Dr. Glaser ✓ Addr. Amended

ASSAYING THE CORRELATION BETWEEN THE DEVELOPMENT OF AN INFECTION BY TRYPANOSOMA EQUIPERDUM AND THE ACTION OF A PULSED AND MODULATED ELECTROMAGNETIC RADIATION

by

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BIOLOGY - Assaying the correlation between the development of an infection by Trypanosoma equiperdum and the action of a pulsed and modulated electromagnetic radiation. Account (*) of Messrs. Andre-Jean Berteaud, Andre-Marie Bottreau, Antoine Priore, Miss Anne-Nelly Pautrizel, Messrs. Francis Berlureau, and Raymond Pautrizel, presented by Mr. Robert Courrier.

Some experiments, accomplished under biological and physical aspects simultaneously, show clearly the characteristics of the action of an electromagnetic radiation on a parasitic infestation already studied by the authors.

INTRODUCTION - A detailed analysis of the radiation emitted from the apparatus developed by one among us (A. Priore), up to the frequencies corresponding to x-rays and gamma rays, has pointed out the essential presence of a UHF electromagnetic radiation pulsed at 9.4 GHz, modulated in amplitude at an HF frequency of 17 MHz, the spatial distribution of which we have determined in a plane perpendicular to the axis of the device. We have likewise observed the existence and the distribution of a direct magnetic field, modulated slowly, of the order of 1 k Gauss.

In considering that analysis, we have completed experiments having the objective of investigating whether the observed biological effects ([1]) can be related in a simple way to the strength of the UHF wave and the duration of the development of the parasitosis. We report the results obtained and show the existence of simple correlations. The processes of infection and the biological measures adopted are similar to those described in a preceding account ([2]).

COMPLETED EXPERIMENTS - We have profited by a spatial knowledge of the UHF power in arranging the infested mice in the "filter cages" with conducting linings which act as wave guides which are traversed by a UHF power varying from one cage to another. We have developed an initial filter which was placed on a diameter perpendicular to the axis of the apparatus and contained 10 cases of 64 cm^2, containing 3 mice per case. We have studied the development of the parasitemia of the mice, which were inoculated via the peritoneum with 2×10^4 Trypanosoma, the first session of radiation taking place 24 hours after the inoculation. The evolution of the parasitemia was plainly related to the level of the UHF power.

Subsequently, we completed a second filter in cylindrical form which permits us, on the one hand, to increase the number of mice per cage (10 instead of 3) and, on the other hand, to quantify more precisely the gradation of UHF power put into play (experiments A and B). The mice were inoculated with 2×10^5 Trypanosoma; the irradiation under the apparatus was distributed over 3 days at the rate of 6 hours of continuous exposure per day, the first radiation taking place 1 hour after inoculation. In every case, the animals infested but not irradiated were retained as controls. The sampling of blood to determine the parasitemia was practised at a fixed time.

PRESENTATION OF EXPERIMENTAL RESULTS - One habitually represents the evolution of the parasitemia p as a function of time t elapsed since infestation, by a curve of the form $\log p = f(t)$ (2).

One obtains a more characteristic representation of the phenomena and a more precise correlation with the known physical parameters by studying the slope ρ of the curve $\log p = f(t)$. By calling t_1 and t_2 two successive times of blood sampling for which the parasitemia is p_1

and p_2 respectively, the mean slope ρ_m is equal to $(1/\Delta t) \log (p_2/p_1$ with $\Delta t = t_2 - t_1$. One may then define a mean rate of the evolution of the parasitemia θ with respect to time as:

$$\log \theta = \rho_m = \frac{1}{\Delta t} \log \frac{p_2}{p_1} .$$

As a consequence, θ is greater than or less than 1, corresponding to an increase or diminution in the parasitemia.

Figure 1 represents the variation of θ as a function of the distance d between each of the different cages and the axis of the tube (experiment A). One sees clearly and in every case a suppression of the parasitemia for d less than 20 cm, whereas, beyond that distance, θ remains always above 1 until the death of all the animals. A second experiment performed entirely within the effective zone of radiation ($d < 20$ cm) confirmed the preceding results. One notes that the evolution of the parameter θ with respect to time for the animals situated beyond 20 cm is comparable to that of the controls, as has been indicated in Figure 1.

We have likewise deduced the variations in θ with the duration of infestation t measured from the initial peritoneal inoculation for various levels of UHF power. The powers indicated are the average powers, the instantaneous powers before being multiplied by the rate of repetition of the impulses, that is to say about 1.45×10^3. Figure 2 shows that above 95 μW average, the value θ always becomes less than 1, and tends toward zero with a rate which is higher as the level is increased. The cage corresponding to a power included between 25 and 95 μW is the limit of the effective zone of the UHF radiation: 2 mice have died and 8 have stabilized.

