a continuity of numbers, subscribers should remit for another year. For the convenience of the mail clerks, they will please also state when their subscriptions expire.

New subscriptions will be entered from the time the order is received; but the back numbers of either the SCIENTIFIC AMERICAN or the SCIENTIFIC AMERICAN SUPPLEMENT will be sent from January when desired. In this case, the subscription will date from the commencement of the volume, and the latter will be complete for preservation or binding.

VOL. XXXVII., No. 15. [NEW SERIES.] *Thirty-second Year.*

NEW YORK, SATURDAY, OCTOBER 13, 1877.

Contents.

(Illustrated articles are marked with an asterisk.)

TABLE OF CONTENTS OF
THE SCIENTIFIC AMERICAN SUPPLEMENT,
No. 98,
For the Week ending October 13, 1877.

Terms.—SCIENTIFIC AMERICAN SUPPLEMENT, one year, postpaid, *five dollars*. One copy of SCIENTIFIC AMERICAN and one copy of SCIENTIFIC AMERICAN SUPPLEMENT, one year, postpaid, *seven dollars*. CLUBS.—One extra copy of the SUPPLEMENT will be supplied gratis for every club of five SUPPLEMENT subscribers at $5.00 each.

All the back numbers of the SUPPLEMENT, from the commencement, January 1, 1876, can be had. Price 10 cents each.

NOW READY.—The SCIENTIFIC AMERICAN SUPPLEMENT for 1876. Complete in two large volumes. Over 800 quarto pages; over 2,000 engravings. Embracing History of the Centennial Exhibition. New Illustrated Instructions in Mechanical Drawing. Many valuable papers, etc. Price five dollars for the two volumes, stitched in paper; or six dollars and fifty cents, handsomely bound in stiff covers.

THE FIRE IN THE U. S. PATENT OFFICE.

On the morning of September 24, a fire broke out in one of the attic model rooms of the Patent Office, in Washington, which destroyed part of the upper portion of the west and north wings of the building. It is not known how the fire originated, but spontaneous combustion among patented chemicals in the upper part of the building is assigned as a probable cause. The edifice above the third story was filled with printed documents and models, the latter made of light inflammable wood. The roof was also of wood. The fire, therefore, had abundant material whereon to feed, and made rapid headway.

It is gratifying, however, to know that all the lower portion of the building, which is fireproof, and in which the active affairs of the Patent Office are conducted, escaped permanent injury. None of the original patent documents were lost: all drawings, specifications, files, etc., remain intact, together with all caveats, assignments, and pending applications for patents. Consequently there will be no interruption of business.

The fire merely swept away a portion of the upper works of the edifice, and, perhaps not unfortunately, destroyed a great accumulation of rubbish. The re-roofing will be rapidly pushed forward, and it probably will be so carried out as to render the business facilities of the Office better than before the fire.

LEVERRIER AND HIS WORK.

In the death of Leverrier the world loses its most eminent astronomer; but unlike many great disciples of science, he bequeaths to posterity not unfinished work which none but a master mind equal to his own could complete, but the record of undertakings carried to successful endings, and together aggregating the noblest astronomical achievement ever accomplished.

Urbain Jean Joseph Leverrier was born at St. Lo, in the old Department of Normandy, France, on March 11, 1811. He was a close student and obtained honors in the Polytechnic School, which entitled him to a choice of employment in any of the select branches of the public service he might desire. Choosing the position of engineer attached to the administration of the government tobacco monopoly, in order that he might possess the necessary facilities for the continuation of his studies, his attention was first directed to chemical experimentation, and in 1837 he published his first original investigations, announcing a new combination of phosphorus and oxygen. His preference, however, was for mathematics, and in 1839 he began the colossal astronomical task, the termination of which he himself announced to the French Academy of Sciences on December 21, 1874.

In order to reach a just estimate of this vast work, it is necessary to recall the fact that in the solar system the mass of the sun is so great that that luminary is capable of swaying the motion of all the planets without being himself disturbed. Although the planets exert an attractive power on the sun, still if their joint attraction were exercised upon him in a straight line, he would not be disturbed by a space equal to his own radius. So vast then is the controlling power of the sun that even the greatest disturbance in the entire system (that resulting from the mutual attraction of Jupiter and Saturn) is inconsiderably small in comparison. But the fact still remains that the planets do disturb each other in varying degrees, and the more massive the planet the greater its influence upon its neighbors. Consequently and conversely, if we know how much one planet disturbs another, we have a means of determining the mass of the influencing body.

This determination was the object of Leverrier's inquiry, and he set to work to examine into the motions of the seven planets known at the period when his labors began. It is scarcely possible for any one, not conversant with the delicate and intricate toil of the astronomer, to appreciate the multitudinous perturbing causes which in such an investigation it becomes necessary to take into account. Some idea may, however, be gained from the fact that in determining the earth's motion around the sun—but one part of his subject—Leverrier reviewed and discussed nine thousand distinct observations. "Our conclusion is," he says, referring to these, "that the observations of the sun leave much to be desired, on account of systematic errors affecting them; and there is no discordance between theory and observation which cannot be attributed to errors in observing."

Still, from these imperfect data, he estimated the sun's apparent monthly displacements and deduced therefrom an estimate of the distance of the sun, showing that the generally accepted figures were too large by between three and four millions of miles.

