PROCEEDINGS

OF

THE ROYAL SOCIETY.

1842. No. 54.

May 26, 1842.

The MARQUIS OF NORTHAMPTON, President, in the Chair.

Thomas Chapman, Esq., was balloted for, and duly elected into the Society.

Richard Quain, Esq., was also balloted for, but was not elected into the Society.

A paper was in part read, entitled, "On the Transparency of the Atmosphere, and the Law of Extinction of the Solar Rays in passing through it." By James D. Forbes, Esq., F.R.S., Sec. R.S. Edinb., Professor of Natural Philosophy in the University of Edinburgh.

June 2, 1842.

The MARQUIS OF NORTHAMPTON, President, in the Chair.

The reading of a paper, entitled, "On the Transparency of the Atmosphere, and the Law of Extinction of the Solar Rays in passing through it." By James D. Forbes, Esq., F.R.S., &c., was resumed and concluded.

This paper is divided into seven sections. In the first, the qualities of heat and light are considered in as far as they modify the comparability and absolute nature of our measures of the influence of the solar rays. All instruments, whether called *Thermometers*, *Photometers*, or *Actinometers*, measure but the peculiar effect to which their construction renders them sensible, but are incompetent to give absolute measures of either heat or light.

The second section treats of the history of the problem of the law and measure of extinction of the solar rays in passing through the atmosphere of the earth in clear weather. The labours of Bouguer, Lambert, De Saussure, Leslie, Herschel, Kämtz and Pouillet are successively passed under review, and their instrumental methods considered.

In the third section, a mathematical problem of considerable difficulty and interest is investigated; principally after the manner of

Laplace. It consists in the determination of the length of the path and the mass of air which a ray of light must traverse in passing through the earth's atmosphere at every different angle of obliquity. The author determines the numerical value of these quantities for all angles of incidence from 0° to 90°.

The fourth section contains an account of the observations made by the author in conjunction with Professor Kämtz in 1832. These were conducted in 1832 at the top and bottom of the Faulhorn, a mountain of the canton of Berne in Switzerland. The lower station was Brientz, and the intercepted stratum of air had 6800 English feet of thickness, corresponding in its weight to about one-fourth of the entire atmosphere. Frequent observations were simultaneously made with the actinometer and other meteorological instruments at both stations, and the loss of solar heat in passing through the intervening mass of air was thus directly determined.

In the fifth section, the observations made from sunrise to sunset, on one peculiarly favourable day (the 25th September, 1832), are carefully analysed; and from the absorption at various obliquities, the law of extinction in the atmosphere, within the limits of observation, is attempted to be deduced.

The sixth and seventh sections include the results of similar, but less perfect observations in 1832 and in 1841.

From the facts and reasonings of this paper, the author deduces, on the whole, the following conclusions:—

1. The absorption of the solar rays by the strata of air to which we have immediate access is considerable in amount for even moderate thicknesses.

2. The diurnal curve of solar intensity has, even in its most normal state, several inflections; and its character depends materially on the elevation of the point of observation.

3. The approximations to the value of extra-atmospheric radiation, on the hypothesis of a geometrical diminution of intensity, are inaccurate.

4. The tendency to absorption through increasing thicknesses of air is a diminishing one; and in point of fact, the absorption almost certainly reaches a limit beyond which no further loss will take place by an increased thickness of similar atmospheric ingredients. The residual heat, tested by the absorption into a blue liquor, may amount to between half and a third of that which reaches the surface of the earth after a vertical transmission through a clear atmosphere.

5. The law of absorption in a clear and dry atmosphere, equivalent to between one and four thicknesses of the mass of air traversed vertically, may be represented, within those limits, by an intensity diminishing in a geometrical progression, having for its limit the value already mentioned. Hence the amount of vertical transmission has always, hitherto, been greatly overrated; or the value of extra-atmospheric solar radiation greatly underrated.

6. The value of extra-atmospheric solar radiation, on the hypothesis of the above law being generally true, is 73° of the actino-

meter marked B 2. The limiting value of the solar radiation, after passing through an *indefinite* atmospheric thickness, is 15° 2′.

7. The absorption, in passing through a vertical atmosphere of 760 millimeters of mercury, is such as to reduce the incident heat from 1 to 0·534.

8. The physical cause of this law of absorption appears to be the non-homogeneity of the incident rays of heat, which, parting with their more absorbable elements, become continually more persistent in their character; as Lambert and others have shown to take place, when plates of glass are interposed between a source of heat and a thermometer.

9. Treating the observations on Bouguer's hypothesis of a uniform rate of extinction to the intensity of the incident rays, the author obtains for the value of the vertically transmitted shares of solar heat in the entire atmosphere,—

By the *relative* intensities at Brientz and the Faulhorn...	0·6842
By the observations at the Faulhorn alone,—	
First method	0·6848
Second method	0·7544
By the observations at Brientz alone,—	
First method	0·7602
Second method	0·7827

The President informed the Meeting that the Council had voted the following Address to Her Majesty, the Queen.

"*To the Queen's Most Excellent Majesty.*

"The Humble Address of the President, Council, and Fellows of the Royal Society of London for improving Natural Knowledge.

"Most Gracious Sovereign,

"We, Your Majesty's most dutiful and loyal subjects, the President, Council, and Fellows of the Royal Society of London for improving Natural Knowledge, beg leave to approach Your Majesty's throne with the expression of our deep sorrow that any subject of Your Majesty should dare to lift his arm against Your Majesty's sacred person. We offer up to Divine Providence the grateful homage of our hearts, that He has been graciously pleased to guard a life so valuable to all the inhabitants of these realms; and we pray most fervently that the same Almighty Protection may long preserve Your Majesty in the possession of health and every other blessing to your family and your people."

The President informed the Meeting that the Council had adopted the following Address to His Royal Highness Prince Albert of Saxe Coburg and Gotha:—

" *To His Royal Highness Prince Albert of Saxe Coburg and Gotha, K.G., F.R.S., &c.*

" The Humble Address of the President, Council, and Fellows of the Royal Society of London for improving Natural Knowledge.

" May it please Your Royal Highness,

" We, the President, Council, and Fellows of the Royal Society of London for improving Natural Knowledge, beg to be permitted, on the present occasion, to offer to Your Royal Highness our congratulation on the providential escape of Her Majesty and Your Royal Highness from the murderous attack of an assassin.

" That the same Almighty Arm may continue to preserve Her Majesty and Your Royal Highness from every danger, and from every evil, is our most sincere and earnest prayer."

June 9, 1842.

The MARQUIS OF NORTHAMPTON, President, in the Chair.

A paper was read, entitled, " On the Specific Inductive Capacities of certain Electric Substances." By William Snow Harris, Esq., F.R.S.

The author, pursuing the experimental inquiry suggested by the theory of Mr. Faraday relative to the differences in specific inductive capacity exhibited by different dialectric substances, instituted a series of experiments for determining with precision their comparative powers of insulation, and of sustaining by induction charges of electricity. The substances to be examined were cast into the form of circular plates and furnished on both their surfaces with circular coatings of tinfoil of a diameter equal to one-half that of the plate, and the electric intensities were measured by electrometers of the same construction as those which he used in his former experiments, and which he has described in his papers already published in the Philosophical Transactions for 1839. The results are stated in tables; from the last of which it appears that the inductive capacities of the dialectric bodies tried, that of air being expressed by unity, are proportional to the following numbers:—

Substances.	Relative capacities.
Air	1
Rosin	1·77
Pitch	1·8
Bees' wax	1·86
Glass	1·9
Brimstone	1·93
Shell-lac	1·95

The author, in conclusion, offers some observations on the expe-