2

PHILOSOPHICAL TRANSACTIONS.

XII. *An Account of Meteorological Observations in Four Balloon Ascents, made under the direction of the Kew Observatory Committee of the British Association for the Advancement of Science. By* JOHN WELSH, *Esq. Communicated by Colonel* SABINE, *R.A., Treas. and V.P.R.S., by the request of the Council of the British Association for the Advancement of Science.*

Received April 27,—Read May 26, 1853.

IN July 1852, the Committee of the Kew Observatory resolved to institute a series of balloon ascents, with the view of investigating such meteorological and physical phenomena as require the presence of an observer at a great height in the atmosphere. The arrangements made for carrying out this resolution have been stated by the Committee in their report to the Council of the British Association, a short account being at the same time given of some of the results derived from the ascents already made. Having been to a great extent entrusted by the Committee with the conduct of the observations and with the instrumental arrangements, I now, at their request, proceed to give a more detailed statement of the mode in which the experiments have been made, and of such results as may most readily be deduced from the observations recorded in the ascents.

The object to which especial attention was devoted, was the determination of the temperature and hygrometric condition of the air at different elevations above the earth's surface. Besides this, the observers were furnished with the means of procuring specimens of the air at different heights for the purpose of analysis, and of examining, if opportunity offered, whether the light reflected from the upper surface of the clouds was polarized.

§ 1. *Instruments and Apparatus.*

The instruments required for the investigations contemplated were—a barometer; dry and wet thermometers; an aspirator; REGNAULT's condensing hygrometer; DANIELL's dew-point hygrometer; a polariscope; and glass tubes, furnished with stopcocks, from which the air had been exhausted. All the instruments which were at all liable to accident were supplied in duplicate. The construction of the meteorological instruments was confided by the Committee to Mr. P. Adie of London, under my own general superintendence. They were executed by him in a very satisfactory manner, having been made with much accuracy and with an anxious wish to promote the success of the experiments; many of the mechanical arrangements for the convenience of observation having also been devised by him.

Barometers.—The barometer employed was of the siphon form, on the construction generally known as Gay-Lussac's. The tube was affixed to a brass scale in much the same way as a thermometer is attached to its scale. The brass scale was fixed within a stout rosewood frame furnished with a door which could be closed during carriage. The diameter of the tube was 0·25 inch. The graduation was made from the middle point upwards and downwards; each division being $\frac{1}{20}$th of an inch long, but representing twice that value; so that an observation of either branch of the siphon would give the length of the column of mercury, subject to a correction for inequality of the tube and error in the position of the zero-point of the scale. A complete observation of the instrument required however readings of both branches of the siphon, the true height of the mercury being the mean of the two. In order to facilitate rapidity of observation, verniers were dispensed with, the height of the mercury being merely estimated with reference to the scale placed behind it, just as if it had been a thermometer of large calibre. As it would have been nearly impossible to obtain in the car of the balloon a complete reading of both branches of the siphon for each observation, the corrections to the readings of the upper branch alone were previously obtained, throughout the anticipated range of the mercury, by the help of a large vacuum apparatus at the Kew Observatory, which has been employed in the pendulum experiments of Colonel Sabine and Professor Stokes. The barometers having been suspended within the receiver, the air was exhausted by about half an inch of pressure at a time, and readings taken from which tables of corrections were computed for different heights of the mercury. These corrections have been applied to all the observations. The difference between the indications of the siphon barometers and those of the Kew standard was also observed: both barometers were found to read 0·025 inch *higher* than the standard. It was found, by intercomparisons made last year, that the standard barometer at the Royal Observatory, Greenwich, reads *lower* than the Kew standard by 0·003 inch. The balloon barometers thus read 0·028 inch *higher* than the Greenwich standard; and, as that barometer has been generally referred to in the computations of height, the equation +0·028 has been applied to the terrestrial observations to render them comparable with those of the balloon barometers. Each barometer was provided with a thermometer to indicate the temperature of the mercury. In order to obtain this temperature more accurately, the bulb of the thermometer (which was cylindrical, about $1\frac{1}{2}$ inch long and $\frac{1}{8}$th of an inch diameter) was immersed in mercury contained in a tube of the same diameter as that of the barometer. The necessity for this precaution was found to be great, as very large differences sometimes existed between the temperature of the air thermometer and that of the mercury.

Dry and Wet Thermometers.—Two pairs of dry and wet thermometers were employed. One pair was mounted with the bulbs protected from radiation by a double conical shade, having highly polished silver surfaces, open at top and bottom to allow the circulation of the air. The inner shade was 2 inches high, $1\frac{3}{4}$ inch wide at the lower, and half an inch at the upper end: the outer shade was also 2 inches high, $2\frac{3}{4}$ inches wide at the lower, and $1\frac{3}{8}$ inch at the upper end*. Both thermometers were furnished with shades exactly similar; the bulbs being thus in the same circumstances, and completely protected from direct radiation. The thermometers were supported, $3\frac{1}{2}$ inches apart, by the arms of a light brass frame, also with a polished silver surface. A small brass cistern was fixed near the wet thermometer, from which water was conveyed to the bulb by a conducting string of floss silk; when however the temperature fell below the freezing-point, the string was cut away and the bulb occasionally dipped in water.

As it was of essential importance that the thermometers should acquire with the utmost possible rapidity the temperature of the surrounding air, an arrangement was made, in connection with the second pair of dry and wet thermometers, for producing artificially a more rapid current over the bulbs than they would be exposed to by the mere vertical motion of the balloon. It was also thought desirable to avoid any tendency to a stagnation of the vapour of water in the neighbourhood of the wet bulb owing to the want of a sufficient circulation of air to carry it off, as might be the case when the balloon was nearly stationary or moving very slowly. An increased velocity in the circulation of the air would also tend to remove the effects of radiation, if the thermometers were not already sufficiently protected by the shades. With these objects the following contrivance was adopted. The thermometers were fixed vertically with their bulbs enclosed in two tubes placed side by side, and connected with each other by a cross tube joining their upper ends; these tubes having silver surfaces, and being further protected by a silver shade of the same dimensions as the outer shade of the other pair of thermometers. The first tube, in which was the bulb of the dry thermometer, had at its lower end a communication with the air: by means of an aspirator a current was produced from this opening, upwards over the dry bulb, then passing, by the communication at the top, into the second tube down which it moved over the wet bulb, leaving it by an opening connected by a flexible pipe with the aspirator. By this means, the temperature of the air was determined in its passage over the dry bulb, and afterwards its hygrometric condition on coming in contact with the wet; the vapour of water formed at the latter being carried off immediately into the aspirator. The whole distance which the air had to

* It might have been preferable to make the inner shade cylindrical instead of conical, as the air would have circulated more freely.

travel, between its entrance into the tubes and its leaving the wet thermometer, was about 4 inches: the diameter of the tubes enclosing the bulbs was 0·4 inch, and that of the connecting tube 0·25 inch. The aspirator was a cylindrical bellows; the valves being so arranged that, when the aspirator was forced open, the air could only enter it by passing over the thermometers: it was worked by attaching a weight to the lower end which pulled it open, the upper end being fixed; when it had opened to nearly its full extent, it was closed by means of a cord passing over pulleys and drawn up by the hand; a large valve allowing the air to escape rapidly from the aspirator as it was closed, and a second valve preventing the air from being driven backwards over the thermometers. Care was taken, in the construction of the different parts, that the aperture of the tubes should not be smaller between the thermometers and the external air, than between them and the aspirator; otherwise the air might, by undergoing a certain degree of expansion, have come in contact with the bulbs in different conditions with respect to temperature and capacity for moisture from those of the external air. This was guarded against by applying a stopcock near the aspirator, whose aperture was sufficiently small. A second flexible tube, with a stopcock, connected the aspirator with REGNAULT's hygrometer; so that the same aspirator might be used simultaneously for both instruments. Two different sizes of aspirator were used in the different ascents; the one being 12 inches diameter, and extending to about 18 inches, occupying about $1\frac{1}{2}$ minute in its descent; the other was 9 inches diameter, extending to 12 inches in 30 to 40 seconds. This was sufficient to produce a current of air over the bulbs at the rate of 12 to 14 feet in a second; the vertical velocity of the balloon seldom exceeding 4 or 5 feet. The thermometers employed were of great sensibility; the bulbs being cylindrical, the diameter not exceeding $\frac{1}{12}$th of an inch, and the length varying from a half to three-quarters of an inch. The length of one degree of the scale was from $\frac{1}{25}$th to $\frac{1}{20}$th of an inch, so that they could readily be read by estimation to 0°·1. The graduation extended to 30° or 40° below zero of FAHRENHEIT. The scales of those used in the first ascent were of brass, but afterwards of ivory, in order to render the column of mercury more visible. The errors of all the thermometers were determined throughout the scale, from about 0° to 70°, by comparison with standards at the Kew Observatory; the comparisons below the freezing-point being made in mixtures of ice and salt. The corrections have been applied to all the readings. These thermometers were found to acquire the temperature of the air very rapidly: when heated 20° above the temperature of the air, and allowed to cool *at rest* in a confined room, they returned to within 0°·5 of the previous reading in about 100 seconds; when gently fanned, by being carried through the room at the rate of 5 or 6 feet in a second, they returned to within 0°·5 in 40 seconds; when under the action of the aspirator they returned to within 0°·5 in 30 seconds, and exactly to the original reading in 45 seconds. Any correction on account of sluggishness in the thermometers must thus be very small: this is shown by the observations of October 21, when the descent took place with about the same velocity as the ascent, and observations were continued to within 3000 feet of the earth. The differences of temperature at the same height are scarcely appreciable, and even frequently in the opposite direction from what would result from insensibility in the thermometer. A few observations were taken during the *descent* on August 17, which, when compared with those made at the same height in the *ascent*, show a difference of about four degrees. The rapidity of the descent was on that occasion about twice as great as that of the ascent, which was also considerable, and the thermometers were not under aspiration. The protection from radiation has been examined by observing the thermometers within a room when alternately exposed to strong sunshine and shade—the effect upon the aspirated thermometers did not exceed 1°·5: in the open air, and with a gentle breeze, the effect was considerably less. The effect upon the free thermometer appeared to be greater; and the difference between its indications and those of the aspirated thermometer during some of the ascents is probably to be ascribed to this cause. It would appear from some portions of the series of August 26, that the long-continued exposure to the sun, in a nearly calm air, has produced an appreciable effect upon the readings of the thermometer, whether aspirated or free. Fortunately, with the exception of the ascent of August 26, the sun's radiation was never powerful; whilst on August 17, when the free thermometers were alone observed, the sun was scarcely ever visible. When the radiation was feeble, and the vertical motion of the balloon considerable, the two thermometers agreed very closely*. As hygrometers there is probably less difference in their value. In the examination of the results of the temperature observations, I have been led to prefer the indications of the aspirated thermometer.

REGNAULT's *Condensing Hygrometer*†.—The only difference in the construction of this instrument, from that usually adopted by M. REGNAULT, was that the small tube, by which the air enters the reservoir to agitate the ether, had a funnel-shaped opening at top to facilitate the supply of ether. The bulb of the thermometer was cylindrical, $1\frac{1}{2}$ inch long, and $\frac{1}{10}$th of an inch diameter. The scale was of ivory, and the thermometer was fixed into the reservoir by a cork.

No use was made of DANIELL's hygrometer as that of M. REGNAULT was found much more convenient for such observations, being to a great extent self-acting.

Polariscope.—This instrument was supplied by Mr. DARKER of Lambeth. Its principle is the same as that employed in Mr. WHEATSTONE's "Polar Clock;" the parts of the polariscope used having, I believe, actually formed portions of one of those instruments. It exhibits the existence of polarization in a conspicuous manner.

Exhausted Tubes for Collecting Air.—These tubes, which were constructed by Messrs. NEGRETTI and ZAMBRA, were about 9 inches long and $\frac{3}{4}$ inch diameter, fitted

* It would be advisable in any future experiments to apply additional shades to all the thermometers, and if possible to use a larger general screen at some distance from them.

† This instrument is described in the "Annuaire Météorologique de la France" for 1849, p. 221.

with stopcocks. They were prepared by Dr. Miller previously to each ascent, and hermetically sealed immediately after their return to King's College.

§ 2. *Observing Arrangements, Personal and Instrumental.*

It was deemed advisable that, in the first ascents at least, two observers should take part in the work. Mr. R. B. Nicklin, who for upwards of two years had been employed at the Kew Observatory and been practised in the observation of instruments, acted as my assistant in the first two ascents. Mr. Nicklin's aid was of essential service, and I wish to express my acknowledgement for the careful manner in which he took the observations with which he was entrusted, and for the readiness with which he assisted me on several occasions, sometimes at considerable personal inconvenience, when unforeseen difficulties arose. Having in these two ascents acquired experience in the observations, and having got the instruments into better working order, in the last two ascents I undertook the observations alone, thus obtaining the power of reaching a greater elevation.

The car attached to the balloon was an oblong basket of wicker-work, about 6 feet long, 3 feet wide, and 2½ feet deep. One end of this was occupied by the observers with the instruments, and the other by Mr. Green, who managed the balloon. A light board, a foot wide, was fixed across the car in front of the observers: at the extremity of this board, and projecting nearly a foot over the side of the car, was erected a light horizontal bar of wood, raised about 9 inches above the board, and inclined at an angle of about 45° to its length, the board being cut away beyond the bar so as not to present any resistance to the circulation of the air. Upon the bar were fixed the thermometers and hygrometers. The aspirator was fixed to the lower side of the board, in which a hole was cut to admit the connecting tubes. On the first ascent the barometers were suspended from the hoop by which the car is attached to the netting of the balloon; this was however found to be inconvenient; and in the subsequent ascents they were suspended by gimbals from the cross board, their verticality being secured by weights attached to the lower ends of the cases. When seated in the car for observation, Mr. Nicklin occupying the right-hand corner and I the left, the stand supporting the thermometers was to my left, at a distance of about 18 inches; the aspirator being underneath the board, which served as a table before us: one barometer was immediately in front of Mr. Nicklin, and the other before myself; the observations could thus be readily taken without rising from our places.

In order to obtain as continuous a record as possible of the variations of temperature and humidity, the observations were taken at very short intervals, generally at every minute, but frequently twice in a minute. In the first two ascents Mr. Nicklin observed one barometer, whilst I observed the thermometers and hygrometers, taking an occasional observation of the second barometer as a check upon the indications of the other. A watch which had been set to Greenwich time was placed in sight of both observers. In the last two ascents, when I was the only observer, the barometer was always read first, and immediately afterwards the thermometers and hygrometers; the whole time occupied being only a few seconds, the error, arising from the observations not being strictly simultaneous, must be very small. Note-books were provided with columns ruled and headed for the different instruments.

§ 3. *Circumstances of the Ascents and General Observations.*

The ascents were made with Mr. C. GREEN's large balloon, well known by the name of the "Royal Nassau." It has been fortunate, for the success of these experiments, that the Kew Committee obtained the cooperation of Mr. GREEN, whose pre-eminence as a skilful aëronaut has been established by upwards of 500 ascents; and whose control over his balloon is so complete, that no one who accompanies him can be otherwise than relieved from apprehension, and free to devote his attention calmly to the work before him. Mr. GREEN on all occasions showed the most anxious desire to contribute to the success of experiments, in which he took great interest.

The ascents took place from the Royal Vauxhall Gardens, which were liberally placed at the disposal of the Committee by Mr. WARDELL, the Lessee. The balloon was inflated with carburetted hydrogen gas, obtained from the Vauxhall and Phœnix Gas-works.

First Ascent, August 17.—The weather, previously to the 17th, had been somewhat variable; on the 16th the wind changed from S.E. to S.W., and on the day of ascent it was from south. Clouds covered about three-fourths of the sky, the lowest stratum being a few detached masses of loose cumulus; a dense mass of cirrostratus (or stratus) being above, with perhaps occasional patches of cumulus intermediate. The ascent commenced at 3^h 49^m P.M., after considerable difficulty had been experienced in the preliminary arrangements, owing to the force of the wind. A short time was lost at first in the attempt to put the instruments into more convenient order, and also from the novelty of the situation. The lowest clouds, which extended only over a small area, and were not near the balloon, were passed before they were noticed; their height was estimated at about 2500 feet. Between this height and about 13,000 feet, the air seemed free of clouds; after this, although the balloon was never in actual cloud, there seemed to be occasional masses of loose cumulus at no great distance. When at the greatest elevation, there was, at apparently a short distance above us, a thick mass of cloud, which was probably the cirrostratus which had been seen from the earth. About this time, and while still rising, a few small star-shaped crystals of snow about $\frac{1}{25}$th of an inch diameter fell upon us. The sun was almost constantly obscured throughout the ascent. The descent commenced at 4^h 46^m P.M., and the earth was reached about 5^h 20^m P.M., near Swavesey in Cambridgeshire, about 57 miles north of London. There seems to have been little, if any variation in the direction of the balloon's flight: it would thus appear that, within the height reached by us, the air was moving from south, at an average rate of about 38 miles an hour. A violent thunder-storm, with heavy rain, occurred about two hours after the descent took place, some symptoms of which were at one time noticed from the balloon at a great distance.

In this ascent it was found impossible to use the aspirator, which was too large when two persons were seated. The free dry and wet thermometers were regularly observed. Some specimens of air were collected during the descent, and supplied to Dr. MILLER.

Second Ascent, August 26.—The wind on the 25th blew strongly from the west, but lulled in the evening. On the 26th it blew from east with moderate force; the sky was to a small extent obscured by detached masses of cumulus, and the sun shone brightly. The ascent took place at 4^h 43^m P.M., and observations were commenced at 4^h 46^m. The clouds were again passed without being perceived, their height, however, was estimated at 3000 feet: above this height no clouds were met with, the sky being exceedingly clear and of a very deep blue colour. The currents of air passed through seem to have been from various directions, but generally moving with little rapidity. On leaving Vauxhall the balloon was at first carried towards the west for about 2 miles: when it reached the height of 5000 or 6000 feet it began to move slowly towards N.N.E. for about 4 miles, until about 5^h 25^m, at an elevation of 12,000 feet, the direction of its motion, which was still for some time very slow, became W.N.W.; this direction it seems to have maintained during the remainder of the ascent, and probably with increased rapidity. The descent commenced at 7^h 0^m, and the balloon reached the earth at 7^h 35^m P.M. near Chesham in the county of Bucks, about 25 miles W.N.W. of London. On this occasion all the instruments were regularly observed: some difficulty was experienced in the observation of REGNAULT'S hygrometer, as the force of the aspirator was not sufficient to produce the great degree of cold required for the deposition of dew. This was remedied by Mr. NICKLIN, who, at the cost of some exertion, maintained an increased strain upon the aspirator during the observations. The sun shone brightly throughout the ascent. Specimens of air were again collected during the descent.

Third Ascent, October 21.—The weather had for a fortnight previously been fine, with an easterly wind; on the 19th the barometer began to fall and the east wind ceased; on the 20th the weather was fine, the air at the surface being calm, and the high clouds moving from S.W.: a fog existed on the night of the 20th, which slowly disappeared on the morning of the 21st, leaving the air in a very calm state and with some haze. A dense mass of cloud covered the sky, one or two slight showers falling about 10 A.M. I was the only observer on this occasion. The ascent commenced at 2^h 45^m P.M., and the balloon rose at first nearly vertically, but soon began to move towards E.N.E. Between the heights of 1000 and 2800 feet various detached and irregular masses of loose scud were encountered, but the balloon had not completely entered the dense mass of cloud till the height of nearly 3000 feet. At a height of 3700 feet the upper surface of the cloud was reached, and the sun was seen shining through thin cirrous clouds, at a great height. The height of the upper surface of the cloud was again observed during the descent at $4^{h}\ 6^{m}$ to be 3450 feet. When the balloon was close to the clouds, it was remarked that the general level of the surface was very uniform, presenting, however, a hillocky appearance; the irregularities being small, apparently not exceeding a very few feet. Shortly after clearing the clouds, a shadow of the balloon was seen on the surface fringed with a glory; with this shadow as a centre, there was also observed a circle of whitish light, the outer edge of it slightly tinged with yellow; its diameter being estimated at 80°. About this time there was noticed, stretching for a considerable length in a serpentine course over the surface of the cloud, a well-defined belt having the appearance of a broad road, both sides being strikingly distinct. When the balloon had attained a height of above 12,000 feet, Mr. Green, who had been watching its motion with reference to the clouds below, decided that, as it seemed to be moving rapidly from N.W., it would be prudent to descend below the clouds, to ascertain our position with reference to the sea, and if there should be space enough to ascend a second time to a greater height. It was found, however, on descending, that we were already very near the sea, indeed, moving along the river Thames within a short distance of its mouth. A second ascent being thus unadvisable, the descent was made at $4^{h}\ 20^{m}$ P.M. on the North bank of the Thames, between the villages of South Benfleet and Rayleigh in Essex, about 30 miles east of London. The average rate of motion was thus about 18 miles an hour, but in the higher part of our course it must have been considerably more.

