subjects. Other specialists serving in the capacity of assistant editors, of which there are 46, give further examination to the prepared abstracts, checking them over before publication. A special feature of "Chemical Abstracts" for many years has been the subject indexes. These are true subject indexes, not indexes of words. The editor gives this work his close personal attention, seeing to it that the indexes are accurate and complete with the entries properly correlated and with superfluous words and entries eliminated. The entry-a-line style, with systematic writing and arrangement of the phrases modifying the subject headings, makes for convenience in use. The author, subject and formula indexes for 1927 contained entries totaling over 150,000.

With the support which has come to this uniquely useful publication, it will be in a position to care for the normal growth of the chemical literature and at the same time expand the abstracts to the most effective average length. Abstracts are to be made more informational and will appear more promptly. It is planned to give industrial chemistry in all its phases increasing attention.

There is a great feeling of satisfaction when an enterprise has been developed to the point where it excels in its specialty. This is true of "Chemical Abstracts." Not only will chemistry and the American Chemical Society benefit directly from the expansion of "Chemical Abstracts," but the many sciences which depend upon it and which contribute but little to its maintenance will also profit. The cost of "Chemical Abstracts" to users is absurdly low; its nearest competitor is offered at several times its subscription price. The support received, therefore, not only constitutes a sound investment for industry but enables industry in a very practical manner and at relatively small cost to encourage science in general and benefit a great number. It only remains to complete the capital sum required to place "Chemical Abstracts" permanently on the sound foundation its service warrants.—*Industrial and Engineering Chemistry.*

SPECIAL ARTICLES

HEATING EFFECTS OBSERVED IN A HIGH FREQUENCY STATIC FIELD

DURING developmental research on a short-wave radio transmitter, certain striking heating effects in the vicinity of the antenna have been noted. A preliminary study has brought out several points of interest in regard to their magnitude and characteristics.

During operation of a twenty-kilowatt apparatus discharging from a six-foot rod to ground with 60,000,000 alternations per second of 15,000 volts, the mouth temperature of one bystander rose 2.2° F. in fifteen minutes, while several other individuals exhibited a somewhat smaller rise of temperature.

Studies made with a smaller, 750 watt set, arranged to give rapid alternations of 3,000 volts difference of potential between two parallel metal plates, indicate that there is a well-defined relation between the rate of heating of solutions of different salt content and the frequency of voltage alternation. Thus, at a frequency of 25,000,000 cycles, a sodium chloride solution of 0.05 per cent. concentration has the fastest

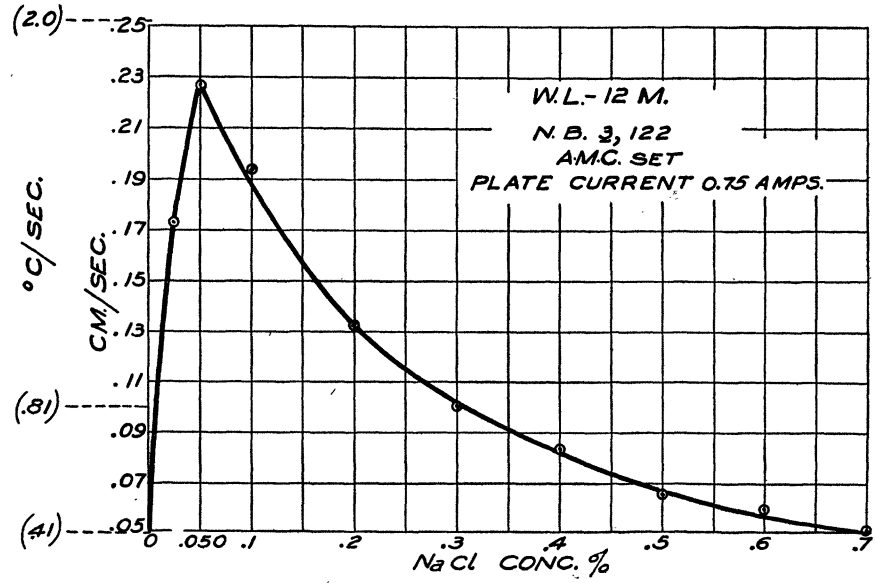

FIG. 1

rate of heating. At a frequency of 10,000,000 cycles a 0.025 per cent. solution heats fastest. The rate of heating in each case falls off abruptly with diminishing concentrations and more gradually with increasing concentrations of the dissolved salt. This is

