tenacious resistance of the great majority of the Spanish professors.

Some champions of modern ideas are happily not wanting in Spain. Among them is one of the most distinguished members of the Madrid Observatory, Sr. Jimenez, who has written an interesting volume on the theory of numbers, which obtained a prize from the Spanish Academy of Science. Sr. Jimenez began to publish a few years ago a theory of light in compliance with the most authorised physico-mathematical doctrines. A man of immense and varied intellect, as a dramatic poet, as an engineer, as a mathematician and economist, and one of the principal men of the revolution, Sr. Echegaray has done much to popularise the modern theories of physics, by a volume dedicated to the General Public, and also by his elementary treatise on thermo-dynamics. He is now publishing some studies on light in a scientific review, which are chiefly intended to extend these studies in our scientific circles. Dr. Vicuña, Professor of Mathematical Physics at the Madrid University, endeavours to do the same by his teaching, and by means of the articles and memoirs which he publishes from time to time. Of these may be mentioned his theory and calculation of steam-engines in accordance with thermo-dynamics.

The scientific instruction which is given to the young men who attended the upper school at the Observatory of Marino, at San Fernando, near Cadiz, is much commended. Every day foreign books are more universally read, translated, and understood, the most popular being those by Tyndall. Prof. Barreda, Felin, Ramos, v. Chamorro are great advocates of modern science. Sr. Escrig y Mieg, the professor at the Institute at Guadalajara, has set up some interesting scientific apparatus there, and has introduced in the pneumatic machine an improvement which reduces the injurious space. The barometer constructed by Sr. Torres, the inventor of probably the most accurate barometer known in European meteorology, merits special mention. It is much to be regretted that owing to special circumstances, his instrument could not figure at the interesting exhibition at South Kensington.

At the Free Institution, lately established for teaching at Madrid, by private enterprise, which the readers of NATURE have already seen referred to in your columns, there is a class of experimental physics, according to the latest development of this science. On the evening of January 28, a series of public lectures were begun, with the object of popularising science in Spain. Dr. Simarro, a young professor at this institution, gave the first lecture on light, and repeated some of Tyndall's most remarkable experiments.

Most of these efforts are, however, still limited to the attempt to spread in Spain a knowledge of the actual state of physical science from other countries which are in a more advanced condition, rather than to contribute to general culture works of original investigation. The interesting studies of Prof. Serrano Faligate, on general and biological physics, some of which have been noticed by English reviewers, are almost the only works on the subject which can be mentioned of importance. It is indeed to be hoped this will no longer be the case when these studies are more generally developed, and act as a stimulant to the genius of the Spanish people.

Madrid FRANCISCO GINEZ DE LOS RIOS

OUR ASTRONOMICAL COLUMN

THE ROTATION of SATURN.—In NATURE (vol. xv. p. 243), reference was made to the discovery by Prof. Asaph Hall of a small, well-defined, very white spot upon the disc of Saturn just below the ring, and to observations which were in progress to ascertain, by means of it, the period of the rotation of the planet upon its axis. Prof. Hall succeeded in following up this spot which was from 2″ to 3″ in diameter until January 2, when the weather having become unfavourable, the planet low, and the spot faint and indistinct, observations were discontinued. From a thorough discussion of the observations at Washington and elsewhere in the United States, Prof. Hall finds for the mean time of the rotation of Saturn—

10h. 14m. 23s·8 ± 2s·30.

It has been necessary to assume that the spot had no proper motion upon the surface of the planet, which is a point on which the observations throw no light.

On the first detection of this spot on December 7, with the view to secure assistance from other observers in noting its central passages on the disc, an ephemeris was circulated from Washington, in preparing which the time of rotation was taken at 10h. 29m. 16·8s., given, as Prof. Hall remarks, "in nearly all the modern text-books as Sir W. Herschel's last and most accurate determination;" notwithstanding this it appears certain that Sir W. Herschel never assigned this period, and its adoption in the Washington ephemeris was so far unfortunate as it may have rather hindered than assisted observations; indeed "through this mistake several observers failed to see the spot."

It is very probable that Prof. Hall has suggested the real cause of the introduction of this erroneous value for the time of Saturn's rotation into so many of the so-called "text-books," the compilers of which rarely concern themselves with references to original authorities, and yet in this case the erroneous value has been given by writers, whom it might well be supposed it was safe to follow. In the *Exposition du Système du Monde*, the first edition of which appeared in An. IV. of the French republican era, Laplace says that Saturn rotates in 0·428, and the ring in 0·437, these figures being decimals of a day; they correspond to 10h. 16m. 19·2s. and 10h. 29m. 16·8s., the former expresses therefore the Herschelian period of rotation (10h. 16m. 0·4s.) to the nearest decimal in the third place, and the latter is the value for rotation of Saturn given in so many astronomical works. Hence Prof. Hall thinks that some one early in the century copied and converted the wrong number from Laplace and "the book-makers have faithfully copied this mistake."

