

ation of the molecules into high and low velocity groups very nearly perfect. A demon might be slaving with the most commendable energy, but all his exertions would be rendered inoperative by the imperfections of our apparatus. To my mind, the evidence for the second law, even applied to the best actual heat engines, is extremely slight.

But even if the evidence were overwhelming, there would be no justification for applying the law to a process of such an entirely different nature as osmosis, where, moreover, there is some presumption that it is not true. No actual membrane is perfectly semi-permeable; some molecules of the solute pass through; it is not wildly improbable that these molecules possess velocities within some narrow range. But if this is so, Maxwell's demon is at work, the second law is not applicable, and thermodynamic reasoning is absurd. Definite experimental proof must be offered before the validity of the law for osmosis can be considered even probable. Some progress might be made by examining the same membrane at different temperatures; if its "degree of imperfection" did not vary rapidly with the temperature, the existence of such a separation as has been suggested would be rendered less probable.

Mr. Whetham has offered some proof already. He points out that there are five assumptions involved, and asserts that the truth of all of them is proved by the agreement between theory and experiment. But he ignores the possibility that two or more of the assumptions may be incorrect and that the errors thus introduced may cancel each other. He offers a particular solution of an equation containing five variables, and assumes that it is the only solution possible.

It must be remembered that there is not perfect agreement between theory and experiment. The errors are larger than those involved in the direct measurement of the pressure and the other quantities involved; there is a systematic error. But this is due, say the thermodynamicists, to the imperfection of the membrane. Exactly so; but that imperfection may invalidate the whole proof; in order to support their proof they may be denying one of their fundamental assumptions.

Mr. Whetham says that to reject the theory because there is no perfect membrane would be as absurd as to reject all thermodynamics because there is no reversible engine. I agree; but then I am such a heretic that I reject both. Our inability to construct a perfectly reversible engine is connected with the impossibility of handling individual molecules; friction and the rest would vanish if we could replace the material cylinder by a swarm of trained demons. When we have constructed a perfectly reversible engine we shall be possessed of the powers of those demons, and we shall be no longer bound by the second law, which merely asserts that we do not possess those powers. So far as physicists are concerned, reversible thermodynamics is "a vain thing."

Neither am I convinced of the perfection of Mr. Whetham's two perfect membranes. They are doubtless perfect so far as the solute is concerned, but his assumption (2) may be violated by the molecules of the solvent. It is quite possible that it is the swifter molecules which escape in the vapour and the slower which escape into the solid, and that, if our experimental devices were sufficiently delicate, we could use the separation thus effected to perform useful work. At any rate, proof is required to the contrary before thermodynamic deductions can be made with accuracy.

So far as I can see, thermodynamic reasoning applied to osmotic phenomena, as to most others, proves nothing but that the sum of the errors introduced by the various rather doubtful assumptions is not very different from zero—a result that does not seem to me worth the labour that has been expended in obtaining it

NORMAN R. CAMPBELL.

Trinity College, Cambridge, May 20.

The Oscillation of Flame Cones.

PROF. GALLOWAY (*NATURE*, April 19, p. 584) considers that my explanation of the phenomenon described by Mr. Temple in his letter (March 29, p. 512) is inadequate, and he offers a different explanation. With the view of deciding the question some experiments have been made here by

Mr. C. E. Whiteley. I may perhaps repeat that the phenomenon in question is the continued descent and re-ascent of the inner cone of a coal-gas and air flame when a suitable mixture of the two is ignited at the end of a glass tube fixed so as to form a prolongation of the metal tube of a Bunsen burner.

The following results were obtained by Mr. Whiteley:—(1) The continued oscillation of the inner cone could not be established with a forced supply of both gas and air, but only when the air was sucked in by the injector action of a gas jet, as in the ordinary Bunsen burner. (Mr. Temple informs me that this was also his method of working.) (2) The continued oscillation of the inner cone could be maintained when the apparatus was tilted even to horizontality or beyond. (3) When the inner cone began to descend a back pressure was immediately produced in the ascending current of gas and air.

I think the determining influence is clear from these observations. When the cone begins to descend and causes a back pressure this will momentarily check the indraught of air without materially checking the supply of gas. A stratum of mixture containing less air is thus produced; its rate of inflammation is less than its upward velocity, and so the cone is carried to the top of the tube. Soon the normal air supply is re-established, a mixture with a higher rate of inflammation is restored, and the cone again descends.

A confirmation of this explanation is afforded by two further observations:—(4) a shortening of the glass tube increases the rapidity of oscillation in conformity with the shorter distance to be traversed by the altered stratum; (5) a "capacity" in the form of a globe at the bottom of the glass tube stops the oscillation. Such an arrangement would both damp the back-pressure impulse and obliterate stratification.

Observations (2) and (5) show, I think, that the chimney-like action suggested by Prof. Galloway cannot be the determining cause, and indeed this could hardly be expected, inasmuch as such action would increase the aspiration of air and produce a mixture having a higher rate of inflammation, a condition which would oppose the other effect, viz. the increased upward velocity of the mixture to which alone Prof. Galloway alludes.

My own previous explanation was inadequate to explain the continued oscillation, and only important in relation to the lighting back of Bunsen flames.

ARTHUR SMITHELLS.

The University, Leeds, May 19.

Ancient Fire Festivals.

IN reference to your series of articles which have recently appeared in *NATURE* on Stonehenge and the ancient festivals, I send you the following notes on a Wiltshire celebration of the August fire customs. Tan Hill Fair is held on August 6, and the coincidence of the name Tan (Celtic for fire) and the date point to a time long prior to our era, when the fire festivals were annually held.

This fair, the origin of which is lost in antiquity, is held in the very last place likely to be chosen for such a purpose, and must have had its beginning at a time when men assembled there for some purpose very different to what brings them there now, for neither roads nor waterways (conditions essential to most fairs) lead to Tan Hill.

Tan Hill is on the highest part of the downs (near Devizes, north Wiltshire), 958 feet above sea-level, looking down on Avebury and dominating the whole country, and crossed only by British trackways which lead to the fair.

Sacred fires lit of old on this Tan Hill would have been seen from Martinsell (near Marlborough), Hackpen, Oldbury, and for miles around, and were probably eagerly watched for by the people taught to expect the blessing on the crops of the ensuing year consequent on these fires; and it is on this bleak, desolate down that one of the largest fairs of the country is held.

Fairs in Ireland and in Wales carry on the same tradition of the ancient fire festival held in August, as well as this one at Tan Hill.

In ancient Ireland this August celebration was called "the *Lugnassad*," the feast of Lug (a sun god), and according to Prof. Rhys "this festival was the great event