Meanwhile, by a most careful analysis of all available observations of Uranus, Leverrier had satisfied himself that that planet was undergoing disturbance by some unknown body. He was in the position, to borrow Professor Proctor's illustration, of an observer who, traveling (say) along a canal, should observe "that certain waves, which had long been of a particular size, began to grow larger. Suppose that, struck by this, he instituted a careful series of measurements of their size, and at last satisfied himself that they had increased. . . If, however, while he had satisfied himself by his wave measurements that the waves had really increased in size, he had also satisfied himself that during his observations the increase had reached its full extent, and had even begun to give place to a slow decrease, tending to restore the original size of the waves, he would manifestly have here an indication which might serve to tell him of the very spot where the disturbance had taken place." Something of this kind had happened in the case of Neptune; and when Leverrier's analysis of the motion of Uranus was finished, it was seen that the displacement had reached its maximum and was beginning slowly to decrease. In order to produce these perceptible effects—and many years were occupied in their production, for it is now known that Uranus only completes his circuit in 84 years, while Neptune requires 164 years—Leverrier assumed that another planet must exist; and from the observed perturbations of Uranus, he calculated the orbit and position of the unknown world. On the 1st of January, 1847, six months after Leverrier had completed the calculations, the planet was found within two degrees of where Leverrier predicted it would appear on that date.

We pass over the long discussion among astronomers as to whether Leverrier or the English observer Adams was the true discoverer of Neptune; both overcame enormous mathematical difficulties, but whether Adams first conceived the existence of Neptune or not, Leverrier certainly earliest made known the discovery to the world.

The quite recent supposed discovery of an inter-Mercurial planet, which afterwards proved to be a sun spot, brought M. Leverrier's investigations into the motions of Mercury prominently forward. He long ago determined that the movements of Mercury, as observed, did not accord with those calculated. "This result," he says, "naturally filled us with inquietude. . . Long years passed, and it was only in 1859 that we succeeded in unraveling the cause of the peculiarities recognized." There exists, he states, in the neighborhood of Mercury, doubtless between that planet and the sun, some matter as yet undiscovered; but whether it consists of one or more small planets or other more minute asteroids, or even of cosmical dust, he does not positively assert. The present opinion is that the meteoric and cometic matter existing in the sun's neighborhood in enormous quantities, produces the perturbations of Mercury; but Leverrier clung to the belief in Vulcan, and manifested the most intense interest in every alleged discovery of that planet. When Lescarbault believed that he had found the inter-Mercurial world, Leverrier was one of the first to abruptly present himself and to demand how the discoverer had dared "to commit the grave offence of keeping your observation secret for nine months. I warn you," he continued, "that I have come here with the intention of doing justice to your pretensions;" and then he examined Lescarbault's primitive apparatus, cross-questioned him sharply, and finally departed, overwhelming the supposed discoverer with his congratulations. How Liais upset this discovery by showing the imaginary Vulcan to be a sun spot is well known; and a repetition of similar experience recently is said to have left the great astronomer disappointed and unhappy.

Leverrier's examination of the motions of Venus resulted in tables of wonderful accuracy. His study of the motions of Mars revealed the influence on that planet of the asteroid zone. Summing up his work, Professor Proctor says: "Beyond question he has deduced from the observed motions of the planets all that at present can be deduced as to the masses of the different known and unknown parts of that complex system which occupies the space ruled over by the sun."

In 1853, M. Leverrier became Director of the Observatory in Paris, which post he occupied until 1870, when he resigned, but in 1872 he resumed its duties, which he has since continued. He took the greatest interest in the large telescope recently erected at the observatory. "It comes none too soon," he replied coldly, when congratulated on its completion; and he at once set to work, hoping by its aid to settle the question of the inter-Mercurial planet. His labors were severe, his rest constantly broken. The task was too much for a man sixty-six years of age, whose life had been one of incessant toil, and he sank under it. His death occurred on September 23d.

MODELS DESTROYED BY THE PATENT OFFICE FIRE.

The Superintendent of Models at the Patent Office gives the number of patented models destroyed as about 87,000. To these should be added the postponed and rejected cases, say about 49,000, making in all about 136,000. The following list will give a pretty accurate idea of the classes destroyed:

Class 1. *Aeration and Bottling.* Aerated liquor apparatus and processes, soda fountains, fire extinguishers, barrel-filling, bungs and vents, bottling, bottle stoppers and washers.

Class 4. *Baths and Closets.* Includes baths, water and earth closets, urinals, washstands and basins, sinks, stench traps, water closet appliances, and water traps.

Class 6. *Beehives.* Includes apiaries, bee feeders, fumigators, honey boxes, moth traps, and swarm indicators.

Class 10. *Bolts, Nuts, Rivets, and Washers.* Consists of varieties of the articles and machines for making them. Of this class the following were saved: Nutlocks, taps, dies, and plates for screw and nut making; but all machines for making these articles were destroyed.

Class 13. *Brakes and Gins.* Machinery for the treatment of raw cotton, flax, and hemp; hair and oakum pickers, and husk splitters.

Class 14. *Bridges.* Includes everything connected with bridges and arches, their piers and abutments, trusses and