well-known decomposition of potassium iodide in sunlight has led us to believe that in this case (KI) the phenomenon is of similar character. The nature of this decomposition of potassium iodide has been much discussed, and observers, misled as it seems to us by a supposed analogy with ordinary photographic reactions, have singularly failed to recognise the possibility of the oxidation of metallic elements by light. Hence they have ascribed this behaviour of potassium iodide to acids, carbonic and other, of the atmosphere. On this point, however, we have satisfied ourselves; first, that in a Sprengel vacuum a 10 per cent. solution remains perfectly colourless in sunlight; and, secondly, that decomposition invariably occurs in an insolated solution when no other gases than nitrogen and oxygen are present.* Here the oxidation can only be that of the alkali metal, and analogy would suggest a similar inference in the case of the oxalates. We are, however, still engaged on the investigation, and our present object is rather to qualify the statement in our previous paper as to the supposed indestructibility of an alkali-oxalate by sunlight, than to advance to a conclusion for which the evidence is not yet sufficient.

XXI. "Preliminary Experiments on the Effects of Long-continued Stress on the Elasticity of Metals." By J. T. Bottomley, M.A., F.R.S.E. Communicated by Sir W. Thomson, F.R.S. Received June 14, 1879.

The following paper is intended to describe the results of experiments on elasticity of wires which have been carried on during the past two years, in the Natural Philosophy Laboratory in the University of Glasgow.

In 1875, at the Glasgow meeting of the British Association, a Committee was appointed, at the suggestion of Sir William Thomson, for the purpose of commencing secular experiments on the elasticity of wires, and a grant of money was placed at the disposal of the Committee.

These experiments have accordingly been commenced. An iron tube about 70 feet long has been erected in the tower of the University. Two wires of gold, two of platinum, and two of palladium,

* The mode in which we insured, as we believe, the absolute freedom of the air employed from acid impurity was the following:—Exhausting tubes to a good Sprengel vacuum, we admitted—by means of the apparatus we described in "Proc. Roy. Soc.," vol. xxviii, p. 210—air which had been standing, with frequent agitation, for six days over a solution of potassium hydrate. To make doubly sure, the exhaustion was again repeated and the purified air a second time admitted. The tubes thus treated acquired a brown tinge in light as quickly as did similar ones simply plugged with cotton wool.

have been hung up, one of each pair with a light stretching weight, and the other with a weight equal to half its breaking weight. Marks have been put upon the wires; and a cathometer has been erected opposite to a window in the tube for the purpose of observing the difference of elongations in each pair of wires.

In connexion with the commencement of these experiments we gave as an experimental exercise to some of the students in the Natural Philosophy Laboratory, the comparison of the stretching and breaking of wires at different speeds. Interesting results followed, and the investigation was then taken up systematically, and is still being carried on.

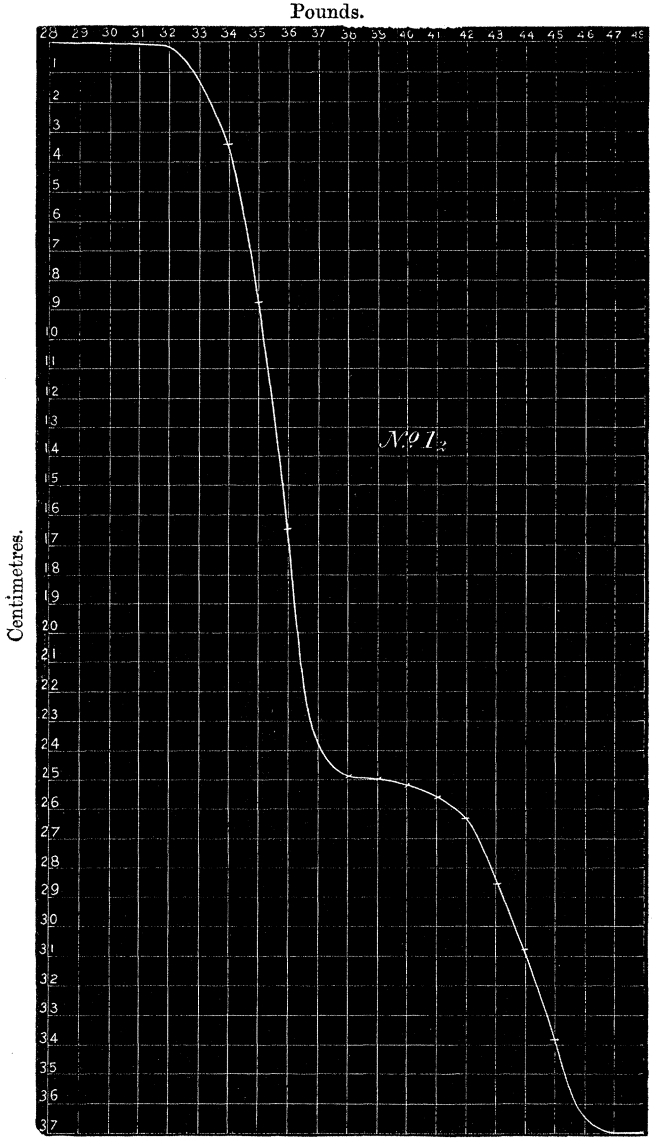
Pure soft iron wires were obtained, and were hung up with an arrangement for measuring the amount of elongation. They were then loaded more or less quickly till they broke, and the elongation with different loads was determined. A large number of curves, of which a specimen is given below, have been traced showing the elongation produced by different loads under given circumstances. They will be considered in detail in a future communication.

