

lengths, I was led to the discovery of some simple relations, the further study of which will perhaps one day help to simplify the theory of flames. By specific flame-length I mean the length of flame of a combustible gas burning in a normal atmosphere at a standard rate through a simple circular orifice under such conditions as to produce a symmetrical, vertical, steady flame capable of being measured. These conditions are not difficult to obtain in the case of coal gas. In fact for a very long time a flame-length test has been in use amongst gas-makers, but as the comparison has not always been made on the basis of volume the results have not always been satisfactory. The system I advocated was that of stating the flame-length for some standard rate. It occurred to me at that time that the flame-length should be proportional to the consumption or rate of issue of the gas. On submitting this theory to experiment I obtained satisfactory evidence that such was the case, as the following table taken at chance from a series of experiments will show:—

Flame-length. Inches.	Rate of consumption per hour. Cubic feet.	Calculated rate for 10" flame. Cubic feet.
2 ... ..	75 ... ..	3'75
3 ... ..	1'13 ... ..	3'77
4 ... ..	1'5 ... ..	3'75
5 ... ..	1'85 ... ..	3'70
6 ... ..	2'25 ... ..	3'75
7 ... ..	2'6 ... ..	3'71
8 ... ..	2'98 ... ..	3'72

I have therefore formulated the following laws:—

1. That the flame-length of a combustible gas is proportional to the consumption.

2. That the flame-length is the distance travelled by a gas in obtaining oxygen for its consumption.

3. That the flame-lengths of different gases are proportional to the relative amounts of oxygen required for their combustion.

The last remains to be proved, and I have been led to experiment upon simple gases such as hydrogen, carbonic oxide, and sulphuretted hydrogen, with the object of determining their specific flame-lengths; but these gases give flames offering great difficulties in measurement. The flames given by coal-gas under suitable and easily-obtained conditions offer no difficulty, but I have not been able at present (owing to the difficulty mentioned above) to obtain very satisfactory results with the above-mentioned three simple gases. Other simple gases have suggested themselves, but the cost of preparing them in a state of purity in sufficient quantity has at present prevented their use. However, with regard to sulphuretted hydrogen and carbonic oxide, I have found their flame-lengths stand in the relation of 3'2 to 1.

In view of the difficulty of measuring the flames of these simple gases I am about to effect the determination by indirect means. By preparing mixtures of known composition that will give easily-measurable flames, I hope to be able to throw some light upon this subject of flame-lengths.

March 22

LEWIS T. WRIGHT

#### Future Development of Electrical Appliances

As many of your readers have doubtless read Prof. Perry's interesting paper on the future development of electrical appliances, a remark on one or two points might not be out of place. In speaking of the application of electricity to railway travelling, Prof. Perry says that the weight of the train would be much reduced under the proposed conditions, and rail friction would be minimised. It strikes us that to have light trains would not be altogether an advantage, for several reasons. The lighter the train the less profitable would be the *vis viva* against a strong wind (and the latter is an important element in railway locomotion). Again, the stability of a heavy carriage is much greater than that of a light one, and a heavy engine in front of the train must steady the whole system. It would be interesting to ascertain from a practical engineer whether a train of six coaches with self-propelling powers could safely run at a speed of fifty-eight miles an hour.

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#### Prehistoric Europe

I AM sorry to have to ask you again to allow me to correct some statements made by Prof. Dawkins in the matter of the Victoria Cave explorations (NATURE, vol. xxiii. p. 482).

1. He says that "the antiquity of man in the Victoria Cave is solely due to the *perferendum ingenium* of Mr. Tiddeman. It was first based on a fragment of fibula which ultimately turned out to belong to a bear. Then it was shifted to the cuts on two small bones." It is not, I believe, usual in the arena to hand over your own broken disabled weapon to your adversary to defend himself with when you take a new one. Yet this appears to be one of Prof. Dawkins's tactics. Who, reading the above remark, would believe that Prof. Dawkins ever held the following opinion? "Although the fragment [of the fibula] is very small, its comparison with the abnormal specimen in Prof. Busk's possession removes all doubt from my mind as to its having belonged to a man who was contemporary with the cave-hyena and the other Pleistocene animals found in the Cave" ("Cave-Hunting," p. 120.)

So far from the evidence having been "shifted" to the two small bones, on the breaking down of the fibula evidence, the latter event happened in 1878, whereas attention was called to the former in the Reports for 1875-6, the respective years of their discovery.

2. "The bones are recent," says Prof. Dawkins. "This is evidently a very old bone," said Prof. Busk, after inspecting and experimenting on one of them submitted to him; and the whole of the circumstances of its discovery confirm that opinion.

3. "The cuts have been probably made by a metallic edge." That is a mere opinion, and to show what it is worth I may remark that at the discussion at the Anthropological Institute in 1877, when Prof. Dawkins stated that the marks looked as if they had been made with a Sheffield whittle, another member, at least equally distinguished, and apparently equally desirous to oppose the evidence, said that the marks seemed to have been made by a rock slipping across the bones.

4. Prof. Dawkins states that there were frequent slips of the materials after I took charge of the work. He has, I think, been misinformed, for his own visits to the Cave during that period were not sufficiently frequent to warrant any such statement, and our endeavour was to work the Cave in such a method as would entirely prevent the possibility of such accidents and the mixture of the remains.

5. Prof. Dawkins goes on to show:—(1) Either that Dr. Geikie and I believe that "there is evidence of inter-glacial or pre-glacial man, possessed of domestic animals, and probably using edged tools of metals" (which we certainly do not); or that (2) in his opinion goat has never existed anywhere save as a domesticated animal, for his remarks proceed upon one or other of these two assumptions.

6. Bones of goat were far from uncommon in the hyena-bed of the Cave, and found under such circumstances as would render their slipping down from higher beds quite impossible. The same is the experience of that distinguished explorer, M. E. Dupont, Director of the Geological Survey of Belgium, in the caves of that country:—"J'en maintiens absolument la co-existence avec ces espèces perdues" (*Journ. Anthropol. Inst.*, vol. vii. No. 2, p. 168). Unfortunately the non-existence of goats in Pleistocene deposits in Great Britain has been elevated to a dogma, and when the animals are found in such association it is immediately assumed that they have slipped from above—a confession to a very slipshod method of working—or, that the beds have previously been disturbed. All such cases should be most carefully inquired into and observed at the time without prejudice.

7. Again, Prof. Dawkins says that I wrote that the fact of the finding of reindeer with the earlier Pleistocene animals was "noteworthy," and that it is now too late to recall it. I do not recall my statement, but I should like it quoted correctly. "Your reporter had an impression that the reindeer remains occurred at some height above the hyena-bed.<sup>1</sup> Be that as it may, Prof. Dawkins's opinion<sup>2</sup> is entitled to great weight, and is indeed the view generally held. At the same time, considering that hyena and reindeer are not uncommonly found together in caves, when, as in this case, we see them mixed together at one or both ends of a section, but separated through an interval of seventy feet in length by a thickness of deposits, we may regard the fact as at least an interesting one, and, when found, noteworthy" (*Brit. Assoc. Reports*, 1876, p. 118). Prof. Dawkins shall have the whole of that. I will not recall even the middle sentence.

R. H. TIDDEMAN

Hastings, March 26

<sup>1</sup> This was also the opinion of Mr. Jackson, our painstaking superintendent, who was daily at the Cave.

<sup>2</sup> *i.e.*, of the co-existence of these animals.