"Electromagnetic Fields and the Life Environment
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increase in the centimetric-wave region and contrariwise to fall below normal at substantially lower frequencies [195]. In that case, however, it was more likely a matter of the effect of two different field intensities. The same assumption may be made in the previously described difference in sensitivity of the auditory analyzer between the 10 and 3 cm wavelengths, since there is no difference in the effect of these waves on the endocrine system nor on the central nervous system [279].

Far more significant than the frequency dependence is the effect of the nature of the emitted signal. The latter may be either unmodulated, so that the electromagnetic field is continuous, with a more or less constant amplitude (cw operation), or modulated. A boundary case of an amplitude-modulated signal is pulse modulation.

Let us imagine an experiment in which we have two generators operating at the same fundamental frequency, one unmodulated and the other in pulsed operation. If the average radiated power of the two devices is comparable, there is no difference in the thermal response of the organism to these different fields [279]. Nevertheless, we can detect different effects. In the single exposure of rats to radiation at a power density of approximately 200 mW/cm^2 in the 10-cm range, cw operation of a generator does not produce any visible effect on the experimental animal even after 30 min, whereas pulsed operation (pulse width 1 μs, repetition frequency 1000 Hz) kills the rat after 3 to 4 min [151]. Postmortem examination reveals only considerable enlargement of the spleen; the histological appearance of the principal organs (including the brain) is normal. In addition, the response of an experimental animal to pulsed-wave radiation is characteristic from the very beginning and indicates the dominant influence of electromagnetic waves on the central nervous system. A pulsed field is thus biologically more effective than a cw field. This conclusion has been reached independently in the USSR, the USA, and Czechoslovakia [118, 145, 151, 254].

It may be assumed that the greater biological activity of pulsed fields is caused by nonthermal effects [118]. Mention has already been made of the difference between the effects of unmodulated and pulsed fields on the development of cataracts [26, 27, 215], morphological changes in the links between neurons [280], and on the rheobase and chronaxy [142]. The wavelengths used in these experiments were centimetric, which are usually used in pulsed operation. But even at metric wavelengths, a greater biological effect of the pulsed field has been demonstrated, for instance on oxidation processes in tissue [118]. With increasing average power density of the field, the difference between the effects of continuous and pulsed fields washes out, since the thermal effect begins to predominate [20].

It has already been stressed that the rf field, in its different manifestations, may have either a stimulatory or a damping effect; moreover either direction may be associated with a given frequency and field characteristics. It depends on its intensity