Finally, if one traces the variation of θ as a function of the power P of the UHF radiation for different durations of infestation (Figure 3) one finds a diminution for the rate of development of the parasitemia θ

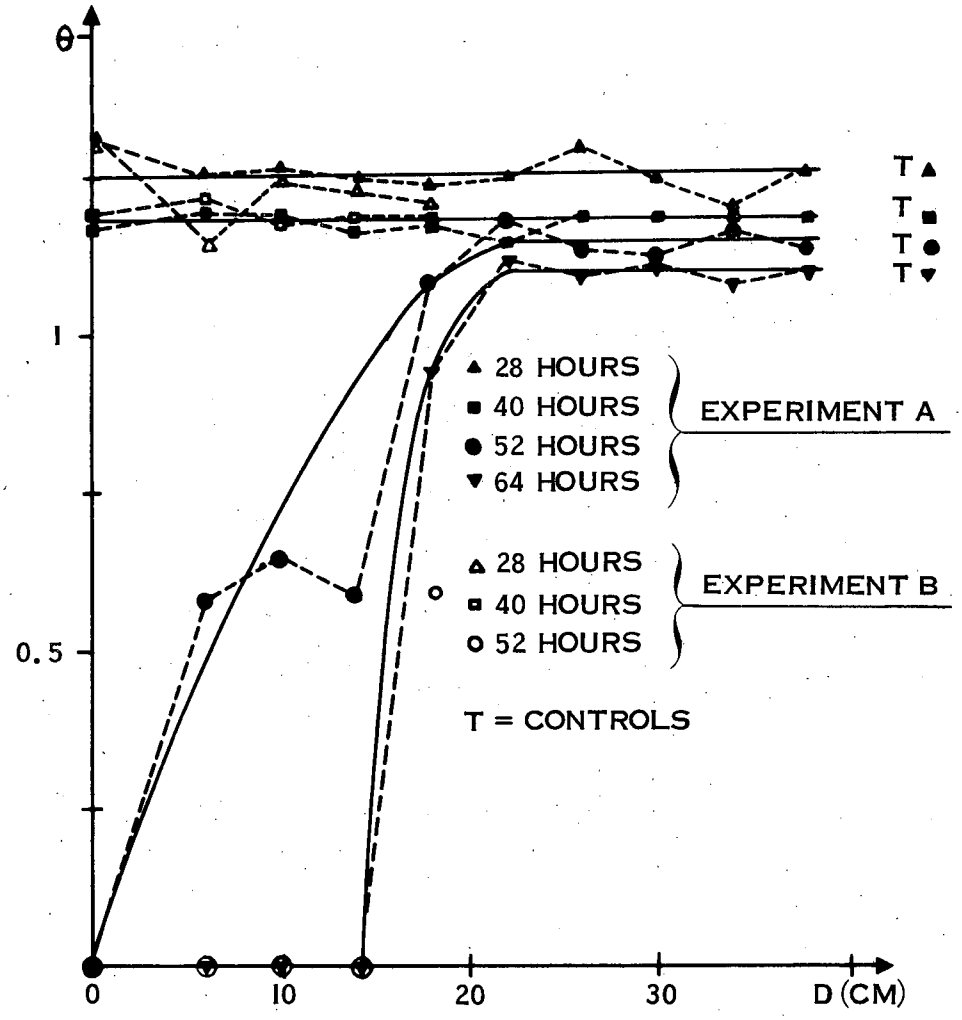

Figure 1 - Evolution of the mean rate of parasitemia θ as a function of the distance d of the animals from the center of the apparatus. The parasitemia is determined from the blood samples taken at the given times.