Hansen in his "Allgemeine Uebersicht des Sonnensystems" gives 10h. 29m. 17s. for time of rotation both of Saturn and his ring; Mädler, "Ueber die Weltstellung der Körper unsers Sonnensystems," has 10h. 16m. for the globe and 10h. 29m. 17s. for the ring, but in the early editions of his treatise on Astronomy (as in that of 1849, pp. 251 and 254) he assigns 10h. 29m. 17s. for the globe, and 10h. 32m., after Herschel, for the ring, adding "wahrscheinlich ist sie der des Saturn selbst gleich und beide sind etwa 10h. 30m. in runder Zahl." Sir John Herschel, in the first edition of his Treatise on astronomy in Lardner's "Cabinet Cyclopædia" published in 1833, gives 10h. 29m. 17s. both for Saturn and the ring, and he probably followed Baily's "Astronomical Tables and Formulæ" which appeared in 1827, and where we find at pp. 39 and 59 the same period 10h. 29m. 16·8s. assigned for both rotations, and Baily expressly states that "the elements of the system are taken for the most part from the *Système du Monde* of M. Laplace (fifth edition, 1824), so that it is possibly to this work, which was one of general reference for many years, that the original oversight suggested by Prof. Hall is to be traced. Sir W. Herschel in the *Philosophical Transactions*, 1790, p. 480, states that his observations of lucid spots upon the ring, supposing them to adhere to it, would be explained by "admitting a revolution of the ring itself in 10h. 32m. 15·4s., and in the volume for 1794, p. 28, he finds for the rotation of the globe of Saturn, 10h. 16m. 0·44s., which are the only values that bear his authority.

Prof. Asaph Hall's value must now be taken as undoubtedly a very close approximation to the true period in which Saturn rotates. According to it, the planet's year consists of 25.217 Saturnian days. To the rarity of spots upon the disc of so small and well-defined a character as that which has been recently observed to such useful purpose at Washington, is perhaps to be mainly attributed the want of an earlier reliable determination of the rotation period in confirmation of Sir W. Herschel's, made upwards of eighty years previously.

THE COMET OF 1812.—In anticipation of the return of this comet to perihelion within the next few years, Prof. Winnecke has published ephemerides to facilitate its

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rediscovery, which have been prepared by Herr Mahn on his suggestion. They appear in the *Vierteljahrsschrift der astronomischen Gesellschaft*, 12 Jahrgang, 2 Heft. Encke's period, 70·7 years, would bring the comet to perihelion again in 1883, but Mr. W. E. Plummer, now of the University Observatory at Oxford, some years since stated that a period of 69·2 years would better agree with normal places which he had very carefully prepared. The comet may therefore visit us in 1881, or possibly much earlier with the unknown effect of perturbation. The sweeping-ephemerides are arranged upon a plan conveniently indicating the line in which the comet should be sought at a particular date. It is a case where the "orbit-sweeper," suggested by Sir George Airy, and advocated by Prof. Winnecke, would, if provided with an object-glass of sufficient optical capacity, render much assistance.

THE COMPANION OF SIRIUS.—In the *Comptes Rendus* of the French Academy of Sciences, August 13, M. Flammarion has a graphical representation of the orbit assigned by Dr. Auwers, to the perturbing companion of Sirius and of the observed course of the small star discovered by Mr. Alvan Clark, with the view to illustrate the increasing differences between theory and observation. Allusion was made to this subject in NATURE (vol. xiii. p. 428), where the differences of Dr. Auwer's ephemeris, 1872-75, were given. The latest measures of the Clark-companion at Washington, show for 1877·21, position $(c - o)$, $+6°·9$, distance $-0''·88$.

Prof. Asaph Hall found no other star in the vicinity of Sirius nearer than one of the thirteenth magnitude, which was measured on February 28, 1877; position 114°·9, distance 72″·09; probably the star seen by Mr. Marth at Malta in January, 1865. An examination of the vicinity with the great refractor was made at the request of M. Tempel, of Florence, who had suspected the existence of several small stars near Sirius.

SATELLITE OF MARS.—One of the newly-discovered satellites of Mars was observed by M. M. Henry at the Observatory of Paris, on August 27.

At 12h. 9m. mean time, position 249° 56′, distance 85″·2, the satellite was very faint, and only observable when the planet was screened from view.