When about 3000 to 4000 feet above the clouds they were examined with the polariscope. The reflected light from the clouds *next* the sun showed no trace whatever of polarization: the slightly bluish-grey clouds on the side *from* the sun showed *very* slight symptoms of polarization, the light of the sky being strongly polarized.

Fourth Ascent, November 10.—This ascent had been delayed for some days, owing to the unfavourable state of the weather, the wind having been generally from a westerly quarter. On the 10th the surface wind and the lower current of scud were moving very slowly from about N.E.: the upper clouds were only occasionally visible, and seemed to proceed from about N.N.W. The ascent commenced at $2^{h}\ 21^{m}\ 40^{s}$ P.M. At a height of 500 feet the first cloud, thin scud, was entered, the *upper* surface being 1970 feet high. A space of 2000 feet was clear of clouds, and at 4000 feet the second stratum of clouds was reached, its *upper* surface being found to be 4900 feet high. After this no clouds were met with, the sun shining through thin cirrous clouds, which must have been at a very great height. From notes taken at Vauxhall by Mr. Gassiot, it appears that, at starting, the balloon moved towards south-west until $2^{h}\ 26^{m}$, when, just as it had reached the *upper* surface of the *first* stratum of clouds, or at a height of about 2000 feet, the direction became easterly. Bearings and altitudes taken by Mr. GLAISHER show that at $2^h\ 44^m$, when the height was 11,000 feet, the balloon was 5 miles S. by E. of Greenwich Observatory. The greatest elevation (22,930 feet) was reached at $3^h\ 16^m$ P.M.; about which time the clouds, which had hitherto obscured the earth, had disappeared, and we perceived that the balloon was rapidly approaching the sea. Mr. GREEN discharged gas copiously, and the descent became very rapid; a landing being effected within 4 miles of the sea, accompanied by a considerable shock which broke several of the instruments. The descent took place, between $3^h\ 40^m$ and $3^h\ 45^m$, at Acryse near Folkstone, about 57 miles E.S.E. from London. The time occupied in moving from a little S.W. of Vauxhall to 5 miles S. by E. of Greenwich, or about 9 miles, was 18 minutes; the remainder of the distance to Acryse, about 50 miles, being accomplished in from 55 to 60 minutes, or at the rate of fully 50 miles an hour.

As the height reached on this occasion was considerably greater than in the previous ascents, the effect of the diminished pressure was more severely felt; both Mr. GREEN and myself having experienced considerable difficulty in respiration, with much breathlessness and fatigue after any muscular exertion.

§ 4. *Description of the Table of Observations.*

All the meteorological observations taken during the ascents are contained in Table I.

Column 1 contains the times at which the observations were made. Column 2 contains the readings of the thermometer attached to the barometer. Column 3 contains the observations of the barometer corrected for temperature, by SCHUMACHER'S tables, and for scale error. The numbers, to which the mark † is affixed, in the observations of August 17 and 26, are the occasional readings by myself of the second barometer. The readings of the barometer were made by estimation to 0·01 inch; but the probable error of an observation, from various causes,—such as rapid change in the height, and the occasional oscillation of the mercury from agitation of the car,—is perhaps 0·03 inch, or even sometimes more. This degree of accuracy appears, however, to be quite sufficient with reference to the changes of the temperature and humidity; an error of 30 or 40 feet in the resulting height being equivalent in general to a change of only one-tenth of a degree of temperature.

Column 4 contains the height above the level of the sea, as deduced from the barometric readings by the formula of LAPLACE. The formula actually employed was

$$z=\log\left(\frac{h}{h'}\right)\times 18336\left(1+\frac{2(t+t')}{1000}\right)\left(1+0{\cdot}002837\cos 2\mathrm{L}\right)\left(1+\frac{z+15926}{6366200}\right)^{*};$$

or expressed in English feet and FAHRENHEIT'S degrees,

$$z=\log\left(\frac{h}{h'}\right)\times 60159\left(1+\frac{t+t'-64}{900}\right)\left(1+0{\cdot}002837\cos 2\mathrm{L}\right)\left(1+\frac{z+52251}{20886900}\right),$$

where z is the height required; h and h', t and t' the height of the barometer cor-

* Annuaire Météorologique de la France, 1849, page 54.

rected for temperature, and the temperature of the air, at the lower and upper stations respectively; L, the latitude. The temperature of the air for the position of the balloon has been derived from the readings of the aspirated dry thermometer (column 5), except on August 17, when the free thermometer only was observed. The temperature and barometric height at the earth's surface have been taken by interpolation from the comparative observations at different stations; the mean height above the sea, of the stations referred to, having been included. The numbers, it will be seen, have been given only to the nearest 10 feet.

Many observers in different parts of the country made corresponding meteorological observations, generally at hourly intervals, on the days of the several ascents. These have been arranged in compact tabular order by Colonel SYKES, Chairman of the Kew Committee, and are appended to this report. The stations selected for comparison with the different days' observations have been those which lay nearest to the course of the balloon. The temperature of the air at the surface of the earth, has been derived from the mean of the observations at all the selected stations, both as regards its *absolute value* and *hourly change*. The *hourly change* of the barometer has been taken from the observations at all the selected stations; but its *absolute height* has always been derived from the mean of the observations at the Royal Observatory, Greenwich, and at the residence of JAMES GLAISHER, Esq., Lewisham. The error likely to result from adopting the height at these two stations as the standard of reference will be in any case very small, and can only affect the *absolute* and not the *relative* heights of the balloon by a few feet; while any uncertainty with regard to the index errors of other barometers is obviated. The quantity +0·028 has been added to the readings of the terrestrial barometers, on account of the index errors of the balloon barometers.

The following are the stations whose observations have been employed, and the resulting mean values for each day of ascent.

August 17, 5 stations, viz.—Greenwich; Lewisham; Enfield; St. John's Wood; Cambridge.

Mean temperature of the air at 4^h P.M. $=71°·2$; hourly change $=-1°·1$.

Mean height of the barometer at 4^h P.M. $=29·740$ in.; hourly change $=-0·036$ in.

August 26, 5 stations, viz.:—Greenwich; Lewisham; St. John's Wood; Kew Observatory; Stone Rectory, Bucks.

Time.	Temperature of the Air. Mean.	Temperature of the Air. Hourly Change.	Barometer. Mean Height.	Barometer. Hourly Change.
h	°	°	in.	in.
4 P.M.	69·7		29·949	
		−2·2		+0·010
5	67·5		·959	
		−2·3		+0·005
6	65·2		·964	
		−2·5		+0·021
7	62·7		·985	

October 21, 2 stations, viz.—Greenwich and Lewisham.

Time.	Temperature of the Air.		Barometer.	
	Mean.	Half-hourly Change.	Mean Height.	Half-hourly Change.
h m	°	°	in.	in.
2 30 P.M.	58·7		29·900	
		0·0		−0·001
3 0	58·7		·899	
		−1·0		− ·004
3 30	57·7		·895	
		−0·8		− ·007
4 0	56·9		·888	
		−0·8		·000
4 30	56·1		·888	

November 10, 2 stations,—Greenwich and Lewisham.

Time.	Temperature of the Air.			Barometer.	
	Greenwich.	Lewisham.	Mean.	Mean Height.	Half-hourly Change.
h m	°	°	°	in.	in.
2 30 P.M.	48·6	50·7	49·7	29·978	
					−0·003
3 0	48·0	49·3	48·7	·975	
					− ·004
3 30	49·0	49·6	49·3	·971	
	Mean		49·2		

As the progress of the temperature at these two stations has been very irregular and indefinite, a mean result has been adopted, and no allowance made for hourly change.

The height, above the mean sea level, of Greenwich =159 feet.

The height, above the mean sea level, of Lewisham = 80 feet.

Mean of both stations . . . . . . =120 feet.

Columns 5–10 contain the results of observations with the aspirated dry and wet thermometers; the tension of vapour, relative humidity (100 being complete saturation), and the calculated temperature of the dew-point having been deduced by Dr. Apjohn's formula and Dalton's Tables of the elasticity of vapour. Column 11 contains the readings of the dry thermometer, corrected for hourly change by means of the numbers deduced above from observations at different stations. The numbers in this column have been employed in the subsequent discussions and in the projected results.

Columns 12–17 contain the observations of the free dry and wet thermometers similarly reduced. Columns 18 and 19 contain the results of the direct dew-point observations with Regnault's Hygrometer, and the corresponding tension of vapour derived from Dalton's Table. When numbers are entered in column 18 with the sign — after them, it is meant that the temperature in the hygrometer had been lowered to the degree stated, but that no dew was deposited.

All the readings of both pairs of dry and wet thermometers have been corrected for index error; the corrections to the dew-point thermometer were very small, and have been neglected.

TABLE I.—Meteorological Observations made in the Four Balloon Ascents of August 17, August 26, October 21, and November 10, 1852.

enwich n Time.	Barometer.		Height above sea-level.	Dry and Wet Thermometers, *aspirated.*						Temperature corrected for change.	Dry and Wet Thermometers, *free.*						REGNAULT'S Hygrometer.	
	Therm.	Reading corrected.		Dry.	Wet.	Diff.	Tension of vapour.	Relative humidity.	Dew-point.		Dry.	Wet.	Diff.	Tension of vapour.	Relative humidity.	Dew-point.	Dew-point.	Tension of vapour.
h m s	°	in.	feet.	°	°	°	in.		°	°	°	°	°	in.		°	°	in.
3 52 0	......	27·40	2,440	......	......	......	......	......	......	62·8	63·0	60·4	2·6	·503	87	58·8		
54 0	......	26·40	3,470	......	......	......	......	......	......	59·2	59·4	57·1	2·3	·451	88	55·6		
54 0	70	26·42†	3,450															
55 0	......	25·80	4,110	......	......	......	......	......	......	58·1	58·2	55·3	2·9	·418	85	53·3		
59 0	......	24·22	5,880	......	......	......	......	......	......	57·8	57·8	43·4	14·4	·164	34	26·6		
59 18	66·5	24·10†	6,020															
59 30	......	23·62	6,580															
4 0 30	......	......	......	......	......	......	......	......	......	54·1	54·1	40·5	13·6	·147	34	23·5		
1 0	......	23·42	6,800	......	......	......	......	......	......	54·1	54·1	40·8	13·3	·153	36	24·7		
1 30	......	23·33	6,910	......	......	......	......	......	......	53·7	53·7	40·1	13·6	·144	34	23·0		
2 0	......	23·13	7,140	......	......	......	......	......	......	53·1	53·1	39·8	13·3	·145	35	23·2		
2 0	63·0	22·96†	7,350															
2 30	......	22·93	7,380	......	......	......	......	......	......	52·3	52·3	39·3	13·0	·144	36	23·0		
3 0	......	22·78	7,550	......	......	......	......	......	......	51·4	51·3	38·4	12·9	·138	35	21·8		
3 30	......	22·83	7,480	......	......	......	......	......	......	50·5	50·4	37·7	12·7	·133	35	20·8		
4 0	......	22·43	7,970	......	......	......	......	......	......	49·8	49·7	37·4	12·3	·136	37	21·4		
4 30	......	22·33	8,100	......	......	......	......	......	......	49·8	49·7	38·3	11·4	·152	41	24·5		
5 0	......	22·14	8,340	......	......	......	......	......	......	50·5	50·4	39·2	11·2	·162	43	26·2		
5 0	61·0	22·13†	8,350															
5 30	......	22·04	8,460	......	......	......	......	......	......	50·2	50·1	39·6	10·5	·172	46	27·9		
6 0	......	21·94	8,590	......	......	......	......	......	......	49·8	49·7	39·1	10·6	·167	45	27·1		
6 30	......	21·84	8,710	......	......	......	......	......	......	49·3	49·2	38·3	10·9	·158	44	25·5		
7 0	......	21·84	8,700	......	......	......	......	......	......	48·0	47·9	37·3	10·6	·152	44	24·5		
7 30	......	21·84	8,690	......	......	......	......	......	......	47·3	47·2	39·4	7·8	·194	57	31·3		
8 0	......	21·74	8,810	......	......	......	......	......	......	47·5	47·3	40·5	6·8	·212	63	33·8		
9 30	......	21·49	9,130	......	......	......	......	......	......	47·0	46·8	37·1	9·7	·159	48	25·7		
10 0	......	21·49	9,120	......	......	......	......	......	......	45·9	45·7	36·7	9·0	·161	50	26·1		
10 30	......	21·34	9,310	......	......	......	......	......	......	44·9	44·7	34·5	10·2	·135	43	21·2		
11 0	......	21·24	9,430	......	......	......	......	......	......	44·0	43·8	33·2	10·6	·122	40	18·4		
11 30	......	21·13	9,560	......	......	......	......	......	......	43·3	43·1	32·5	10·6	·117	40	17·3		
12 0	......	21·00	9,730	......	......	......	......	......	......	42·8	42·6	32·3	10·3	·119	41	17·8		
12 35	57·0	20·78†	10,020	......	......	......	......	......	......	43·1	42·8	32·5	10·3	·121	42	18·2		
13 0	......	20·65	10,180	......	......	......	......	......	......	41·8	41·5	31·7	9·8	·127	46	19·5		
13 0	......	20·62†	10,220															
13 30	......	20·45	10,440															
14 0	......	20·25	10,700	......	......	......	......	......	......	40·4	40·1	31·2	8·9	·132	50	20·6		
14 0	54·0	20·27†	10,680															
14 30	......	20·10	10,900	......	......	......	......	......	......	40·0	39·7	30·3	9·4	·122	47	18·4		
15 0	......	20·06	10,950	......	......	......	......	......	......	39·4	39·1	31·9	7·2	·149	58	23·9		
15 15	......	19·76†	11,360															
15 30	......	19·80	11,290	......	......	......	......	......	......	38·1	37·8	32·0	5·8	·160	65	25·9		
16 0	......	19·52	11,680	......	......	......	......	......	......	37·3	37·0	31·7	5·3	·162	68	26·2		
16 15	......	19·57†	11,600															
16 30	......	19·51	11,690	......	......	......	......	......	......	37·0	36·7	31·5	5·2	·161	68	26·1		
17 0	......	19·40	11,840	......	......	......	......	......	......	36·5	36·2	31·2	5·0	·160	69	25·9		
17 30	......	19·35	11,900															
18 0	......	19·25	12,040	......	......	......	......	......	......	36·1	35·7	30·8	4·9	·158	69	25·5		
18 30	......	19·15	12,180	......	......	......	......	......	......	35·7	35·3	30·8	4·5	·161	70	26·1		
19 0	......	19·14	12,200															
19 30	......	19·15	12,190	......	......	......	......	......	......	36·5	36·1	32·9	3·2	·182	79	29·5		
20 0	......	19·16	12,150	......	......	......	......	......	......	34·8	34·4	31·4	3·0	·175	81	28·4		
20 20	48·0	19·15†	12,160															
20 30	......	19·16	12,140	......	......	......	......	......	......	34·1	33·7	29·9	3·8	·160	76	25·9		
21 0	......	19·15	12,160	......	......	......	......	......	......	34·5	34·1	30·1	4·0	·160	75	25·9		
21 30	......	19·06	12,280	......	......	......	......	......	......	33·7	33·3	31·5	1·8	·184	88	29·8		
22 0	......	18·91	12,500															
22 20	47·0	18·87†	12,550															
22 30	......	18·66	12,860	......	......	......	......	......	......	33·9	33·4	31·4	2·0	·182	87	29·5		

Table I. (Continued.)

Date	Greenwich Mean Time.	Barometer. Therm.	Barometer. Reading corrected.	Height above sea-level.	Dry and Wet Thermometers, *aspirated*. Dry.	Wet.	Diff.	Tension of vapour.	Relative humidity.	Dew-point.	Temperature corrected for change.	Dry and Wet Thermometers, *free*. Dry.	Wet.	Diff.	Tension of vapour.	Relative humidity.	Dew-point.	Regn. Hygro... Dew-point.
	h m s	°	in.	feet.	°	°	°	in.		°	°	°	°	°	in.		°	°
August 17, 1852.	4 23 0	......	18·56	13,000	....	....	......	......	......	....	33·7	33·2	31·3	1·9	·182	88	29·5	
	24 0	......	18·21	13,470	....	....	......	......	......	....	30·3	29·8	28·4	1·4	·166	90	26·9	
	24 15	44·0	18·13†	13,590														
	24 30	......	18·11	13,610														
	25 0	......	17·87	13,960	....	....	......	......	......	....	28·4	27·9	26·6	1·3	·156	89	25·2	
	25 30	......	17·77	14,100	....	....	......	......	......	....	27·5	27·0	25·9	1·1	·153	92	24·7	
	25 30	......	17·82†	14,020														
	26 0	......	17·47	14,550	....	....	......	......	......	....	27·0	26·5	25·0	1·5	·146	89	23·4	
	26 20	......	17·39†	14,680														
	26 30	......	17·37	14,710	....	....	......	......	......	....	27·1	26·6	24·6	2·0	·141	86	22·4	
	27 0	......	17·27	14,850	....	....	......	......	......	....	26·3	25·8	24·2	1·6	·141	88	22·4	
	27 15	39·0	17·08†	15,150														
	27 30	......	17·06	15,170	....	....	......	......	......	....	25·5	24·9	23·4	1·5	·137	89	21·6	
	27 45	38·0	16·97†	15,310														
	28 0	......	16·97	15,310	....	....	......	......	......	....	24·9	24·3	23·0	1·3	·136	90	21·4	
	28 20	......	16·98†	15,290														
	28 30	......	16·96	15,330	....	....	......	......	......	....	25·3	24·7	23·0	1·7	·134	87	21·0	
	29 0	......	16·86	15,480	....	....	......	......	......	....	24·9	24·3	22·6	1·7	·132	87	20·6	
	29 30	......	16·67	15,780	....	....	......	......	......	....	24·6	24·0	(27·)					
	30 0	......	16·67	15,780														
	31 0	37·0	16·52†	15,970	....	....	......	......	......	....	21·5	20·9						
	31 30	......	16·37†	16,200	....	....	......	......	......	....	20·4	19·8	18·4	1·4	·114	89	16·6	
	32 0	35·0	16·32†	16,280	....	....	......	......	......	....	20·0	19·4	18·0	1·4	·112	88	16·1	
	33 0	......	16·26	16,380	....	....	......	......	......	....	20·5	19·8	18·3	1·5	·113	88	16·4	
	33 30	......	16·16	16,550	....	....	......	......	......	....	20·5	19·8	17·7	2·1	·107	84	14·9	
	34 0	......	16·16	16,560	....	....	......	......	......	....	21·6	20·9	18·8	2·1	·112	84	16·1	
	34 15	......	16·06†	16,730														
	34 30	......	16·11	16,650	....	....	......	......	......	....	21·7	21·0	16·1	4·9	·085	63	8·7	
	35 0	......	16·06	16,730														
	35 30	......	16·06	16,720	....	....	......	......	......	....	21·0	20·3						
	36 0	32·0	15·96	16,880	....	....	......	......	......	....	20·4	19·7						
	36 30	......	15·96	16,870	....	....	......	......	......	....	20·0	19·3						
	37 0	......	15·96	16,870	....	....	......	......	......	....	19·6	18·9						
	37 0	......	15·92†	16,930														
	37 30	......	15·87	17,020	....	....	......	......	......	....	20·0	19·3						
	38 0	......	15·86	17,050	....	....	......	......	......	....	20·4	19·7	17·7	2·0	·108	84	15·1	
	38 0	......	15·80†	17,150														
	38 30	......	15·67	17,370	....	....	......	......	......	....	20·5	19·8	17·0	2·8	·101	79	13·3	
	39 0	......	15·57	17,530	....	....	......	......	......	....	19·5	18·8	16·0	2·8	·096	78	12·0	
	39 30	......	15·47	17,680	....	....	......	......	......	....	18·8	18·1	14·1	4·0	·083	69	8·1	
	40 0	30·0	15·37	17,860	....	....	......	......	......	....	18·6	17·9	14·4	3·5	·087	73	9·3	
	40 0	... ..	15·32†	17,950														
	40 30	......	15·17	18,200	....	....	......	......	......	....	17·9	17·2						
	41 0	......	15·17	18,170	....	....	......	......	......	....	16·4	15·7	9·4	6·3	·054	49	−3·2	
	41 30	... ..	15·07	18,310	....	....	......	......	......	....	14·5	13·8	7·7	6·1	·050	49	−5·2	
	42 0	......	14·86	18,670	....	....	......	......	......	....	14·0	13·3	7·2	6·1	·049	49	−5·8	
	42 15	......	14·67†	19,010														
	42 30	......	14·81	18,750	....	....	......	......	......	....	13·6	12·8	7·3	5·5	·053	53	−3·7	
	43 0	......	14·76	18,840	....	....	......	......	......	....	13·5	12·7	8·1	4·6	·060	61	−0·5	
	43 15	28·0	14·62†	19,090														
	43 30	......	14·66	19,020	....	....	......	......	......	....	13·2	12·4	7·5	4·9	·057	58	−1·8	
	43 45	......	14·54†	19,220														
	44 0	......	14·56	19,189	....	....	......	......	......	....	12·1	11·3	7·2	4·1	·060	64	−0·5	
	44 30	......	14·46	19,340	....	....	......	......	......	....	11·2	10·4	6·7	3·7	·061	67	−0·1	
	45 0	......	14·46	19,310	....	....	......	......	......	....	9·8	9·0	6·4	2·6	·065	76	+1·6	
	45 0	......	14·36†	19,500														
	45 30	......	14·41	19,420	....	....	......	......	......	....	10·5	9·7	7·7	2·0	·072	82	4·3	
	46 0	......	14·35	19,510	....	....	......	......	......	....	9·5	8·7	6·6	2·1	·068	80	2·8	
	46 30	......	14·41†	19,380	....	....	......	......	......	....	8·7	7·9	6·3	1·6	·070	85	3·6	

TABLE I. (Continued.)

