Mitogenetic Radiation and Bioluminescence

By DR. J. B. BATEMAN

THIS article is occasioned by recent popular descriptions[1–5] of an apparently well-attested case of luminescence in a human being in Italy, and the references to mitogenetic radiation which accompany them. The subject is a woman suffering from asthma. She is psychologically abnormal —intensely religious and hysterical—and the phenomenon of light emission occurs during light sleep, in circumstances which suggest that it is connected with these abnormalities. It lasts about three seconds, is of sufficiently high intensity to be photographed with an exposure of one sixteenth of a second, and is accompanied by increased respiratory movements, greatly increased pulse rate, and by the utterance of "moaning sounds and expressions".

The phenomenon is certainly unusual. The Italian peasants are said to regard it as a manifestation of holiness; Signor Protti[5] attributes it, less picturesquely and perhaps less correctly, to the action of "blood radiation" in causing luminescence of certain substances in the skin. Protti's explanation is very unconventional, for bioluminescence is generally supposed to be a type of chemiluminescence, produced during the oxidation of certain substances, the luciferins, in presence of enzymes known as luciferases[6]. Naturally this mechanism has not been demonstrated in the rare cases of luminescence in human beings, but one would hesitate to accept an entirely different kind of explanation without strong positive evidence in its favour. It is possible that some instances of human luminescence are due only to infection by luminous bacteria.

The casual references to "blood radiation" are presumably intended to imply that the existence of such radiation is firmly established and its nature quite generally known. This is not the case. The fundamental experiment of Gurwitsch, claiming to show the emission of radiation from an onion root tip which could stimulate mitoses in a second root placed near it, has been, and continues to be, subjected to severe criticism. Indeed, the state of the subject at present makes a final decision with regard to the validity of this experiment quite impossible. This uncertainty has not, however, deterred Gurwitsch and his pupils from an elaborate development of their ideas, both experimental and speculative; unfortunately, there are contradictions at almost every stage.

The supposed identity of the radiation with short-wave ultra-violet light, fundamental to the most important later experiments, itself rests on contradiction, the resolution of which should have been the primary object of later research. Thus, although behaving in certain experiments like ultra-violet light (being transmitted by quartz and absorbed by glass, etc.), mitogenetic radiation can pass, without being significantly absorbed, along the interior of an onion root or through a considerable thickness of a suspension of yeast in beer wort. Further, there is no agreement with regard to wave-length. Gurwitsch[7], by experiments with filters and by spectral dispersion of the radiation, found a wave-length 190–250 mμ; Reiter and Gabor[8], by the same means, found 340 mμ, and both sets of workers were able to confirm fully their own conclusions by experiments with ultra-violet light from artificial sources. Ignoring, or explaining away, these very serious discrepancies, Gurwitsch continues to regard mitogenetic radiation as ultra-violet radiation of wave-length 190–250 mμ.

If this contention is correct, it should be possible to detect mitogenetic radiation by purely physical means, but satisfactory evidence is unfortunately lacking. Positive results obtained with a photosensitive form of the Geiger-Müller electron counter[9,10], the most sensitive apparatus available, are offset by several negative results[11–13], and the latter also demonstrate how easily spurious positive effects can be obtained if experimental conditions are not properly controlled. The most recent experiments[13] suggest that mitogenetic radiation, if it exists, cannot be detected by any known physical method; its intensity is certainly less than about 300 $h\nu$/cm.^{2} sec.

There is no space for a more detailed discussion: some quite characteristic points have already been referred to in NATURE[14] and a detailed review will appear elsewhere[15]. It is only important for the present to note that references to mitogenetic radiation, and with them Protti's reference to blood radiation, should be regarded with scepticism. Even if mitogenetic radiation exists, it is almost certainly too feeble to be capable of causing emission of visible fluorescence. Protti's explanation for his remarkable case of bioluminescence is therefore to be rejected.

[1] *Times*, April 7, 1934.
[2] *ibid.*, April 12.
[3] *ibid.*, May 5.
[4] *Observer*, April 22, 1934.
[5] Protti, *Illustrated London News*, May 19, 1934.
[6] Newton Harvey, "The Nature of Animal Light" (Lippincott, Philadelphia, 1920).
[7] Gurwitsch, "Das Problem der Zellteilung physiologisch betrachtet" (Berlin, 1926). "Die Mitogenetische Strahlung" (Berlin, 1932).
[8] Reiter and Gabor, "Zellteilung und Strahlung". *Sonderheft der wissenschaftlichen Veröffentlichungen aus dem Siemens-Konzern* (Berlin, 1928).
[9] Rajewsky, *Phys. Z.*, **32**, 121; 1931. "Zehn Jahre Forschung auf dem physikalisch-medizinischen Grenzgebiet." Herausgegeben von F. Dessauer (Leipzig, 1931).
[10] Frank and Rodionow, *Biochem. Z.*, **249**, 322; 1932.
[11] Seyfert, *Jb. wiss. Bot.*, **76**, 747; 1932.
[12] Gray and Ouellet, *Proc. Roy. Soc.*, B, **114**, 1; 1933.
[13] Kreuchen and Bateman, in press.
[14] Hill, NATURE, **131**, 501, April 8, 1933.
[15] Bateman, *Biol. Rev.*, in press.