BIOLOGICAL NOTES

THE DEVELOPMENT OF THE NERVES IN VERTEBRATES.—Mr. Balfour's discovery that the spinal nerves of sharks and rays are developed as outgrowths from the central nervous system has been followed by a similar revelation with regard to birds. Mr. (now Dr.) A. M. Marshall (of Cambridge) has given an account of investigations respecting the origin of nerves in the fowl (*Journ. Anat.*, April, 1877), describing a longitudinal ridge arising on the summit of the neural canal, and giving off paired processes, the rudiments of the posterior roots of the spinal nerves. Hensen has made analogous observations on the spinal nerves of the rabbit. The anterior roots arise later, distinct from one another, as processes from the spinal cord. Mr. Balfour has endeavoured to solve the difficult question of the relations of the cranial to spinal nerves. He finds as yet no traces in the brain of anything comparable to anterior roots of nerves; all the nerves are posterior roots. The fifth, or trigeminal, arises from the dorsal summit of the hind-brain very early, just like a dorsal root of a spinal nerve. This nerve also, instead of being a compound one, is at any rate in its origin perfectly simple. The auditory nerve and the facial arise by one common root. The glossopharyngeal and vagus have a series of distinct roots. In an adult Scyllium twelve separate strands have been counted in the vagus nerve. This number, and their origin like so many separate spinal nerves, opens up interesting questions in regard to the primitive segmentation of the head and the loss or condensation of segments in the evolution of the vertebrates. Dr. Marshall's observations on the cranial nerves of the chick, so far as they go, correspond to Mr. Balfour's. It appears that there is no definite indication of a limit between head and trunk afforded by the central nervous cord, by the outgrowths from it, or by the mode of development of the nerves. It is open for consideration whether the absence of anterior roots to the cranial nerves may not furnish such a limit; this would be very convenient for morphology.

INSECT AID IN FERTILISATION OF FLOWERS.—Mr. Thomas Meehan, of Philadelphia, continues to bring forward cases to show that many flowers are not so dependent on insect fertilisation as has been imagined. Recently (*Proc.* Acad. Nat. Sciences, Philadelphia, 1877, p. 128) he has instanced the common mignonette, which usually does not seed when forced in greenhouses in winter. It has been asserted that this is due to the absence of suitable insects to produce fertilisation. But last winter Mr. Meehan's specimens took to producing seed in abundance, two to six perfect seeds in every capsule. This showed that some other circumstance had come into play which affected the reproductive organs, insect aid having been as much absent as in other cases.

INSECTIVOROUS PLANTS.—Dr. C. Cramer, of Zürich, publishes, under the title "Ueber die Insectenfressenden Pflanzen," a useful epitome of all that has at present been recorded respecting the singular phenomenon of "Insectivorous Plants." In a series of papers in *Flora*, on the Mechanics of the Movements of these plants, A. Batalin calls attention to a hitherto neglected paper of Oudemans, published (in Dutch) in 1859, in which he describes the greater part of the phenomena of irritation in Venus's fly-trap (*Dionæa muscipula*), agreeing in almost every point with the description subsequently given by Darwin and others.

SPONTANEOUS MOVEMENTS IN PLANTS.—M. E. Rodier, of Bordeaux, has described a singular series of automatic or spontaneous movements in a well-known water-plant, *Ceratophyllum demersum*. They consist of a rhythmical motion caused by a curvature of the axis extending over six hours, which is neutralised in the course of the next twelve hours, and followed by a curvature in the opposite direction extending over four hours, which is again neutralised in four hours, the whole cycle thus extending over a period of twenty-six hours. The movement appears to be entirely unaffected by light.

DISCOVERY OF OXYGEN IN THE SUN BY PHOTOGRAPHY, AND A NEW THEORY OF THE SOLAR SPECTRUM[1]

I PROPOSE in this preliminary paper to indicate the means by which I have discovered oxygen and probably nitrogen in the sun, and also to present a new view of the constitution of the solar spectrum.

Oxygen discloses itself by bright lines or bands in the solar spectrum and does not give dark absorption lines like the metals. We must therefore change our theory of the solar spectrum, and no longer regard it merely as a continuous spectrum with certain rays absorbed by a layer of ignited metallic vapours, but as having also bright lines and bands superposed on the background of continuous spectrum. Such a conception not only opens the way to the discovery of others of the non-metals, sulphur, phosphorus, selenium, chlorine, bromine, iodine, fluorine, carbon, &c., but also may account for some of the so-called dark lines, by regarding them as intervals between bright lines.

It must be distinctly understood that in speaking of the solar spectrum here, I do not mean the spectrum of any

[1] Paper by Prof. Henry Draper, M.D. Read before the American Philosophical Society, July 20, 1877. We are indebted to Dr. Draper's kindness for the plate and illustrations which accompany this paper.

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