Greenwich Mean Time.	Barometer. Therm.	Barometer. Reading corrected.	Height above sea-level.	Dry and Wet Thermometers, *aspirated*. Dry.	Wet.	Diff.	Tension of vapour.	Relative humidity.	Dew-point.	Temperature corrected for change.	Dry and Wet Thermometers, *free*. Dry.	Wet.	Diff.	Tension of vapour.	Relative humidity.	Dew-point.	REGNAULT'S Hygrometer. Dew-point.	Tension of vapour.
h m s	°	in.	feet.	°	°	°	in.		°	°	°	°	°	in.		°	°	in.
4 47 0	......			......	......	......	......	......	......	8·9	8·1							
47 30	......	14·46	19,300															
49 0	......	14·86	18,630	......	......	......	......	......	......	12·3	11·4							
50 0	......	15·17	18,090	......	......	......	......	......	......	13·3	12·4							
50 30	......	15·27	17,920	......	......	......	......	......	......	13·3	12·4							
51 0	......	15·48	17,580	......	......	......	......	......	......	14·6	13·7							
51 30	24·0	15·58	17,420	......	......	......	......	......	......	15·4	14·5							
51 30	......	15·63†	17,330															
52 0	......	15·88	16,920	......	......	......	......	......	......	15·9	15·0							
52 15	24·0	15·83†	17,010															
52 30	......	16·08	16,590															
53 0	......	16·39	16,090	......	......	......	......	......	......	17·2	16·2	15·2	1·0	·103	92	13·9		
54 0	......	16·59	15,790	......	......	......	......	......	......	19·0	18·0	16·2	1·8	·102	85	13·6		
54 30	......	16·89	15.320	......	......	......	......	......	......	19·5	18·5							
55 0	......	17·10	15,000	......	......	......	......	......	......	20·5	19·5	18·8	0·7	·120	94	18·0		
56 45	......	17·77†	14,020															
57 0	......			......	......	......	......	......	......	25·0	24·0							
57 40	......	18·11†	13,530	......	......	......	......	......	......	26·0	25·0							
58 0	24·0	18·36†	13,170	......	......	......	......	......	......	27·3	26·2							
58 30	......	18·71†	12,680	......	......	......	......	......	......	28·4	27·3							
5 0 30	......	19·57†	11,500	......	......	......	......	......	......	32·0	30·9	29·8	1·1	·177	92	28·7		
1 30	......	20·28†	10,570	......	......	......	......	......	......	36·5	35·4	29·8	5·6	·145	64	23·2		
3 0	......	20·88†	9,790	......	......	......	......	......	......	38·0	36·9	29·8	7·1	·133	56	20·8		
5 0	......	22·31	8,020	......	......	......	......	......	......	43·0	41·8	30·8	11·0	·106	38	14·6		
5 30	......	22·51	7,780	......	......	......	......	......	......	45·4	44·2	31·5	12·7	·096	31	12·0		
6 0	......	22·91	7,310	......	......	......	......	......	......	48·0	46·8							
4 46 0	......	......	......	65·9	61·5	4·4	·500	79	58·7	65·9	66·0	61·7	4·3	·505	79	59·0		
47 0	......	29·34	710	64·5	60·9	3·6	·498	82	58·5	64·5	65·3	61·3	4·0	·501	80	58·7		
47 30	71·0	29·18†	860															
48 0	......	29·19	850	63·8	59·9	3·9	·478	80	57·3	63·9	64·8	60·7	4·1	·490	80	58·1		
49 0	......	28·89	1,140	63·2	59·5	3·7	·473	81	57·0	63·3	63·8	59·7	4·1	·472	79	56·9		
50 0	......	28·40	1,620	61·1	57·8	3·3	·450	83	55·5	61·2	62·5	58·1	4·4	·443	78	55·1		
51 0	......	28·10	1,920															
51 40	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	50·0	·373
52 0	......	27·85	2,160	......	......	......	......	......	......	......	60·9	57·3	3·6	·440	82	54·9		
52 30	......	......	......	59·9	56·2	3·7	·421	80	53·5	60·1								
53 0	......	27·70	2,310	58·9	55·8	3·1	·421	83	53·5	59·1	60·9	56·9	4·0	·429	79	54·1		
53 30	......	......	......	58·9	55·5	3·4	·414	82	53·0	59·2								
54 0	......	27·40	2,620	58·3	55·3	3·0	·415	84	53·1	58·6	60·3	55·7	4·6	·405	77	52·4		
54 30	......	......	......	58·0	54·8	3·2	·406	83	52·5	58·3	59·6	55·6	4·0	·410	80	52·8		
55 0	......	27·11	2,910															
55 30	......	......	......	56·3	54·6	1·7	·419	91	53·4	56·7								
56 0	......	26·90	3,120	55·8	53·2	2·6	·389	86	51·2	56·2	57·7	53·7	4·0	·382	79	50·7		
57 0	......	26·41	3,630	54·8	52·0	2·8	·371	84	49·8	55·2	56·8	52·9	3·9	·372	79	49·9		
57 30	......	......	......	54·4	51·6	2·8	·366	84	49·4	54·8								
58 0	......	26·16	3,900															
58 0	65·3	26·17†	3,890															
58 30	......	......	......	52·5	50·0	2·5	·348	86	48·0	52·9	54·9	50·7	4·2	·341	77	47·4		
59 0	......	25·77	4,300	51·5	48·7	2·8	·329	84	46·3	52·0	54·1	49·6	4·5	·324	76	45·9	44·3	·307
59 30	......	......	......	51·0	47·9	3·1	·317	82	45·2	51·5								
5 0 0	......	25·32	4,780	49·8	46·9	2·9	·307	83	44·3	50·3	52·4	48·6	3·8	·319	79	45·4	40·5	·269
1 0	......	24·92	5,230	49·8	46·6	3·2	·302	82	43·8	50·3	50·5	46·8	3·7	·299	79	43·6		
2 0	......	24·47	5,710	46·7	45·4	1·3	·307	92	44·3	47·3								
2 30	......	......	......	45·7	44·3	1·4	·294	91	43·1	46·3	......	......	......	......	......	......	41·?	·274
3 0	......	24·12	6,100	44·7	43·0	1·7	·278	89	41·5	45·3	47·1	44·2	2·9	·279	83	41·6		
3 30	......	......	......	43·8	42·4	1·4	·274	91	41·0	44·4	46·1	43·3	2·8	·271	83	40·7	39·0	·255
4 0	......	23·68	6,590	42·7	41·1	1·6	·260	89	39·5	43·3	44·9	42·7	2·2	·270	86	40·6		
4 40	......	......	......	41·8	40·0	1·8	·248	88	38·2	42·5	......	......	......	......	......	......	35·5	·226

TABLE I. (Continued.)

Greenwich Mean Time.	Barometer. Therm.	Barometer. Reading corrected.	Height above sea-level.	Dry and Wet Thermometers, *aspirated.* Dry.	Wet.	Diff.	Tension of vapour.	Relative humidity.	Dew-point.	Temperature corrected for change.	Dry and Wet Thermometers, *free.* Dry.	Wet.	Diff.	Tension of vapour.	Relative humidity.	Dew-point.	REGNAULT'S Hygrometer. Dew-point.	(cut off)
August 26, 1852. h m s	°	in.	feet.	°	°	°	in.		°	°	°	°	°	in.		°	°	in.
5 5 0	......	23·13	7,230	41·0	39·8	1·2	·252	92	38·7	41·7	43·6	40·9	2·7	·249	83	38·3		
6 0	......	22·78	7,650															
6 30	......	....	....	40·8	35·7	5·1	·183	67	29·6	41·5								
7 0	......	22·33	8,200															
8 0	......	22·08	8,510	42·3	31·0	11·3	·107	37	14·9	43·1								
8 30	......	....	....	42·4	30·0	12·4	·092	32	10·8	43·2	......	......	......	......	......	......	14·—	
9 0	......	21·74	8,940	41·7	29·0	12·7	·073	26	4·7	42·5	42·7	32·0	10·7	·110	38	15·7		
9 30	......	....	....	41·1	28·5	12·6	·082	30	7·8	42·0	......	......	......	......	......	......	10·—	
10 0	......	21·54	9,190	41·3	29·0	12·3	·088	32	9·6	42·2	41·7	31·7	10·0	·123	44	18·7	7·—	
10 30	......	....	....	41·7	30·0	11·7	·099	35	12·8	42·6	......	......	......	......	......	......	6·0	77
11 0	......	21·44	9,320	....	....	......	......	......	....	....	43·6	34·9	8·7	·150	50	24·1		
11 30	......	....	....	42·5	32·0	10·5	·113	39	16·4	43·4	43·6	33·0	10·6	·120	40	18·0		
12 0	......	21·32	9,480															
12 30	......	....	....	41·8	29·5	12·3	·092	33	10·8	42·8	44·0	32·0	12·0	·102	34	13·6		
13 0	......	21·24	9,580	42·3	29·5	12·8	·088	31	9·6	43·3								
13 30	58·4	....	....	40·9	27·2	13·7	·068	25	2·8	41·9								
14 0	......	21·14	9,690	39·8	26·6	13·2	·069	26	3·2	40·8	42·7	30·1	12·6	·095	33	11·7		
15 0	......	21·04	9,820	39·9	27·1	12·8	·075	28	5·4	41·0	43·6	31·2	12·4	·104	35	14·1		
16 0	......	20·94	9,970	42·0	30·6	11·4	·107	38	14·9	43·1	44·5	33·4	11·1	·120	39	18·0		
16 30	......	....	....	42·4	31·2	11·2	·113	39	16·4	43·5								
17 0	......	20·75	10,200	39·8	28·5	11·3	·095	36	11·7	40·9	42·3	31·6	10·7	·120	42	18·0		
17 0	......	20·74†	10.210															
18 0	......	20·70	10,260	40·0	29·7	10·3	·108	41	15·1	41·2	42·3	32·0	10·3	·118	41	17·5		
18 30	......	....	....	41·8	31·0	10·8	·113	40	16·4	43·0								
19 0	......	20·70	10,290	42·7	32·0	10·7	·114	39	16·6	43·9	43·4	34·6	8·8	·149	50	23·9		
20 0	......	20·85	10,100	43·8	32·6	11·2	·114	38	16·6	45·1								
21 0	......	20·75	10,200	40·5	28·8	11·7	·094	35	11·4	41·8								
22 0	58·0	20·65	10,340	40·8	29·5	11·3	·102	38	13·6	42·1	......	......	......	......	......	......	12·—	
22 0	......	20·59†	10,420	....	....	......	......	......	....	....	......	......	......	......	......	......	10·8	92
22 30	......	....	....	40·8	29·4	11·4	·101	37	13·4	42·1								
23 0	......	20·43	10,620	40·2	28·4	11·8	·092	35	10·8	41·6	42·8	32·4	10·4	·121	41	18·2		
23 30	......	....	....	39·5	28·1	11·4	·094	36	11·4	40·9								
24 0	......	20·25	10,840	37·6	27·3	10·3	·099	41	12·8	39·0	......	......	......	......	......	......	6·0	77
24 30	......	....	....	37·2	27·1	10·1	·097	40	12·2	38·6	......	......	......	......	......	......	6·0	77
24 40	......	....	....	....	....	......	......	......	....	....	38·9	29·4	9·5	·116	46	17·1		
25 0	......	20·10	11,050	38·5	28·1	10·4	·102	41	13·6	40·0	39·4	30·5	8·9	·127	49	19·5		
26 0	......	20·15	10,980	38·4	28·1	10·3	·102	41	13·6	39·9	39·0	30·2	8·8	·126	49	19·3		
26 30	......	....	....	38·8	29·1	9·7	·113	45	16·4	40·3								
27 0	......	20·20	10,920	39·4	29·1	10·3	·109	42	15·4	40·9								
27 30	......	....	....	39·1	28·5	10·6	·102	40	13·6	40·6	39·4	30·9	8·5	·133	52	20·8		
28 0	......	20·28	10,810	38·0	26·6	11·4	·085	34	8·7	39·6								
28 30	......	....	....	36·8	26·6	10·2	·093	39	11·1	38·4								
29 0	......	20·14	10,970	35·4	25·9	9·5	·094	42	11·4	37·0	......	......	......	......	......	......	10·—	
29 30	......	....	....	34·0	25·1	8·9	·094	44	11·4	35·6	36·2	27·1	9·1	·104	45	14·1		
30 0	......	19·95	11,210	33·9	25·0	8·9	·094	44	11·4	35·5	......	......	......	......	......	......	8·0	83
30 30	......	....	....	36·0	26·9	9·1	·104	45	14·1	37·7								
31 0	......	19·80	11,440	35·9	27·0	8·9	·106	46	14·6	37·6	35·6	28·1	7·5	·122	54	18·4		
31 30	......	....	....	35·4	26·4	9·0	·102	45	13·6	37·1	36·7	29·4	7·3	·132	56	20·6		
32 0	......	19·73	11,540	36·8	27·2	9·6	·103	44	13·9	38·5								
32 30	......	....	....	37·5	27·6	9·9	·103	43	13·9	39·2	39·5	32·0	7·5	·142	55	22·6		
33 0	......	19·65	11,650	37·2	26·8	10·4	·095	40	11·7	39·0								
34 0	......	19·59	11,740	37·3	27·2	10·1	·100	42	13·1	39·1	40·0	31·6	8·4	·140	53	22·2		
35 0	......	19·59	11,740	38·0	27·7	10·3	·102	41	13·6	39·8								
35 30	......	....	....	38·8	28·1	10·7	·101	40	13·3	40·6	38·0	30·0	8·0	·131	53	20·4	12·0	96
36 0	......	19·60	11,730															
36 50	......	....	....	36·8	27·2	9·6	·103	44	13·9	38·7								
37 0	......	19·64	11,650	....	....	......	......	......	....	....	40·7	33·3	7·4	·153	56	24·7		
37 30	......	....	....	35·7	25·8	9·9	·093	41	11·1	37·6								
38 0	......	19·60	11,690	35·0	25·1	9·9	·089	40	9·9	36·9								

TABLE I. (Continued.)

Greenwich Mean Time.	Barometer.		Height above sea-level.	Dry and Wet Thermometers, *aspirated.*						Temperature corrected for change.	Dry and Wet Thermometers, *free.*						REGNAULT'S Hygrometer.	
	Therm.	Reading corrected.		Dry.	Wet.	Diff.	Tension of vapour.	Relative humidity.	Dew-point.		Dry.	Wet.	Diff.	Tension of vapour.	Relative humidity.	Dew-point.	Dew-point.	Tension of vapour.
h m s	°	in.	feet	°	°	°	in.		°	°	°	°	°	in.		°	°	in.
5 38 30	......	....	....	33·6	23·8	9·8	·082	39	7·7	35·6								
39 0	......	19·55	11,730	32·5	22·8	9·7	·077	38	6·1	34·5								
39 30	......	....	....	32·9	22·8	10·1	·075	36	5·4	34·9								
40 0	54·7	19·52	11,790	34·0	23·3	10·7	·074	35	5·0	36·0	......	......	......	......	......	......	6·0	·077
40 30	......	19·50†	11,840	35·8	25·6	10·2	·090	40	10·2	37·8								
41 0	......	19·50	11,830	34·7	23·6	11·1	·073	33	4·7	36·8								
41 30	......	....	....	33·9	23·2	10·7	·074	35	5·0	36·0								
42 0	......	19·32	12,050	32·5	22·3	10·2	·073	36	4·7	34·6	37·5	28·9	8·6	·121	50	18·2		
42 30	51·5	19·27†	12,150	34·9	24·7	10·2	·085	38	8·7	37·0								
43 0	......	19·20	12,220	32·7	22·3	10·4	·072	35	4·3	34·8	36·8	28·1	8·7	·116	49	17·1		
43 30	......	....	....	31·9	21·9	10·0	·073	37	4·7	34·1	......	......	......	......	......	......	0·—	
44 0	52·5	19·15	12,280	31·9	22·1	9·8	·075	38	5·4	34·1	......	......	......	......	......	......	−3·—	
44 30	......	....	....	31·2	21·2	10·0	·069	36	3·2	33·4	33·3	......	......	......	......	......	−5·0	·050
45 0	52·5	19·10	12,330															
46 0	52·5	19·07	12,360	29·0	21·3	7·7	·085	47	8·7	31·3								
46 30	......	....	....	29·2	21·1	8·1	·081	45	7·4	31·5								
47 0	......	19·05	12,390	29·0	21·1	7·9	·083	46	8·1	31·3								
47 30	......	....	....	30·9	23·2	7·7	·091	47	10·5	33·2	......	......	......	......	......	......	+4·0	·071
48 0	53·6	19·05	12,420	31·5	23·4	8·1	·093	47	11·1	33·8								
48 30	......	....	....	32·5	24·2	8·3	·096	47	12·0	34·8								
49 0	......	19·04	12,470	34·7	26·2	8·5	·106	48	14·6	37·1								
49 30	......	....	....	34·1	26·1	8·0	·109	51	15·4	36·5								
50 0	......	19·00	12,480	30·6	23·9	6·7	·105	55	14·4	33·0								
50 30	......	....	....	30·9	24·7	6·2	·113	59	16·4	33·3	......	......	......	......	......	......	0·0	·061
51 0	54·5	18·90	12,610	29·9	....	......	......	......	....	32·3	32·7	25·2	7·5	·107	53	14·9		
51 30	......	....	....	29·6	21·9	7·7	·088	48	9·6	32·1								
52 0	......	18·80	12,740	28·9	21·3	7·6	·086	48	9·0	31·4								
52 30	......	....	....	27·6	20·5	7·1	·086	50	9·0	30·1								
53 0	54·6	18·71	12,840	27·0	20·3	6·7	·087	52	9·3	29·5								
53 30	......	....	....	27·2	20·4	6·8	·087	52	9·3	29·7	......	......	......	......	......	......	−4·0	·052
54 0	54·8	18·70	12,890	29·5	22·5	7·0	·096	53	12·0	32·1								
55 0	......	....	....	28·7	21·8	6·9	·093	52	11·1	31·3								
56 0	......	18·68	12,930	30·0	23·2	6·8	·101	54	13·3	32·6								
56 30	......	18·87†	12,690															
57 0	55·4	18·78	12,860	35·4	27·1	8·3	·114	51	16·6	38·1								
57 30	......	....	....	35·1	27·1	8·0	·115	52	16·8	37·8								
58 0	56·5	18·94	12,610	34·2	25·9	8·3	·106	49	14·6	36·9								
58 30	......	....	....	34·9	26·4	8·5	·107	49	14·9	37·6								
59 0	......	19·20	12,260	35·8	27·3	8·5	·113	50	16·4	38·6								
59 30	......	....	....	36·4	26·0	10·4	·091	39	10·5	39·2								
6 0 0	......	19·48	11,860	....	....	......	......	......	....	....	35·7	25·2	10·5	·086	38	9·0		
1 0	57·0	19·59	11,700	35·0	24·7	10·3	·084	38	8·4	37·8								
2 0	58·2	19·59	11,690	34·6	24·9	9·7	·089	41	9·9	37·5								
2 30	......	....	....	32·5	24·2	8·3	·095	47	11·7	35·4								
3 0	......	19·45	11,870	33·1	25·2	7·9	·103	50	13·9	36·0								
4 0	51·0	19·25	12,140	32·7	25·2	7·5	·106	50	14·6	35·7								
4 0	......	19·23†	12,170															
5 0	......	19·17†	12,220	29·5	23·2	6·3	·103	57	13·9	32·5								
6 0	......	19·17†	12,210	29·0	22·8	6·2	·102	57	13·6	32·0								
7 30	......	19·28†	12,110	33·5	26·8	6·7	·122	58	18·5	36·6								
9 0	......	....	....	33·9	27·0	6·9	·121	57	18·2	37·0	35·8	24·7	11·1	·079	35	6·8		
11 0	......	....	....	....	....	......	......	......	....	....	36·3	25·7	10·6	·088	38	9·6		
12 0	......	19·60	11,650															
13 0	49·1	19·40	11,920	32·1	23·7	8·4	·091	45	10·5	35·4								
13 30	......	....	....	33·6	25·0	8·6	·098	46	12·5	37·0	34·7	24·5	10·2	·084	38	8·4		
14 0	......	19·26	12,130	32·4	24·4	8·0	·099	49	12·8	35·8	......	......	......	......	......	......	+5—	
15 0	47·8	19·16	12,270	32·9	25·2	7·7	·105	51	14·4	36·3	......	......	......	......	......	......	+2·5	·067
15 50	......	....	....	31·2	24·2	7·0	·105	54	14·4	34·7	......	......	......	......	......	......	+1·0	·064
16 0	......	19·01	12,460															

