Ephemeris for Greenwich Mean Midnight.

1908	α (true) h. m.	δ (true) ° ′	log Δ	Brightness
Oct. 1·5	21 32·4	+72 58·4	0·1249	2·7
2·5	21 18·8	+72 5·0		
3·5	21 6·4	+71 6·9	0·1170	2·9

LARGE GROUP OF SUN-SPOTS.—The large group of sun-spots referred to in these columns on August 13, and again on September 10, has again been brought into view by the sun's rotation, this making the third rotation during which the same group has been seen. Its persistent activity is evidenced by the fact that it is once more visible to the naked eye, although the separate spots seem to be somewhat smaller and more scattered.

THE ORBIT OF ζ CANCRI C.—The measures of ζ Cancri made since 1756 are brought together by Prof. Doberck in No. 4273 of the *Astronomische Nachrichten* (September 14), and are supplemented by a few brief notes concerning the orbit of the smaller component (C) of the primary pair.

It will be remembered that this system was the first for which the existence of three components was established, the duplicate character of the larger star of the primary pair being discovered by Herschel in 1781. Subsequent observations showed that the motion of C is very irregular, and led to the suspicion that this star is accompanied by a dark companion. Independent evidence of the existence of this invisible companion is deduced by Prof. Doberck from measures made by Profs. Burnham and Barnard between 1891 and 1905.

He also finds that the star C moves round the centre of gravity of C and D (the dark body) in a circle of 0″·158 radius, the period being 17·43 years. Assuming the combined mass of A and B to be equal to that of the sun, it follows that the relative masses of A, B, C, and D are 0·5, 0·5, 0·62, and 0·43 respectively.

SEARCH-EPHEMERIS FOR COMET TEMPEL$_3$-SWIFT.—A continuation of the ephemeris, published by M. E. Maubant in No. 4269 of the *Astronomische Nachrichten*, for the comet discovered by Tempel in 1869 is given below:—

Ephemeris 12h. M.T. Paris.

1908	α h. m.	δ ° ′	log r	log Δ
Sept. 30	7 3·4	+31 3·5	0·0619	9·8396
Oct. 4	7 20·9	+30 16·9	0·0622	9·8411
8	7 37·4	+29 23·7	0·0634	9·8431
12	7 52·8	+28 25·4	0·0655	9·8454
16	8 7·2	+27 23·4	0·0683	9·8478

Three ephemerides are given, that from which the above is taken being computed for the mean date (September 30·88) for perihelion passage. According to the above, the comet should be some 2° S. of Castor on October 6, and about 45′ N. of Pollux on October 9.

THE MANORA OBSERVATORY.—According to a note published in No. 400 of the *Observatory* (p. 362, September) the Manora Observatory, the instruments of which were recently announced for sale, has been purchased by an anonymous person, who invites observers of all nations to observe with the equatorial.

A NEBULOUS FIELD IN TAURUS.—In the September number of the *Bulletin de la Société astronomique de France* (p. 400) Prof. Barnard has an interesting discussion of an extensive nebulosity, which he has photographed, in the constellation Taurus.

A splendid reproduction accompanies the note, and shows the peculiarities discussed. These consist of long dark lanes, in an otherwise nebulous region crowded with stars, apparently devoid of both stars and nebular matter, and Prof. Barnard discusses the hypothesis that their appearance is caused by the interposition of absorbing material between the background of nebula and stars and the earth. He finds this explanation difficult to embrace, but so far is unable to offer a more reasonable one. The field covered by the photograph lies between R.A. 4h. om. to 4h. 34m., and dec. +24° to +28°·5.

THE ISOTHERMAL LAYER OF THE ATMOSPHERE.

THE important discussion of which we give here a detailed account was organised by the committee of Section A of the British Association, and took place at the recent meeting.

It was intended that M. L. Teisserenc de Bort should open the discussion, but he was unable to be present, and sent the following communication:—

Permit me to open the discussion on the isothermal layer and the inversions of temperature which are found there by recalling in a few words the results obtained during the past twelve years. Our experiments at Trappes have shown, in the first place, that the temperature ceased to diminish at a certain height after having passed through a point of maximum rate of decrease about 3000 metres lower down.