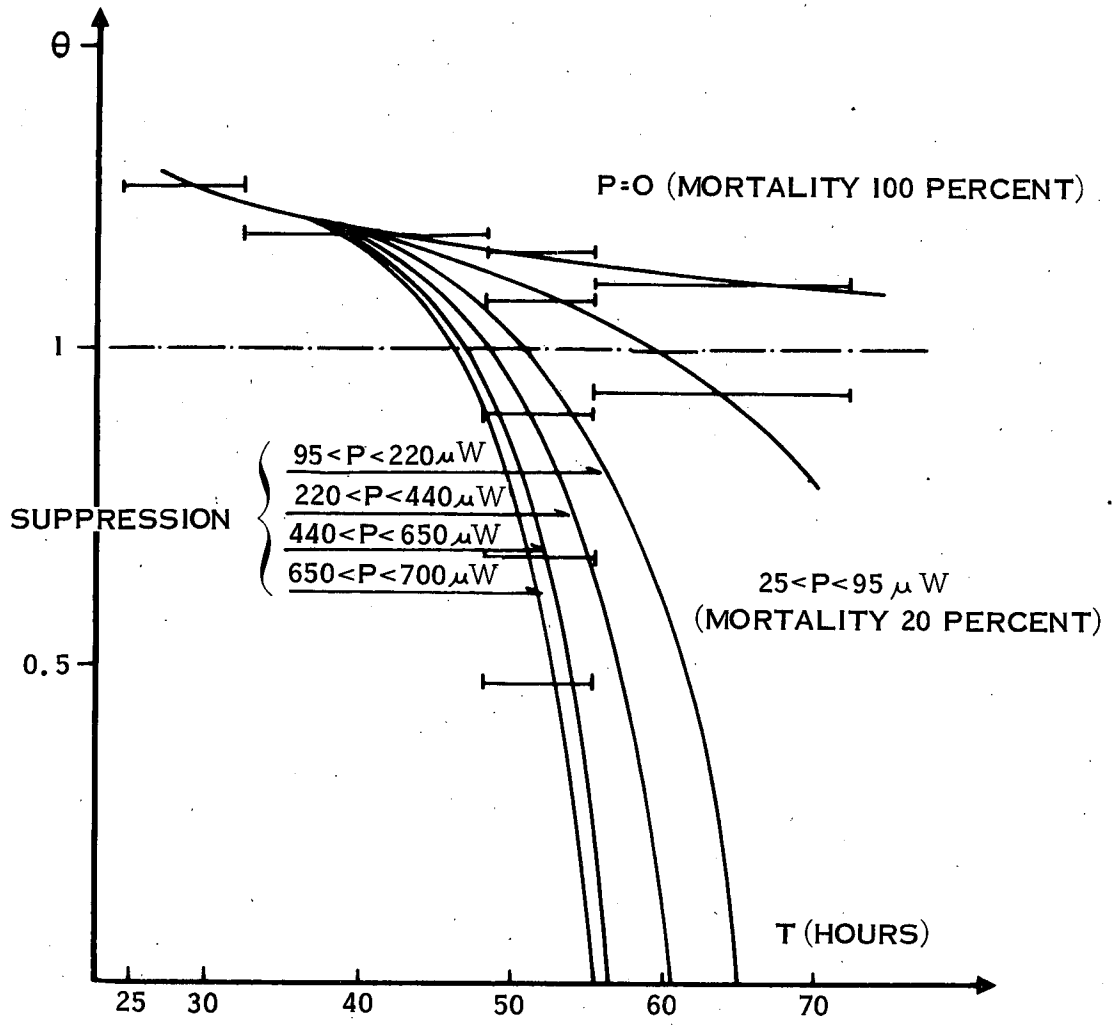

Figure 2 - Evolution with respect to time of θ for various UHF powers, the initial time being that of the peritoneal infestation.

