Spectra and Latent Energy in Flame Gases

AFTER flame has travelled through an inflammable gaseous mixture the gases remaining are not merely hot CO_2, etc. They emit luminous radiation for a long time (if their temperature is kept up), their temperatures as determined by the sodium line reversal method are too high, and they have associated with them a long-lived latent energy which amounts to a considerable proportion of the heat of combustion. The evidence for this has been summarised in a recent article in the *Engineer*[1].

The spectral examination of the after-glow of CO_2 after excitation in a vacuum tube, and of CO-flames, by Prof. Fowler and Mr. Gaydon[2] suggests that during combustion CO_2 molecules are formed of a type similar to those responsible for the after-glow. It is conceivable that the latent energy in flame gases may be associated with metastable CO_2 and H_2O molecules, or it may be that it results from a dissociation of these molecules in a manner quantitatively widely different from that of ordinary thermal dissociation.

In the case of CO-air combustion we have found that the latent energy is much greater in constant pressure combustion than in closed vessel explosions. To take a typical example, in a particular mixture burning at 5 atmospheres the latent energy is 15 per cent of the heat of combustion, whereas when this mixture is exploded in a large closed vessel at such initial pressure that the explosion pressure is 5 atmospheres, it is only about 5 per cent (and would only have been about half of this had the initial pressure been 5 atmospheres).

An interesting correlation with flame and explosion spectra may be made. Prof. Bone and his co-workers have shown that there is a "marked shortening in the ultra-violet" in CO-explosion spectrograms when compared with those from ordinary CO-flames[3]. It would thus seem that the greater the latent energy in the CO-flame gases the greater the relative intensity of the ultra-violet radiation; and this suggestion is further supported by a comparison of Prof. Bone's spectrograms with our latent energy determinations in the constant pressure burning of pure CO-mixtures at various pressures.

As will be clear, however, from the typical example given above, there appears to be some essential difference between combustion in CO-explosions in a large vessel and in CO-flames. It would be of interest to take spectrograms of the after-glow from the flame gases left behind the flame front as it travels through a long tube filled with CO-mixtures. It seems possible that, whereas after the uniform slow movement the spectrogram would be of the ordinary flame type, its character may change to that of the explosion type when nearing detonation.

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[1] "Temperature and Latent Energy in Flame Gases", *Engineer*, June 1, 1934.
[2] *Proc. Roy. Soc.*, A, **142**, 362; 1933.
[3] "Gaseous Combustion at High Pressures". Bone, Newitt and Townend. (Longmans, 1929.) Pp. 196.

Lunar Periodicity in the Conjugation of *Conchophthirius lamellidens* Ghosh.

THE ciliate *Conchophthirius lamellidens*, living as an ectoparasite on the gills of a fresh-water mussel *Lamellidens marginalis* Lamarck, has been under our observation for nearly two years. The specimens were collected from ponds in Calcutta. We had seen conjugation in this ciliate from time to time, but it was not until September 1933 that we started keeping proper records in order to determine the frequency of occurrence of this process. Our method of procedure has been to examine four mussels every day and search the gill scrapings for conjugants.

The accompanying diagram (Fig. 1) on which we have plotted the average number of conjugants against the day on which they occurred during six months, together with the maximum and minimum air temperatures for those months in Calcutta, is self-explanatory. It clearly shows that the number of conjugants for the month has usually been highest on the day following the new moon. In the month of December the peak was shifted by five days. In this month the temperature graphs show the arrival of the first cold wave of the season (though mild) a few days before the new moon. This appears to be not only responsible for shifting the anticipated date from December 18 to 22, but also for making the process linger over a number of days. The 'slackers', therefore, were in evidence even up to January 8, 1934. The data for March were just available at the time of writing. The arrival of an unusual cold wave about the middle of the month appears to have retarded the process so much that only one pair of conjugants was seen on the date anticipated, namely, March 16.

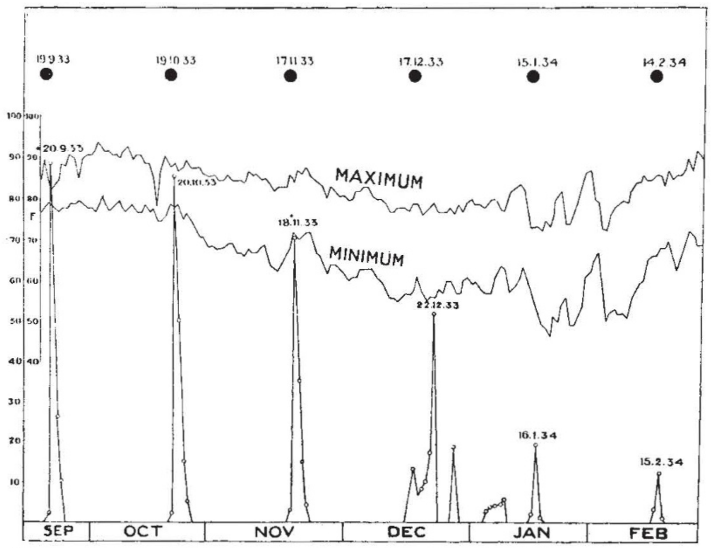

FIG. 1. Lunar periodicity in conjugation of *C. lamellidens*. Ordinates show average number of conjugants.

The graph suggests that (*a*) normally the peak occurs on the day following the new moon if there are no disturbing factors, of which the air temperature fluctuations is an important one; (*b*) the number of conjugants simulates the annual variation of the air temperature. That the air temperature and its oscillations do exercise a controlling effect on the number of conjugants in a month is apparent from