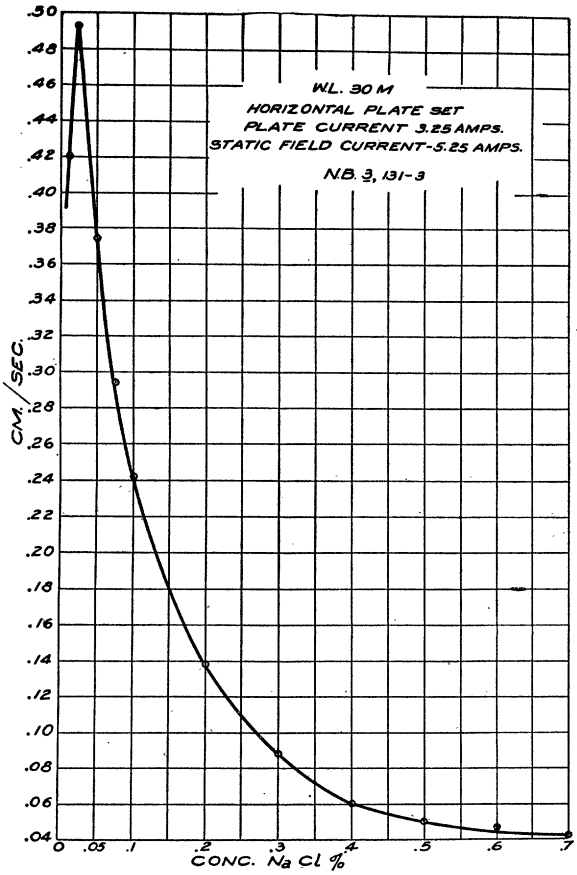

FIG. 2

illustrated by the curves of Figs. 1 and 2. These curves show the relative rates of heating of sodium chloride solutions of different concentrations in high frequency fields of 12 and 30 meters wave-length (25,000,000 and 10,000,000 frequencies) respectively, all other conditions being kept constant. The ordinates are centimeters expansion per second of the solution from a closed tube of about 6 cc content into an attached capillary tube. They might readily be given as degrees rise of temperature per second, but this might imply a greater significance than the figures really possess, as their magnitude varies with the relative dimensions of the tube and the constants of the high frequency apparatus used. The interest of the curves lies in the relative rates of heating of the solutions of various concentrations at the two frequencies of voltage alternation.

Solutions of different salts, but of the same electrical conductivity, heat alike. The rate of heating is apparently proportional to the product C^2R for the conducting path introduced between the plates, the value of R for maximum heating varying with the frequency. For any given solution or other body of suitable conductivity the rate of heating is directly proportional to the length of conducting path measured perpendicular to the plates and inversely proportional to its area of cross-section. Hence the rate of heating of solutions is very much modified by the shape and dimensions of the containing vessel. Thus, in two tubes—B and C—of the same length (measured perpendicular to the plates), but containing, respectively, 22 and 6 cc of salt solution, the former heated 1° C. in 2.3 seconds and the latter in 0.8 second in a field where the capacity was sufficient to heat two tubes of size B as rapidly as one.

The heating effect is, in all these cases, developed within the conducting solution itself. The plates remain cold at all times and are separated by an air gap from the introduced containers and other objects under study. Contact with the plates will produce arcs several inches long and burning and charring of inflammable materials which touch them.

Conducting bodies suspended in a non-heating fluid will generate heat and raise the temperature of the whole mixture. For instance, a T tube containing four cc of distilled water alone did not heat perceptibly in two minutes. One tadpole (1.5 cm long) was introduced, after careful washing with distilled water, and the temperature rose 1.6° C. in 31 seconds while the tadpole was alive and 6.6° C. in 2 minutes after it was dead. In the presence of more tadpoles, the rate of heating was greater. The tadpole was employed in this test partly because it was available, but also because it embodies the conditions of a small amount of salt solution enclosed conveniently within a semi-permeable membrane.

