tion were visible when I first looked at it in August. . . . By moments of better seeing its two sides showed darker than its middle ; that is, it was already double in embryo, with a dusky middle-ground between the twin lines. In October the doubling had sensibly progressed . . . the ground between the twin lines had grown lighter. By November the doubling was unmistakable."

Let us now turn again to the canals, and see what explanation Mr. Lowell gives to account for their origin and subsequent duplication. The idea he adopts is one that has already been suggested by Schiaparelli and Pickering, namely vegetation. The water in its passage from the pole fills a canal, and thus irrigates the country on both sides for agricultural pursuits. The actual canals themselves we do not see ; but at a later period the vegetation raised thereby becomes apparent, which gives us the visible canals. The darker lines which cross the dark markings, or the more permanent areas of vegetation, represent also a more advanced growth of vegetation, caused by the supply of water, which passes on its journey to fill those in the brighter regions. Observation at Flagstaff has shown that "there is no canal in the dark areas which does not connect with one in the brighter regions."

So much, then, for the canals and their origin ; but how about their apparent duplication? Mr. Lowell, however, has little to say on this point.

"Exactly what takes place . . . I cannot pretend to say. It has been suggested that a progressive ripening of vegetation from the centre to the edges might cause a broad swath of green to become seemingly two. There are facts, however, that do not tally with this view."

From the above extract, it will be seen that Mr. Lowell does not like to commit himself to any statement in explanation of this phenomenon—at any rate, not at present. There seems, however, many reasons to believe that if the canals be due to vegetation, then their doubling is most probably the results also of vegetation ; how this comes about is, however, still a moot point.

One of the best instances we have on the earth, of a large strip of land being fertilised once a year directly by an inundation of a large river, is that of the Nile valley. In following, however, the phases which the country on each side of her banks undergoes at the time of and after the flood, it is difficult to account for the development of the duplicity as observed on the Martian disc. Perhaps the irrigation scheme on the surface of Mars has been carried to such an extreme degree of development, that smaller parallel canals on each side of, and some distance from, the larger ones have been constructed so as to become filled and eventually cut off from the main canal when the water commences to recede. In this way the land would be best fertilised at first on the banks of the main canal, but at a later date on those of the smaller canals. The appearance of a canal should then begin by being single ; as time went on it should broaden, and eventually become double, the two most fertilised strips being parallel, but at some distance from the main canal. The connecting channels between the main and lateral canals, or rather, the vegetation along these lines, would most probably be invisible on account of their extreme shortness.

Such an explanation as this overcomes the difficulty that there are some canals that do not appear double. One has only to assume that the side canals in these cases have not yet been constructed, and duplicity is on this hypothesis impossible. Whatever the real explanation may be, it is certain that greater attention must be paid to the actual development and fading, before this problem can be looked upon as really solved.

In conclusion, we cannot help remarking on the very logical handling of the subject in this volume. The author makes out, further, a very good case for the hypothesis of "vegetation," which will be hard to oppose. It does seem, however, rather premature for him to draw such decided conclusions from this, his first large series of observations ; but his own words show that even these views may be considerably changed by future observation, and he has not, therefore, tied himself too fast to them. In the chapter on the germination of the canals, he remarks that "perhaps we may learn considerably more about it at the next opposition. At this the tendril end of our knowledge of our neighbour we cannot expect hard wood."

The observations of Mr. Lowell have, nevertheless, added greatly to our knowledge of the surface-markings on this planet, and astronomical science owes him a debt of gratitude for the energy he has displayed in fitting out and conducting this expedition, that has been rewarded with such interesting and valuable results.

The book itself not only appeals to professional astronomers, but should be read by all those interested in observations of Mars, for it is written in language that will be found comprehensible even to the uninitiated. The illustrations, which are numerous, are by no means lacking in quality, and considerably enhance the value of the book.

WILLIAM J. S. LOCKYER.

THE SCIENTIFIC DEPARTMENT OF THE IMPERIAL INSTITUTE.