The altitude at which the diminution ceases changes with the character of the weather; it may descend as low as 8 kilometres at Paris during a cyclone, while it rises as high as 13 or 14 kilometres in high-pressure areas and in front of large cyclones.

I indicated these peculiarities for the first time in October, 1901, in a communication to the Luftschiffart Verein at Berlin, then in a communication to the Meteorological Society of France in March, 1902, and I developed these conclusions in a note to the Académie des Sciences in April, 1902.

A short time after, in the early part of May, 1902, Prof. Assmann showed from the ascents of six rubber balloons that not only was there a cessation of the decrease of temperature, but also an inversion. This inversion had also been very marked in the first ascents by Hermite and Besançon, but Prof. Assmann sought to explain it as being due to the effect of solar radiation on the thermometer, while the ventilation produced by the rapid ascent of the balloon showed that it could not be referred to such an error in the thermometer record.

Having once demonstrated the existence of this isothermal layer for places in the neighbourhood of Paris, we sought to find the evidence of it in other regions in order to show that it was a general phenomenon. Ascents made by us and our assistants in the winter of 1900–1, by M. de Quervain in Russia, by Mr. Eggenberger at Bath in England in 1902, have made it evident that the phenomenon was a general one. On referring to the results of the international ascents made in different countries, it is seen that the cessation of the temperature decrease is found in the case of all the balloons sent up, and that it is impossible to refer it to insufficient ventilation, since the phenomenon was well marked in ascents made during the night. Since this time, ascents made on board the *Princesse Alice* by Prof. Hergesell in 1905 have furnished evidence of the existence of the layer near the Azores; ascents made in the United States by Mr. A. L. Rotch have furnished evidence of its existence there with the peculiarities I have indicated, *i.e.* high up over high-pressure areas and low down over low-pressure areas.

The expeditions of the *Otaria*, organised in conjunction with my friend Mr. Rotch, have proved the existence of the zone in the tropics, and have shown that it is further from the earth near the equatorial regions where the trade winds meet.

Finally, the ascents made at the end of the winters of 1907 and 1908 by the French-Swedish expedition organised by the Observatory of Trappes, with the support of Prof. Hildebrandson, have shown that near the Arctic Circle, at Kiruna, the layer exists and possesses general characteristics analogous with those found in these regions.

The results of series of daily ascents for eight, ten, or more days in succession in February, 1901, March, 1903, and May, 1904, have proved that the change of altitude of the point where the temperature ceases to fall is accompanied by changes of temperature of 10° C., 15° C., 20° C. in an interval of a day or two at heights between 9 and 13 kilometres, variations great enough to be felt near the surface during the same time.

Thus the equalisation of temperature in the course of

the year, which had been supposed to be nearly complete at 8 or 9 kilometres altitude, does not exist, but, on the contrary, sudden changes of temperature occur with the passage of cyclones and anticyclones which would furnish to an observer in those regions the chief evidence of the changes occurring at the surface.

Causes of the Isothermal Layer.—The summary of the observed phenomena has led me to this conclusion, that the cessation of the temperature diminution is due to the fact that there is at these heights no considerable vertical convection.

The fact that one meets with layers of air thousands of metres thick where the temperature increases and decreases rapidly, and others where it is stationary, is incompatible with the existence of motion of the air accompanied by pressure variations, which always tend to produce a vertical temperature gradient more or less near that for the adiabatic state. It does not follow that the movement in the isothermal layer must be horizontal, but that it takes place along the isobars without crossing these surfaces nearly in the manner in which a body rolls on an inclined plane.

These ideas have been developed in several communications, in particular at the Conférence d'Aérostation scientifique at St. Petersburg in September, 1904.

Dr. Shaw, in the absence of M. L. Teisserenc de Bort, opened the discussion. He explained what was the main feature of the phenomenon, and showed how it had been corroborated by *ballons-sondes* ascents made in England. The temperature of the air decreases in the lower layers on the average at 5° C. or 6° C. per kilometre up to a height of about 10 kilometres. Above this height the temperature ceases to fall rapidly and falls very slowly indeed, or remains constant or in some cases increases. It had been suggested that the phenomenon might be due to a change in the composition of the air at great heights.

