unbroken since its founding in 1869, it should have no less than $500,000 more in annual income. This would be accomplished by the sixtieth anniversary endowment fund of $10,000,000, first proposed some time ago, but thus far not vigorously advanced. So alarmingly urgent has become our situation that we can delay no longer. It is to be hoped that the next annual report will see this fund substantially in hand or promised."

Serving with President Osborn as a preliminary committee will be the following trustees: Treasurer James H. Perkins, Secretary S. Brinckerhoff Thorne, George T. Bowdoin, Douglas Burden, Cleveland E. Dodge, Clarence L. Hay, Junius S. Morgan, Jr., A. Perry Osborn, Daniel E. Pomeroy, Henry W. Sage, Leonard C. Sanford and Felix M. Warburg. George H. Sherwood, director of the museum, will be secretary of the committee.

Reviewing in his annual report the museum's status, which he declared was now threatened by lack of funds, President Osborn said: "All wealth and all health comes from knowledge of nature, and the American Museum of Natural History is advancing the knowledge of nature and the inspiration of nature on a scale unknown before in the whole history of education and of civilization."

But the present budget, he stated, was only "a minimum working budget," which had recently failed to cover some of the most valuable of the museum's activities. "Our explorations," he continued, "our researches, our expeditions, our publications, our educational work in school, college and university, our library, are suffering for want of adequate financial support to overcome the doubling or trebling of all costs since the fatal year 1914.

"The department of public health is entirely suspended; the library is very seriously crippled; were it not for Mr. Childs Frick's gifts, the department of vertebrate paleontology would have to stop its expeditionary work; other departments, like geology and geography and invertebrate paleontology, are operating at half their former rate; although under very able leadership, entomology is short-handed, and in practically all the exhibition halls of the museum the work of completing educational equipment has stopped.

"The two departments in which late President Morris K. Jesup was deeply interested, namely, woods and forestry and anthropology in all its branches, are restricted severely by retrenchment and undermanned."

Reporting on educational and scientific work of the museum, Director Sherwood noted the loss by death or resignation of seven members of the scientific staff, and added: "These men were all experts in their respective fields. It has been impossible to replace them because of the present critical financial emergency of the museum. In the depletion of our scientific personnel, research and publication are seriously retarded, and the museum is losing prestige in science.

"Overhead expenses must go on. They have had to be met at the expense of exploration, research and publication. The necessary financial retrenchment has reduced to a minimum the allowance for the research and publication side of the museum, until in 1929 almost none of the normal income could be devoted to exploration, which consequently has had to depend upon the special gifts of friends. When this situation is considered in conjunction with the museum's severe losses in scientific personnel the disastrous effect upon our scientific progress must be evident."

The income of the sixtieth anniversary endowment fund, it was announced by President Osborn, would be allotted for permanent support of exploration, research and publication; for additional assistants, to release curators and research workers for scientific projects and publication; for raising staff salaries to university and college grades; for the educational equipment and modernizing of the fifty old and new exhibition halls completed or under construction; for intensive high school, college and university education in laboratories and exhibition halls; for extension of the educational service, now reaching more than 1,000,000 public school children, to secondary schools; for preparation of existing exhibitions and collections to render the highest educational service to students and the visiting public, and for purchase of books to aid in the research activities. Provision also must be made, it was stated, for the development of future plans in connection with the addition of a new building section by the state and three new sections by the city, under the arrangement whereby the city provides land and buildings, and trustees and public the scientific work and the exhibitions.

G. N. P.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

HIGH FREQUENCY EQUIPMENT FOR BIOLOGICAL EXPERIMENTATION

GROWING interest in the biological utilization of the electromagnetic spectrum in the range of frequencies made available by improvements in the three electrode vacuum tube has led to the design of a convenient apparatus for treatment of the usual laboratory animals and materials.

With the apparatus here described high frequency fields can be applied to a wide variety of forms—from the smallest of insects to large rats. It has been found that very small objects require a concentration of the field and this requirement has been met by an arrangement for quick and easy interchange of plates in the exposure circuit, the subsequent tuning being accomplished merely by shifting an ammeter shunt along two parallel bars.

