heat expanded the lower atmosphere, the upper cloud-stratum would be lifted, flattened, and broken into patches, the result being a mackerel sky. Should, however, the expansion in the lower atmosphere take place very slowly, it was possible that the cloud, though thinned, would remain unbroken. Rapid motion of the atmosphere would elongate the cloud in the direction of motion; and, if accompanied by expansion from below, would rupture the cloud into ribs or bars at right angles to the current. If the mass of the cloud were stationary or moving slowly, prominent parts might be drawn out into "mares'-tails."

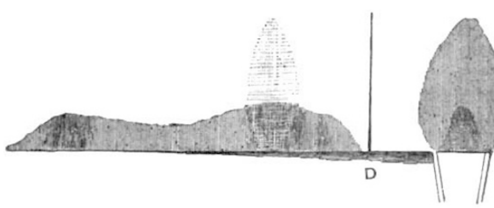
FURTHER EXPERIMENTS ON FLAME

In my former paper, published in NATURE, vol. xxxi. p. 272, I showed that there are two classes of continuous spectra, viz. those due to an incandescent precipitate, in which case the flame has the power of reflecting and polarising light; and, secondly, flames that possess no reflecting power, but give a soft continuous spectrum without maxima or minima.

Of this second class is carbonic oxide, which gives, at normal pressures, a fairly bright, and at increased pressure, according to Dr. Frankland, a very bright, continuous spectrum. I have observed its spectrum recently under reduced pressure, using an apparatus similar to that described by Dr. Frankland in his "Experimental Researches," p. 884 *et seq.*

I had considerable difficulty at first in keeping the flame alight at anything like low pressures, and finally adopted a glass jet, of a trumpet shape, increasing very gradually from 1 millimetre to 3 millimetres in diameter, the flame being farther shielded from draughts by a wide disk of cork 10 millimetres below the mouth of the jet.

Experiment 1.—Carbonic oxide was burnt in oxygen. The flame was densest close to the jet, and diminished in brightness



Flame of carbonic oxide burning in oxygen at 60 mm. pressure, with spectrum showing maxima. The continuous spectrum at the bottom is given by the red-hot top of the glass jet.

to the tip, without any definite separation into mantles with a space between. At normal pressure every part of it gave a continuous spectrum.

At about 260 millimetres there began to be a noticeable concentration of the light in the violet and the green in the position of the principal bands of the carbon spectrum. At 120 millimetres the concentration was unmistakable, but the spectrum was still continuous. At 60 millimetres it presented the appearance shown in the sketch. There appeared to be a second maximum in the green—not, however, at all well defined—but the principal maximum was continued upwards into a faint green cloud corresponding to the very faint tip of the flame; this cloud was perfectly isolated, but, unlike the carbon bands, was brightest in the middle.[1] I failed to see a similar cloud over the maximum in the violet, but this might be owing to insufficient light, my pumps being only able to maintain so high a vacuum against a very small flame. Mr. T. Legge, of Trinity, who was with me, observed that the comparative absence of the blue was very remarkable.

My supply of oxygen becoming exhausted, I had to use air. The flame became less bright, and the maxima less marked. By turning it very low, we brought the gauge down to 40 millimetres. The flame still burnt steadily.

Finally, at 60 millimetres pressure, I adjusted the flame to a height of three-quarters of an inch, opened the air-taps, and checked the pumps. The flame increased in brightness and decreased in size to rather more than a quarter of an inch at normal pressure, the spectrum becoming again perfectly continuous.

[1] It is impossible in a woodcut to give a true idea of the extreme faintness of this isolated cloud. It is only visible when the brighter part of the spectrum is hidden from the eye, and the room is perfectly dark.

Experiment 2.—Having the apparatus ready, I repeated Dr. Frankland's experiment of burning coal-gas in air under reduced pressure. He says that "finally, at 6 inches pressure, the last trace of yellow disappears from the summit of the flame, leaving the latter an almost perfect globe of a peculiar greenish-blue tint."

He used a jet contracted at the mouth to 1·5 millimetres. With my much wider trumpet-shaped jet, by turning on more gas I could produce smoke at 160 millimetres so as to blacken the glass chimney. At 120 millimetres the light was noticeably less vivid, the flame having a diluted appearance, but the spectrum showed the usual carbon lines much more sharply defined, the mantles being very much thicker than at normal pressure. With this exception there was no difference caused by the reduction of the pressure to 60 millimetres, and even then, on turning up the gas a little, the ellipsoidal flame became pointed, and the yellow light, giving the incandescence spectrum, re-appeared in the tip of it. It is evident that the trumpet-shaped jet allows carbon to be precipitated in the flame at much lower pressures than the contracted jet. In the same way alcohol heated in a bulb tube burns from the mouth of it with a bright and even smoky flame, whereas it burns from a wick with a blue one.

One phenomenon observed by Dr. Frankland I was disappointed not to see. He says: "Just before the disappearance of the yellow portion of the flame there comes into view a splendid halo of pinkish light forming a shell half an inch thick around the blue-green nucleus; . . . the colour of this luminous shell closely resembles that first noticed by Gassiot in the stratified electrical discharge passing through a nearly vacuous tube containing a trace of nitrogen." He does not speak of having used the spectroscope to determine the nature of this pink glow.

I went considerably below the lowest pressure mentioned in his paper, viz. 4·6 inches, but entirely failed to reproduce it. But I have noticed that very small flames from capillary tubes, observed under a power of 100 in the microscope, are sometimes tinged with rose-colour in the outer mantle, from a very faint trace of sodium orange light mingling with the blue of the soft outer mantle; and I think that the jet he used or the glass chimney may have been sufficiently heated to give a rosy tinge to the flame.

One other point I would call attention to. The appearance of the gas-flame at low pressures is precisely like that of a very small gas-flame under the microscope. The inner mantle appears to be bordered with bright green light, due to the principal green band of the carbon spectrum extending slightly beyond the others. Beyond this, again, comes a zone of violet light due to the band in the violet, and in most cases this extends nearly, if not quite, to the outer mantle. At ordinary pressures this can only be seen with a magnifying-glass, except with a special burner; but the *in vacuo* flame is, as it were, magnified as to its structure, which is thus visible to the naked eye. This fact suggests that flames may in a sense obey Boyle's law, *i.e.* that the space required for complete combustion under given conditions varies inversely as the pressure. I am continuing my experiments.

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SOCIETIES AND ACADEMIES

LONDON

Royal Society, November 18.—"The Coefficient of Viscosity of Air. Appendix." By Herbert Tomlinson, B.A. Communicated by Prof. G. G. Stokes, P.R.S.

In the previous experiments by the author on this subject, the coefficient of viscosity of air was determined from observations of the logarithmic decrement of amplitude of a torsionally vibrating wire, the lower extremity of which was soldered to the centre of a horizontal bar. From the bar were suspended vertically and at equal distances from the wire a pair of cylinders, or a pair of spheres. The distances of the cylinders or spheres from the wire were such that the *main* part of the loss of energy resulting from the friction of the air may be characterised as being due to the *pushing* of the air.

Acting on a suggestion of Prof. Stokes, the author proceeded to determine the coefficient of viscosity of air by suspending a hollow paper cylinder about 2 feet in length and half a foot in diameter, so that its axis should coincide as to its direction with the axis of rotation. The cylinder was supported by a light hollow horizontal bar, about 7 inches in length, to the centre of which the vertically suspended wire was soldered. The wire