Table I. (Continued.)

August 26, 1852.

Greenwich Mean Time.	Barometer. Therm.	Barometer. Reading corrected.	Height above sea-level.	Dry and Wet Thermometers, *aspirated.* Dry.	Wet.	Diff.	Tension of vapour.	Relative humidity.	Dew-point.	Temperature corrected for change.	Dry and Wet Thermometers, *free.* Dry.	Wet.	Diff.	Tension of vapour.	Relative humidity.	Dew-point.	Regnault's Hygrometer. Dew-point.
h m s	°	in.	feet	°	°	°	in.		°	°	°	°	°	in.		°	°
6 16 10	......	....	....	....	....	......	......	......	....	....	35·3	23·7	11·6	·072	32	4·3	
16 30	......	....	....	29·0	23·0	6·0	·105	59	14·4	32·5							
17 0	47·3	18·95	12,530	29·9	23·2	6·7	·102	55	13·6	33·4	32·2	22·5	9·7	·078	39	6·4	
18 0	......	18·85	12,670	29·7	23·2	6·5	·103	56	13·9	33·2	30·9	22·5	8·4	·087	45	9·3	
18 30	......	....	....	29·0	22·7	6·3	·102	57	13·6	32·6	31·3	22·7	8·6	·087	45	9·3	
19 0	46·6	18·71	12,880	30·0	23·3	6·7	·103	56	13·9	33·6	32·3	23·2	9·1	·087	43	9·3	− 1·0
19 40	......	....	....	30·0	23·2	6·8	·101	55	13·3	33·6	32·1	22·7	9·4	·082	41	7·7	− 4·0
20 0	45·9	18·66	12,950	30·1	23·2	6·9	·101	54	13·3	33·7							
20 30	......	....	....	30·5	23·4	7·1	·101	53	13·3	34·1							
21 0	45·0	18·55	13,110	29·9	23·2	6·7	·103	56	13·9	33·6	31·6	22·2	9·4	·080	41	7·1	
21 40	44·6	18·49†	13,170														
22 0	......	18·46	13,200	26·7	21·3	5·4	·101	61	13·3	30·4	29·0	20·5	8·5	·077	43	6·1	
23 0	44·5	18·26	13,500	27·4	21·9	5·5	·104	61	14·1	31·1	29·0	21·2	7·8	·086	48	9·0	+ 2·0
24 0	......	18·11	13,720	....	....	......	......	......	....	....	29·5	21·9	7·6	·091	50	10·5	
25 0	43·0	17·97	13,920	26·7	20·1	6·6	·089	54	9·9	30·5	28·0	21·2	6·8	·093	54	11·1	
25 40	......	....	....	26·0	19·4	6·6	·086	53	9·0	29·9	27·0	20·4	6·6	·090	54	10·2	0·0
26 0	42·6	17·85	14,080	25·6	19·3	6·3	·087	55	9·3	29·5	26·4	20·5	5·9	·095	58	11·7	
26 30	......	17·78†	14,220	27·7	20·5	7·2	·088	51	9·6	31·6	26·3	20·3	6·0	·094	58	11·4	
27 0	......	17·77	14,180	24·2	18·5	5·7	·087	58	9·3	28·1	25·8	20·2	5·6	·096	60	12·0	
27 0	......	17·75†	14,210														
28 0	......	17·62	14,440	26·1	20·3	5·8	·095	59	11·7	30·1	26·1	20·4	5·7	·096	60	12·0	
28 30	......	....	....	22·9	18·3	4·6	·094	65	11·4	26·9	25·1	19·6	5·5	·091	58	10·5	
29 0	......	17·45	14,640	22·5	18·3	4·2	·087	62	9·3	26·5	24·8	19·4	5·4	·094	61	11·3	
29 30	......	17·39†	14,750	23·1	18·9	4·2	·090	62	10·2	27·1	24·5	19·3	5·2	·095	62	11·7	
30 0	......	17·35	14,790	21·9	18·9	3·0	·106	76	14·6	25·9	24·5	19·5	5·0	·097	64	12·2	
30 0	......	17·33†	14,820														
31 0	39·8	17·31	14,870	23·1	19·3	3·8	·103	72	13·9	27·2							
32 0	39·0	17·26	14,930	21·9	18·5	3·4	·102	74	13·6	26·0							
32 30	......	....	....	22·4	19·1	3·3	·106	75	14·6	26·5	24·0						
33 0	......	17·16	15,090	21·6	18·9	2·7	·108	79	15·1	25·8	......	....	......	......	......	....	+ 12·0
34 0	......	17·12	15,130	20·6	18·2	2·4	·107	81	14·9	24·8	22·5						
35 0	......	17·12	15,130														
35 20	......	....	....	20·8	18·3	2·5	·107	80	14·9	25·1	22·2	....	......	......	......	....	+ 6·0
36 0	......	17·17	15,060														
36 30	......	....	....	22·2	18·9	3·3	·105	75	14·4	26·5							
37 0	......	17·13	15,110	20·8	17·9	2·9	·103	78	13·9	25·1							
38 0																	
39 0	......	16·92	15,410	....	....	......	......	......	....	....	19·4	16·4	3·0	·090	71	10·2	
39 30	......	....	....	....	....	......	......	......	....	....	18·8						
40 0	......	16·61	15,900	19·0	....	......	......	......	....	23·5	19·3	11·9	7·4	·054	43	− 3·2	
41 0	......	16·41	16,180	16·3	10·5	5·8	·058	51	− 1·4	20·8	17·5	9·7	7·8	·044	38	− 8·4	
42 0	......	16·26	16,400	14·6	8·7	5·9	·051	48	− 4·7	19·1	......	....	......	......	......	....	−10−
43 0	......	16·14	16,600	14·8	9·6	5·2	·059	55	− 0·9	19·4	19·5	10·8	8·7	·044	35	− 8·4	−15−
43 40	......	....	....	17·0	11·3	5·7	·062	54	+ 0·4	21·6	19·5	12·1	7·4	·056	44	− 2·3	−17·0
44 0	......	16·06	16,760														
45 0	......	15·96	16,900	15·3	10·3	5·0	·063	58	+ 0·8	20·0							
46 0	......	15·95	16,940	16·3	10·7	5·6	·061	54	− 0·1	21·0	18·3	11·7	6·6	·059	49	− 0·9	
46 10	......	....	....	16·9	11·2	5·7	·062	54	+ 0·4	21·6							
46 20	......	....	....	....	....	......	......	......	....	....	15·6	9·4	6·2	·053	48	− 3·7	
47 0	......	15·96	16,930														
48 0	......	15·96	16,920	16·5	11·0	5·5	·062	55	+ 0·4	21·3	16·6	10·5	6·1	·057	50	− 1·8	
49 0	......	....	....	13·4	8·6	4·8	·059	58	− 0·9	18·2	15·6	9·0	6·6	·050	46	− 5·2	
50 0	33·4	15·86	17,010	12·4	7·6	4·8	·056	57	− 2·3	17·3	15·1	8·5	6·6	·049	45	− 5·8	
51 0	......	15·64	17,400	13·2	8·2	5·0	·056	56	− 2·3	18·1							
52 0	......	15·46	17,660	10·6	6·7	3·9	·058	63	− 1·4	15·6	14·0	7·8	6·2	·049	47	− 5·8	
52 30	......	....	....	10·2	6·8	3·4	·061	68	− 0·1	15·1							
53 0	......	15·31	17,890														
54 0	......	15·21	18,060	9·1	6·7	2·4	·066	77	+ 2·0	14·1							
55 0	......	15·01	18,370	7·3	5·7	1·6	·068	85	2·8	12·4							

TABLE I. (Continued.)

enwich n Time.	Barometer.		Height above sea-level.	Dry and Wet Thermometers, *aspirated*.						Temperature corrected for change.	Dry and Wet Thermometers, *free*.						REGNAULT'S Hygrometer.	
	Therm.	Reading corrected.		Dry.	Wet.	Diff.	Tension of vapour.	Relative humidity.	Dew-point.		Dry.	Wet.	Diff.	Tension of vapour.	Relative humidity.	Dew-point.	Dew-point.	Tension of vapour.
m s	°	in.	feet	°	°	°	in.		°	°	°	°	°	in.		°	°	in.
56 0	......	14·91	18,590	9·5	6·5	3·0	·063	72	0·8	14·6								
56 15	......	14·88†	18,650															
57 0	......	14·76	18,870	9·9	6·7	3·2	·063	71	0·8	15·1	12·4	7·7	4·7	·058	59	− 1·4		
57 30	......	......	......	9·7	6·6	3·1	·063	72	0·8	14·9	12·4	7·4	5·0	·055	56	− 2·8		
58 0	......	14·65	19,070	10·1	7·1	3·0	·065	73	1·6	15·3	12·1	8·0	4·1	·062	64	+ 0·4		
58 30	......	14·68†	19,000															
59 0	......	14·61	19,100	8·3	6·3	2·0	·067	80	2·4	13·6								
59 0	......	14·66†	19,010															
0 0	......	14·69†	19,000	10·5	7·5	3·0	·066	73	2·0	15·8								
47 0	......	29·73	280	57·3	50·6	6·7	·305	64	44·1	57·3								
48 0	......	29·34	640	55·7	50·0	5·7	·309	68	44·5	55·7								
48 30	62·2	29·12	850	54·8	49·6	5·2	·310	70	44·6	54·8								
49 0	......	28·97	990	54·3	49·1	5·2	·304	70	44·0	54·3	54·6	49·4	5·2	·308	71	44·4		
49 30	......	28·82	1,130	53·6	48·6	5·0	·301	71	43·7	53·6	53·7	48·7	5·0	·302	71	43·8		
50 0	......	28·50	1,440	52·4	48·0	4·4	·301	74	43·7	52·4	52·6	48·2	4·4	·303	74	43·9		
51 0	......	28·05	1,880	50·3	46·4	3·9	·288	76	42·5	50·3	50·3	46·5	3·8	·290	77	42·7		
51 30	......	......	......	49·8	46·0	3·8	·285	77	42·2	49·8								
52 0	......	27·61	2,310	49·3	46·1	3·2	·293	81	43·0	49·3	49·6	46·3	3·3	·294	80	43·1		
53 0	......	27·25	2,670	49·5	48·6	0·9	·346	94	47·8	49·5	50·0	48·7	1·3	·343	92	47·5		
53 35	......	......	......	......	......	......	......	......	......	......	50·4	49·4	1·0	·355	94	48·5		
54 0	......	27·10	2,820	51·0	50·0	1·0	·363	94	49·2	51·0	51·4	50·7	0·7	·375	96	50·1		
55 0	......	26·95	2,980	51·1	50·6	0·5	·376	97	50·2	51·1	51·7	51·4	0·3	·388	98	51·1		
56 0	59·0	26·83	3,100	50·7	50·5	0·2	·378	99	50·4	50·7								
56 30	......	......	......	......	......	......	......	......	......	......	51·7	51·0	0·7	·379	96	50·5		
57 0	......	26·67	3,260	......	......	......	......	......	......	......	51·6	50·9	0·7	·378	96	50·4		
58 0	......	26·52	3,420	50·1	50·1	0·0	·374	100	50·1	50·1	......	......	......	......	......	......	48·0	·349
0 0	......	26·19	3,760	50·7	50·1	0·6	·368	96	49·6	50·7								
0 35	......	......	......	51·3	50·2	1·1	·365	93	49·3	51·3								
1 0	......	25·96	4,010	51·7	50·1	1·6	·359	91	48·9	51·7	54·1	51·0	3·1	·355	83	48·5		
1 30	60·6	25·84	4,140	52·3	49·9	2·4	·348	86	48·0	52·3								
2 0	......	25·73	4,260	......	......	......	......	......	......	......	53·8	50·3	3·5	·343	81	47·5		
2 30	......	25·55	4,450	52·1	49·3	2·8	·337	84	47·0	52·2								
3 0	......	25·48	4,520	52·0	49·1	2·9	·334	83	46·8	52·1	52·6	49·1	3·5	·328	80	46·2		
4 0	......	25·07	4,960	50·3	45·9	4·4	·282	75	41·9	50·4	52·0	46·4	5·6	·276	69	41·3		
4 35	......	......	......	49·9	45·0	4·9	·268	72	40·4	50·0	51·4	45·6	5·8	·266	68	40·2		
5 0	58·5	24·70	5,370	49·6	44·5	5·1	·261	71	39·7	49·8	50·6	45·0	5·6	·261	68	39·7		
5 30	......	......	......	48·9	44·0	4·9	·258	72	39·3	49·1								
6 0	......	24·38	5,710	48·1	43·5	4·6	·255	73	39·0	48·3	49·2	43·7	5·5	·249	69	38·3		
6 30	......	......	......	47·3	42·8	4·5	·250	73	38·4	47·5								
6 40	......	24·08	6,050															
7 0	......	23·95	6,190	46·6	42·3	4·3	·247	74	38·1	46·8								
7 30	......	......	......	46·3	42·0	4·3	·245	75	37·9	46·5								
8 0	......	23·46	6,750	44·9	40·6	4·3	·231	74	36·2	45·2	45·9	41·1	4·8	·232	72	36·3		
9 0	......	23·29	6,940	44·5	39·0	5·5	·206	67	32·9	44·8								
10 0	55·0	22·92	7,380	44·3	37·9	6·4	·189	61	30·5	44·6	......	......	......	......	......	......	27·0	·167
11 0	......	22·73	7,590	42·9	36·2	6·7	·173	59	28·1	43·3								
11 30	53·6	22·49	7,880	42·4	34·7	7·7	·153	53	24·7	42·8								
12 0	......	22·31	8,090	41·6	34·2	7·4	·152	55	24·5	42·0								
12 40	......	......	......	40·8	33·8	7·0	·153	57	24·7	41·2	42·7	34·8	7·9	·153	53	24·7		
13 0	......	22·07	8,370	40·0	32·9	7·1	·146	55	23·4	40·4	39·6	32·7	6·9	·146	56	23·4		
13 30	......	......	......	39·6	32·4	7·2	·142	55	22·6	40·1								
14 30	......	21·46	9,110	37·8	30·8	7·0	·139	57	22·0	38·3								
15 0	......	21·31	9,290	36·7	30·6	6·1	·145	62	23·2	37·2	36·7	30·4	6·3	·142	60	22·6		
16 0	......	21·08	9,550	35·7	30·9	4·8	·157	69	25·4	36·2	37·1	31·2	5·9	·151	63	24·3		
17 0	......	20·78	9,950	34·5	29·8	4·7	·150	69	24·1	35·1	35·6	30·1	5·5	·147	65	23·6		
17 30	......	......	......	33·8	29·4	4·4	·150	71	24·1	34·4								
18 0	......	20·54	10,240	32·7	28·9	3·8	·151	74	24·3	33·3	33·9	28·7	5·2	·140	66	22·2		
18 30	......	......	......	32·1	28·4	3·7	·149	74	23·9	32·7	......	......	......	......	......	......	20·0	·129

TABLE I. (Continued.)

