THE additions to the Zoological Society's Gardens during the past week include a Western Slender-billed Cockatoo (*Licmetis pasinator*) from Western Australia, presented by Mrs. Halford Stephens; a Crossed Snake (*Psammophis crucifer*), a Hoary Snake (*Coronella cana*), two Ring-hals Snakes (*Sepedon hæmachtes*) from South Africa, presented by Mr. J. E. Matcham; a Common Wombat (*Phascolomys wombat*), a White-backed Piping Crow (*Gymnorhin leuconota*) from Australia, deposited; wo Pennant's Parrakeets (*Platycercus pennanti*) from Australia, purchased; a Rufous Rat Kangaroo (*Hypsiprymnus rufescens*), a Red Kangaroo (*Macropus rufus*), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

THE TEMPERATURE OF THE SUN.—Ebert's recent estimate of the solar temperature (NATURE, vol. lii. p. 232), based upon Langley's energy curves for heated solid bodies, is called in question by Dr. Paschen (*Astrophysical Journal*, vol. ii. p. 202). It appears that certain precautions have not been taken in formulating the law derived from experimental data, and that consequently the law does not hold even for the limits of temperature between which direct observations can be made. The chief defects of the former evaluations is that the prismatic energy curves have not been transformed into those for the normal spectrum; and when this is taken into account, the supposition that the wave-length of maximum energy is inversely proportional to the square root of the absolute temperature falls to the ground.

From a series of experiments made with the object of furthering theoretical investigations, Dr. Paschen considers it extremely probable that "the wave-length of the maximum of energy in the spectrum of an absolutely black body is inversely proportional to the absolute temperature." Assuming provisionally as the quantitative results of his observations, wave-length of max. energy × absolute temp. = 2700, and adopting Langley's value of $0\mu{\cdot}5$ (μ = ·001 mm.) for the position of maximum energy in the normal solar spectrum, Dr. Paschen finds the solar temperature to be 5400° on the absolute scale, or 5130° C. This means that the sun gives an energy spectrum which is the same as that of an absolutely black body at 5130° C.; and this would be its temperature if its light were entirely a consequence of its heated condition, and if its surface possessed no selective reflection. Attention is drawn to the fact that as our experimental methods are improved, our estimates of the magnitude of the sun's temperature are reduced. Dr. Paschen's value is more than a thousand degrees lower than that of Messrs. Wilson and Gray.

THE DOUBLE STAR OΣ·285.—Dr. See, to whom we are indebted for the revision of the orbits of so many double stars, has lately given us another in the case of OΣ·285 (*Ast. Jour.* No. 356). We are almost tempted to ask whether any practical good results from the premature attempt to determine an orbit where insufficient observations exist, or where the chance errors of observations mask the apparent path of the star. Of course, one very practical value such inquiries may have, especially in the case of a close double star, is to point out the times when observations are likely to prove possible and effective. But the question arises, whether an elaborate interpolation formula or real elliptic elements are dealt with. We are the more concerned to put this question, because Dr. See himself points out that Mr. Gore has, from practically the same observations, given elements strikingly at variance with those to which he has been conducted. The more conspicuous differences between the two sets of elements are shown below.

	Gore (1845-1892).		See (1845-1895).
Period ...	118·57 years	...	76·67 years
Excentricity ...	0·58 ,,	...	0·470 ,,
Node ...	106°·58′ ,,	...	62°·2 ,,
Inclination ...	45·42 ,,	...	41·95 ,,

The difficulty of deciding which of the two orbits is the more probable representation of the motion is increased by the fact, that the position angle computed from both is very similar. Previous to 1865 and subsequent to 1887 (in the interval 1865–87, the observations were very uncertain, owing to the close approach of the components) the position angles computed from the two orbits for the same date are rarely separated by a degree, while occasionally the observations differ from the computed place by as much as ten degrees. Dr. See gives an ephemeris for the next five years, and if trustworthy observations can be made of stars separated by about o″·3, additional light will be thrown on the motion of this interesting pair.

THE SPECTRUM OF α AQUILÆ.—The fact that the lines in the spectrum of α Aquilæ are much broader than the corresponding lines in the majority of stellar spectra, was first noticed by Prof. Pickering, who suggested that this appearance might be due to a very rapid rotation of the star. Photographs taken at Kensington and Potsdam have also shown this haziness of the lines.

The spectrum of this star has formed the subject of a somewhat extended research by M. Deslandres at the Paris Observatory, and by the use of a comparison spectrum enabling him to determine the velocity in the line of sight, he has obtained results of great interest (*Comptes rendus*, Nov. 4, p. 629). He finds that very frequently there are fine double bright lines running through the middle of the dark lines of hydrogen, and even sometimes through those of iron and calcium; the brightness of these lines varies with respect to the general intensity of the spectrum, and M. Deslandres attributes them to the chromosphere of the star.

