## DEVELOPMENT OF NEW TOOLS FOR SCIENCE.

### II. From Hollow Tree To Stethographone.

By

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### 1. Stethoscope.

For the location of special organs and special sounds in normal and affected tissues, the doctor's percussion, and auscultation tests have made many a diagnosis possible in the past; even to-day they equal in importance probably the tongue test for the quick recognition of trouble in the body system.

The sound study of chest and heart complaints especially disclose to the experienced physician quickly an abnormal condition. One instrument (in addition to the ever present fever thermometer) has therefore seemingly become an indispensable tool for the practitioner, namely the stethoscope. This apparatus was invented in Paris in 1819 by the French physician R. T. Laennaac, who first used a tube of rolled up paper, in order thus to transmit more clearly to his own ear, the faint sounds of breathing and heartbeat from the chest of one of his patients. He improvised a tool first conceived from the recollection of a boyhood's experience; he heard the whispered voice of a friend, at the other end of a hollow tree, much more distinctly when the sound waves passed through it. The apparatus was quickly improved, so that we have to-day a more sensitive gadget, equipped now for both ears, and even, if desired, with ear phones.

### 2. Stethographone.

In our experiments with transparent animals, esp. the crustacean Daphnia magna and the cold blooded, so-called scale-less telescope fish (Carassius auratus var. macrophtalmus Duerigen) and the domestic Gobiella, studying mainly the heart action and the effects of age, environment and medicine, it became expedient to check our results with those obtainable with the so-called higher animals or warm-blooded vertebrates. As test objects we used the usual laboratory animals, e. g. mouse, rat, guinea pig, rooster, rabbit, cat and dog, finally including also human beings. This testing, without surgery or without creating any discomfort or injury was made possible by the development of the stethographone. With the astounding improvement in the construction of sensitive microphones and amplification units,

it was felt that a combination of the two would furnish a much improved stethoscope, not only much more sensitive in pick-up, but also in sound, loud enough for general audibility without earphones. Consequently with the efficient help of a former student, Mr. W. S. Gilbert, a radio engineer now, such apparatus was developed by the author, while director of the Gross laboratory for Biological and and Biochemical Research ( Philadelphia College of Pharmacy and Science).

A super-sensitive crystal microphone is placed over the organ to be tested, e.g. the heart of the test object, the sound, thus picked up, is amplified in the pre-amplifier and then again in a second amplification system, connected with loud speakers. This listening-in equipment includes another like microphone, in order to demonstrate simultaneously the normal and depressed heart beat of 2 test animals or the faster heart beat in young animals and persons, as compared with old ones. The impulses may also be conducted into a mechanical counter "*countameter*," which is synchronized with the audible heart beat, and thus permits quantitative records, irrespective of the rate of the heart beat (reaching in a rat as much as 532 beats per minute as measured in normal male rats, 120-135 gms. 50 days old, at a temperature of 86-89 °C.). An *oscillograph*, introduced into the electrical amplification system, permits the simultaneous recording of the impulses as they are commuted in the cathode tube of the oscillograph into lines of light. These running lines, corresponding to heart and valve action, and comparable to the tracings in electrocardiography, can be photographed with the motion picture camera.

Thus improvement of heart action, as a result of rest, or drug action, or the evaluation of heart depressants or that of heart-and respiratory stimulants can be undertaken as well as comparative responses of animals and man. One drawback in the tropics is the high humidity, which has lowered in our apparatus somewhat the high sensitivity of the microphones for the audible recording of any adult's heartbeat and heart murmurs. It is, of course, our conviction that this difficulty, as well as the static interference, disturbing at times, will be overcome, in order to make the instrument generally applicable for human use, as well as for laboratory testing.

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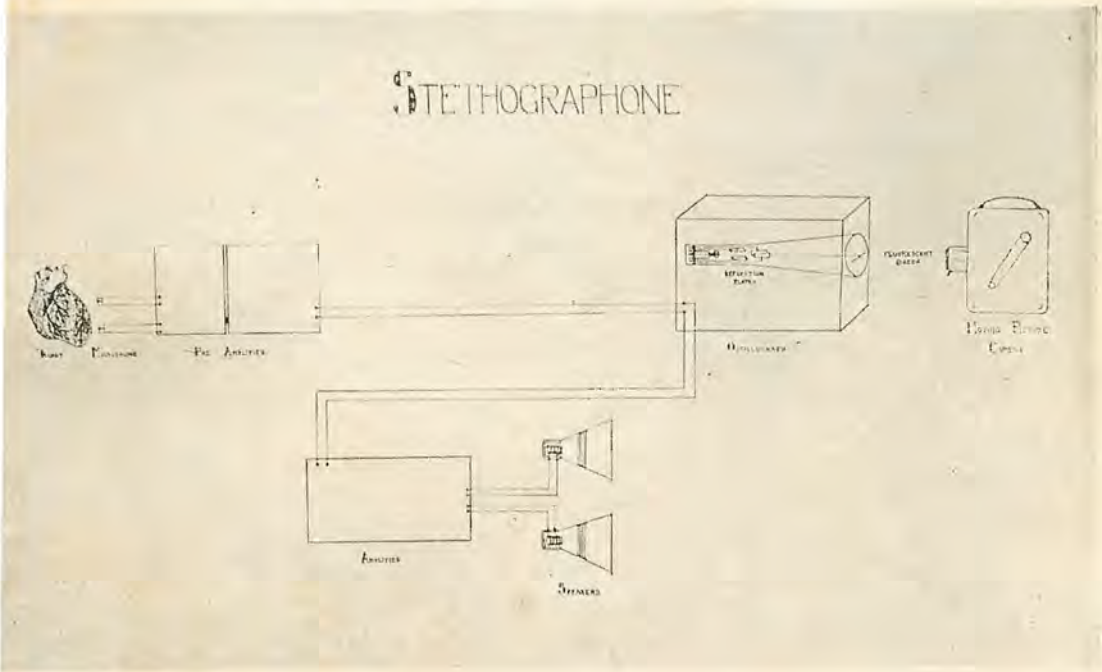
Fig. 7. The height to which the jute grows in Bangpahan district, where the land is flooded every year. Note the man standing in water by the side of the plants.

Fig. 8. Water in some places is so deep that the harvesting operation has to be done on boats. The jute plants are pulled up and the roots chopped off later.




E. B.

Dr. Viehoever, pressing a super-sensitive microphone against the dog's heart, listens to the beats coming through amplifier on right. Dial of the oscillograph at right shows the vibrations converted into lines of light.