Frequencies from about 150.000.000 cycles per second (2 meters) to about 50.000.000 cycles per second (6 meters) are available. The circuit generating these frequencies is similar to those used by Schereschewsky[1] and Christie,[2] and the range is sufficient to cover that part of the spectrum found by Schereschewsky to be the most promising. The output on the exposure circuit can be conveniently controlled from 0 to about 4.5 amperes, the maximum being high enough to kill insects in a few seconds and mice or other small laboratory animals in from three to ten minutes.

The generating and exposure circuits are mounted on a wooden base built in the form of a stair step, the generating circuit being above and back of the exposure circuit. The overall length is thirty-nine inches, the height ten inches and the width fifteen inches. A slanting panel connects the two levels of the step, and the transformers, rheostat, fuses, etc., are placed behind this panel (Fig. 1).

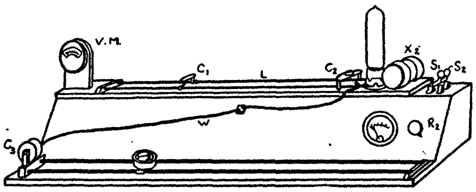

FIG. 1

In the accompanying diagram of this high frequency generator the generating circuit is shown at A and the exposure circuit at B (Fig. 2). The supply voltage for the filament and the plate of the vacuum tube is obtained from 110 volt, A. C., source. Five ampere fuses are used on the A. C. leads.

The transformer T_1 supplies current for heating the tube filament. An Acme 100 watt, filament lighting transformer is used. The primary voltage is 110 volts at 60 cycles and the secondary voltage is 12. Transformer T_2 supplies the plate voltage; it is rated at 100 watts, 110 volts primary, 1100 volts secondary. Two small 15 ampere S. P. S. T. knife switches are provided, S_2 controlling the filament current and S_1 the plate voltage.

At X_1 is a small high frequency choke in series with the plate transformer winding and with the oscillator inductance rod L. It is composed of about fifty turns of No. 36 D. S. C. magnet wire wound on a ½-inch tube of insulating material. It may be omitted if the transformer is located at some distance from the oscillator. At R_1 is a grid leak resistor. It is not critical and may be of from 5.000 to 10.000 ohms.

The by-pass condenser C_1 must be of such insulation as to stand the plate voltage. A Sangamo 250 micro-microfarad condenser sealed in bakelite is satisfactory. A tuning condenser is placed at C_2. It is a small two-plate variable condenser and was made by removing all but one stationary and one rotary plate from a General Radio 15 micro-microfarad variable condenser. At X_2 are two high frequency chokes made by winding about fifteen turns of No. 14 copper wire on a 2½-inch diameter tube.

The rheostat at R_2 is for the control of the filament current. Almost any type of .5 ohm rating will do. It should be of such resistance and current capacity as to limit the filament current to about 6.25 amperes when used in conjunction with the filament transformer above described. The ammeter A on the generating circuit provides a check on the filament current. A Jewell, pattern No. 74, 0–8 amperes, A. C., is satisfactory.

The inductance rods L, upon which C_1 slides, are ¼-inch copper tubes about 22 inches long. They may be of any length depending upon the highest wavelength desired. The separation of the two rods at L alters their inductance materially as well as their high frequency resistance, and, for this reason, a separation of less than two inches is not recommended. In this instance the separation is 2.25 inches.

By changing the position of the by-pass condenser C_1 along these rods a means is provided for changing the inductance in the oscillatory circuit, and hence the frequency. As a means of fine adjustment to a predetermined frequency, the small variable condenser C_2 is connected at the base of the tube. The actual frequencies generated may be conveniently measured by the Leecher wire system.

The exposure circuit is similar to the oscillatory circuit except that here the vacuum tube capacity has been replaced by the condenser plates C_3. It is between these plates that the actual exposure of experimental material is made. Both the oscillatory and

[1] J. W. Schereschewsky, Public Health Service Bulletin, 1926, p. 1939; Public Health Service Bulletin, 1928, p. 927.

[2] R. V. Christie and A. L. Loomis, *Journal of Experimental Medicine*, 49, v. 2, 1929.

exposure circuits are shown in the diagram (Fig. 2) by heavy lines.