Measurements of the radial velocity are given for fifty-six dates, and they clearly indicate periodic but complex variations. The maximum velocity of approach with respect to the sun was 38·4 km. per second on September 19, 1892, and of recession 11·4 km. per second on July 25, 1895. There appears to be a great oscillation with a maximum velocity every forty-three days, and superposed on this are one or more secondary oscillations, one of which has probably a period of about five days. M. Deslandres believes his results to indicate that Altaïr is at least a spectroscopic triple star; but he states that for a more complete knowledge of the phenomena, better apparatus and a less variable sky than that of Paris will be necessary.

β Ursæ Minoris also exhibits rapid fluctuations of velocity, and M. Deslandres' results in connection with this star will form the subject of a future paper.

VARIABILITY OF RED STARS.—In the current number of *Knowledge*, Dr. Brester gives a general account of his theory as to the cause of variability in red stars (see NATURE, vol. xxxix. p. 492), and extends it a step in order to account for the appearance of bright lines. It is assumed that the stars in question are cooling bodies, and that the atmospheres are sufficiently cooled down to permit the existence of chemical compounds. When some of the vapours are cooled to the dew point, they will condense in obscuring clouds, and produce a minimum without any reduction of temperature. In addition to saturated vapours, if we follow Dr. Brester, the atmospheres will also contain molecules of dissociated matter, which will only combine after the condensation of the saturated vapours has rendered the mixture sufficiently concentrated. The combination of the dissociated molecules produces heat enough to vapourise the clouds, and the maximum is restored by the opening to view of the constantly glowing interior. The presence of bright lines in the spectrum of a variable star near maximum is ascribed to "luminescence" produced by the chemical combination of the dissociated molecules. Thus, the bright lines at the maximum, according to Dr. Brester, are not the effect of heat, but rather of cooling. Dr. Brester finds some justification for this supposed origin of bright lines in the fact that carbon bisulphide gives a discontinuous spectrum at no higher a temperature than 150°; but it must be remembered that the bright lines in question are usually those of hydrogen, and there is no experimental demonstration that these lines can be produced except at a high temperature. To us it seems easier to regard the bright lines of hydrogen as being produced by true elevations of temperature about the time of maximum, such as are explained by the meteoritic hypothesis.

TYPHOID FEVER EPIDEMICS IN AMERICA.

THE factors which control the dissemination of disease are so numerous, and in many cases so complicated, that it is often only after long and patient searching that an epidemic is successfully tracked to the original nidus from which it has sprung.

By the careful record of data of this description, compiled with accuracy and care, we shall gradually become possessed of trustworthy material out of which an historical survey may be built up, and the task of deciphering the course and conduct of epidemic diseases materially lightened.

As a contribution to the history of typhoid fever epidemics, we warmly welcome the able report of some outbreaks of this disease in Massachusetts, made by, as well as under the direction of, Prof. W. T. Sedgwick.

The work before us was included, in the first instance, in the Twenty-fourth Annual Report of the State Board of Health of Massachusetts, but has been, and we think wisely, issued also as a separate pamphlet. No less than nine outbreaks of typhoid fever were investigated, but perhaps the most interesting and important is that which occurred in Lowell, one of the largest cities in the Merrimack Valley, and depending mainly for its water supply on the Merrimack River. Public attention was first called in December 1890 to the serious character of the epidemic of typhoid fever in the city, when it became known that in the preceding month 122 cases had been reported. and twenty-eight deaths from this disease had taken place. After a long and exhaustive investigation, the river water supply became suspected of being the vehicle of the specific infection to which the epidemic must be attributed. Prof. Sedgwick set to work, therefore, to find if there had been any special or unusual infection of the river *above* Lowell, and the discovery was made that an outbreak of typhoid fever, "such as had not been known for forty years," had occurred during the previous August, September, and October in a small village only three miles above Lowell, and situated on a small stream running into the Merrimack River. Four at least of the cases of typhoid fever were proved to have directly infected this small brook, which joins the river only two and a half miles above the intake of the Lowell Waterworks. Dr. Sedgwick states in his report that "the Merrimack River is regularly polluted above Lowell, not only by Stony Brook, but very extensively by the large cities of Nashua, Manchester, Concord, and Fitchburg, the sewers of all of which pour their raw contents directly into the Merrimack River or the Nashua. This they had been doing for months and years; and to the fact that Lowell has been willing to drink this regularly polluted water, *totally unpurified by filtration*, is chargeable the fact that typhoid fever has annually been excessive in that city. But the conditions were no worse than usual in these cities in September and October 1890. There was, however, as has been shown, an infection of a small and seemingly insignificant feeder of the Merrimack only two and a half miles above the intake of the Lowell Water Works, such as is not known to have occurred there for forty years." With respect to the chemical and bacterial examinations of the water, Dr. Sedgwick writes as follows:—

"These were made in the hope of discovering some unusual condition of the river, or of possibly detecting the Eberth bacillus itself. But, as usually happens in typhoid fever epidemics, the worst was over before the examinations began. The chemical examinations showed nothing that was not already known. The bacterial analyses revealed a noteworthy excess of *Bacillus coli communis*, confirming the chemical evidence of the presence of sewage in the city water as drawn from the river, but no Eberth bacilli were found."