Date	Greenwich Mean Time.	Barometer. Therm.	Barometer. Reading corrected.	Height above sea-level.	Dry and Wet Thermometers, *aspirated.* Dry.	Wet.	Diff.	Tension of vapour.	Relative humidity.	Dew-point.	Temperature corrected for change.	Dry and Wet Thermometers, *free.* Dry.	Wet.	Diff.	Tension of vapour.	Relative humidity.	Dew-point.	Regn. Hygrometer. Dew-point.	Tension of
	h m s	°	in.	feet	°	°	°	in.		°	°	°	°	°	in.		°	°	
October 21, 1852.	3 19 0	......	20·22	10,650	31·7	27·6	4·1	·142	72	22·6	32·3								
	19 30	......	....	....	31·2	27·0	4·2	·138	71	21·8	31·8								
	20 0	......	20·03	10,900	31·1	26·2	4·9	·129	67	20·0	31·8	31·0	26·3	4·7	·130	68	20·2		
	21 0	......	19·85	11,130	29·8	25·7	4·1	·131	71	20·4	30·5	31·6	26·8	4·8	·132	67	20·6		
	22 0	......	19·63	11,420	29·4	25·2	4·2	·128	71	19·8	30·1	30·4	25·9	4·5	·130	69	20·2		
	23 0	......	19·41	11,700	27·8	24·1	3·7	·126	73	19·3	28·6	29·2	24·7	4·5	·123	68	18·7		
	24 0	......	19·23	11,940	26·8	23·2	3·6	·121	73	18·2	27·6								
	25 0	......	19·10	12,130	26·8	22·6	4·2	·115	69	16·8	27·6	28·2	23·8	4·4	·119	70	17·8		
	26 0	40·4	18·95	12,320	25·9	....	......	......	......	....	26·8	......	....	......	......	......	....	17·0	[illegible]
	27 0	......	18·85	12,450	24·9	....	......	......	......	....	25·8	27·5	24·2	3·3	·129	76	20·0		
	28 0	......	18·73	12,630	25·9	....	......	......	......	....	26·8								
	28 30	......	....	....	25·8	22·0	3·8	·114	71	16·6	26·7								
	29 0	......	18·72	12,640	25·7	22·0	3·7	·115	72	16·8	26·7	27·6	24·3	3·3	·130	76	20·2		
	29 30	......	....	....	26·0	22·0	4·0	·113	70	16·4	27·0								
	30 0	......	....	....	26·9	23·0	3·9	·119	72	17·8	27·9	27·7	24·1	3·6	·127	74	19·5	19·0	[illegible]
	30 25	......	18·85	12,470															
	31 25	......	19·15	12,050	26·5	23·4	3·1	·126	77	19·3	27·5	27·8	24·2	3·6	·127	74	19·5	18·0	[illegible]
	33 50	......	19·97	10,960	29·7	25·7	4·0	·131	71	20·4	30·8	......	....	......	......	......	....	19·0	[illegible]
	36 0	......	20·67	10,070	33·4	29·2	4·2	·150	72	24·1	34·6								
	37 30	......	21·24	9,360	35·5	30·2	5·3	·149	66	23·9	36·7	36·2	31·3	4·9	·159	69	25·7		
	38 0	......	21·50	9,040	36·5	30·2	6·3	·140	60	22·2	37·7								
	39 0	43·6	21·81	8,660	....	....	......	......	......	....	....	38·6	32·3	6·3	·149	59	23·9		
	39 30	......	21·92	8,530	38·4	31·0	7·4	·136	55	21·4	39·7								
	40 0	......	22·05	8,380	39·3	31·2	8·1	·132	51	20·6	40·6								
	41 0	......	22·25	8,140	40·8	31·5	9·3	·125	46	19·1	42·1	......	....	......	......	......	....	25·0	[illegible]
	42 30	44·5	22·46	7,900	42·5	....	......	......	......	....	43·8	......	....	......	......	......	....	24·0	[illegible]
	43 30	......	22·55	7,800	43·2	35·1	8·1	·153	52	24·7	44·6	43·4	37·7	5·7	·195	66	31·4		
	45 0	......	22·49	7,870	42·5	35·2	7·3	·160	55	25·9	43·9								
	46 0	......	22·40	7,970	42·4	34·7	7·7	·153	53	24·7	43·8								
	48 0	......	22·31	8,090	42·9	34·7	8·2	·149	51	23·9	44·4	......	....	......	......	......	....	20·0	[illegible]
	49 0	......	22·34	8,060	43·7	36·3	7·4	·169	56	27·4	45·2	43·1	35·7	7·4	·164	56	26·6		
	50 0	......	22·55	7,810	44·3	35·9	8·4	·156	51	25·2	45·7	44·6	37·3	7·3	·177	57	28·7		
	53 0	......	23·42	6,780	46·1	39·8	6·3	·206	63	32·9	47·7	46·6	40·6	6·0	·216	65	34·3		
	54 0	......	23·62	6,550	46·4	41·2	5·2	·229	69	35·9	48·0								
	54 20	......	....	....	....	....	......	......	......	....	....	46·5	41·5	5·0	·233	70	36·4		
	57 30	47·5	23·70	6,450															
	58 30	......	23·74	6,400	44·7	40·8	3·9	·236	76	36·8	46·5	......	....	......	......	......	....	35·0	[illegible]
	4 1 30	......	24·62	5,420	46·7	42·4	4·3	·247	74	38·1	48·5								
	3 30	......	25·51	4,460	49·4	45·6	3·8	·284	78	42·1	51·3								
	4 0	......	25·75	4,210	....	....	......	......	......	....	....	49·5	46·2	3·3	·295	80	43·2		
	5 0	......	26·12	3,820	50·6	47·6	3·0	·314	82	45·0	52·5	50·6	48·1	2·5	·325	85	46·0		
	5 45	......	26·47	3,450	50·6	48·6	2·0	·335	88	46·8	52·5	50·6	48·7	1·9	·338	89	47·1		
	6 30	51·0	26·73	3,180	50·2	48·7	1·5	·342	91	47·5	52·1								
	8 0	......	27·03	2,880	50·1	49·1	1·0	·352	94	48·3	52·1								
November 10, 1852.	2 22 30	52·0	29·85	240	49·6	44·3	5·3	·247	67	38·1	49·6								
	23 0	......	29·55	510															
	23 30	......	29·47	580	48·2	43·5	4·7	·245	70	37·9	48·2	48·1	43·2	4·9	·240	69	37·3		
	24 30	......	28·96	1,060	46·4	42·2	4·2	·239	72	37·1	46·4	46·3	41·9	4·4	·233	71	36·4		
	25 0	52·0	28·66	1,330	45·0	41·6	3·4	·242	77	37·5	45·0								
	25 30	......	28·35	1,630	43·6	40·8	2·8	·241	80	37·4	43·6								
	26 10	......	27·99	1,970	42·3	38·7	3·6	·214	75	34·0	42·3	42·0	38·0	4·0	·203	72	32·5		
	27 10	......	27·18	2,760	39·6	37·4	2·2	·218	83	34·5	39·6	39·5	37·1	2·4	·214	82	34·0		
	28 0	......	26·78	3,150	38·0	36·5	1·5	·218	88	34·5	38·0	37·8	36·3	1·5	·217	89	34·4		
	29 0	......	26·23	3,700	37·2	36·2	1·0	·221	92	34·9	37·2	37·2	36·2	1·0	·221	92	34·9		
	29 30	......	25·93	4,010	36·8	36·0	0·8	·222	94	35·1	36·8								
	30 40	......	25·40	4,560	35·5	34·7	0·8	·211	94	33·6	35·5	......	....	......	......	......	....	33·0	[illegible]
	31 0	......	25·08	4,890	34·3	34·0	0·3	·211	98	33·6	34·3								
	32 0	......	24·65	5,350	33·7	33·4	0·3	·206	97	32·9	33·7	33·8	33·4	0·4	·206	97	32·9		

TABLE I. (Continued.)

Greenwich Mean Time.	Barometer. Therm.	Barometer. Reading corrected.	Height above sea-level.	Dry and Wet Thermometers, *aspirated.* Dry.	Wet.	Diff.	Tension of vapour.	Relative humidity.	Dew-point.	Temperature corrected for change.	Dry and Wet Thermometers, *free.* Dry.	Wet.	Diff.	Tension of vapour.	Relative humidity.	Dew-point.	REGNAULT'S Hygrometer. Dew-point.	Tension of vapour.
h m s	°	in.	feet	°	°	°	in.		°	°	°	°	°	in.		°	°	in.
2 33 10	......	24·17	5,880	34·7	33·4	1·3	·197	90	31·7	34·7								
34 0	44·3	23·94	6,140	35·6	31·4	4·2	·160	71	25·9	35·6								
34 30	......	23·76	6,350	35·8	30·8	5·0	·150	66	24·1	35·8	36·3	31·8	4·5	·161	69	26·1		
35 0	......	23·63	6,500	35·8	30·8	5·0	·150	66	24·1	35·8								
35 30	......	23·45	6,700	35·6	31·4	4·2	·161	71	26·1	35·6								
36 30	43·0	23·12	7,070	34·7	31·2	3·5	·167	76	27·1	34·7	35·1	31·4	3·7	·166	75	26·9		
37 30	......	22·72	7,530	33·9	31·6	2·3	·178	84	28·9	33·9	33·7	31·3	2·4	·176	83	28·5		
38 0	......	....	....	32·7	31·0	1·7	·179	88	29·0	32·7								
38 30	......	22·29	8,030	32·7	31·4	1·3	·186	91	30·1	32·7								
39 0	......	21·97	8,420	32·5	31·4	1·1	·187	92	30·2	32·5	32·2	31·2	1·0	·186	93	30·1		
40 0	......	21·58	8,890	31·4	29·7	1·7	·171	88	27·7	31·4	31·3	29·7	1·6	·172	89	27·9		
41 0	40·5	21·07	9,510	29·8	27·2	2·6	·149	81	23·9	29·8								
42 0	......	20·71	9,970	29·5	26·2	3·3	·138	76	21·8	29·5	28·8	25·9	2·9	·139	78	22·0		
43 0	......	20·17	10,630	26·9	24·2	2·7	·132	79	20·6	26·9	27·2	24·1	3·1	·129	77	20·0		
44 0	......	19·65	11,310	24·9	22·4	2·5	·124	80	18·9	24·9	......	....	......	......	......	....	16·0	·111
45 30	......	18·74	12,500	20·3	(32)	......	......	......	....	20·3	20·6	(32)	......	......	......	....	10·0	·089
46 30	36·0	18·30	13,080	17·4	....	......	......	......	....	17·4								
47 0	......	17·90	13,650	16·3	....	......	......	......	....	16·3	16·8							
47 30	......	17·75	13,860	15·9	12·4	3·5	·076	68	5·8	15·9								
49 0	......	16·66	15,480	13·4	8·9	4·5	·060	59	− 0·5	13·4								
49 40	29·5	16·44	15,820	12·8	8·1	4·7	·057	58	− 1·8	12·8								
50 30	......	16·23	16,150	....	....	......	......	......	....	....	12·7	8·4	4·3	·060	61	− 0·5		
51 0	......	15·96	16,580	11·9	10·3	1·6	·081	84	+ 7·4	11·9								
52 0	......	15·28	17,620	7·0	5·6	1·4	·068	85	+ 2·8	7·0	9·1	5·9	3·2	·060	69	− 0·5		
52 30																		
54 0	......	14·72	18,520	3·8	1·3	2·5	·052	74	− 4·2	3·8								
55 0	......	14·44	18,990	2·7	0·6	2·1	·052	77	− 4·2	2·7	4·2	0·4	3·8	·043	60	− 9·1	−30(?)	·019
56 0	......	14·24	19,330	1·5	− 0·1	1·6	·053	82	− 3·7	1·5								
57 0	......	14·01	19,730	0·4	− 0·5	0·9	·056	90	− 2·3	0·4	1·1	− 0·8	1·9	·050	78	− 5·2		
58 0	......	14·04	19,690	1·0	+ 0·2	0·8	·058	91	− 1·4	1·0								
59 0	......	14·20	19,400	1·5	0·0	1·5	·054	83	− 3·2	1·5	2·6	+ 1·1	1·5	·056	83	− 2·2		
3 1 0	......	14·78	18,430	4·4	+ 0·9	3·5	·046	64	− 7·4	4·4	5·2	2·5	2·7	·053	71	− 3·7		
2 0	18·2	14·95	18,110	3·4	− 0·2	3·6	·042	60	− 9·7	3·4								
3 30	......	14·94	18,130	3·4	− 1·8	5·2	·031	44	−18·0	3·4	4·8	− 0·2	5·0	·035	48	−14·0		
5 0	......	14·60	18,700	2·2	− 2·1	4·3	·035	53	−14·0	2·2	3·9	− 0·9	4·8	·035	49	−14·0		
6 0	......	14·40	19,020	0·5	....	......	......	......	....	0·5	3·0	− 1·0	4·0	·039	57	−12·0		
7 0	14·0	14·08	19,560	− 1·3	....	......	......	......	....	− 1·3								
8 30	11·5	13·60	20,430	− 2·3	....	......	......	......	....	− 2·3	......	....	......	......	......	....	−22·0	·027
9 0	......	13·45	20,650	− 5·1	....	......	......	......	....	− 5·1								
10 30	......	13·02	21,380	− 9·3	....	......	......	......	....	− 9·3								
12 0	......	12·65	22,110	− 9·6	....	......	......	......	....	− 9·6								
13 0	......	12·51	22,370	−10·5	....	......	......	......	....	−10·5								
14 30	......	12·40	22,640	− 8·9	....	......	......	......	....	− 8·9								
15 0	......	12·24	22,930															
16 0	......	12·24	22,930															
17 0	......	....	....	− 6·5	....	......	......	......	....	− 6·5								
19 0	......	12·94	21,640	− 5·3	....	......	......	......	....	− 5·3								

§ 5. *Variation of Temperature with Height.*

The observations of temperature given in the preceding table, with the corresponding heights, have been divided into groups, each group being composed of the observations within 1000 feet*. The numbers employed are those in column 11 of the table, which have been corrected for the change occurring in the temperature during the continuance of the experiments, as given by corresponding observations at the earth's surface. This correction is very probably inaccurate to some extent; but our information is as yet so imperfect with regard to the diurnal variations of temperature in the upper parts of the atmosphere, that no other course has appeared open to me. Any error arising from this cause is probably small in any of the series now under consideration, with the exception perhaps of August 26, when the hourly changes, as well as the time occupied in the ascent, were considerable. These groups are contained in the following table:—

Table II.—Means of Groups of the Observations of Temperature at different heights in the four Balloon Ascents of 1852, with the differences between the observed temperatures and those calculated by equations (1.) and (2.) from each whole series, and from the adopted divisions of each series.

Date.	Groups.			Temperature, observed − calculated.					
	No. of obs.	Height.	Temperature.	Whole Series.		Lower Division.		Upper Division.	
				By eq. (1.).	By eq. (2.).	By eq. (1.).	By eq. (2.).	By eq. (1.).	By eq. (2.).
		feet	°	°	°	°	°	°	°
August 17	(1)	(120)	(71·2)	−1·4	+1·3	0·0	......	(−5·1)	(−7·5)
	1	2,440	62·8	−2·4	−1·4	0·0	......	(−5·6)	(−7·3)
	1	3,460	59·2	−2·8	−2·4	0·0	......	(−5·8)	(−7·1)
	1	4,110	58·1	−1·9	−1·7	(+1·3)	......	(−4·7)	(−5·8)
	1	5,880	57·8	+3·2	+2·8	(+7·3)	......	(+0·9)	(+0·3)
	3	6,800	54·0	+3·2	+1·6	(+6·8)	......	(+0·2)	(−0·2)
	5	7,530	51·4	+2·0	+1·1	(+6·9)	......	+0·1	−0·2
	8	8,550	49·0	+2·7	+1·7	(+8·1)	......	+1·1	+1·0
	7	9,470	44·4	+1·0	−0·1	(+6·9)	......	−0·4	−0·4
	4	10,680	40·4	+0·7	−0·4	(+7·2)	......	−0·3	−0·2
	4	11,620	37·2	+0·4	−0·6	......	......	−0·3	−0·1
	8	12,250	34·9	+0·1	−0·9	......	......	−0·5	−0·3
	3	13,480	30·8	−0·2	−0·9	......	......	−0·4	−0·2
	4	14,550	27·0	−0·7	−1·1	......	......	−0·6	−0·4
	6	15,510	24·4	−0·3	−0·4	......	......	0·0	+0·1
	10	16,600	20·6	−0·8	−0·4	......	......	−0·1	−0·1
	6	17,440	19·6	+0·9	+1·6	......	......	+1·7	+1·7
	6	18,490	15·0	−0·5	+0·9	......	......	+0·6	+0·5
	8	19,320	10·5	−2·4	−0·5	......	......	−1·0	−1·3

* The third group of October 21 extends only from 2000 to 2670 feet; the two observations between the latter height and 3000 feet, showing a marked change which refers them more intimately to the succeeding group. The lowest group in each series depends solely upon observations taken in the car, with the exception of that of August 17, when no observations having been recorded below 2000 feet, the general temperature at the earth has been adopted as the first result.

TABLE II. (Continued.)

Date.	Groups.			Temperature, observed — calculated.					
	No. of obs.	Height.	Temperature.	Whole Series.		Lower Division.		Upper Division.	
				By eq. (1.).	By eq. (2.).	By eq. (1.).	By eq. (2.).	By eq. (1.).	By eq. (2.).
		feet.	°	°	°	°	°	°	°
August 26	3	700	64·8	+1·6	+2·3	− 0·2	+ 0·2		
	2	1,380	62·2	+0·8	+1·4	− 0·4	− 0·3		
	5	2,480	59·1	+0·6	+0·9	+ 0·4	+ 0·2		
	4	3,390	55·7	−0·4	−0·3	+ 0·3	0·0		
	4	4,430	51·7	−1·7	−1·7	0·0	− 0·3	(− 9·8)	(−12·3)
	3	5,620	48·0	−2·3	−2·5	+ 0·5	+ 0·5	(− 9·5)	(−11·4)
	3	6,350	44·3	−4·1	−4·3	− 0·6	− 0·3	(−10·8)	(−12·3)
	3	7,390	41·9	−3·7	−4·1	(+ 0·7)	(+ 1·6)	(− 9·7)	(−10·8)
	3	8,730	42·9	+0·8	+0·4	(+ 6·4)	(+ 8·3)	(− 4·2)	(− 4·9)
	10	9,510	42·3	+2·2	+1·8	(+ 8·6)	(+11·2)	(− 2·2)	(− 2·1)
	20	10,590	41·0	+3·7	+3·3	(+11·1)	(+14·9)	+ 0·2	− 0·1
	25	11,630	37·4	+2·9	+2·5	(+11·2)	(+16·3)	0·0	0·0
	46	12,490	34·0	+1·7	+1·4	(+10·9)	(+17·1)	− 0·5	− 0·4
	5	13,350	31·9	+1·9	+1·6	......	......	+ 0·3	+ 0·4
	11	14,500	28·1	+1·1	+1·0	......	......	+ 0·4	+ 0·6
	7	15,200	25·3	+0·1	+0·1	......	......	− 0·1	+ 0·1
	8	16,700	20·2	−1·1	−0·8	......	......	− 0·1	− 0·1
	4	17,460	16·5	−2·8	−2·3	......	......	− 1·3	− 1·3
	8	18,750	14·5	−1·4	−0·6	......	......	+ 1·0	+ 0·8
October 21......	4	690	55·5	−1·4	+2·1	+ 0·2	......	(−10·9)	(−10·1)
	3	1,480	52·1	−3·1	−1·0	− 0·4	......	(−11·7)	(−11·0)
	3	2,360	49·5	−3·6	−3·1	+ 0·2	......	(−11·3)	(−10·8)
	10	3,330	51·4	+0·5	−0·3	(+ 5·5)	......	(− 6·1)	(− 5·8)
	6	4,420	51·7	+3·3	+1·5	(+ 9·8)	......	(− 2·1)	(− 1·9)
	6	5,530	48·9	+3·1	+0·6	(+10·9)	......	− 1·2	− 1·1
	7	6,580	46·5	+3·1	+0·5	(+12·3)	......	− 0·1	0·0
	8	7,770	44·1	+3·4	+1·1	(+14·1)	......	+ 1·6	+ 1·5
	9	8,280	41·7	+2·2	+0·2	(+13·6)	......	+ 0·9	+ 0·8
	6	9,380	36·9	−0·1	−1·1	(+12·7)	......	− 0·2	− 0·3
	8	10,520	32·7	−1·7	−1·2	......	......	− 0·6	− 0·6
	4	11,550	29·2	−2·8	−0·5	......	......	− 0·6	− 0·6
	9	12,430	27·0	−3·0	+1·1	......	......	+ 0·2	+ 0·2
November 10...	2	410	48·9	−0·1	+4·7	+ 0·2	......	(− 9·3)	(+ 1·5)
	4	1,500	44·3	−2·0	+1·4	− 0·3	......	(−10·6)	(− 1·4)
	1	2,760	39·6	−3·5	−1·6	− 0·2	......	(−11·4)	(− 3·9)
	2	3,430	37·6	−3·9	−2·6	+ 0·3	......	(−11·4)	(− 4·7)
	3	4,490	35·5	−3·3	−3·0	(+ 1·2)	......	(−10·3)	(− 4·8)
	2	5,620	34·2	−1·8	−2·4	(+ 5·1)	......	(− 8·1)	(− 3·8)
	4	6,420	35·7	+1·7	+0·5	(+ 9·6)	......	(− 4·2)	(− 0·6)
	3	7,460	33·8	+2·4	+0·7	(+11·6)	......	(− 2·9)	(− 0·3)
	3	8,440	32·2	+3·2	+1·1	(+13·7)	......	(− 2·5)	(+ 0·4)
	2	9,740	29·6	+3·9	+1·3	......	......	− 0·2	+ 0·9
	1	10,630	26·9	+3·4	+0·7	......	......	− 0·2	+ 0·4
	1	11,300	24·9	+3·1	+0·3	......	......	− 0·1	+ 0·1
	1	12,500	20·3	+1·5	−1·2	......	......	− 1·1	− 1·3
	3	13,530	16·5	+0·3	−2·3	......	......	− 1·7	− 2·3
	2	15,650	13·1	+2·1	+0·4	......	......	+ 1·3	+ 0·5
	1	16,580	11·9	+3·3	+2·0	......	......	+ 3·0	+ 2·2
	1	17,620	7·0	+1·0	+0·4	......	......	+ 1·2	+ 0·5
	6	18,480	3·3	−0·6	−0·4	......	......	+ 0·1	− 0·4
	6	19,460	0·6	−0·8	+0·2	......	......	+ 0·4	+ 0·2
	2	20,540	− 3·7	−2·4	−0·3	......	......	− 0·6	− 0·4
	2	21,510	− 7·3	−3·6	−0·4	......	......	− 1·2	− 0·6
	3	22,370	− 9·7	−3·9	+0·5	......	......	− 1·0	+ 0·1