M. L. Teisserenc de Bort had succeeded in sending up balloons carrying vacuum tubes, which were opened and re-sealed electrically at a height of 14 kilometres. The samples of air so obtained were examined spectroscopically, and the examination showed that there was no change in the composition of the air sufficient to account for the cessation of temperature diminution.

Mr. Rotch said the only *ballons-sondes* which have been sent up in America were those dispatched by him. Since 1904 seventy-six rubber balloons have been launched from St. Louis, and all but one have been recovered. The majority of those which rose higher than eight miles (12,870 metres) entered the stratum of relatively high temperature.

All the ascents occurred after sunset, so that there can be no question as to the effect of solar radiation. The instruments used were of M. Teisserenc de Bort's construction, and were verified for low pressures and temperatures before and after the ascents. The warm stratum, which was not isothermal, but became warmer with increased height, was at its lowest level in summer, having a mean minimum temperature of −54°·6 C. at 12,000 metres. During the autumn of 1907 the warm stratum of temperature was penetrated eight times, the mean minimum temperature of −60°·5 C. occurring at 12,370 metres.

The changes in the level of the minimum temperature from day to day were large. Thus the minimum of −67°·1 C. at a height of 14,500 metres, on October 8, was followed two days later by a descent of the minimum of −62°·2 C. to 12,000 metres. In the first case, the temperature at the highest point reached, viz. 16,500 metres, was −58°·1 C., and in the second case, when 15,000 metres was attained, −56°·0 C. On November 6 the minimum temperature of −52°·2 C. occurred at 9700 metres, but the place of occurrence of the minimum of −63°·1 C. had risen to 14,250 metres on November 8. The temperatures at the highest points reached were −50°·5 C. at 10,000 metres and −60°·2 C. at 15,380 metres respectively.

These observations, made near latitude 35° N., show the warm stratum to be at a distinctly higher level than in northern Europe, whereas the results obtained by the expedition sent jointly by M. Teisserenc de Bort and the author to explore the atmosphere over the tropical Atlantic in 1906–7 show that it was there considerably higher. In fact, the observations obtained over the equator up to 15,000 metres show no reversal of temperature, and a lower temperature than exists at a corresponding height in northern latitudes.

Mr. Cave said that during the last week in July he was able, by means of theodolites, to follow four balloons into the isothermal layer. From these observations it appeared that the wind velocity increased to a maximum just below the isothermal zone, and decreased rapidly above. The wind velocities were very high, and most of the balloons went out to sea; one, sent up on July 28, was recovered. From the record of the meteorograph it appears that the isothermal layer was entered at 11,500 metres; the theodolite observations indicated that this was the height of the maximum wind velocity; above this the velocity dropped to eight miles per hour at 13,000 metres.

Mr. W. H. Dines said that he knew there had been some doubt expressed about the existence of the isothermal layer, and possibly there were still some who thought that the results obtained were due to instrumental errors. Such a view was now quite untenable, for about seventy ascents had been made in the British Isles during the last eighteen months, and the results entirely confirmed those previously made on the Continent and in America, although the instruments used for recording the temperature were of a totally different pattern. These ascents had mostly been made at about the time of sunset, so that no possibility of solar influence might be present, but in every case (about sixty), when sufficient height had been reached, the temperature gradient had become negligible or of opposite sign. After calibrating many instruments he was convinced that the temperatures recorded were, with but few exceptions, trustworthy within two or three degrees centigrade.

The results, however, were most remarkable, and it was not surprising that doubts about their accuracy were expressed. It had been found that over places only a few hundred miles apart, and at the same time, the temperatures might be widely different, and within the same week and over the comparatively small area of the British Isles differences of 30° C. had been recorded, namely, −40° C. at 15,000 metres, at Limerick on July 27, −60° C., at Pyrton Hill, Oxon., on the same date, and −69° C., at Pyrton Hill on July 29 and again on July 30. Very similar differences between Manchester, Ditcham Park, and Pyrton Hill had been noted on previous occasions.