The following is a general account of the experiments that have been made.

Lengths from the same hank of the wire, which was specially drawn for the purpose, were hung up and a scale pan having been attached to the lower end, weight was put on till the scale pan and added weight together made up 28 lbs. This was the greatest weight that could be put upon the wire in its natural condition, without causing *permanent* elongation. The wire was generally left with this load applied to it for 24 hours. Sometimes the wire ran down very slightly in the 24 hours with the load, but not often.

Some of the wires were then broken quickly. One pound was added to the scale pan, say every three or every five minutes, except in cases where the wire was visibly running down, when no fresh weight was added till the running down stopped. Another set of wires was broken by adding a pound every 24 hours; another set was broken by adding three-fourths of a pound every 24 hours; another set by adding half a pound every 24 hours; and an experiment was commenced in which a quarter of a pound was to be added each day, but this was discontinued, and to this wire there was added one-sixteenth of a pound, not at regular intervals, but only after the wire had borne the weight on it for upwards of 24 hours without suffering any perceptible elongation. When a small weight is added to a wire, as was done in this case, the elongation takes place very slowly. The wire goes on running down slowly, often for several days, and it was in order to cause the whole effect of the previous weight to have been produced before any fresh weight was added that this mode of adding weight was adopted. The experiment unfortunately was brought to

an end after about five months had been expended on it by the wire becoming rusted through. A fresh wire was, however, suspended some months ago, and was carefully varnished to prevent rusting. It is now under experiment.



Wire No. 1_2, put up February 18, 1878, broke March 10 with 48 lbs., elongation 37 cent., or 8·132 per cent.

The following tables contain a considerable part of the results of these experiments.

Two kinds of wire were used both of pure soft iron wire, drawn for the purpose of these experiments, but differing slightly in the treatment during the annealing process. They are distinguished in our note books as " Black annealed wire " and " Bright annealed wire." Tables I and III show the results of quick breaking of these two wires, and Tables II and IV the results of slow breaking. It will be seen that the slow and long-continued application of stress has invariably strengthened the wire, a result in itself of great importance. It should tend to correct some of the views commonly held as to the danger of applying severe loads, as tests to iron structures, such as steam boilers. It appears that the iron wire here employed was in more than one case actually improved in strength by about 10 per cent. As the wires tested were about 16 feet long and very uniform, it is very unlikely that the wires 8, 9, 14, 15, in Table II, were abnormally strong over such a length; while the wire 12, in Table II, the only one which is not strengthened, may readily have contained some slight flaw, or may have been broken by some jar in putting on the weights.

The result as to amount of elongation is no less important. Wires broken rapidly receive an elongation of over 25 per cent. on the average; while the same wire broken slowly is only elongated by about 7 per cent., and in the case of the bright annealed wires so small elongation as 4·79 per cent. was found with a breaking weight increased by $5\frac{1}{2}$ per cent.

