PROCEEDINGS

OF

THE ROYAL SOCIETY.

May 4, 1876.

Capt. F. J. O. EVANS, R.N., C.B., Vice-President, in the Chair.

The Presents received were laid on the table, and thanks ordered for them.

In pursuance of the Statutes, the names of the Candidates recommended for election into the Society were read from the Chair as follows:—

Capt. William de Wiveleslie Abney, R.E.
Prof. Henry Edward Armstrong, Ph.D.
Rev. William B. Clarke, M.A., F.G.S.
James Croll, F.R.S.E.
Edwin Dunkin, Sec. R.A.S.
Prof. John Eric Erichsen, F.R.C.S.
David Ferrier, M.A., M.D.
Col. Augustus H. Lane Fox.
Prof. Alfred Henry Garrod, M.A.
Robert Baldwin Hayward, M.A.
Charles Meldrum, M.A., F.R.A.S.
Edward James Reed, C.B.
Prof. William Rutherford, M.D.
Robert Swinhoe, F.R.G.S.
Prof. Thomas Edward Thorpe, Ph.D.

The following Papers were read:—

I. "Supplementary Note on the Theory of Ventilation" (see Paper read on the 28th of January, 1875). By FRANCIS S. B. FRANÇOIS DE CHAUMONT, M.D., Surgeon-Major, Army Medical Department, and Conjoint Professor of Hygiene, Army Medical School. Communicated by Prof. STOKES, Sec. R.S. Received March 8, 1876.

In my previous paper I endeavoured to establish a basis for calculating the amount of fresh air necessary to keep an air-space sufficiently pure

for health, taking the carbonic acid as the measure. The results showed that the mean amount of carbonic acid as respiratory impurity in air undistinguishable by the sense of smell from fresh external air was under 0·2000 per 1000 volumes *. My object in the present note is to call attention to the relative effects of temperature and humidity upon the condition of air, as calculated from the same observations.

If we adopt the figures of Class No. 1 (that is "fresh," or not differing sensibly from the external air) we find the following:—

Temperature.	Humidity.	Carbonic acid.
63° F.	73 per cent.	0·1943 per 1000 volumes.

If, now, we arrange the observations according as they differ from the above standard of temperature and humidity, and note the record of sensation attached to each, we may ascertain how far the said record departs (if at all) from what it ought to have been as calculated from the actual CO_2. To do this we may employ the numerical values of the different classes, taking No. 1 (fresh) as unity, thus:—

Class.	Sensation.	Value.
No. 1.	Fresh	1·00
2.	Rather close	2·13
3.	Close	3·46
4.	Extremely close	4·66

Taking each observation and dividing the CO_2 found by the mean quantity of No. 1, viz. 0·1943, we get a number which will give the *theoretical* value of its effect upon the se nes; and by comparing this with the *actual* value of the *recorded* sensation, we can note whether the difference is *plus* or *minus*, if any. All observed quantities of CO_2 below 0·1943 are considered equal to that number, and all quantities above 0·9054 as equal to it, as the sense of smell does not seem capable of differentiating quantities except between those limits.

Out of 458 fully recorded cases, 186 gave a recorded sensation *in excess* of the theoretical value—that is, the air seemed less pure than would have been expected from its CO_2. In these the average temperature and humidity were both above Class 1.

* In the former paper the amount was given at 0·1830 per 1000; but on revising the calculations, a previously unobserved error was found in one of the constants employed, the correction for which would have the effect of altering the figures a little, the changes being as follows.—

Classes.		Respiratory impurity as CO_2. Original figures.	Corrected figures.
No. 1.	Fresh	0·1830	0·1943
2.	Rather close	0·3894	0·4132
3.	Close	0·6322	0·6708
4.	Extremely close	0·8533	0·9054

Except for the sake of rigid accuracy the difference is immaterial, as I adopted 0·2000 as the limit of respiratory impurity in an air-space well ventilated, and the corrected number 0·1943 is still below that.

152 cases gave a recorded sensation *below* the theoretical value—that is, the air seemed purer than would have been expected from its CO_2. In those cases the average temperature was above, but the average humidity below the mean of Class 1.

120 cases gave a recorded sensation that exactly corresponded with the theoretical value. In those cases the average temperature was above and the average humidity below the mean of Class 1.