In order to deduce from these numbers an approximation to the normal progression of temperature, freed from accidental irregularities, each series was in the first instance arranged in equations of the form—

$$T=X+YH, \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1.)$$

T being the observed temperature at the height H; Y the change in degrees of temperature due to 1000 feet of height; and X the temperature at the level of the sea, which, with the addition of the quantity YH, would best represent the observed temperatures throughout the series, on the supposition of the change being uniform with the height. X and Y were eliminated by the method of least squares, and the following values obtained for the different series:—

	Aug. 17.	Aug. 26.	Oct. 21.	Nov. 10.
X=	72°·76	64°·98	58°·49	50°·02
Y=	− 3·097	− 2·617	− 2·291	− 2·496
Mean error .	1·72	2·16	2·65	2·56

On the supposition that the rate of change is not constant, but that it varies with the height, the following interpolating equation was employed,—

$$T=x+yH+zH^2+ \&c., \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2.)$$

omitting higher powers of H than the second. When the same method of elimination was adopted, the following values were found:—

	Aug. 17.	Aug. 26.	Oct. 21.	Nov. 10.
x=	70°·17	64°·11	53°·36	44°·69
y=	− 2·363	− 2·346	+ 0·1132	− 1·095
z=	− 0·03613	− 0·01424	− 1·868	− 0·06070
Mean error	1·30	2·13	1·35	1·71

In Table II. will be found the differences between the observed temperatures, and those resulting from the two forms of equation employed. The progress of those differences in each series seems to follow a distinct law; there being in all cases a maximum of negative differences at a short distance from the earth, varying from about 2500 feet on October 21, to 6000 feet on August 26, followed also in each by a maximum of positive differences at an additional height of 3000 to 5000 feet. This peculiar departure from a regular progression will be distinctly traced in the projected results (Plates XIX.—XXII.). It is there seen, in all the four series, that after a steady decrease of the temperature in the lower portion of the curve, this decrease becomes arrested, and, for a space of about 2000 feet, the temperature remains almost constant, or even increases by a small amount; the decrease being afterwards resumed and continued, without much variation, throughout the upper portion of the curve. In the series of August 17 and 26 this fact is strikingly coincident with a large and abrupt diminution in the amount of aqueous vapour; the same coincidence being exhibited, in a less marked manner, on November 10. On October 21, the departure from a uniform decrease is very decidedly shown in connection with the stratum of dense cloud passed through. The temperature had been uniformly decreasing until the thick cloud was reached, when a decided rise commenced, which continued through the cloud, and for a space of about 600 feet above it; after which height the decrease was resumed, at first slowly, and afterwards with more rapidity.

The disturbance in the variation of the temperature now noticed, is in each series exhibited in such a systematic manner, that the hypothesis of a regular progression at all heights can scarcely be maintained. In order therefore to arrive at some approximate value of the normal variation of temperature in the atmosphere, it appears necessary to make abstraction of the disturbing cause. This I have endeavoured to do by dividing each series into two divisions; 1st, between the earth and the height where the diminution of temperature appears to be arrested; 2nd, above the point where the regular diminution of temperature seems to be resumed, omitting the space which is under the influence of the disturbance. The divisions adopted for the four series are as follows:—

	Aug. 17. Feet.	Aug. 26. Feet.	Oct. 21. Feet.	Nov. 10. Feet.
Lower division	0 to 4000	0 to 7000	0 to 2700	0 to 4000
Upper division	7000 to 20,000	10,000 to 19,000	5000 to 13,000	9000 to 23,000

These partial series have been examined by the same methods as the entire series; the number of groups in the lower division being, however, with the exception of August 26, too small to admit of the application with any advantage of equation (2.). The results for the different series are as follows:—

		By Equation (1.).			By Equation (2.).			
		X	Y	Mean error.	x	y	z	Mean error.
Aug. 17	Lower division	71·62°	−3·598°	0·00°				
	Upper division	76·68	−3·371	0·73	79·17°	−3·771°	+0·01484°	0·71°
Aug. 26	Lower division	67·46	−3·549	0·39	66·75	−2·969	−0·08220	0·30
	Upper division	76·36	−3·355	0·60	81·68	−4·104	+0·02552	0·58
Oct. 21	Lower division	57·77	−3·581	0·26				
	Upper division	68·77	−3·376	0·82	67·81	−3·162	−0·01119	0·80
Nov. 10	Lower division	50·21	−3·760	0·26				
	Upper division	59·45	−3·046	1·22	48·05	−1·516	−0·04791	1·02

The values of the constants in equation (2.), deduced from the higher divisions, show that, in the two series of August 17 and 26, the temperature decreases *less* rapidly as we ascend; whilst the values for October 21 and November 10 indicate a contrary result. The value of the second term (z) is, with the exception of the series of November 10, very small, and the amounts of the mean errors show that the observations are little better represented than by the single constant of equation (1.).

On the whole, we are scarcely at liberty to conclude from these results that the progress of the temperature, when free from disturbing influences, is other than *uniform* with the height.

Confining our attention now to the results deduced by equation (1.), we infer from them that in each series the rate of decrease of temperature, *below* the stratum where the disturbing influence exists, is *greater* than above that stratum; the ratio of the rate of decrease in the lower division to that in the higher, being—

On Aug. 17, 1·067; on Aug. 26, 1·058; on Oct. 21, 1·061; and on Nov. 10, 1·234.

If, in order to obtain the mean rate of decrease of temperature in the atmosphere, freed from disturbing causes, we allow to the lower and upper series values proportional to the spaces within which the observations for each division occur, we have the following numbers representing the decrease of temperature for 1000 feet of height:—

Aug. 17	° 3·434	Oct. 21 . . .	° 3·431
Aug. 26	3·440	Nov. 10 . . .	3·205

the values for the first three series being almost identical; that for the fourth differing from them by $\frac{1}{15}$th of the whole.

It may be convenient to give here the results for the rate of diminution of temperature obtained by different methods, expressed in the form usually adopted by meteorologists, viz. the height in feet equivalent to a decrease of one degree FAHRENHEIT.

	Aug. 17.	Aug. 26.	Oct. 21.	Nov. 10.
From the whole series	322·9	382·0	436·5	400·6
From first and last groups only . .	316·3	358·8	411·9	374·7
From lower division	277·9	281·8	279·3	266·0
From upper division	296·5	298·1	296·2	328·3
Mean of two divisions	292·0	290·7	291·5	312·0

The amount of distortion in the curve representing the diminution of temperature, produced by the disturbing influence which has been noticed, may be approximately stated at 7° on Aug. 17; 10°½ on Aug. 26; 11°½ on Oct. 21, and 12° on Nov. 10.

§ 6. *Variation of the Hygrometric Condition of the Air.*

As the amount of aqueous vapour in the air must necessarily decrease with the temperature, even although the proportion to the whole capacity of the air for moisture should remain constant, the changes at different heights may probably be most conveniently studied by examining the results for the "Relative Humidity," or the proportion which the amount of vapour present in the air bears to that which it would contain were it completely saturated. Since these changes do not, as in the case of temperature, appear to follow any regular course from which normal results might be derived, I shall here only state briefly the most prominent peculiarities presented by each series, referring for further information to the table of observations and to the projected results.

August 17.—We see by the curve of relative humidity for this day, that, from the earth's surface to the height of about 4000 feet, the humidity slightly increased; the presence of a considerable quantity of moisture being also shown by the existence of a partial stratum of cloud at the height of about 2500 feet. Between the heights of 4000 and 5880 the humidity decreased *with great rapidity* from about 85 to less than 35. For a considerable space little alteration took place, with the exception of a sudden increase at the height of about 9000 feet, which was confined to a stratum of not more than 400 feet; but as the evidence of its existence depends upon only one or two observations it may perhaps be doubtful. From 10,000 feet to 12,300, the humidity gradually increased to about 90, which value it retained very constantly through fully 4000 feet. After 16,500 feet there were considerable irregularities, there being however a comparatively dry stratum between 18,000 and 19,000 feet, which was followed by a decided increase in the humidity. These indications agree well with what is stated in § 3. with regard to the occasional existence of cloud above the height of 13,000 feet, and with the fact that at the highest point reached a mass of cloud was seen at a short distance above. In this series we can trace the existence of two distinct strata of moist air, besides a third, which undoubtedly existed at a greater height, but which was not quite reached.

August 26.—As on the first ascent, the humidity steadily increased from the earth's surface. Between the heights of 7200 and 8950 feet it also *rapidly* diminished from 92 to 26. For some distance the variations were no greater than might be supposed to arise from uncertainty of observation in such extreme circumstances. It will be remarked, on examining the curve of the tension of vapour, that whilst the indications of Regnault's hygrometer did not differ much from those of the wet thermometer at the height of about 11,000 feet, the difference became considerable at about 12,000 or 13,000 feet; thus rendering it probable that at the latter heights the relative humidity, as deduced from the dry and wet thermometers, was too great. The general accordance between the two hygrometers was however nearly restored at about 15,000 feet, confirming the rise which there took place in the amount of vapour. We may therefore consider that there was little change in the humidity from 9000 to 14,000 feet, a decided increase having however occurred at 15,000 feet, followed by a diminution till 16,400 feet; an increase having been again indicated in the remainder of the curve. The principal stratum of vapour on this day extended from the earth to 7200 feet, a second and perhaps a third of smaller thickness existing at 15,000 and 18,000 feet.

October 21.—The amount of moisture in the air on this occasion was considerable. The relative humidity increased as we left the earth, at first slowly till the height of 2000 feet, when irregular masses of cloud became frequent, and afterwards with more rapidity, till within the principal cloudy mass, at a height of 3450 feet, it attained the point of complete saturation. After leaving the cloud the humidity diminished steadily but not very rapidly till 5300 feet, where a slight rise commenced, continuing till 6700 feet; it then decreased till 8300 feet, when it rose again and remained nearly constant at 70 for the last 3000 feet of the ascent. The changes occurring in this series were neither to the same extent nor so abrupt in their character as those shown in the first two.

November 10.—The humidity, again, as in all the previous series, increased from the earth to the first cloud, which was at a low elevation and of but little density; upon leaving it, at about 1900 feet, a slight depression took place. Immediately above this low cloud a different current of air existed, shortly after entering which the humidity again increased until, in the second cloud, it became nearly complete; the decrease, after leaving the cloud at 5000 feet, becoming rapid and attaining a minimum at 6500 feet. A second well-defined maximum was reached at 8300 feet, followed at 10,000 feet by a secondary minimum. The humidity diminished on the whole till about 15,800 feet, when a sudden increase commenced, which continued from 16,500 to 17,600 feet, followed by an equally sudden decrease at 18,000 feet, the humidity subsequently increasing. The fluctuations in this series were numerous, there having been no fewer than four or perhaps five different strata of vapour.

§ 7. *General Remarks.*

The principal results deduced from the experiments described may be thus generally stated.

The temperature of the air decreases uniformly with the height above the earth's surface, until at a certain elevation, varying on different days, the decrease is arrested, and for a space of from 2000 to 3000 feet the temperature remains nearly constant, or even increases by a small amount; the regular diminution being afterwards resumed and generally maintained, at a rate slightly less rapid than in the lower part of the atmosphere, and commencing from a higher temperature than would have existed but for the interruption noticed. This interruption in the decrease of temperature is accompanied by a large and abrupt fall in the temperature of the dew-point, or by actual condensation of vapour, from which it may be inferred that the disturbance in the progression of temperature arises from a development of heat in the neighbourhood of the plane of condensation. The subsequent falls in the temperature of the dew-point are generally of an abrupt character, and corresponding interruptions in the decreasing progression of temperature are sometimes distinguishable, but in a less degree; as might indeed be expected from the fact, that at lower temperatures the variations in the absolute amount of aqueous vapour are necessarily smaller, and their thermic effects consequently diminished.

Dr. MILLER's *Analysis of Air collected in the Ascents.*

"King's College, London, 5 May, 1853.

"MY DEAR SIR,—The following particulars of my examinations of some of the specimens of air collected by Mr. WELSH in the course of the balloon ascents made under the superintendence of the Kew Committee of the British Association, may not be unacceptable to the Fellows of the Royal Society as supplementary to a part of Mr. WELSH's report and observations.

"The samples of air collected upon the 26th of August appear to have been taken in the most unexceptionable manner, and it was upon these only that my experiments were made. The recipients for the air were wide glass tubes, about 5 cubic inches in capacity, to each of which a portion of barometric tubing, 3 or 4 inches in length, was attached, as a neck that might receive a cap and stopcock, and which would admit also of being hermetically sealed afterwards by the blowpipe. Two of these tubes were furnished with excellent stopcocks, and were found able to support without leakage for twenty-four hours the exhaustion obtained by an air-pump, the gauge of which indicated a pressure of 0·5 inch.

"Having been thus tested they were exhausted to this extent immediately before the ascent took place, and were filled with the specimens to be examined by simply opening and then closing the stopcock, the altitude being determined by an observation of the barometer at the moment. In the third tube, a Torricellian vacuum was obtained, the tube being then sealed and drawn off, so as to admit of being broken at a filemark when the air was to be collected; after the specimen had been thus obtained, the aperture was closed by thrusting the neck of the tube into a cap filled with softened wax.

"The tubes were within twenty hours after the air had been collected hermetically sealed by myself, and the proportions of oxygen and nitrogen determined with great care by detonation with hydrogen in 'REGNAULT's Eudiometer.'

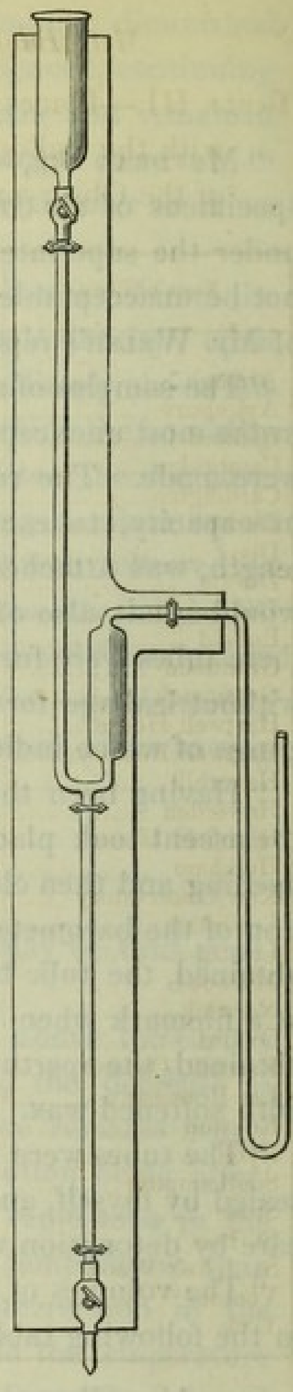
"The volumes of oxygen found in the air collected at different altitudes are given in the following table:—

	Altitude.	Volume of oxygen.
Air collected at King's College		20·920
Tube 2	13,460 feet	20·888
Tube 3	18,000 feet	20·747
Tube (G 1), Torricellian vacuum	18,630 feet	20·888

"From these observations it would appear that the composition of the atmosphere, as regards the proportion of oxygen and nitrogen, scarcely varies more as we ascend through the first half of that atmosphere (for at an altitude of about 3½ miles one-half of the atmosphere lies beneath us), than it is found to vary at different spots upon the surface: that there is, in fact (as GAY-LUSSAC had long since announced as the result of his experiments, made at a time when the methods of gaseous analysis were less perfect than at present), no sensible difference in the composition of the atmosphere upon the surface, and at the greatest heights accessible to man.

"In quantities of air so limited as those at my disposal, it was not possible to determine accurately the proportion of carbonic acid which they contained. Its presence however was distinctly shown by the formation of a film of carbonate of lead upon a solution of the subacetate which was introduced to a portion of the air confined over mercury.

"I have found a form of pipette, a sketch of which I subjoin, very useful for transferring small quantities of gases over mercury. It saves a great deal of fatigue, and I think contributes to precision in the results obtained. Its working is so simple as hardly to require description. It is first completely filled with mercury by closing the lower steel stopcock and opening the upper one, then pouring in mercury by the funnel until the metal escapes by the open end of the long bent tube; the upper stopcock is now closed, the bent tube introduced into the jar containing the gas to be transferred, and the end of the tube is lifted above the level of the metal in the jar of gas; the lower stopcock is then opened, mercury runs out, and gas takes its place; when a sufficient quantity has entered, the end of the tube is depressed beneath the mercury, a little of the metal enters and seals the opening, the lower stopcock is closed, and the pipette with its contents is withdrawn: the bent tube is now introduced beneath the jar which is to receive the gas. The funnel at top is filled with mercury, the upper stopcock opened, and the descending column of mercury expels the gas into the vessel destined to receive it.



"I am, my dear Sir,

"Yours very truly,

"WILLIAM ALLEN MILLER."

"*To Colonel Sykes,*
Chairman of the Kew Committee."

Meteorological Observations during the Ascents at different places.

TABLE III.—Places at which Meteorological Observations were taken in connection with the Balloon Ascents of 1852, with the Geographical coordinates, and name of the Observer or Authority.

Name of Place.	Latitude.	Longitude.	Height above sea level.	Authority.
	° ′ ″	° ′ ″		
Armagh	54 21 13	6 38 52 W.	209	Rev. Dr. Robinson, F.R.S.
Aylesbury	51 49	0 49 15 W.	284	Thomas Dell, Esq.
Bedford	52 8	0 28 W.	100	Dr. S. Herbert Barker.
Cambridge	52 12 52	0 5 53 E.	80	Professor Challis, F.R.S.
Cardington	52 7	0 24 W.	......	S. C. Whitbread, Esq.
Derby*	52 55	1 28 16 W.	100?	Mr. Davis, Optician.
Diss*	52 22	1 6 E.	130	Thomas E. Amyot, Esq.
Dublin	53 21	6 15 W.	24½	Rev. R. V. Dixon, A.M.
Edinburgh	55 27 23	3 10 45 W.	354	Professor Smyth, F.R.S.E.
Enfield	51 39	0 4 57 W.	76½	Rev. J. M. Heath.
Grantham	52 54 52	0 39 0 W.	190	J. W. Jeans, Esq.
Greenwich	51 28 38	0 0 0	159	The Astronomer Royal.
Hartwell House	51 49	0 51 W.	250	Dr. Lee, F.R.S.
Hartwell Rectory	51 48 36	0 51 W.	290	Rev. C. Lowndes, M.A., F.R.A.S.
Haverhill	52 5	0 26 36 E.	......	Wm. W. Boreham, Esq., F.R.A.S.
Hawerden	53 11 0	3 2 0 W.	260	Dr. T. Moffat, F.R.A.S.
Highfield House	52 57 30	1 10 W.	204	E. J. Lowe, Esq., F.R.A.S.
Holkham	52 57 10	0 48 E.	39	Samuel Shellabear, Esq.
Kew Observatory	51 28 37	0 15 45 W.	40?	Captain Younghusband, R.A., F.R.S.
Lewisham	51 28	0 1 W.	80	James Glaisher, Esq., F.R.S.
Linslade	51 55	0 40 W.	313	John Osborn, Jun., Esq.
Marboué	48 6 57	1 20 3 E.	361	M. Le Commandant Delcros.
Norwich	52 37	1 16 E.	33	Wm. Brooke, Esq.
Oxford	51 45 40	1 15 30 W.	210	M. J. Johnson, Esq., F.R.S.
Rosehill, Oxford	51 43 50	1 14 W.	270?	John Slatter, Esq.
Les Rousseaux	47 30 58	2 20 10 E.	......	M. Le Commandant Delcros.
Royston	52 2 40	0 0 30 W.	271	Hale Wortham, Esq.
Ryde	50 45	1 11 30 W.	110	Benjamin Barrow, Esq.
Southampton	50 54 34	1 24 25 W.	60	Dr. Drew, F.R.A.S.
Stone	51 47 57	0 52 16 W.	320	Rev. J. B. Reade, M.A., F.R.S.
St. Ives*	52 20	0 5 W.	......	John King Watts, Esq.
St. John's Wood	51 31	0 15 W.	150	George Leach, Esq.
Ventnor*	50 36	1 13 W.	150	Dr. Martin.
York	53 57 48	1 4 W.	50	John Ford, Esq.