THE extended organisation of the experimental branch of the Scientific and Technical Research Department of the Imperial Institute is now nearly complete, and the whole of the west corridor of the second floor is occupied by well-equipped laboratories, instrument rooms, and sample examination rooms, whilst the recently appointed staff of skilled chemists is already engaged in the scientific and technical investigation of numerous Indian and Colonial products, which are likely to prove of commercial importance or of scientific interest.

The winter course of lectures will be opened on Monday, November 9, at 8.30 p.m. with a discourse by Prof. Wyndham Dunstan, F.R.S., the recently appointed Director of the Scientific Department, the subject of which will be "Illustrations of some of the work of the Scientific and Technical Research Department of the Imperial Institute." After the lecture the research laboratories of the department will be open for the inspection of visitors, and a number of interesting exhibits will be on view.

On November 16, Mr. William Crookes, F.R.S., will deliver the first of two illustrated lectures on the "Diamond Fields of Kimberley," in connection with which a number of specimens and experiments of great interest will be shown. Among other topics Mr. Crookes will discuss the nature and probable origin of the diamond, and will give an account of recent researches of his own. On the occasion of the first lecture, Lord Loch will preside.

On the two remaining Monday evenings in November, illustrated lectures will be given by Prof. J. W. Judd, C.B., F.R.S., the Dean of the Royal College of Science, on "Rubies, Natural and Artificial, with special reference to their Occurrence in the British Empire" (November 23), and by Dr. J. H. Bryan, F.R.S., on "Flight, natural and artificial" (November 30).

Succeeding lectures, the dates of which will be duly announced, will be given by Prof. A. H. Church, F.R.S., Professor of Chemistry to the Royal Academy, on "Some Food-grains of India" ; by Dr. Schlich, C.I.E., of the Royal Indian Engineering College, Cooper's Hill, on "The Timber Supply of the British Empire" ; by the Hon. W. Pember Reeves, Agent-General for New Zealand, on "The Hot Springs District of New Zealand" ;

by Colonel Watson, R.E., on "Schools of Modern Oriental Studies"; by Mr. A. Montefiore Brice, on "The Results of the Jackson-Harmsworth Expedition"; a course of three lectures, by Dr. J. L. W. Thudichum, on "The Nature and Manufacture of Wine, with special reference to Colonial Wines"; by Mr. J. Norman Lockyer, C.B., F.R.S., on "How the British Empire aids in Solar Inquiries"; by Prof. W. E. Ayrton, F.R.S., on "Sixty Years of Submarine Telegraphy"; by Mr. Spencer Pickering, F.R.S., on "The Woburn Experimental Fruit Farm." These lectures are open to Fellows of the Institute, and to persons introduced by them.

We warmly congratulate the Executive Council on the new departures. The acknowledgment of the importance of science on the part of the Governing Body comes none too soon.

Much remains to be done in this direction before the Institute can be held to fill the place which many of its best wishers consider it ought to occupy.

FRANCOIS FELIX TISSERAND.

IT is impossible that we should have learnt the death of an astronomer so eminent as M. Tisserand, the Director of the Paris Observatory, without feelings of the deepest regret, yet its terrible suddenness lends an added note of pathos to the melancholy event. From the report of the Paris correspondent of the *Times*, it appears that on the evening of Monday, October 19, M. Tisserand was present at the dinner celebrating the signing of the marriage contract of the son of the late Admiral Mouchez. On the following morning, apparently without the slightest warning, M. Tisserand expired, the cause of death being congestion of the brain. Astronomy, not only in France, but wherever the science is studied, has thus sustained a tremendous and irreparable loss, and especially will sympathy be extended to the members of the staff of the Paris Observatory, who, twice within a few years, have been deprived of their chief.

