Letters to the Editor

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NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 310.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Deep Diathermic Effect and Localisation by Means of 'Auxiliary Dielectric Electrodes' in the Condenser Field

AT present it is impossible to heat the deeper parts of a body of uniform transverse section and homogeneous structure to a higher temperature than its peripheral parts by means of high-frequency currents. With present-day methods the loss of oscillating energy by leakage and radiation is so great that probably less than 20 per cent of it is used for heating effects. Further, it is impossible to localise, to concentrate or even to direct the field more than very vaguely. Any object brought into the field deforms it in an uncontrollable way.

I have found a method by which the condenser field can be made to produce a greater effect at the deeper parts than at the peripheral parts by the use of 'auxiliary dielectric electrodes'. Between the two metal plates, of 2–3 in. diameter, of the high-frequency apparatus is placed a glass tube, about 4 in. long and half an inch in diameter. Near one end is a side tube for filling. The ends are closed by flat glass walls. An air space of $\frac{1}{2}$ in. is interposed between the metal electrodes and the glass ends. The tube is filled with white of egg. On exposure to the field, coagulation commences at the middle of the tube and gradually extends towards the ends, which remain cool. The coagulation does not occur if the long axis of the tube is parallel to the electrodes. If in this position suitable cylindrical auxiliary dielectric electrodes, one to two inches in diameter, made of agar, wax, ebonite, etc., be placed so as to occupy the space between the metal electrodes and the tube and be in contact with electrodes and tube, then coagulation occurs in that part of the tube which lies between the auxiliary electrodes. If we arrange the tube again lengthwise and apply a short dielectric cylinder to one end, a longer one to the other, the point of coagulation will be moved towards the longer dielectric. Different shape or different material of one dielectric may modify this effect.

A similar experiment can be performed with minced muscle, liver, kidney, etc. In some experiments it was possible to heat a 580 gm. piece of ox-liver to a considerably higher temperature in the centre than at the borders. For example, thermometers 0·6 in. from each side, and a thermometer in the middle and so 2·5 in. from the sides, registered as follows :

	Left edge	Centre	Right edge
Starting temperature	12°	9°	11°
After 10 minutes	15·8°	15·6°	15°

At this time the temperatures throughout the piece might be considered as equal. The room temperature was 18·5°. The following temperatures were reached :

After 10 minutes	19·6°	23·3°	18·3°
After a total of 60 minutes	31·7°	40·7°	31·2°
Total rise	19·7°	31·7°	20·2°

Of course, in the living animal such differences will scarcely be obtainable, except in quite special circumstances, on account of the considerable heat convection by the circulating blood and lymph. The effect is nearly the same for any wave-length between 3 and 30 metres.

These experiments prove the possibility of deep-heating, of localising and of concentrating the lines of force and of directing the field. A further advantage is the considerable reduction of the losses by leakage and radiation ; the loss in the dielectric itself depends on its transparency for these waves.

Differences in the size of cross-sections of different parts of the object cause an increased heating-effect on the site of the smallest sections, and prominent points or corners sometimes heat up quickly. This inconvenience can be overcome by moulding the dielectric substance around or partly around the smaller cross-sections, so that they are artificially increased. In that way it is possible to heat equally through a cross-section situated anywhere by leaving this section free and moulding dielectric substance round the other parts of the object. This produces a localised heating of the whole section, for example, an elbow or a knee.

The greatest difficulty in human application is the apparent necessity of electrodes of bigger size than the object. Not only is the relation of the size of the electrodes to the object important, but also the relation between the length of the object to its cross-sections. This can be corrected to a great extent by suitably shaped auxiliary electrodes. Recent experiments seem to show that it is sufficient if one electrode only is bigger ; and if one does not wish to reach a higher temperature in the centre than near the surface, then two small electrodes are sufficient for a practically equal heating.

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Jan. 16.

Well Gauges as Seismographs

A NUMBER of workers[1] have noted that distant earthquakes are registered on automatic water stage recorders operated on deep wells. In each of these cases, the time scale was so small that the earthquake record was merely a thick line transverse to the direction of time movement. We recently fixed a gauge in a well at Lodi, California, with a Bosch-Omori seismograph drum, rate 15 mm./min., and smoked paper recording. The well is known as 3612A2. It is located at lat. 38° 07′ 38″ N., long. 121° 16′ 29″ W. in the Mokelumne area of the San Joaquin Valley. It is of circular cross section, diameter 6 in., depth 76·0 ft. below ground surface which is at an altitude of 46·9 ft. above mean sea-level. This well, which is not cased below the water surface, is in unconsolidated alluvial deposits of