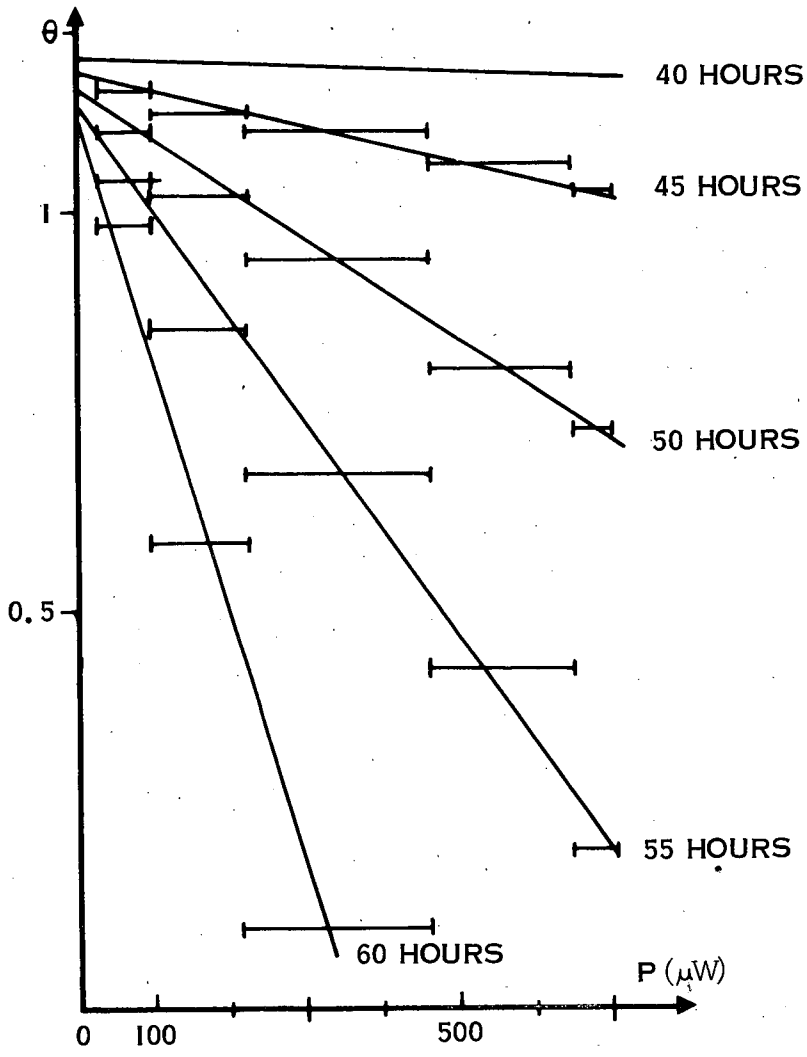

Figure 3 - Variation of θ as a function of the UHF power for different durations of infestation.

which is nearly linear with respect to the power P, whatever the periods of infestation may be.

In conclusion, beyond a duration of infestation of 50 hours and with a given sequence of exposure to the radiations of the Priore apparatus, one observes a decrease in the rate of development of the parasitemia which is proportional to the power of the modulated UHF wave. These experiments indicate the necessity for the UHF radiation at 9.4 GHz emitted by the Priore apparatus, but by no means signify that this signal is the only one necessary or even that its role is preponderant. In fact, in the case of a complementary experiment which consisted of exposing the animals to only a radiation of 9.4 GHz (not modulated) with an equivalent power, we did not observe any notable biological effect, the treated animals behaving the same as the controls (100% mortality). We are following up our work in this area of research.

(*) Session of 1 February 1971.

(1) Work having benefited from the assistance of the O.M.S., Geneva, and of the D.R.M.E., Paris.

(2) R. Pautrizel, A. Priore, F. Berlureau, and A. N. Pautrizel, Comptes rendus, 269, Serie D, 1969, p. 1889.

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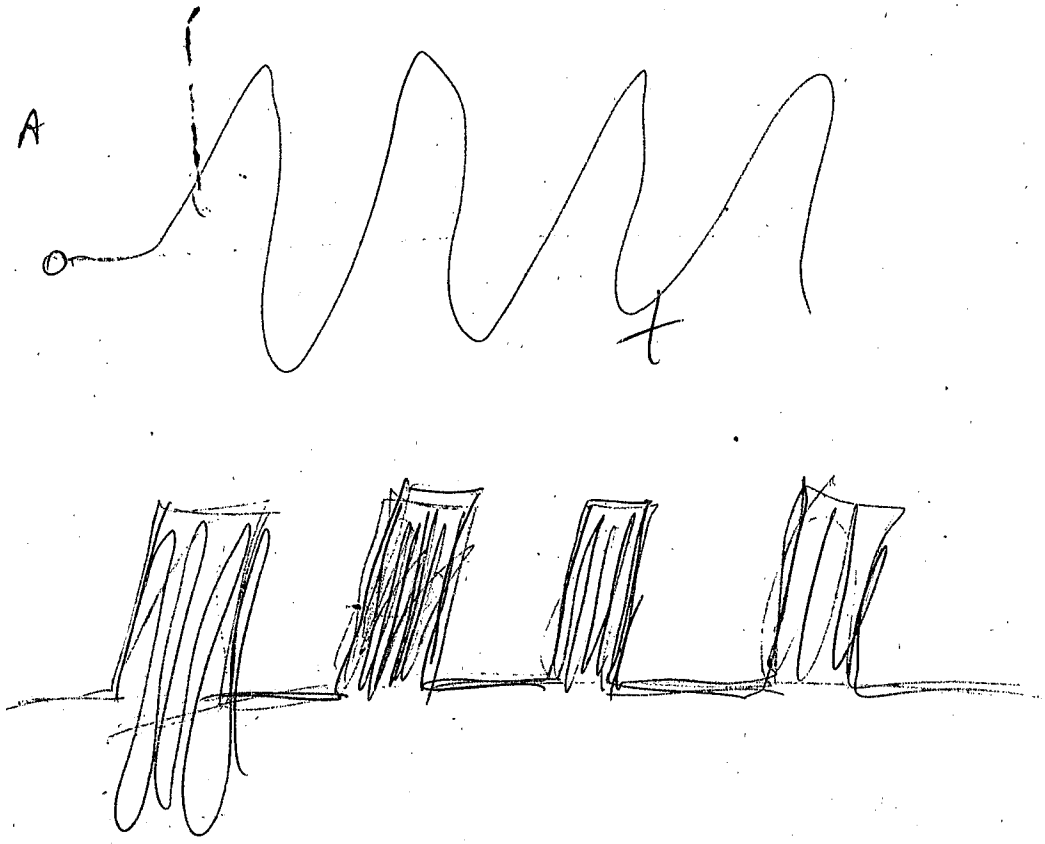
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