LETTERS TO THE EDITOR

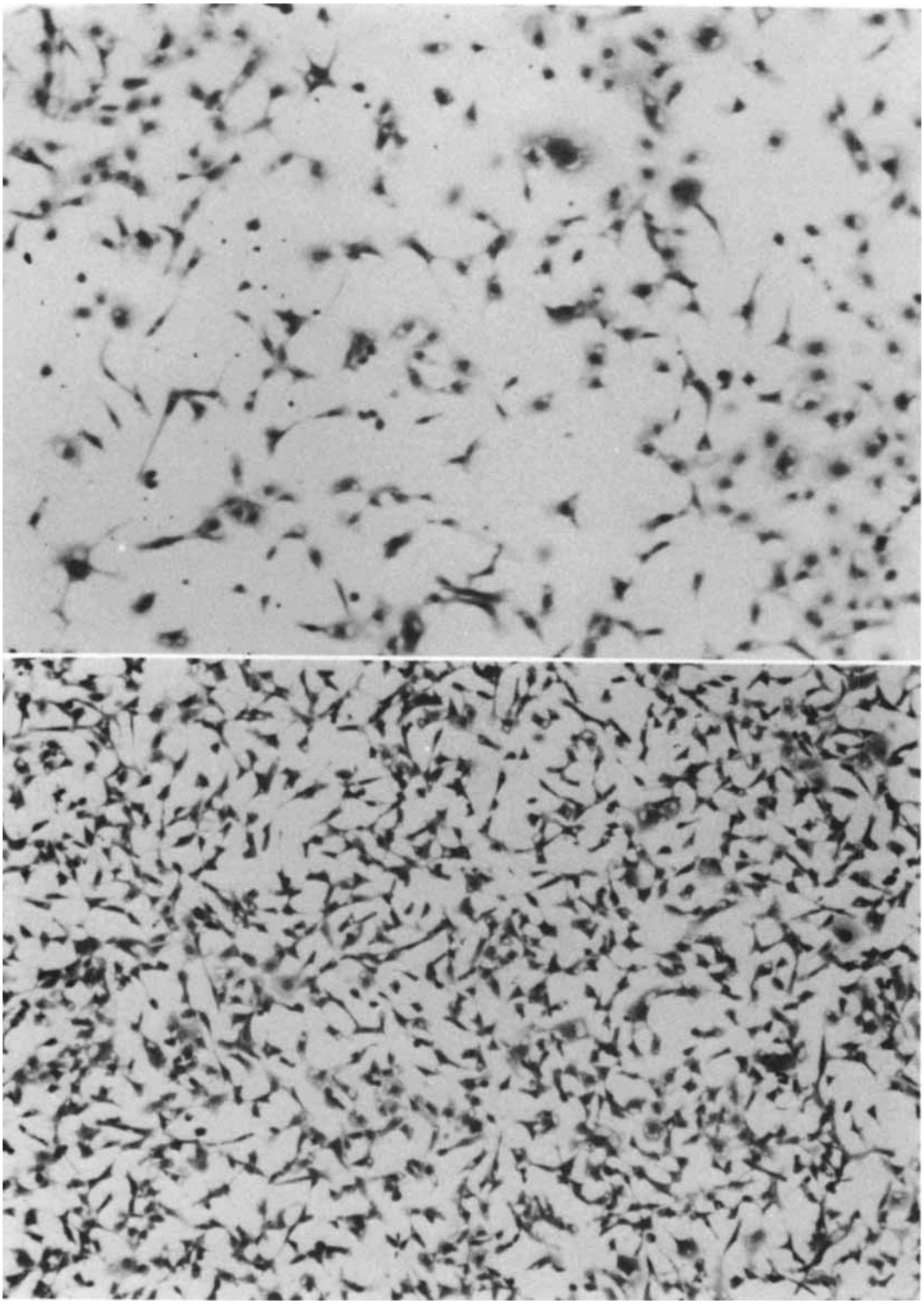
Electrostimulation and Undetected Malignant Tumors