We do not, however, attach perhaps the same importance as Dr. Sedgwick to the detection of the *B. coli communis* in the water, as we believe that this organism, or forms closely allied to it, may be found far more frequently present in pure peaty or other upland surface waters than is usually surmised, and that such microbial forms are not *necessarily* indicative of the access of sewage to a given water-supply.

The epidemic of typhoid fever, which apparently started above Lowell, infecting the Merrimack River, supplying that city with water, subsequently extended to Lawrence, situated on the same river, nine miles below Lowell, and a so using its waters for drinking purposes. In this connection Dr. Sedgwick remarks: "Inasmuch as there is good reason to believe that this unusual epidemic was caused by the unusual infection of the river at North Chelmsford and at Lowell, it is interesting to observe that some of the infectious material was apparently able to survive the comparatively unfavourable conditions imposed by the long and slow passage through the Lawrence reservoir and the service pipes." [The "unfavourable conditions" here referred to are the processes of sedimentation to which the microbial contents of the water would be exposed under these circumstances.] "It would seem therefore that, while much of it must have perished *en route*, some of it did not; and, as the time of year was November and December, we are safe in concluding that during these months, under certain conditions, some of the infectious material of typhoid fever may be conveyed nine miles by a river, may slowly travel through a distributing reservoir, and still remain effective to a very dangerous extent if swallowed in drinking water." During the four years preceding 1891, the average mortality from typhoid fever in Lowell is stated to have been 8·44 per 10,000, whilst in 1890-91 it rose to 19·54 per 10,000. Thus the average death-rate from typhoid fever is considerably higher than we experience in London, but it sinks into comparative insignificance when we contrast it with the statistics of typhoid fever in Chicago compiled by Dr. O. M. Huff, of that city. In 1891 the deaths directly attributed to typhoid fever in Chicago amounted to no less than 16·64 per 10,000. In 1892 the condition of things was somewhat improved, although the death-rate, says Dr. Huff, still remained three times as great as in New York, five times as great as in London, and more than six times the rate of Berlin. Dr. Huff has made a minute study of the relation of typhoid fever to the water supply of Chicago, and has come to the conclusion that the contamination of the drinking water supplied to the city with sewage is the "efficient cause" of this alarming mortality. It is stated that Lake Michigan "serves both as a water-bucket and a cesspool for Chicago." An American scientific journal, in reviewing this report, reasonably suggests that every resident of Chicago ought to be advised of the fact that there is death in the water-pipe.

It is to be hoped that the attention now being bestowed in America on subjects both directly and indirectly connected with public health will lead to beneficial practical results, and that the distribution of water openly contaminated with sewage in its raw, unfiltered condition for drinking purposes, will be summarily prohibited by law in all countries before such grave consequences have again to be met as attended the distribution in Hamburg of raw, unfiltered river Elbe water for dietetic purposes.

G. C. FRANKLAND.

AN ACCOUNT OF THE CONSTRUCTION AND STANDARDISATION OF APPARATUS, RECENTLY ACQUIRED BY KEW OBSERVATORY, FOR THE MEASUREMENT OF TEMPERATURE.

THE accuracy of the measurements made at Kew Observatory may, without exaggeration, be regarded as a matter of national concern. It is right, therefore, that the scientific public should be made acquainted with the principles involved and the methods of comparison employed in any series of measurements conducted at the Observatory; more especially when a new departure is made, either in the apparatus used or in the nature of the observations.

In the absence from England of Prof. Callendar, F.R.S., the writer, at the request of the Kew Committee, undertook the responsibilities connected with the preparation and standardisation of the apparatus, recently installed at Kew, for the accurate measurement of temperatures—particularly of high temperatures.

It would be impossible, without unduly trespassing upon these pages, to give a full description of the principles on which the measurements of temperatures by platinum thermometers are founded, or of the methods of standardisation adopted. I will, however, endeavour to briefly indicate reasons for our faith in the principles involved and the accuracy of the methods employed.

I make this communication with the (unofficial) consent of the Kew Sub-Committee, to whom the oversight of this matter was delegated; at the same time it should be understood that the writer alone is responsible for the statements, or opinions, advanced in the following pages.

Sir Douglas Galton in his address at Ipswich remarked that "British students of science are compelled to resort to Berlin or Paris when they require to compare their more delicate instruments and apparatus with recognised standards." We may now hope, however, that, at all events as regards temperature measurements, his statement will ere long require modification.

I. *Brief Explanation of the Terminology and of the Principles involved in the Measurements of Temperature by Platinum Thermometers.*

A platinum temperature scale is one so constructed that a rise of one degree on that scale at any temperature would cause the electrical resistance of a platinum wire to increase by one-