The absence of any temperature gradient in the air is definite proof of the absence of any vertical circulation, but this alone did not present any difficulty. He (Mr. Dines) had always thought that the vertical circulation was chiefly due to the heat set free when aqueous vapour was condensed to water, and since it was known that the relative humidity was small at great heights, it might well be that above 10 or 12 kilometres there was no aqueous vapour, and therefore no vertical circulation. The difficulty was how large temperature differences could exist at small distances apart without producing convection currents. In a mass of gas at rest under a conservative system of forces the isobaric or isothermal surfaces must be coincident. In this case the temperature observations led to two contradictory results—they showed that there was no circulation and also that the isobaric and isothermal surfaces were not identical. At a height of 15 kilometres a very small change of pressure would produce a large adiabatic change of temperature, but it was difficult to see how, with so small a mass of air left above, changes of pressure could be produced. The accelerations produced by curvilinear motion of the air particles and by the effect of the earth's rotation an a moving body appeared to be far too small for the purpose. Was it possible that the upper air could carry a sufficiently strong electric current to be influenced by the earth's magnetic field, and so produce forces comparable with gravity? Prof. Schuster had suggested some such origin for the daily variation of the magnetic declination.

Mr. Gold said that any explanation of the existence of the isothermal layer must take into consideration the effect of atmospheric radiation. On the assumption that the radiation per unit area from a layer of gas was proportional to the mass of gas in the layer, and that the

absorption followed the same law, he had worked out some results for the earth's atmosphere. If the atmosphere were of uniform constitution, so that the absorption by a layer of air of given mass was the same at whatever height the layer was taken, then the state of convective equilibrium could not exist to heights greater than those corresponding to a pressure equal to half the surface pressure. He found that for greater heights than this the radiation absorbed from the earth and the rest of the atmosphere alone was greater than that emitted at a temperature corresponding to the state of convective equilibrium. In consequence of this the temperature of the air in the upper layers would rise, and there would be a further increase owing to the absorbed solar radiation. In the actual case, the absorbing power of the atmosphere diminishes with increasing height owing to the diminution in the proportional amount of water vapour present. The absorbing power was therefore taken to be equal to $\alpha/(q-p)$, where α and q are constants. Two values were taken for q, for one of which the diminution in absorbing power was quicker, in the other slower, than the diminution in the proportion of water vapour present. The value of α was deduced from the observations of Langley, Paschen, and others.

The conclusions arrived at were:—

(1) If the temperature gradient in the lower layers of the atmosphere is such that $T \propto p^{\frac{1}{4}}$, *i.e.* is approximately adiabatic, and if the upper layer is isothermal, then the state $T \propto p^{\frac{1}{4}}$ must extend to a height greater than that for which $p = p_0/2$, and in general less than that for which $p = p_0/4$, where p_0 is the surface pressure.

(2) The temperature in the lower layers cannot be maintained by absorption of terrestrial and solar radiation; these layers tend to grow cooler, and their temperature is kept up by the supply of heat through convection from the earth's surface and by condensation of water vapour in the atmosphere.

(3) The lowest possible temperature in the atmosphere over a place at temperature 300° A. must be greater than 150° A. or 210° A., according as the atmosphere radiates and absorbs throughout the spectrum or transmits freely 25 per cent. of the earth's radiation.

Prof. Turner said that whereas meteorologists were perhaps primarily concerned with the facts themselves, and physicists with the causes of them, astronomers were interested in the effects of the existence of this isothermal layer, especially in the phenomena of atmospheric refraction. It had been usual to make certain assumptions about the upper air for the calculation of refraction, and these assumptions were now shown to be wrong. Were the refractions calculated on such assumptions wrong? The answer seemed to be that very rough assumptions were sufficient for astronomers; he had found, for instance, that the assumption of two homogeneous shells of air would give empirical results corresponding closely to the facts observed.

Further, no very great improvement was found by adding a third shell—the chief step came in taking two instead of one. Possibly this fact (that two shells were absolutely necessary, but a third was not so much needed) was in some way connected with the existence of two principal regions in the atmosphere.

Prof. J. J. Thomson asked if there was any indication of the thickness of the layer, and remarked that the ionisation in the atmosphere was a maximum at a layer considerably below this layer.