Arranging these results and putting F for the temperature in degrees of Fahrenheit, and H for the humidity per cent., we have :—

$+ \ 58^\circ 6 \ F + 86 \ H = + \ 197 \cdot 70$	[1]	Aggregate difference of the recorded and the theoretical value of sensation.
$+ \ 230 \cdot 8 \ F - 82 \ H = - \ 117 \cdot 37$	[2]	Do.
$+ \ 244 \cdot 0 \ F - 91 \ H = \ 0$	[3]	Do.

Adding the two last equations, we have,

$+ \ 474^\circ \cdot 8 \ F - 173 \ H = - \ 117 \cdot 37$	[4]	Do.

From [1] and [4] we can determine the respective values of F and H, which are as follow :—

$$F = 0 \cdot 4730 \qquad H = 1 \cdot 9765$$

Or, stated in terms of CO_2, by multiplying by 0·1943,

$$F = 0 \cdot 0919 \qquad H = 0 \cdot 3833 \text{ per 1000 vols.}$$

Taking F as unity, we have,

$$F : H :: 1 \cdot 0000 : 4 \cdot 1789$$

Or an increase of 1 per cent. of humidity has as much influence on the condition of an air-space (as judged of by the sense of smell) as a rise of 4°·18 of temperature in Fahrenheit's scale, equal to 2°·32 Centigrade, or 1°·86 Réaumur.

This may be taken as a proof of the powerful influence exercised by a *damp* atmosphere, corroborating the conclusions arrived at by ordinary experience ; and it follows that as much care ought to be taken to ensure proper hygrometric conditions as to maintain a sufficiently high temperature. This is especially the case in the wards or chambers of the sick, in which regular observations with the wet and dry-bulb thermometers ought to be made ; these would probably give a valuable indication of the condition of the ventilation, either along with or in the absence of other more detailed investigations. Thus a room at the temperature of 60° F. and with 88 per cent. of humidity contains 5·1 grains of vapour per cubic foot: suppose the external air to be at 50° F. with the same humidity, 88 per cent. ; this would give 3·6 grains of vapour per cubic foot ; to reduce the humidity in the room to 73 per cent., or 4·2 grains per cubic foot, we must add the following amount of external air,

$$\frac{5 \cdot 1 - 4 \cdot 2}{4 \cdot 2 - 3 \cdot 6} = 1 \cdot 5,$$

or once and a half the volume of air in the room. If the inmates have each 1000 cubic feet of space, it follows that either their supply of fresh air is short by 1500 cubic feet per head per hour, or else that there are sources of excessive humidity within the air-space which demand immediate removal.

II. "On the Effect of Heat on the Chloride, Bromide, and Iodide of Silver." By G. F. RODWELL, F.R.A.S., F.C.S., Science Master in Marlborough College. Communicated by Professor TYNDALL, F.R.S. Received March 10, 1876.

III. "On the Effects of Heat on some Chloro-brom-iodides of Silver." By G. F. RODWELL, F.R.A.S., F.C.S., Science Master in Marlborough College. Communicated by FREDERICK GUTHRIE, F.R.S., Professor of Physics in the Royal School of Mines. Received April 13, 1876.

IV. "On the Absorption-Spectra of Bromine and Iodine Monochloride." By H. E. ROSCOE, F.R.S., and T. E. THORPE. Received March 16, 1876.

(Abstract.)

The paper contains the results of an exact series of measurements of the absorption-spectra of the vapours of the element bromine and of the compound iodine monochloride, made with the object of ascertaining whether the molecules of these two gases vibrate identically or similarly, their molecular weights and colour of the vapours being almost identical. The two spectra, which are both channelled, were compared simultaneously by means of one of Kirchhoff's 4-prism spectroscopes, the position of the lines being read off by reflection on an arbitrary scale. In order to determine the wave-lengths of these bands, the wave-length of each of 27 air-lines lying between the extremes of the absorption-spectra was ascertained by reference to Thalén's numbers; whilst for the purpose of reducing the readings of the absorption-bands to wave-lengths a graphical method was employed, the details of which are given in the paper. This method appears to be one of general applicability for the plotting of spectra.

Tables then follow giving the wave-lengths of 66 bands of each absorption-spectrum; and a map accompanies the text in which the bands are drawn to a scale one half that of Ångström's "Spectre Normal."

A careful comparison of these Tables and of the map shows that, although both spectra contain a large number of lines which are nearly coincident, the spectra as a whole are not identical, either when the vapours are examined at high or low temperatures, or when the lengths of the columns of absorbing gas are varied.