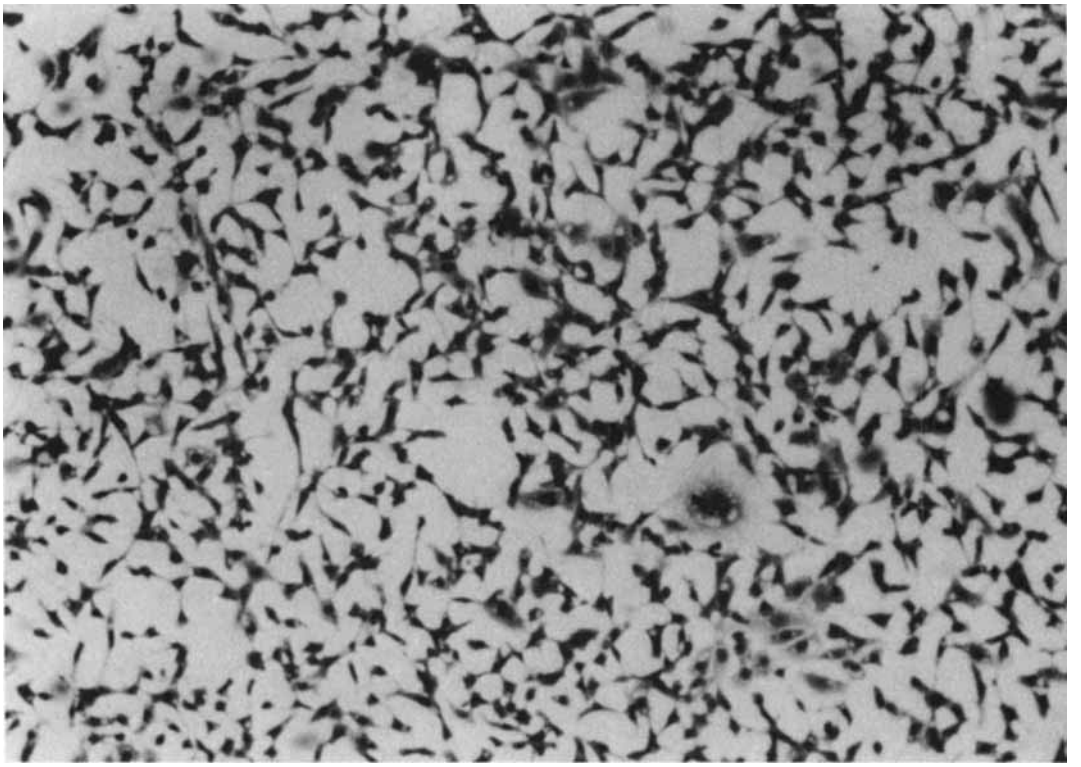
Dear Sir,

The increasing clinical use of electrical devices to stimulate bone growth poses an interesting question: If the osteogenic response is due to a general growth stimulating effect,[1] rather than being unique to bone, can the technique also stimulate the growth of an undetected malignant tumor located within the pathway of the electrical current?

While the electrical properties of bone have been well-documented,[4] less recognized is the fact that malignant tumors are also electrically active, displaying high electronegativity, the magnitude of which is roughly linearly correlated with the degree of malignancy.[5,7] Regenerating tissues also demonstrate a high electronegativity and experimentally, such an electrical environment has been shown to stimulate regenerative growth in species not normally possessing such a capability.[2,10] Electropositive environments produced in the same experiments have been associated with the failure to stimulate growth or actual tissue destruction. These observations suggest that electronegative environments are associated with growth stimulation and electropositive ones with growth retardation. Several attempts have been made to apply this concept in the treatment of experimentally induced tumors.[6,8] Recently, this concept has been challenged on the basis of the markedly different electrochemical processes at the anode compared to the cathode. It has been proposed that the growth stimulation is a factor related more to power density than polarity.[3] Simon *et al.*[9] have reported the increase in number of metastases with experimental tumors in rats by cerebral electrostimulation.

While there have been no reports of the stimulation of a preexisting malignancy or the development of a new malignancy associated with clinical electrostimulation, this study is a preliminary attempt to evaluate such a possibility.[1] We employed tissue culture techniques using a strain of human fibrosarcoma (HT 1080, type CCL 121) obtained from American Type Culture (Bethesda, Maryland). Stock cultures of these cells were easily mantained in Eagle's minimum essential medium with added nonessential amino acids, Earle's balanced salt solution, and Hepe's buffer. No antibiotics of fungistatics were used. Plastic triwell culture dishes (Lab-Tek polystyrene, 100 × 15 mm) were prepared by placing sterile, glass microscope cover slips in the bottom of each chamber and inserting sterile, stainless steel (20AWG) electrodes through the side walls such as to overlay the cover slips in two of the chambers. A conducting bridge of brain–heart infusion agar was placed between these two chambers. All three chambers were seeded simultaneously with equal aliquots of the sarcoma cells from the stock culture. The same medium was used for the experimental cultures as for the stock cultures. After initial seeding the cultures were incubated for 48 hours at 37°, whereby the cells multiplied and became firmly attached to the glass cover slip, but had not yet formed a confluent monolayer. Using a battery-operated, current-controlled, direct-current generator, a current of 360 nA was transmitted between the two electrodes at an average voltage of





FIGS. 1A–1C. Sarcoma 1080 cells harvested from the same experiment. (A, top left, see previous page) Control chamber. (B, bottom left, see previous page) Positive chamber. (C, above) Negative chamber (×60).

1.1 V. The current was administered for 24 hours at 37°, at which time it was discontinued, the cover slips removed and simultaneously fixed with methanol, and then stained with Wright-Giemsa.

In five separate trials, the results were identical. By direct visual observation, the density of the cover slips, from both the positive and the negative chambers, was markedly increased over that of the control. Microscopic examination revealed an approximately three-fold increase in the cell population in both experimental chambers (Figs. 1A–1C). No attempt was made to study the mitotic rate in these cultures, and although mitoses were not uncommon, there were many binucleate cells as well; the possibility of amitotic divisions cannot be excluded.

It would therefore appear that currents and voltages obtainable with electrical devices and used to stimulate osteogenesis can also enhance the growth of human fibrosarcoma cells *in vitro* in a nonpolarity-dependent fashion, lending support to the concept that power density is the determining factor. Further studies, *e.g.*, assessment of the minimal current level necessary to produce the stimulation; the effects of alternating current in the same range; and the effects of currents induced by exposure to pulsating magnetic fields, would seem desirable.

Clinically, this study cannot evaluate the possibility of inducing malignant transformation of preexisting, premalignant lesions or of cells actively engaged in a healing process, *e.g.*, fracture healing. At present, it would appear prudent not to administer elec-

tro stimulation to patients with suspected premalignant or malignant lesions located within the current pathway.

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