A specimen curve showing the relation between stretching weight and elongation is here given. It will be seen that the stretching does not go on uniformly. At the beginning the wire resists stretching very much, till the weight of 32 lbs. is reached. If, however, a weight of 29 lbs. be put on at first this resistance is overcome, and the curve goes uniformly down till a weight of about 35 lbs. is reached. About this point the wire appears to become abnormally stiff again, and resists weights up to about 42 lbs. This stiffness is again broken down by this weight and the wire runs rapidly down with increasing loads. These features are noticed in every curve and at very nearly the same loads.

It might be supposed that the stiffness at the very beginning is due to a skin of oxide acquired in the drawing and annealing process. This is not the case however. The wire may be cautiously elongated in such a way that the skin must be broken through *and the stiffness is still retained.* The stiffness acquired after loading to the extent of 35 lbs. could not in any case be accounted for by skin-stiffness.

Table I.—Quick Breaking of Iron Wire, ·036 inch in diameter, at various speeds. "Black Annealed Wire."

Number of experiment.	Rate of adding weight.	Breaking weight in pounds.	Per cent. of elongation on original length.
1	½ lb. per minute.	45	25·4
2	1 ,, 5 minutes.	45¼	25·9
3	,, ,, 5 ,,	45¼	24·9
4	,, ,, 4 ,,	44¼	24·6
5	,, ,, 3 ,,	44¼	24·9
6	,, ,, 3 ,,	45¼	29·6
7	,, ,, 5 ,,	44¼	27·8

Table II.—Slow Breaking of Iron Wire, ·036 inch in diameter, at various speeds. "Black Annealed Wire."

Number of experiment.	Rate of adding weight.	Breaking weight in pounds.	Per cent. of elongation on original length.
1	1 lb. per 24 hours	48	7·58
2	,,	48	8·13
3	,,	47	7·05
4	,,	47	6·51
5	,,	47	8·62
6	,,	47	5·17
7	,,	46	5·50
8	¾ lb. per 24 hours	49	8·50
9	,,	48¼	8·81
10	,,	46	7·55
11	,,	46	6·41
12	,,	45½	6·62
13	½ lb. per 24 hours.	48	8·26
*14	,,	50	8·42
15	,,	49	7·18

* Towards the end of the experiment weights were not put on at regular intervals, but much slower than ½ lb. per day.

Table III.—Quick Breaking of Iron Wire, ·036 inch in diameter, at various speeds. "Bright Annealed Wire."

Number of experiment.	Rate of adding weight.	Breaking weight in pounds.	Per cent. of elongation on original length.
1	1 lb. per 5 minutes	44¼	28·5
2	,, 5 ,,	44¼	27·0
3	,, 4 ,,	44¼	27·1

Table IV.—Slow Breaking of Iron Wire, ·036 inch in diameter, at various speeds. "Bright Annealed Wire."

Number of experiment.	Rate of adding weight.	Breaking weight in pounds.	Per cent. of elongation on original length.
1	1 lb. per 24 hours	47	6·92
2	½ " "	47	4·79
3	½ " "	46½	6·00

I have to acknowledge the very great assistance rendered to me in the carrying out of these experiments by Mr. Sinclair Couper, who has not only most faithfully carried out the work entrusted to his charge, but has in many cases originated and carried out experiments at various points of the inquiry.

XXII. "Note on the paper (read April 24)* 'A Summary of an Inquiry into the Function of Respiration at Various Altitudes on the Island and Peak of Teneriffe.'" By WILLIAM MARCET, M.D., F.R.S. Received June 16, 1879.