François Felix Tisserand was born in the department of Côte d'Or on January 15, 1845. He entered the Normal School at Paris in 1863, and in 1868 gained his Doctorate in Science. Although elected an *agrégé* in 1866, he did not take up the duty of giving instruction, but joined the staff of the Imperial Observatory as assistant astronomer. In 1873, the astronomical service was reorganised by M. Le Verrier, and M. Tisserand was nominated Director of the Toulouse Observatory, and Professor of Astronomy in the Faculty of Sciences of the same town. Subsequently he became Professor of Theoretical Mechanics at Paris, but was transferred, in May 1883, to the chair of Mathematical Astronomy. In this year he began that series of lectures at the Sorbonne, the delivery of which has been attended with the happiest results, for these lectures, given first as the deputy, and subsequently as the successor to M. Puiseux, led eventually to the preparation of that great work with which M. Tisserand's name will ever be connected, the "Traité de mécanique céleste." Though engaged for some twenty years on this work, and necessarily much occupied with official duties, his energy was not exhausted, nor his services to science limited by this task, which few men could have undertaken and brought to a successful issue. In 1874, he accompanied M. Janssen to Japan for the purpose of observing the transit of Venus, and a few years later he was charged with the duty of completing Delaunay's "Théorie de la Lune." Some of the results of this close study of Delaunay's work are shown in the third volume of the "Traité," in the chapters entitled "Réflexions sur la théorie de Delaunay."

M. Tisserand's original memoirs and papers, the most important of which were contributed, though not exclusively, to the *Comptes rendus*, indicate a remarkable activity, and even an exceptional versatility, if that be possible within the range of astronomical science. These papers are far too numerous to mention in detail, but among them are valuable contributions on the theory of interpolation, on problems presented by the minor planets and meteors, on observations of sun spots, &c. While at Toulouse, M. Tisserand made a collection of exercises in the infinitesimal calculus, which he published in 1876. But the subject with which M. Tisserand's name will always be associated is Celestial Mechanics. The first volume of his "Traité de Mécanique céleste" appeared in 1888; the fourth, which was understood to be the last, has very recently been placed in the hands of astronomers. This is not the place to attempt any analysis of that great work, of which perhaps it is not too much to say, that it will render a similar service to the astronomers of the next century, that the work of Laplace did to those of the last. Herein will be found a unique collection of methods, exhibiting great elegance in the mathematical formulæ, and everywhere enriched by critical and historical reference to the original work of other masters in particular departments. This work will always stand as a worthy monument to the memory of its author.

In 1892, on the death of Admiral Mouchez, M. Tisserand was selected to fill the position of Director of the Paris Observatory. This appointment carried with it, almost of necessity, that of the Presidency of the *Comité permanent*, to whom is entrusted the details connected with the preparation of the *Carte du Ciel*. How loyally he has struggled to give impetus to the scheme that his predecessor had so much at heart, is shown by the various reports which he has presented to the Council of the Observatory, and of which summaries have appeared from time to time in NATURE. Under his auspices, a bureau for the measurement of negatives has been established or extended, additional instruments have been provided for measurement, and energy and progress have everywhere marked his short rule. He has struggled manfully with the arrears of meridian observations, and had schemed a plan of publication reaching as far as 1899. While thoughtful of the necessities of the old astronomy, he has not been unmindful of the new, as the free hand given to M. Deslandres, and the work emanating from the spectroscopic department, abundantly prove. Cut off at the early age of fifty-one, and after so short an occupancy of the post of Director, he has perhaps not had full opportunity to declare his capacity in many directions, but he has done more than enough to justify his selection to the important post he filled, and to furnish a model to his successor. For he worthily upheld the traditions of the institution; and it is not saying too much, although it is saying a very great deal, when we affirm that he was a worthy successor in the line of illustrious astronomers who had preceded him in the control of the Paris Observatory. He had received an abundance of honours, too long to fully enumerate, for the scientific societies of all nations were proud to enrol him among the list of their honoured associates. He was decorated with the Legion of Honour in 1874, and four years later succeeded Le Verrier among the full members of the Academy. He was a member of the Bureau des Longitudes, and held other positions of dignity and credit. The St. Petersburg Academy voted him the *Prix Schubert*, and the Royal Astronomical Society elected him a Foreign Associate in 1881. W. E. P.

DR. HENRY TRIMEN.

THE friends of Henry Trimen who saw him during his last visit to England—a twelvemonth ago last summer—would not be altogether unprepared for a serious turn in the malady, or rather maladies, from which he suffered; yet the news of his death on the