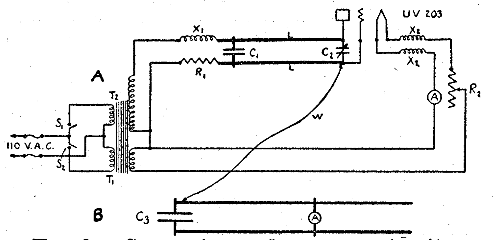

FIG. 2. Generating and exposure circuits.

On the exposure circuit there are also two parallel rods of ¼-inch copper tubing, in this case at 3½ inches separation; and, in order to give sufficient tuning range, they are 34 inches long. Along these rods, acting as a shunt, slides the ammeter A of the exposure circuit. This ammeter provides a means of determining the point of resonance of the circuit, and also a relative measure of the output. A Jewell, pattern No. 64, Radio Frequency, 0–5 amperes, is used. The actual tuning of the exposure circuit may be accomplished either by changing the position of the ammeter along the two parallel rods or by changing the separation of the condenser plate C_3.

Two metal posts about four inches high hold the condenser plates at C_3. These posts are connected at their bases with the two parallel rods; they may be insulated by a cross member of bakelite or some other insulating material. Although not absolutely necessary, the whole of the exposure circuit may be insulated from its wooden support. The plate posts are drilled and threaded for a ¼-inch bolt. Circular sheet copper plates of varying size may be screwed to these bolts by soldering the proper-sized nut to the back of each plate.

Coupling between the oscillatory and the exposure circuits presents somewhat of a problem when dealing with frequencies as high as here used. It has been found best to use a very loose inductive coupling and then provide a single wire feeder much like the usual radio antenna feeder. This wire feeder is shown at W on the circuit diagram. The coupling may be varied by changing the position of the feeder clip on the grid inductance rod of the oscillator. However, in practice it has been found that little change in coupling is required.

Several types of standard vacuum tubes could be adapted to this apparatus, but the UV 203, 50 watt tube has proved very satisfactory. It has a high filament emission as compared to tubes with thoriated filaments, and it gives sufficient output for nearly all kinds of biological experimentation. With this tube the lowest wave-length available is about three meters, although it is possible by tuning to the second harmonic on the exposure circuit to use a wave-length of less than two meters. Higher wave-lengths are easily obtained by extending the length of the rods in the oscillatory circuit. For lower wave-lengths a push pull oscillator composed of tubes of very low internal capacity is necessary. Amplifiers to increase the output of vacuum tube oscillators at these wave-lengths have not proved satisfactory.

To the apparatus here described may be added an A. C. voltmeter at the 110 volt A. C. source. If it is desired, larger animals than rats may be treated by adding a set of square exposure plates of large size and wide separation. These plates may be mounted on the slanting panel and connected by copper rod feeders to the exposure circuit.

All the parts listed are standard electrical equipment and may be obtained from radio supply houses at remarkably low cost.

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REDUCING MOISTURE EVAPORATION FROM PETRI DISH CULTURES

GROWTH-RATE studies and other laboratory studies of wood-rotting fungi require a constant moisture content of the wood upon which such tests are made. This is essential to the control of the moisture factor, which is an extremely important one in all such studies. In one of the growth-rate studies now under way, octagonal disks of wood 3″ x 3″ x ⅛″, having a moisture content of 100 per cent. oven-dry basis, were placed in 100 mm x 15 mm Petri dishes, inoculated with the fungus and then placed in an incubator at 27° C. In a few days it was observed that a loss of water from the wood disk by evaporation through the space between the two parts of the dish proceeded at such a rapid rate that growth of the mycelium was inhibited, and if continued for a longer period death of the fungus resulted.

To prevent this loss of water, it was suggested that the space between the cover and the bottom of the dish be filled with a plastic, impervious substance, such as modeling clay, paraffin or beeswax. However, the inconvenience of sterilizing, then introducing these materials into the crevice, presented difficulties that were reduced by the use of another method. This method is simple but effective and consists in the application of a wide rubber band to the periphery of the dish so that it covers the opening between the two parts and overlaps on the bottom and top sufficiently to prevent slipping off (Fig. 1). The bands were especially made by A. W. Faber in two sizes, 3⅝″ long by 2″ wide, for use with Petri dishes of 15 mm depth, and 3⅝″ x 1¾″ for those of less depth.