Dr. Walker stated that the Indian peasants were so ignorant that he had not yet ventured on sending up *ballons-sondes* there, the chances of recovering them being so remote.

THIRD INTERNATIONAL CONGRESS FOR THE HISTORY OF RELIGIONS.

OXFORD has good reason to be proud of the success of the congress, which was held there from September 15 to September 18; not only was the general level of the papers high, but the attendance of members—nearly 600—was so large that the Transactions will contain, besides the presidential addresses, some of the more important papers in full, with an abstract of the remainder. The total number of papers was well over 100, hence the need for limitations.

At an Oxford congress of religions it was natural that a part should be played by the Father of Anthropology, and the enthusiasm with which Dr. Tylor was greeted when he introduced the president, Sir A. C. Lyall, was as flattering a tribute to his greatness as he could desire. The subject of Sir A. C. Lyall's address was religious conflicts and the conditions under which one religion attained predominance over its competitors; he held that State recognition has been indispensable to religious consolidation, and ascribed to the absence of State regulation the freedom characteristic of Hindu theology.

The congress was divided into nine sections, besides a general one for papers of wider import, and in each section a presidential address was delivered; Sir John Rhys dealt with Celtic religion, and pointed out that our evidence was precarious, and our knowledge inferential only; Prof. Giles said that the Chinese had a sky-god, Tien, who received, however, neither respect nor sacrifice; eventually this power became an abstraction; Mr. Hartland discussed, among other things, magic, a subject also dealt with by Dr. Jevons; Prof. Petrie discussed Egyptian religion, and pointed out that the prominence of the funerary cult in it was accidental and due to the rise of the bed of the Nile, which had covered up the Egypt of the living; in the life of the ordinary man, the local sacred animal or totem figured largely; the murder of a cat would have set Alexandria in flames, even down to Roman times.

Of the other papers, some were sensational, like that of Prof. Haupt, who maintained the non-Semitic descent of Christ; he argued that Galilee was denuded of Jews in 164 B.C., and that when the Jewish religion was reintroduced fifty years later, it was imposed on Assyrian colonists introduced by Tiglath Pileser; an effective criticism on this view was made by Dr. Gaster, who pointed out that the Jews would have been ready enough to seize on a much less valid ground for denying Christ's descent from David.

Dr. J. G. Frazer also dealt with Jewish beliefs, but his notes on them were the wonderful collections of parallel instances from all parts of the world which we expect from him; he traced the silent widow, for example, in North America, Madagascar, and Australia, where a two years' ban rests upon them, and has been perhaps a potent cause in the development of gesture language.

Dr. A. J. Evans read a paper on the cults of Minoan Crete, and pointed out that recent discoveries corroborated the views which he put forward in 1900; Minoan cults were predominantly aniconic, though images were also found; the cult objects were trees and pillars, and the double axe; the principal divinity was a nature goddess. As a pendant to this paper may be mentioned Miss Harrison's discussion of bird and pillar cults, in which she argued that the change from the "matriarchal" to the "patriarchal" stage caused a change of sex in the most important divinity.

Anthropologists are far from being agreed as to the definition of religion, and, not unnaturally, there was an attempt to define it in the section devoted to religions of the lower culture. Mr. Marrett held that Tylor's animism was far wider than religion, though it did not embrace all religion; the real criteria were two—first, the presence of *mana*, magico-religious force, and, secondly, the negative rites set up by a belief in *mana*, and commonly known as tabu; when the personal element became prominent in religion, animism came in; but it is really a primitive philosophy far wider than the supernatural.

Special interest attached to Dr. Seligmann's account of the Veddahs, from whom he has just returned; with them, as with many other races, fear was the main emotion, and at death they deserted the cave, leaving the body without food or fire; the cult of the dead was almost the central feature of the psychical life of the Veddahs. Funerary customs were also dealt with by Mr. T. C. Hodson in a paper on the Assam hill tribes, and by Mr. N. W. Thomas; the latter summarised Schmidt's views, as yet unpublished, as to the three strata in the population of Australia—old and new Australian and (?) Papuan—and pointed out that the burial customs largely followed the linguistic lines; in the south and west of Australia fear