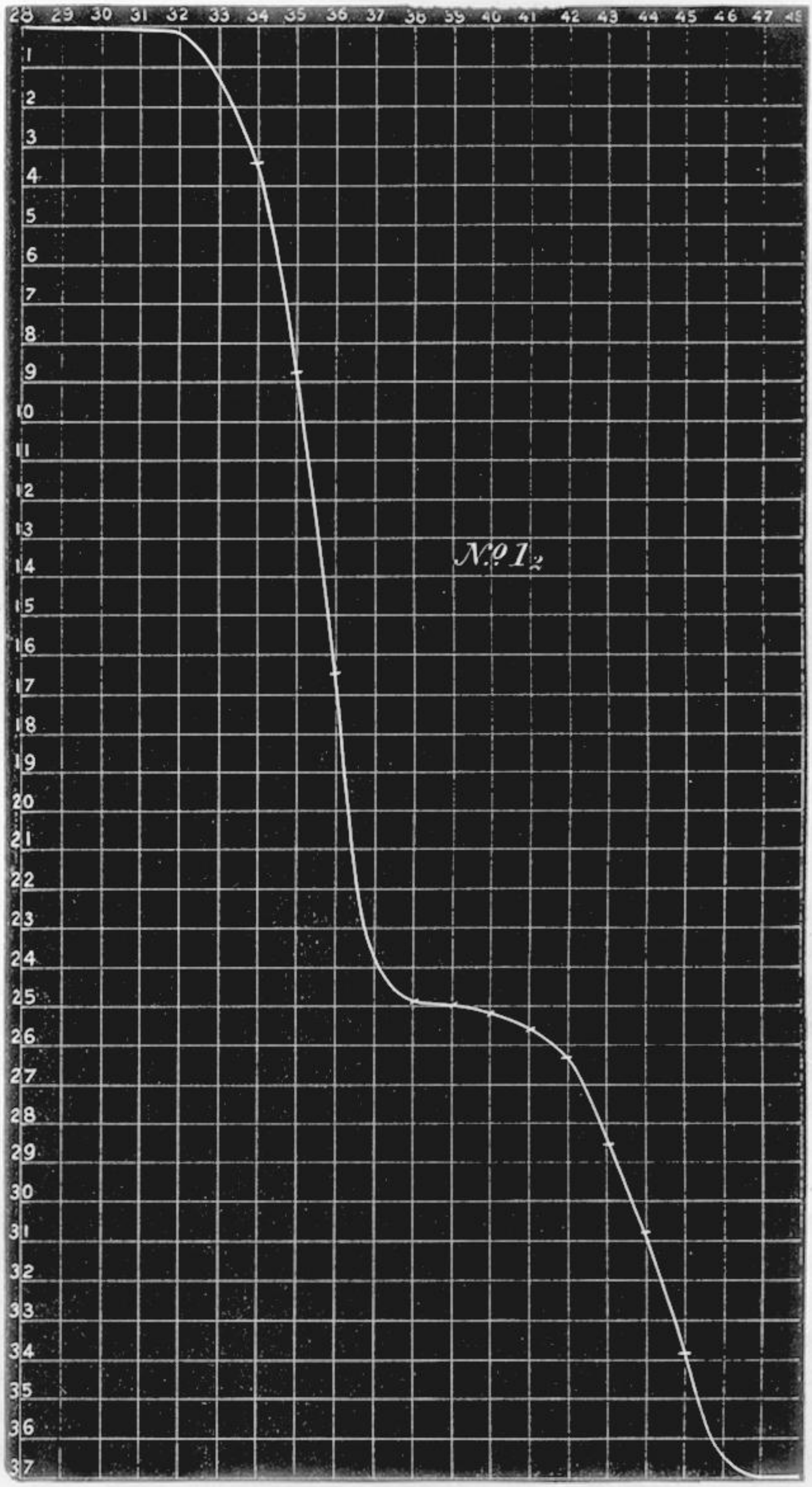
In the above-stated communication, after alluding to Dr. Rattray's observations† and remarking that I had formerly held the same views as he did, namely, that less carbonic acid was exhaled under increasing temperatures of the sun; I add, I am now compelled, however, to alter this view, and to conclude that more carbonic acid is formed in the body under a tropical or nearly tropical sun than under temperate latitudes.

Lest I should be considered as ascribing to the sun's heat a power which so far has not been acknowledged by physiologists, namely, that of increasing the formation of carbonic acid or the combustion in the body, I must beg to explain in a few words how the question now stands. I shall end by asking leave to suspend any opinion as to the cause of the increase of combustion in the body I observed to take place on the Island of Teneriffe, until more direct experiment has been brought to bear on the subject.

From trustworthy experiments by known authors, heat and light are found to act differently with respect to the formation of carbonic acid in the animal and human body; increased heat, as a rule, diminishes the production of this gas, and it is generated in excess under increased light.

* "Proc. Roy. Soc.," vol. xxviii, p. 498.

† "Proc. Roy. Soc.," 1870, 1871, 1873.



Wire No. 1_2, put up February 18, 1878, broke March 10 with 48 lbs., elongation 37 cent., or 8·132 per cent.