Marked heating occurs wherever there are attenuated conducting paths, particularly if these run perpendicular to the plates or are connected asymmetrically to similar paths which run perpendicular to the plates. In the latter case, the action is that of an antenna collecting charge (induced) from the parallel plate and conducting it to the perpendicular path partially bridging the space between the plates. Thus, if a capillary, running parallel to the plates, be attached at the middle of a larger tube placed perpendicular, both filled with a suitable conducting solution, the contents of the capillary will not heat at all. If the same capillary be attached near the end of the larger tube, its contents will boil as soon as the high frequency discharge begins.

In rats killed after sublethal treatments the only evidence of tissue damage yet observed has been in the outer layers of the muscle cells of the heart immediately adjacent to the pericardial cavity and at the tips of the liver lobes. Such treatments have been shown to raise the temperature of the region exposed, in this case the lower thorax, to 115° F. in three minutes without affecting the rectal temperature. This would indicate that the site of greatest heat development is not in the blood stream nor in the more vascular tissues.

For animals destined for survival, the simplest method for raising the general body temperature rapidly by high frequency is to expose the torso alone between narrow plates, allowing the head and extremities to project outside the field on either side. When the whole body is exposed to a field of sufficient strength to raise the rectal temperature at the rate of about a degree per minute there occurs overheating, blistering and stiffening of the ears and of the leg muscles unless they are adequately shielded. Methods of shielding are being studied and will be presented in a later publication.

An animal whose extremities have been thus overheated while under an anesthetic exhibits upon return of consciousness a most remarkable absence of symptoms, aside from the loss of use of the muscles actually affected. There is no evidence of local tenderness nor of any other discomfort up to the time when breaking away of the killed skin exposes adjacent tissues to outside infection.

These preliminary experiments reveal a field of the utmost interest to the experimental physiologist. Here is a method for producing at will any degree of fever without the introduction of bacteria, toxins, foreign proteins or other adventitious material or condition into the animal body. The increase of temperature is produced directly within the animal structures as in ordinary fever. It occurs promptly while the animal is in a normal condition in other respects. Its uncomplicated effects are thus thrown open to direct study. We may hope very soon to solve the long-vexed question of whether fever is a functional response or merely a condition secondary to infection or trauma.

It may be well in this connection to offer a word of warning. It would seem advisable to use extreme care and to postpone until after thorough investigation the exposure of human beings to the more powerful types of this apparatus. We can not yet predict with certainty just where extreme local heating might occur before the general body temperature gave sufficient warning. The serous cavities would seem to offer the optimum conditions for such local heating, endangering the adjacent tissues.

These general observations are presented at this time for the assistance of any who may be initiating research with such apparatus. Work is being continued in these laboratories, bearing particularly upon the characteristic heating effects produced by high frequency fields both in animal structures and in simpler systems and their modifying reactions upon physiological function and bacteriological and pathological growth.

Grateful acknowledgment is made for the constant encouragement and assistance received from Dr. W. R. Whitney, of the Research Laboratory of the General Electric Company, at Schenectady, as well as for the loan of the necessary apparatus and for its modification from time to time to suit the needs of the work.

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SEX STERILITY AND THE DIMINUTIVE COPULATORY ORGAN IN THE DOMESTIC FOWL

STERILITY associated with the absence of the male copulatory organ in the domestic fowl has been noted according to the following observations:

While making anatomical examinations of the cloaca of White Leghorns for the presence of the diminutive copulatory organ, four yearling cockerels out of seventy-eight were found in which the organ was absent. Three have proven sterile or sexually abnormal.

One of the four had been killed. During the autopsy the testes were found to be abnormally small, as in a non-functioning state, being one fourth normal size. Records were examined for fertility tests and a second cockerel lacking the organ had been in a mating pen with twelve pullets for two weeks during January, 1928, without fertilizing a single egg.

The two remaining cockerels have now been tested. One fertilized three out of thirty-seven eggs, thirteen days after mating. The fourth fertilized twenty-three out of twenty-four eggs set, being the only one of the four to prove normal. Thirty-three of the remaining seventy-four have been tested, and all showing the organ have fertilized 65 to 98 per cent. of eggs set.

The capons examined (four in number) lack the copulatory organ. Unlike the capon, however, the cockerels lacking the gland retained the characters generally considered as secondary sexual. They appeared as vigorous as any other healthy cockerel. In view of these facts the indications are strong that at least one type of sterility may be detected in the