many of the characteristic chemical and serological properties of virus protein, may be obtained. As a whole, the preliminary results indicate that only slight changes occur in the protein molecule on inactivation by the four methods mentioned. Although there is always a possibility, as with any apparently pure substance, that the crystalline tobacco-mosaic virus protein may consist of two closely related components, one active and the other inactive, the available evidence indicates that the virus activity is a specific property of this high molecular weight protein. It appears likely, therefore, that the slight changes in the protein, which result from treatment with formaldehyde, hydrogen peroxide, nitrous acid or ultra-violet light, cause it to lose its ability to infect susceptible plants.

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SUPERIOR INFLUENCE OF THE MOTHER ON BODY SIZE IN RECIPROCAL HYBRIDS

IN previous papers[1] it has been shown that in rabbits and in mice, when races of unlike body size are reciprocally crossed or reciprocally backcrossed, the maternal group of larger body size produces offspring of larger body size. In other words, the mother has greater influence than the father on the body size of the offspring. This might be supposed to be due either to cytoplasmic influence of the egg or to an influence exerted by the mother during gestation. The latter alternative seems to be excluded in the case of some amphibian crosses recently described by Käte Pariser,[2] in which a similar difference is found between reciprocal crosses produced by subspecies of Triton of different body size, but in which the development of the young takes place outside the body of the mother. The crosses made by Pariser were studied primarily with reference to the sex ratio and problems of sex determination, but incidentally they throw light on size inheritance.

The superior influence of the mother is shown with especial clearness in the reciprocal crosses between *Triton palmatus* and *Triton alpestris*. The mean body lengths of metamorphosed individuals of the respective parent species are, *T. palmatus* 26.0 mm, and for *T. alpestris* 37.2 mm. Hybrids produced by *T. palmatus* mothers have a body length of 25.3 ± 0.4 mm, whereas those produced by *T. alpestris* mothers average 29.1 ± 0.3 mm. The difference between these means, 3.8 ± 0.5 mm, is nearly 8 times its probable error, and so, highly significant. It follows that the cytoplasm of the *alpestris* egg at the time of fertilization must contain sources of growth energy much superior to those found in the cytoplasm of the *palmatus egg*. Whether it is legitimate to explain their presence there as a result of previous activity of maternal nuclear material remains to be demonstrated, if indeed this further question is capable of experimental solution. But at any rate an immediate effect of the maternal cytoplasm is clearly shown.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A LOW COST ELECTROCARDIOPHONE FOR TEACHING PURPOSES

MANY teachers, particularly those teaching physiology and physical diagnosis, recognize the electrocardiophone as an extremely valuable instrument with which to demonstrate heart and respiratory sounds to a large group of students. Until just recently, however, such equipment has been both complicated and costly, keeping many from enjoying its advantages. Recently a new type of microphone has appeared on the market which has opened the field for a simple and inexpensive electrocardiophone. The cost should not run over fifty dollars for the entire instrument.

It is the purpose of this article to describe such a unit, the outstanding features of which are simplicity, compactness and low cost, and which will do almost anything which the more complicated instruments will do.

The basis of this electrocardiophone is the crystal type microphone as sold under the Brush patents. This microphone operates on the piezo-electric principles as defined by Curie in 1880. Thus, if crystals which exhibit pyro-electric properties are subjected to compression or tension, opposite charges of electricity appear at the ends of the crystal; thus a small alternating voltage is generated between two metal places glued at opposite ends of the crystal. The material used for these crystals is Rochelle salts. When a sound is impressed on the crystal the bending strain will set up a voltage between the ends. This voltage is then applied to the grid of a pre-amplifier tube. No polarizing voltage or magnetic field is needed and no input transformer is used. The audio output is almost as large as that obtained from a highly damped carbon microphone. There is no background noise, and the frequency response is good enough. Several carbon microphones were tried and found to be less satisfactory, since the vibrations caused by body movements produced a good deal of rattle and

[1] *Proc. Nat. Acad. Sci.*, 20: 621–625, December, 1934; *Genetics*, July, 1936 (in press).