* The barometrical observations at Derby, Diss, St. Ives, and Ventnor have not been corrected for temperature.

TABLE IV.—Meteorological Observations, made at Various Places on the days of the Four Balloon Ascents in 1852.

Observations on August 17, 1852.

Hour.	Barom.	Therm. Dry.	Therm. Wet.	Tension of Vapour.	Barom.	Therm. Dry.	Therm. Wet.	Tension of Vapour.	Barom.	Therm. Dry.	Therm. Wet.	Tension of Vapour.	Barom.	Therm. Dry.	Therm. Wet.	Tension of Vapour.
h	in.	°	°	in.	in.	°	°	in.	in.	°	°	in.	in.	°	°	in.
	Aylesbury.				Bedford.				Cambridge.				Cardington.			
9 A.M.	......	...	...	......	29·79	67·4	62·0	0·498	29·912	65·5	63·0	0·550	29·793	65·0	60·5	0·482
2 P.M.	29·568	72·3	66·7	0·590												
3	·523	73·0	68·5	·642	......	...	...	......	·813	72·0	68·6	·656	·725	70·8	65·0	·552
4	·515	69·8	65·7	·585	·70	73·1	67·0	·590	·814	71·3	68·5	·660	·717	70·0	66·0	·593
5	·502	69·3	66·0	·601	·66	70·6	66·8	·611	·789	70·3	68·1	·658	·669	69·2	66·0	·602
6	·485	67·0	65·7	·616	·65	69·6	67·0	·630	·774	69·3	67·7	·656	·678	67·4	66·0	·622
7	·477	66·0	65·0	·606	·64	68·4	66·5	·627	·756	67·8	66·5	·622	·668	67·0	65·0	·595
8	·487	62·0	62·0	·559	·62	66·1	65·0	·605	·730	67·5	66·3	·631	·623			
	Derby.				Dublin.				Diss.				Enfield.			
2 P.M.	29·74	71·0	64·0	0·518	......	...	...	......	29·85	70·0	66·0	0·593				
3	·74	72·0	65·0	·538	29·679	69·2	62·7	0·499	·80	70·0	66·0	·593	29·754	72·8	66·0	0·561
4	·71	70·0	64·5	·545	·682	68·5	62·0	·486	·78	69·5	66·0	·599	·735	71·7	66·6	·593
5	·71	68·0	65·0	·583	·682	67·6	61·8	·490	·78	69·0	66·0	·604	·707	69·9	66·0	·594
6	·69	67·0	64·0	·563	·686	66·9	60·9	·472	·76	68·5	66·5	·626	·696	69·5	66·0	·599
7	·68	65·5	63·5	·565	·689	63·5	59·0	·456	·74	67·0	65·5	·610	·657	68·9	66·0	·605
8	·68	64·5	63·0	·561	·709	62·5	58·9	·464	·73	65·0	64·0	·586	·650	66·8	64·8	·591
	Edinburgh.				Haverhill.				Hawerden, Chester.				Highfield House.			
9 A.M.	......	...	...	......	......	...	...	......	......	...	...	......	29·722	69·2	63·3	0·517
2 P.M.	......	...	...	......	29·750	72·0	65·5	0·554	29·450	67·5	63·0	0·528				
3	29·279	67·7	...	......	·734	72·0	66·3	·580	·454	67·8	64·0	·554	·653	75·0	67·0	·569
4	·264	67·5	...	......	·720	73·0	67·3	·601	·430	68·0	64·0	·552	·652	71·5	65·3	·553
5	·282	66·2	...	......	·705	71·0	67·5	·631	·428	66·9	63·9	·561	·639	68·8	65·2	·581
6	......	...	...	......	·674	69·8	66·8	·588	·420	66·5	64·0	·569	·623	67·0	64·5	·579
7	......	...	...	......	·663	68·0	66·5	·631	·420	65·8	63·5	·561	·607	65·0	63·9	·583
8	......	...	...	......	·629	66·2	64·8	·597	·414	...	...	......	·594	64·2	63·0	·565
	Holkham.				Linslade.				Norwich.				Oxford.			
9 A.M.	29·888	66·5	62·4	0·520	29·595	64·0	59·3	0·558	29·906	68·0	64·0	·552				
2 P.M.	......	...	...	......	·525	69·3	63·3	·516	......	...	...	......	29·630	72·1	66·4	0·583
3	·796	74·4	67·2	·582	·505	71·3	64·2	·521	·786	73·0	68·0	·625	·615	70·4	66·0	·589
4	·785	72·3	66·4	·581	......	70·2	64·8	·553	·766	72·0	68·0	·636	·577	67·6	65·1	·591
5	·784	72·2	67·0	·601	·457	68·5	64·9	·575	·756	72·0	68·0	·636	·587	67·7	65·0	·587
6	·763	68·8	65·2	·581	·454	67·4	65·1	·593	·748	70·0	67·0	·625	·507	66·0	64·8	·600
7	·756	67·2	64·7	·583	......	...	...	......	·716	68·0	66·0	·616	·528	65·8	64·8	·602
8	·735	66·3	64·0	·571	·420	63·9	62·3	·546	·709	65·0	64·5	·601	·512	65·1	64·7	·607
	Rosehill, Oxford.				Ryde.				Southampton.				St. Ives.			
9 A.M.	29·639	65·0	61·0	0·497	29·850	63·8	61·9	0·536	29·812	66·1	63·0	0·544				
2 P.M.	......	...	...	......	·748	65·9	65·7	·629	·729	71·0	67·0	·615	29·70	73·0		
3	·554	68·6	64·7	·568	·731	66·8	66·2	·635	·711	67·7	66·0	·619	·69	72·0		
4	·507	66·5	64·5	·585	·667	65·8	64·2	·583	·674	67·9	65·6	·603	·68	72·0		
5	·529	65·0	64·8	·611	·667	65·8	63·7	·568	·656	67·0	66·0	·627	·68	72·0		
6	·443	65·0	64·6	·605	·639	64·9	64·2	·593	·626	66·0	65·0	·606	·65	70·0		
7	......	...	...	......	·622	64·8	63·7	·579	·624	64·0	62·9	·574	·65	68·0		
8	......	...	...	......	·623	64·0	63·5	·581	(?) ·867	63·5	62·0	·542	·58	67·0		

Table IV. (Continued.)

Hour.	Barom.	Therm. Dry.	Therm. Wet.	Tension of Vapour.	Barom.	Therm. Dry.	Therm. Wet.	Tension of Vapour.	Barom.	Therm. Dry.	Therm. Wet.	Tension of Vapour.	Barom.	Therm. Dry.	Therm. Wet.	Tension of Vapour.
h	in.	°	°	in.	in.	°	°	in.	in.	°	°	in.	in.	°	°	in.
Observations on August 17, 1852.																
	St. John's Wood.				York.											
9 A.M.	29·785	62·8	60·3	0·500	29·721	66·0	63·0	0·545								
2 P.M.																
3	·663	69·8	66·3	·605	·734	71·0	64·5	·535								
4	·647	69·5	66·5	·615	·710	71·0	64·0	·519								
5	·608	68·8	65·8	·600	·701	69·0	64·0	·542								
6	·596	68·6	66·2	·615	·701	69·0	64·0	·542								
7	·552	68·8	66·4	·620	·713	68·0	63·5	·537								
8	·580	65·0	64·0	·586	·707	66·0	64·0	·575								
	Armagh.				Grantham.				Greenwich.				Lewisham.			
9 A.M.	29·297	65·5	62·6	0·538	29·688	66·4	61·4	0.493	29·804	64·0	58·1	0·426				
3 P.M.	......	...	...	......	·623	70·3	64·0	·527	·692	75·4	65·6	·520	29·762	74·9	69·2	0·645
3½	......	...	...	......	·615	69·6	63·6	·522	·689	74·0	66·1	·552	·755	72·3	67·0	·600
4	......	...	...	......	·617	69·0	63·6	·529	·683	71·7	65·0	·543	·751	71·7	67·7	·630
4½	......	...	...	......	·618	68·5	63·7	·538	·655	71·1	64·8	·543	·725	71·6	67·4	·621
5	·437	64·2	58·6	·437	·600	68·0	63·5	·537	·636	70·6	65·0	·555	·714	70·7	67·5	·635
5½	·440	64·6	58·8	·438	·571	67·5	63·5	·544	·623	69·8	65·0	·564	·686	70·0	67·1	·629
6	·449	65·0	59·1	·442	·579	67·4	63·5	·544	·621	69·1	65·1	·575	·688	69·1	67·0	·636
6½	·446	64·5	59·1	·442	·584	66·9	63·1	·538	·619	69·1	65·1	·575	·678	68·8	66·9	·636
7	·446	64·1	58·6	·438	·561	66·2	62·8	·536	·602	68·6	65·4	·590	·648	68·4	67·6	·652
7½	·464	61·4	57·2	·429	·551	65·9	62·6	·533	·607	61·4	60·5	·521	·656	64·0	63·7	·588
8	·451	59·6	57·0	·444	·546	65·6	62·6	·537	·593	62·5	61·0	·524	·672	63·2	62·8	·570
8½	......	...	...	......	......	...	...	......	·593	63·5	61·6	·530				
9	......	...	...	......	·548	64·8	63·0	·558	·593	64·2	62·9	·562				
Observations on August 26, 1852.																
	Aylesbury.				Bedford.				Cambridge.				Derby.			
9 A.M.	......	...	...	......	30·030	62·6	58·8	0·459	30·023	64·2	60·0	0·476				
2 P.M.	29·721	72·3	66·0	0·568												
3	·722	73·5	66·3	·564	·043	72·1	65·8	·562	·020	68·4	64·9	·576	29·97	68·0	62·0	0·492
4	·727	70·6	65·0	·555	·062	70·0	65·0	·561	·017	67·8	64·8	·579	·98	68·0	63·0	·522
5	·734	69·9	65·4	·575	·070	69·4	64·5	·552	·018	67·7	64·1	·559	·98	67·0	62·0	·503
6	·744	66·0	63·3	·553	·070	66·5	63·0	·539	·031	66·4	63·0	·540	29·98	65·0	61·0	·496
7	·759	60·7	59·7	·507	·079	64·0	61·5	·522	·056	63·2	60·9	·513	30·00	62·0	59·0	·472
8	·775	58·7	58·2	·486	·079	61·2	60·0	·510	·065	61·0	58·8	·477	30·00			
	Diss.				Edinburgh.				Enfield.				Holkham.			
9 A.M.	......	...	...	......	......	...	...	......	29·916	63·0	59·5	0·475	30·004	58·6	57·4	0·465
2 P.M.	29·97	64·0	60·0	0·478												
3	·97	65·5	61·0	·491	......	...	...	......	·941	70·9	64·6	·538	·037	67·0	60·8	·468
4	·97	65·0	61·0	·496	......	...	...	......	·942	69·8	63·9	·529	·038	66·0	59·2	·433
5	·98	63·5	61·5	·528	29·634	66·7	...	......	·945	69·2	63·4	·520	·037	63·6	58·1	·430
6	·98	62·5	59·5	·480	......	...	...	......	·955	67·8	63·0	·524	·055	61·7	58·0	·448
7	·99	59·5	57·0	·445	......	...	...	......	......	...	...	......	·064	60·4	57·8	·457
8	......	...	...	......	......	...	...	......	......	...	...	......	·080	59·8	57·2	·447
	Norwich.				Oxford.				Royston.				Southampton.			
9 A.M.	......	...	...	......	......	...	...	......	......	...	...	......	29·911	64·1	62·4	0·547
2 P.M.	30·039	66·0	60·0	0·456	29·820	72·1	65·1	0·541								
3	·040	66·0	60·0	·456	·822	71·0	64·6	·538	29·784	70·1	63·3	0·507				
4	·044	65·5	60·0	·461	·820	70·1	63·3	·507	·789	69·4	63·2	·512				
5	·046	65·0	60·0	·467	·832	68·4	64·0	·548	·799	66·8	62·2	·512				
6	·052	62·0	59·0	·472	·830	67·0	63·8	·557	·798	63·7	60·0	·482	·925	69·0	66·5	·620
7	·058	59·0	57·5	·464	·848	65·3	62·2	·528	·822	60·3	58·5	·477	·929	65·0	63·7	·576
8	·066	55·0	54·5	·429	·857	63·0	61·0	·519	·827	58·0	56·8	·457				

TABLE IV. (Continued.)

Hour.	Barom.	Therm. Dry.	Therm. Wet.	Tension of Vapour.	Barom.	Therm. Dry.	Therm. Wet.	Tension of Vapour.	Barom.	Therm. Dry.	Therm. Wet.	Tension of Vapour.	Barom.	Therm. Dry.	Therm. Wet.	Tension of Vapour.
h	in.	°	°	in.	in.	°	°	in.	in.	°	°	in.	in.	°	°	in.
Observations on August 26, 1852.																
	Stone.				St. Ives.				St. John's Wood.							
9 A.M.	29·637	67·4	64·0	0·559	......	...	...	......	29·862	62·8	61·3	0·529				
2 P.M.	·646	72·6	65·6	·551	29·85	72·0	...	......	......	...	...	......				
3	·648	68·9	64·0	·543	·85	71·0	...	......	·866	68·5	64·2	·553				
4	·646	68·9	64·5	·558	·85	69·0	...	......	·874	67·8	63·8	·548				
5	·656	68·7	63·5	·529	·86	69·0	...	......	·879	66·8	63·8	·560				
6	·664	66·6	62·9	·535	·87	68·0	...	......	·888	64·8	62·8	·552				
7	·689	63·0	60·3	·498	·89	64·0	...	......	·911	62·8	60·4	·503				
8	·694	60·9	58·8	·479	·90	61·0	...	......	·920	61·8	59·8	·497				
	Grantham.				Greenwich.				Kew.				Lewisham.			
9 A.M.	29·850	61·8	57·4	0·430	29·873	66·8	62·2	0·512								
Noon	......	...	...	......	·879	69·6	63·6	·522								
3 P.M.	·869	64·5	58·7	·436	·880	71·1	64·1	·521	......	...	...	......	29·958	72·7	66·5	0·579
3½	·872	65·0	59·3	·447	·880	71·1	64·1	·521	29·978	69·6	64·4	0·547	·952	72·5	66·2	·571
4	·873	65·4	59·7	·454	·876	70·9	63·8	·514	·992	69·1	64·0	·540	·956	71·8	66·0	·573
4½	·872	65·9	60·2	·462	·888	69·6	63·1	·507	·995	68·2	63·9	·547	·968	68·3	64·0	·549
5	·875	65·4	60·0	·463	·893	67·1	61·6	·489	·993	67·2	63·1	·534	·970	67·8	63·7	·545
5½	·879	64·5	58·5	·430	·887	66·6	62·0	·507	·992	66·7	63·0	·537	·967	67·5	63·5	·542
6	·883	64·0	57·9	·419	·890	64·5	60·2	·478	29·996	65·1	61·4	·507	·982	65·5	62·6	·538
6½	·884	63·0	57·7	·425	·897	63·8	59·6	·469	30·006	63·5	60·9	·510	·983	64·0	61·6	·524
6¾	......	...	...	......	......	...	...	......	·019	63·1	60·5	·503				
7	·885	61·0	57·3	·437	·911	62·7	59·1	·466	......	...	...	......	·989	62·7	61·0	·522
7½	·893	60·6	56·7	·424	·913	62·0	58·8	·466	......	...	...	......	29·994	62·2	60·5	·513
8	·897	59·6	56·3	·425	......	...	...	......	......	...	...	......	30·001	61·5	60·0	·506
8½	......	...	...	......	......	...	...	......	......	...	...	......	·009	60·6	59·2	·493
9	·903	57·9	55·6	·425	·929	59·3	57·3	·456	......	...	...	......	·013	59·6	58·5	·485
Observations on October 21, 1852.																
	Bedford.				Enfield.				Hartwell House.				Hartwell Rectory.			
9 A.M.	29·94	46·6	46·0	0·318	29·984	46·5	45·9	0·317	29·810	49·3	47·8	0·329	29·695	47·8	47·8	0·346
1 P.M.	·88	56·6	53·5	·385	·917	52·0	50·2	·356								
2	·86	57·0	54·0	·394	·906	52·0	50·9	·373	·766	56·8	51·0	·321				
3	·85	56·4	53·0	·375	·891	52·0	51·5	·387	·766	55·8	51·0	·332				
4	·85	55·0	51·8	·361	·871	52·1	51·8	·394	·750	55·3	51·2	·343				
5	·85	54·0	51·7	·369	·871	52·0	52·0	·400	·742	54·0	51·0	·352				
6	·87	54·0	51·7	·369	·886	51·5	51·0	·380	·754	54·9	51·9	·364	29·626	54·0	52·5	·389
7	·87	54·1	52·0	·376	......	...	...	......	·734	54·6	53·0	·395				
	Linslade.				Norwich.				Oxford.				Rosehill, Oxford.			
9 A.M.	29·728	48·1	47·5	0·336	......	...	...	......	......	...	...	......	29·759	48·4	48·3	0·351
1 P.M.	·693	54·5	51·3	·354	......	...	...	......	29·789	55·0	52·8	0·386	·720	53·5	51·8	·378
2	·665	55·2	50·5	·327	29·932	53·0	51·0	0·364	·763	54·9	52·8	·387	·705	53·4	51·4	·369
3	·659	55·0	50·9	·339	·932	53·0	51·0	·364	·758	54·7	52·3	·377	·694	53·8	52·0	·380
4	·645	53·9	50·5	·342	·916	52·5	51·4	·379	·736	54·1	52·5	·388	·672	53·8	52·2	·384
5	·639	53·1	50·1	·340	·906	51·0	50·0	·362	·736	54·0	52·6	·392	·677	53·1	52·1	·390
6	·639	52·6	50·1	·346	·906	48·0	47·0	·326	·736	54·0	53·0	·402				
7	·623	51·9	51·2	·381	·906	47·8	47·7	·344	·731	54·0	53·2	·407				
	Ryde.				Stone.				St. John's Wood.				Ventnor.			
9 A.M.	29·933	53·1	52·0	0·388	29·649	48·3	47·8	0·340	29·892	46·3	45·6	0·313				
1 P.M.	·897	59·8	55·5	·402	·617	54·6	52·4	·380	·827	56·0	52·5	·367	29·912	60·0	56·0	0·412
2	......	...	...	......	·597	56·3	53·5	·389	·815	55·8	53·3	·390	·892	60·0	57·0	·440
3	·889	59·0	55·0	·397	·586	54·4	51·6	·362	·810	57·3	53·8	·386	·874	60·0	57·0	·440
4	......	...	...	......	·574	53·7	51·6	·370	·795	54·5	51·9	·369	·872	60·0	57·0	·440
5	......	...	...	......	·571	53·0	51·3	·371	·795	54·9	52·8	·387	·872	60·0	57·0	·440
6	·887	56·0	54·8	·426	·578	53·4	51·5	·372	·804	54·8	52·8	·389	·874	60·0	57·0	·440
7	......	...	...	......	·562	52·7	51·5	·379	·792	54·0	52·5	·389	·874	60·0	57·0	·440
8	......	...	...	......	·554	52·7	51·9	·389	......	...	...	......				
9	......	...	...	......	·550	52·7	51·9	·389	·783	53·0	52·0	·389				

TABLE IV. (Continued.)

Observations on October 21, 1852.

