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X-RAY-SONIC METHOD OF STUDYING THE HEART

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X-RAY-SONIC METHOD OF STUDYING THE HEART

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Our prominent scientists and clinicians have always called for a complex combination of methods of investigations which most fully permit the study of complicated biological processes. It has become especially necessary at the present time to combine methods by means of which it would be possible to obtain an objective idea of the construction of organs and their functions simultaneously with an analytical investigation. One form of such a combination is the unification of X-Ray and acoustical methods of investigation. Such a combination, naturally, could be realized on the basis of a highly developed X-Ray and electro-acoustical technique and of a high level of physiology and clinic of the cardio-vascular system.

One of the reasons which stimulated us to devise a method of simultaneous investigation of the form and the function of an organ was the discrepancy between the data obtained by the practicing physician in an examination of the heart and the data of an X-Ray examination.

Our device for the wiring for sound of the X-Ray screen consists of two basic blocks -- an X-Ray and an electro-acoustical. Electro-acoustical instruments of special design are used for sonic accompaniment of the roentgenological viewing and the recording of acoustical manifestations.

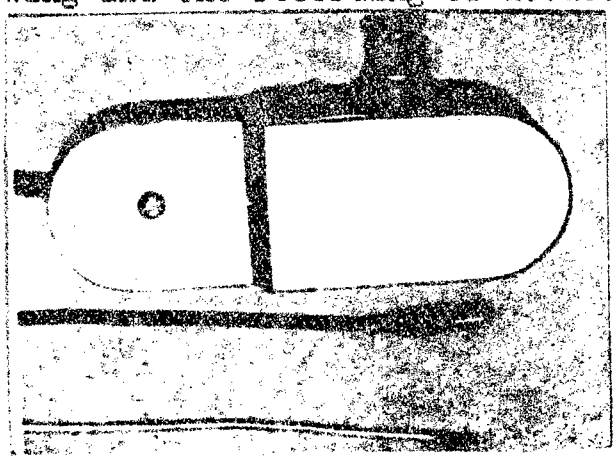

Fig. Microphones for X-Ray sonic investigation of the heart.

The electro-acoustical block of our system contains microphones, amplifiers, loudspeakers, oscillographs and photoelements. In the laboratory microphones were prepared for the pickup of sounds from the external surface of the chestcage, as were small-size microphones -- catheters for the pickup of heart sounds from the lumen of the oesophagus and directly from the heart cavity.

This system of loudspeakers permits the reproduction of amplified heart sounds in the X-Ray room at the time of the fluoroscopy or in an auditorium, with an intensity up to 90 dcb.

An eight-track oscillograph simultaneously records eight-different signals. The photoelements record in detail the pulsatory oscillation of the contour and shadow of the heart mass. Simultaneously, an electrocardiogram is recorded for comparison of the mechanical work of the heart with the electrical activity of the heart muscle.

An intra-oesophageal small-size microphone-catheter picks up the heart sounds directly from the lumen of the oesophagus. By placing the microphone-catheter on various sectors of the oesophagus, we hear sounds as though originative from an exposed heart. It should be remembered that sound waves radiated by the heart undergo marked changes in passing through the wall of the chest cage. Intraoesophageal auscultation excludes this factor and facilitates the full study of the sound field from the direction of the posterior mediastinum. Intraoesophageal auscultation of the heart sounds at the time of fluoroscopy of the organs of the chest cage make it possible to obtain an idea of the condition of the left ventricle, the left auricle, and the large vessels. It is difficult to overestimate the effectiveness of this method. Several years of experience have demonstrated that by means of this method it is easy to diagnose blue /cyanotic/ and white /non-cyanotic/ heart lesions with minimum inconvenience to patient and physician.

A device was recently constructed in our laboratory in collaboration with the Institute of Acoustics of the Academy of Sciences USSR by means of which it was possible to conduct acoustical catherterization directly in the heart chambers. This small microphone of two millimeters diameter (see figure) is intended for diagnostic purposes as well as for acoustical control at the time of operations upon the heart. It should be noted that there are a number of acoustical phenomena in the heart which have not as yet been fully explained -- the so-called X-sounds.

At the present time we are conducting experimental investigations of the mechanism of formation of these X-sounds.

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