[2] *Rev. Español de Biol.*, 5: 11–93, 1936.

noise. There are several companies who sell the crystal microphone with a bell type of stethoscope on the front. A button conveniently located on the side is used to turn the instrument on and off after it has been placed in the proper position, thus eliminating much of the problem of feed-back.

As to the amplifiers, since the microphone audio level is down 60 Db. a pre-amplifier must be used ahead of the straight audio amplifier. Of course the size of the room and the intensity of the sound desired has much to do with the type of amplifier used. The amplifier to be described is sufficient for use in a lecture hall about thirty by forty-five feet and seating about one hundred and twenty students. A variety of tube combinations are available, all of which give about the same results if properly used. It is important that the microphone cable should be shielded and the shield connected to ground. The high-gain input circuit should be shielded and kept away from the high-level audio section. A.C. filament and high voltage supplies may be used for all stages of the amplifier, but excellent filtering is required for the high-gain amplifier in order to eliminate all hum. The amplifier is mounted on one metal chassis, the power supply on a second metal chassis, each one being two by eight by seventeen inches. The first stage consists in a type 6C6 tube using pentode connections and giving a voltage gain of ninety. This is resistance-capacity coupled to a second type 6C6 tube triode connected, and giving a gain of twenty-two and a half. This is in turn transformer coupled to the driver stage consisting of a pair of type 76 tubes in push-pull. The final stage is transformer coupled to this and consists in a pair of type '42 tubes in push-pull. A universal output transformer is used. The volume control is placed in the grid circuit of the second tube. A tone control for cutting off the high frequencies is placed across the output of the second tube. A type '80 tube is used in the rectifier for all stages. As to the speaker, any good small dynamic speaker is satisfactory, the field supply may be obtained from the power supply used for the final amplifier. The speaker is connected to the final amplifier through a fifty-foot five-wire cable. The speaker should be mounted in the center of a baffle not smaller than three by four feet; if the baffle is smaller, the sounds are very much distorted. Several types of magnetic speakers were tried and found to be very unsatisfactory. The speaker is placed at the back of the lecture hall, the amplifiers and microphone in the front of the room with the patient. This arrangement helps to reduce the feed-back and places the patient in full view of the class. When the lecture hall is empty the feed-back is very annoying, but when it is filled with students, as during a lecture, there is no trouble even with the gain up all the way. The volume is more than necessary to be plainly heard from any part of the lecture hall described above.

The sounds are very realistic and there are no extraneous sounds to confuse the listener. Murmurs and irregularities in both intensity and rate of the heart are easily demonstrated, as are many of the respiratory sounds. A certain amount of common sense must be used in handling this instrument; thus a heart sound which is so faint that it is heard with difficulty with an ordinary bell type stethoscope will not be heard at all on the electrocardiophone. In general, it is best to choose a person having a fairly thin chest wall as the subject, and again it is best to have the subject either sit or stand or lie on his left side rather than to pick up the heart sounds with the patient lying on his back.

At the Temple Universtiy School of Medicine in Philadelphia such an instrument has been built by the department of physiology and it appears to be quite satisfactory for teaching. When the heart sounds are first studied, the normal sounds are demonstrated and discussed. The entire class hears the sounds in exactly the same quality and intensity and the lecturer can properly interpret what is being heard. In the same way, in the lectures in physical diagnosis it should be possible to demonstrate many of the pathological as well as the normal sounds found in the heart and lungs. In the large clinics where a patient is presented to the whole class, individual study of the patient is impossible, but with this instrument the important conditions could be demonstrated. In this way the patient is subjected to the least discomfort and the students receive the benefit of studying the patient. Since all the students hear exactly the same sounds, the pathology can not be confused with other conditions and even missed entirely, as is so often the case when a large number of persons hurriedly examine the same patient.

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