Hour.	Barom.	Therm. Dry.	Therm. Wet.	Tension of Vapour.
h	in.	°	°	in.
Grantham.				
9 A.M.	29·851	47·2	46·4	0·321
Noon	......	...	...	......
1 P.M.	·794	51·6	49·5	·343
1½	......	...	...	......
2	·786	53·0	50·4	·349
2½	......	...	...	......
3	·760	52·5	49·4	·331
3½	......	...	...	......
4	·768	51·7	49·8	·350
4½	......	...	...	......
5	·747	51·0	49·6	·352
5½	......	...	...	......
6	·748	51·0	49·5	·350
6½	......	...	...	......
7	·743	51·0	49·9	·360
9	·717	51·6	50·3	·362
Greenwich.				
9 A.M.	29·887	48·3	46·0	0·299
Noon	·860	58·2	53·4	·365
1 P.M.	·845	59·7	53·7	·356
1½	......	...	...	......
2	·838	57·9	51·6	·323
2½	·836	58·7	51·9	·322
3	·835	58·7	52·4	·334
3½	·832	57·4	52·4	·349
4	·828	56·9	52·1	·347
4½	·826	56·4	51·9	·348
5	·831	55·9	51·9	·353
5½	·826	55·4	51·9	·359
6	·813	55·9	51·9	·353
6½	·806	54·8	51·4	·353
7	......	54·2	51·0	·350
9	·796	52·8	50·0	·341
Lewisham.				
9 A.M.	29·958	45·5	45·0	0·308
Noon				
1 P.M.	·907	59·1	53·8	·366
1½	·907	58·6	52·8	·346
2	·908	58·0	52·0	·333
2½	·908	58·6	52·1	·328
3	·907	58·7	53·7	·367
3½	·901	58·0	53·6	·373
4	·893	56·9	54·1	·397
4½	·893	55·7	54·0	·409
5	·891	54·7	53·3	·402
5½	·892	54·2	53·2	·405
6	·891	55·0	52·2	·370
6½	·895	55·3	53·0	·387
7	·892	53·0	52·0	·389
9				

Observations on November 10, 1852.

Hour.	Barom.	Therm. Dry.	Therm. Wet.	Tension of Vapour.
Bedford.				
9 A.M.	29·97	46·6	43·6	0·265
3 P.M.	·96	47·6	44·0	·263
Cambridge.				
1 P.M.	30·061	47·8	44·2	0·265
2	·058	48·2	44·0	·256
3	·056	47·1	43·8	·264
4	·047	46·5	44·0	·275
5	·033	46·1	43·5	·268
6	·029	44·6	43·5	·285
7	·025	44·2	43·5	·290
Diss.				
10 A.M.	29·99	46·0	44·5	0·292
1¼ P.M.	·98	48·5	46·0	·296
2¼	·98	48·0	45·0	·280
3½	·98	47·5	44·5	·275
5½	·96	44·5	43·5	·287
7	·96	43·5	43·0	·287
Enfield.				
9 A.M.	29·991	49·8	46·8	0·300
6 P.M.	·940	...	...	......
Grantham.				
9 A.M.	29·922	41·6	39·5	0·236
1 P.M.	·904	44·7	42·5	·263
2	·893	44·4	42·3	·262
3	·884	44·3	42·3	·263
4	·880	43·7	42·0	·264
5	·869	43·2	41·8	·265
6	·871	42·4	41·2	·262
7	·860	42·2	40·8	·256
9	·834	41·5	40·4	·256
Greenwich.				
9 A.M.	29·937	48·6	45·9	0·293
Noon	·928	51·0	44·6	·237
1 P.M.	·918	50·5	45·7	·267
1½	·920	50·5	45·7	·267
2 P.M.	29·918	50·1	45·4	0·265
2½	·917	48·6	45·0	·273
3	·914	48·0	44·5	·258
3½	·911	49·0	44·7	·262
4	·910	48·9	44·6	·261
4½	·910	47·7	44·0	·262
5	·905	47·3	43·6	·257
5½	·893	46·3	42·5	·244
6	·893	46·1	42·6	·249
6½	·900	46·1	42·5	·247
7	·894	46·1	42·6	·249
Hartwell House.				
9 A.M.	29·756	47·0	45·8	0·309
3 P.M.	·712	48·5	44·5	·263
Lewisham.				
9 A.M.	30·015	49·2	47·6	0·326
1 P.M.	·005	51·0	47·8	·309
1½	30·001	51·0	47·6	·305
2	29·987	50·8	47·5	·305
2½	·984	50·7	47·6	·308
3	·980	49·3	46·3	·295
3½	·975	49·6	46·5	·295
4	·975	49·0	45·7	·284
4½	·974	47·9	45·4	·291
5	·974	47·7	45·5	·295
5½	·966	47·0	44·8	·287
6	·964	47·0	44·7	·285
6½	·962	46·8	44·5	·283
7	·951	46·6	44·2	·279
Norwich.				
9 A.M.	30·013	46·7	43·7	0·266
Noon	29·997	48·4	43·4	·240
3 P.M.	·993	48·3	42·3	·218
6	......	44·7	42·4	·261
9	......	43·7	42·7	·279
Oxford.				
10 A.M.	29·891	48·3	45·4	0·286
1 P.M.	·863	49·5	46·2	·291
2	·859	49·0	46·0	·291
3	·852	48·9	45·3	·277
4	·836	48·1	45·3	·286
5½	·832	47·0	44·1	·272
6	·836	46·9	44·0	·271
7	·821	46·1	43·5	·269
Rosehill, Oxford.				
9 A.M.	29·829	47·2	44·8	0·285
Royston.				
10 A.M.	29·836	47·5	44·7	0·279
6 P.M.	·789	43·5	42·4	·275
Ryde.				
9 A.M.	30·023	51·6	50·5	0·368
Southampton.				
1½ P.M.	29·966	52·6	50·0	0·343
2	·959	52·9	50·0	·340
3	·942	52·9	50·3	·347
4	·945	51·5	50·0	·356
6	·938	50·6	49·6	·357
Stone.				
9 A.M.	29·707	46·3	44·2	0·282
9 P.M.	·627	44·7	42·6	·265
St. Ives.				
1 P.M.	29·44	44·0		
2	·42	44·0		
3	·37	45·0		
4	·35	48·0		
5	·28	48·0		
6	·27	48·0		
7	·27	48·0		
St. John's Wood.				
9 A.M.	29·932	48·3	46·3	0·306
5 P.M.	·891	46·6	44·1	·277
6	·884	46·3	43·6	·268

Table IV. (Continued.)

Hour.	Barom.	Therm.		Tension of Vapour.	Barom.	Therm.		Tension of Vapour.	Barom.	Therm.		Tension of Vapour.	Barom.	Therm.		Tension of Vapour.
		Dry.	Wet.			Dry.	Wet.			Dry.	Wet.			Dry.	Wet.	
h	in.	°	°	in.	in.	°	°	in.	in.	°	°	in.	in.	°	°	in.
	Les Rousseaux, Aug. 17.				Les Rousseaux, Aug. 26.				Marboué, Oct. 21.				Marboué, Nov. 10.			
7 A.M.	29·475	67·1	62·0	0·502	29·443	63·1	59·0	0·460	29·752	34·9	32·7	0·179	29·719	43·0	41·2	0·255
9	·456	69·1	63·1	·513	·445	72·0	61·3	·427	·752	52·0	47·1	·283	·703	49·3	46·4	·297
Noon	·395	76·7	66·4	·534	·449	78·8	66·9	·525	·691	60·1	53·2	·338	·668	57·6	52·7	·354
3 P.M.	·296	80·8	68·2	·546	·454	78·3	67·6	·553	·667	59·2	54·1	·371	·650	56·3	50·7	·319
9	·297	70·5	67·3	·630	·494	67·8	63·0	·524	·635	49·5	46·8	·304	·628	44·6	41·9	·252

Description of the Plates.

PLATE XIX. XX. XXI. and XXII.

The results for each ascent of the observations of temperature, tension of vapour, and relative humidity are projected in these Plates. For the most part each individual observation is given, except when they were very numerous and occurring at too close intervals of height to be easily represented. In such cases groups have been taken, but no group ever contains more observations than were recorded within 200 feet.

The ordinates represent the height above the level of the sea, one division being equivalent to 200 feet; the abscissæ representing the temperature of the air, the tension of vapour, or the relative humidity.

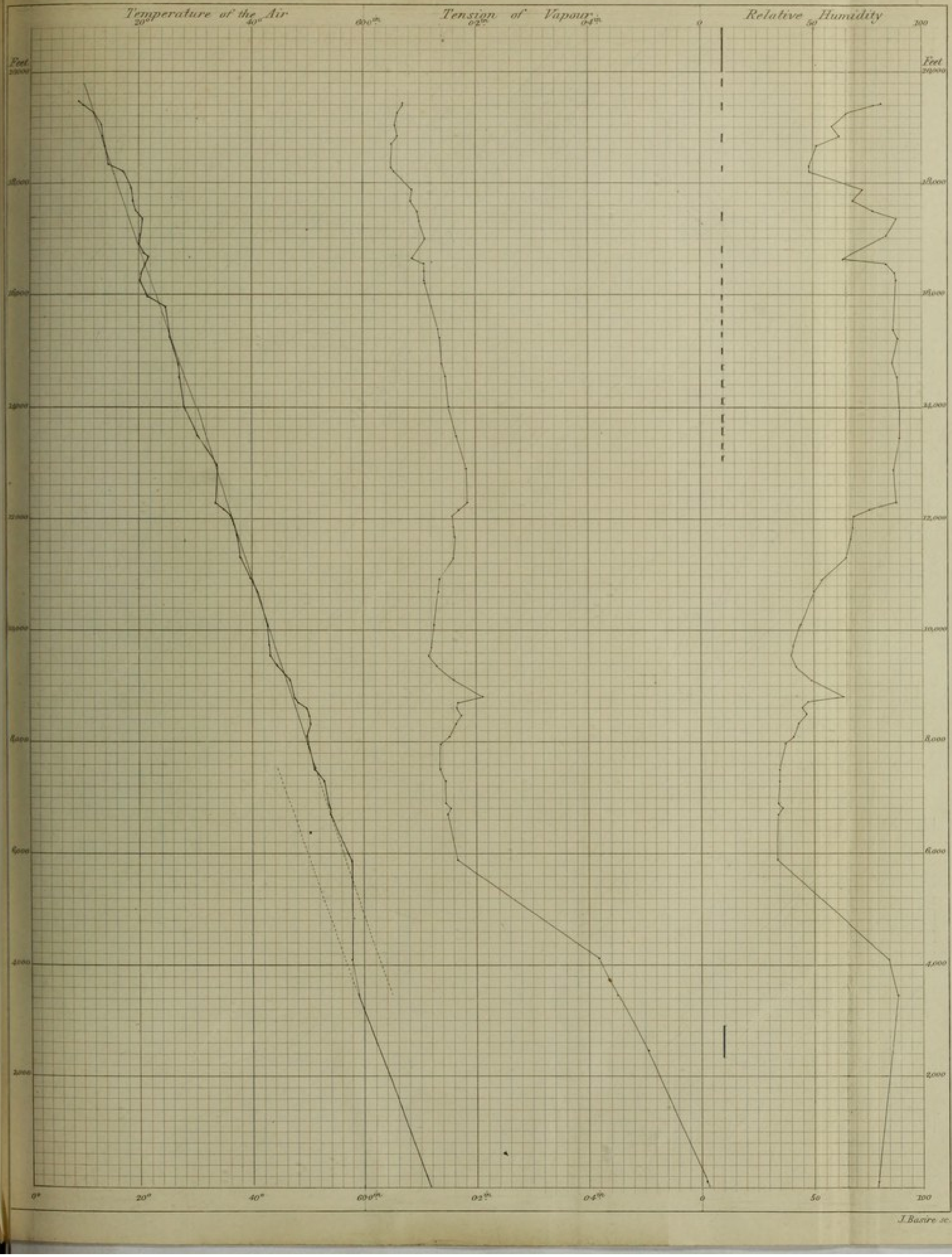
The scale employed for the temperature is one division to 2° Fahr.; for the tension of vapour, ten divisions to 0·2 inch of pressure of mercury; and for the relative humidity, twenty divisions to the whole range 0—100.

The straight lines drawn through the curves of temperature are deduced from the results of equation (1.) for the upper and lower divisions in each series (see p. 25).

The points ⊙ in the curves of tension of vapour are from the indications of Regnault's hygrometer.

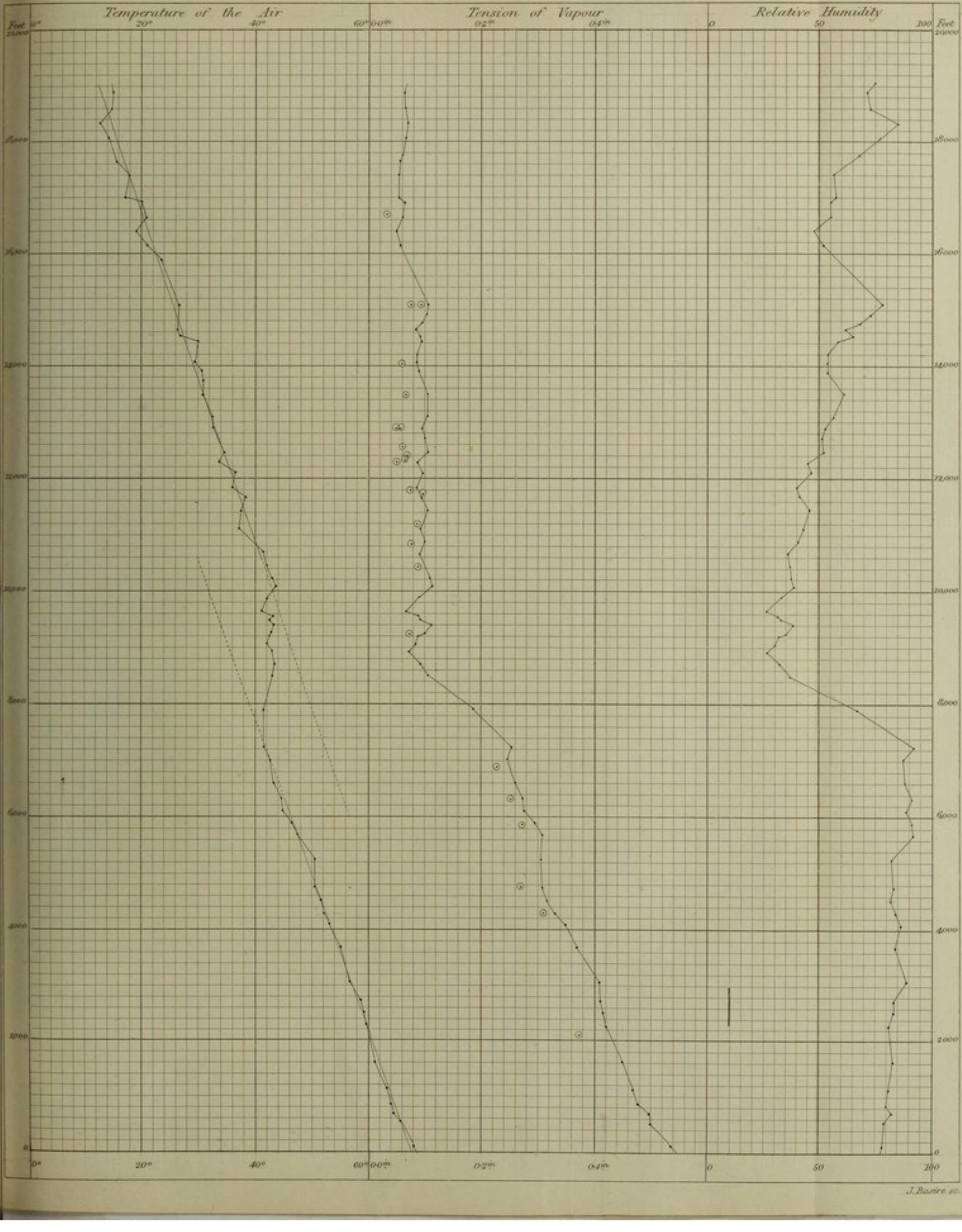
In the divisions occupied by the relative humidity the strong vertical lines correspond to the heights at which clouds existed in the air, dotted lines being drawn when the cloud was only partial.

Meteorological observations in the Balloon Ascent of August 17th 1852.

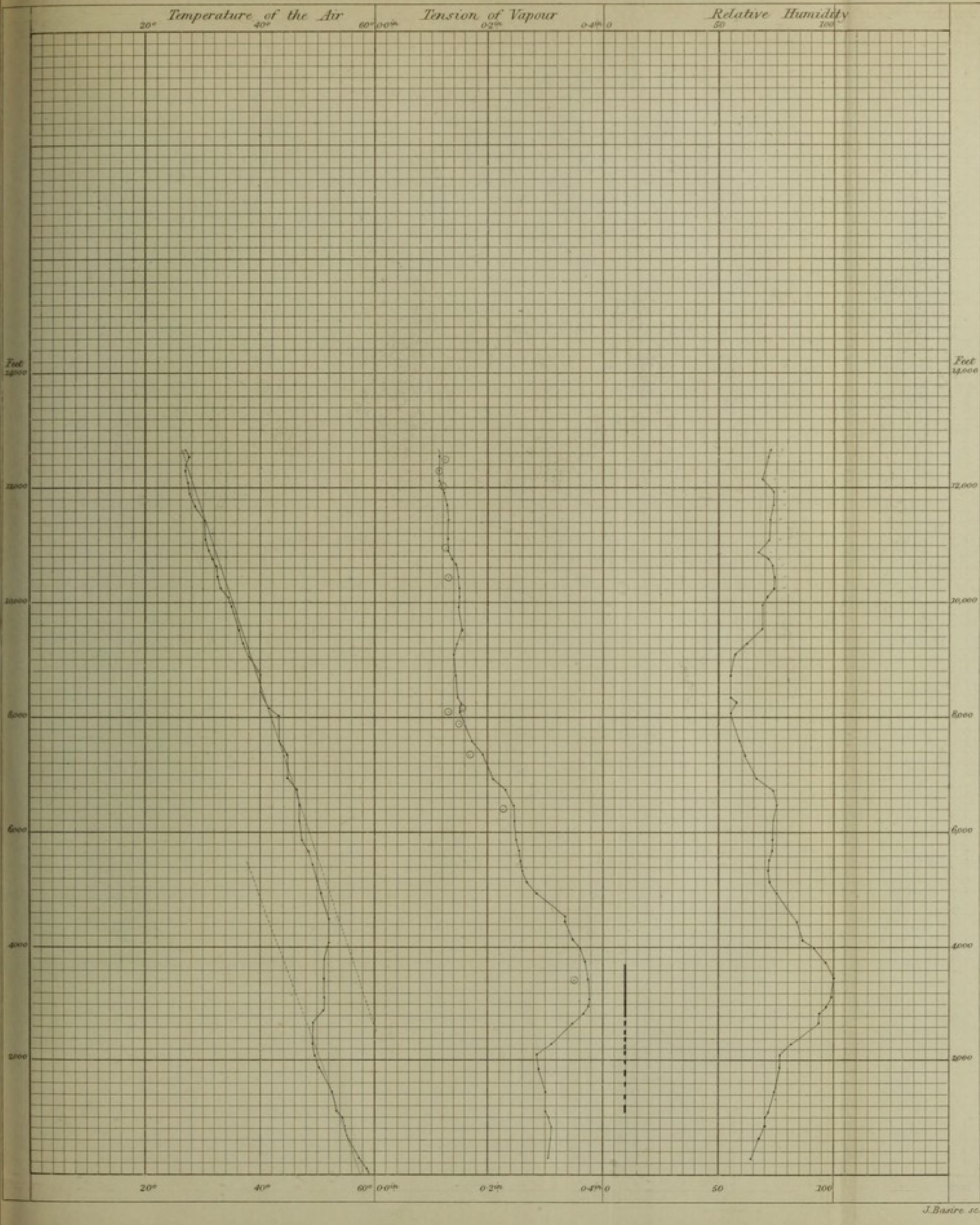


J. Basire sc.

Meteorological observations in the Balloon Ascent of August 26th 1852.



Meteorological observations in the Balloon Ascent of October 21st 1852.



J. Basire sc.

Meteorological observations in the Balloon Ascent of November 10th 1852.