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Directed Roentgenography of the Thorax.

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By a directed chest exposure is meant a roentgen exposure of the chest at any phase of the cardiac cycle. This is accomplished by the synchronization of the exposure with a definite phase of the circulatory phenomena, heart sounds, pulse wave or electrocardiographic impulse.

McPhedran and Weyl[1] found the use of the heart sounds unsatisfactory for this purpose because of interference of the extraneous sounds, but utilized the pulse wave with success. A cannula is applied over the carotid artery and the pulse thrust is transmitted to a tambour. A light beam reflected from a mirror on the tambour enters a photoelectric cell at the appropriate point in the cardiac cycle. The photoelectric current is amplified and actuates the X-ray switch after an appropriate delay. The sudden outward thrust of the carotid pulse occurs simultaneously with systole (mechanically), and in order to obtain an exposure at the end of diastole, a delay of slightly shorter duration than the cardiac cycle is necessary. The method is, therefore, not feasible when there is an irregularity of rhythm.

Meek and Eyster[2] used the electrocardiograph as a control. They closed the X-ray switch manually by estimating the appropriate point from the pulse wave and checked the result by noting the disturbance produced by X-ray exposure in simultaneously recorded cardiogram. Thus it was possible to state at what point in the cycle any particular exposure had been taken, but this method of timing cannot be very accurate and there must of necessity be many exposures which are not properly timed.

Our method makes use of the cardiac action current. This method was considered by McPhedran and Weyl and discarded by them as being too cumbersome. As developed by us, we believe it to be simpler and more effective than any method based upon the pulse.

The practical details are essentially these. The patient's leads are connected to those points which by means of a previous electrocardiogram have been found to yield a high erect or inverted R wave

[1] McPhedran and Weyl, *Radiology*, 1928.

[2] Meek and Eyster, *Am. J. Roentgenology*, 1920, **7**, 471.

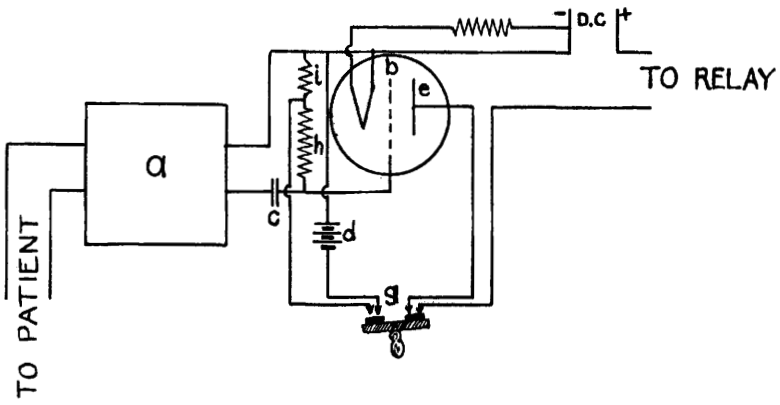

FIG. 1.

(over one millivolt and well above all other peaks of the electrocardiogram). The voltage thus led off is amplified two or three thousand times by means of a 2-stage amplifier (a in Fig. 1), the output of which is connected to the grid of a thyratron tube (b), through a condenser (c). As long as this condenser is connected to a charging battery (d), through the resistance (h), the grid is held so far negative that no discharge can occur. When all is ready for the exposure, the charging battery is disconnected and at the same time, the thyratron plate (e) is connected to a source of D.C. voltage through a relay. This double switching operation is accomplished by means of a switch as indicated diagrammatically at (g). The condenser now discharges through appropriate resistances (h and i), with a time constant of about 2 seconds, raising the grid potential until one of the high cardiac voltage pulses brings it over the critical voltage. The thyratron then becomes conducting and the X-ray contact is made by the relay, which by virtue of the properties of the thyratron now stays closed until the circuit to the plate is interrupted. Any suitable timer may be used, although we have found an arrangement based upon the charging of a condenser by the X-ray tube current to be most satisfactory.[3] Time delay devices may be inserted between the thyratron and the X-ray switch to make the exposure at any predetermined time after the R wave.

By means of an arrangement of relays, we have been successful in obtaining 2 pictures on the same film of the heart in 2 different selected phases of the same cardiac cycle. By this means we expect to investigate the relationship between the amplitude of heart motion, as shown by differences in the size of the heart shadow, and cardiac stroke output.

Further study will be necessary to determine the optimum point

[3] Schwarzchild, M. M., *Radiology*, 1930, **15**, 132.

of the cardiac cycle at which to expose roentgenograms in order that the unsharpness due to cardiac action may be minimized. Such study is in progress and involves the simultaneous recording of electrocardiogram and roentgenokymogram by a method similar to that used by us for the study of heart sounds.[4]

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Clinical Identification and Measurement of Urinary Sugars.

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In the routine urinalysis of the Prudential Laboratory all copper-reducing urines have for some years been measured by our modification[1] of Sumner's[2] di-nitro-salicylic acid method. Because of its speed, accuracy and independence of personal equations of technicians we use the Photo-Electric Scopometer,[3] but the method also works well with Junior Scopometer,[4] colorimeter or even permanent test tube standards.*

After Lasker and Enklewitz[5] drew attention to the fact that urines containing keto-pentose reduce Benedict's qualitative copper reagent at room temperature, we observed that ketose-containing urines also reduced our di-nitro-salicylic acid reagent at room temperature, perhaps more perceptibly than they do copper. When the reductions of di-nitro-salicylic acid by keto-pentose at room temperature were measured and the tests then boiled and the total reductions measured in our usual way, the results proved very consistent. We therefore began placing all di-nitro-salicylic acid tests in a water bath at 30° for 5 minutes and measuring whatever reduction might occur before going on in our usual way to boil the tests and measure the total reduction.

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[4] Hirsch and Schwarzchild, *Acta Radiologica*, 1934, **15**, 2, 84, 100.

[1] Rose, A. R., Schattner, F., and Exton, W. G., *Tr. Assn. Life Insurance Med. Directors of America*, 1929, **16**, 178.

[2] Sumner, J. B., *J. Biol. Chem.*, 1925, **63**, 393.

[3] Exton, Wm. G., *Am. J. Clin. Path.*, 1932, **2**, 411.

[4] Exton, Wm. G., *J. Am. Med. Assn.*, 1929, **92**, 708.

* Procurable from the Standard Reagents Co., 1709 Colonial St. (W. Oaklane), Philadelphia, Pa.

[5] Lasker, Margaret, and Enklewitz, Morris, *J. Biol. Chem.*, 1933, **101**, 289.