partially collapsed lung may be obtained by briefly pinching off the rubber tubing leading to the water valve.

Oxygen flow is carefully regulated by means of the differential valve on the oxygen tank. When the flow is properly regulated, oxygen bubbles gently through the water valve at all times except during inspiration, when the flow is temporarily interrupted. Even during inspiration there should not be much rise of water level in the glass tubing of the valve.

For satisfactory operation, obstruction of the intratracheal tube must be avoided. If there is excessive trauma during intubation, blood is almost sure to clog the tube. Rats that have colds or mild chronic pneumonitis should not be used because excess secretion clogs the intratracheal tube. Suction or repeated insertion of the stylet will sometimes free a clogged intratracheal tube.

We have used the method described in this paper in more than 300 thoracotomies on rats, about 200 of which were pneumonectomies. It has proved satisfactory and easy to use once the technic has been mastered. Best results were obtained when temperature and humidity were moderate. Hot, humid days seemed to cause a definite increase of the operative mortality rate.

Summary. For performance of intrathoracic operations on the rat pentobarbital sodium and scopolamine were found to be effective anesthetic agents. A plastic intratracheal tube was devised for use in such operations and has proved to be satisfactory. A simple water valve apparatus for administration of oxygen under positive pressure was devised for use with the intratracheal tube.

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Intravascular and Intracardiac Pressure Recording in Man: Electrical Apparatus Compared with the Hamilton Manometer.*

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An electrical apparatus has been used for recording blood pressures, (peripheral artery, right auricle, right ventricle and pulmonary artery), pleural pressure, and mask pressure in man. The method was tested for accuracy and fidelity in reproduction of the pressure tracings by comparison with the Hamilton manometer[1] used extensively for the recording of right heart pressure.[2,3] Records were obtained of simultaneous tracings on both systems, permitting a beat to beat study (Fig. 1, A and B). A record was also taken on the Hamilton manometer with the electrical recording off (Fig. 1, C).

The electrical pressure pick-up unit used was the Clark Pressure Capsule.† This capsule consists of 2 small coils mounted in a small round metal case (38 mm in diameter and 12.5 mm thick) and separated by a

* Under contract with Aero-Medical Laboratory, Wright Field, Dayton, Ohio. Additional support was provided by the Commonwealth Fund and the Life Insurance Medical Research Fund Gift for Study of Action of Certain Cardiovascular Drugs.

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† Clark Capsule, designed by James C. Clark, Wright Field, Dayton, Ohio. Aerotronics Inc., Camden, Ohio, licensed to manufacture the capsule.

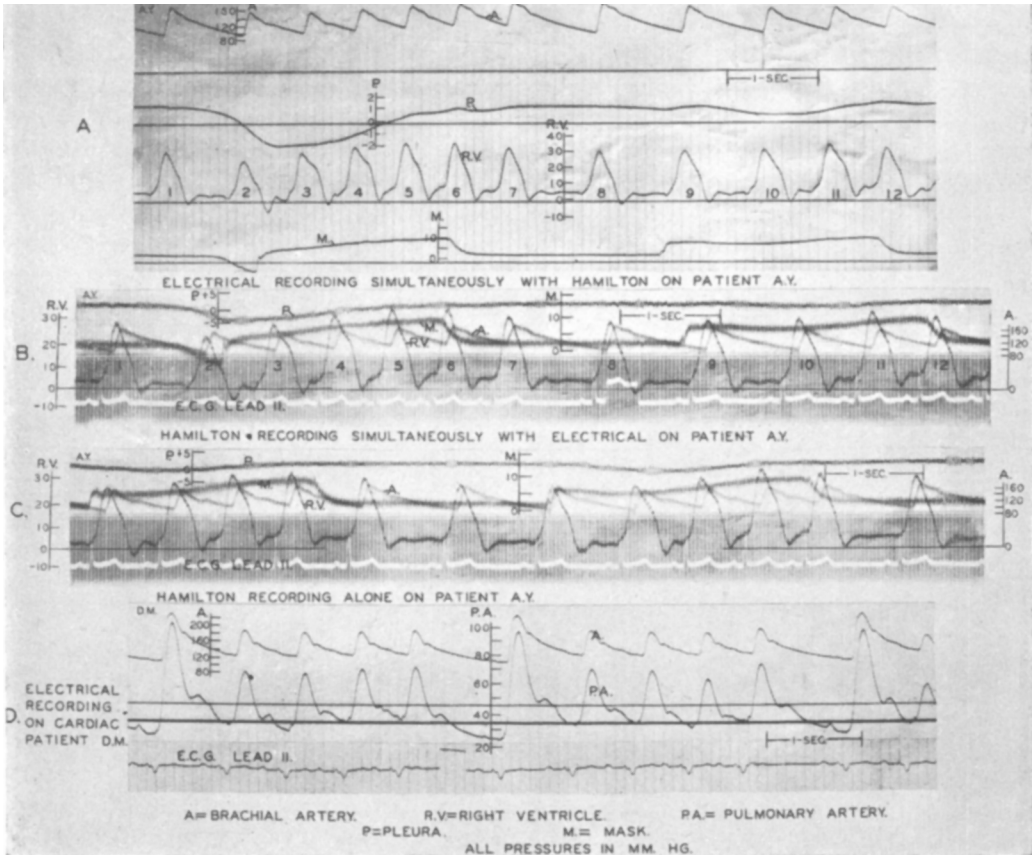

FIG. 1.

Electrical and Hamilton Pressure Recordings.

A. From above downward, brachial artery pressure, intra-pleural pressure, right ventricle pressure and face mask pressure. Patient breathing with an intermittent positive pressure respirator. Artificial pneumothorax previously present connected for pressure recording. Electrical recordings made simultaneously with the Hamilton given below and 12 consecutive corresponding heart beats shown, both arterial and right ventricle pressure pulse waves, the latter being numbered for ease in identification.

B. From above downward, intra-pleural pressure, face mask pressure, brachial artery pressure, right ventricle pressure and ECG lead II. Hamilton manometer recording made simultaneously with the electrical recording in A on the same patient.

C. Hamilton manometer recording alone on the same patient as above, but with the electrical apparatus disconnected. Tracing taken just previous to A and B shown above. Pressure tracings and ECG in the same order as in B above.

D. Electrical recording of brachial artery pressure (upper) and pulmonary artery (lower) with simultaneous ECG lead II in a cardiac patient with both systemic and pulmonary hypertension and a left bundle branch block.

diaphragm of varying thickness, depending on the pressure sensitivity required. The coils carrying a 1000 kc current on each side of the diaphragm of the capsule are balanced in the circuit of a bridge. When the 2 coils are properly balanced in the bridge a galvanometer connected through an amplifier for recording is set on the camera screen at a desired zero point. When pressure is exerted on one side of the capsule, a slight movement of the diaphragm occurs which alters the magnetic reluctance, creating an electrical imbalance of the bridge, which is amplified and the resulting galvanometer deflection recorded on an oscillograph type recording camera.

Electrical parts used:

1. Bridge (Balance type 3-103B Consol-

idated Engineering Corporation, Serial No. 3341).

2. Amplifier (Consolidated Engineering Amplifier, 4-channel type 1-106, Serial No. 3123, and Oscillator, carrier type 2-104B, Consolidated Engineering, Serial No. 2983).

3. Recording camera (Oscillograph, recording, type 5-101A, Consolidated Engineering, Serial No. 4775).

By changing the amplification a wide range of pressures could be measured without going off scale. Large deflections of the tracings could be secured for any pressure range encountered, and the amplification adjustment could be made quickly by turning a dial as needed. The calibrations for the electric recordings were linear for any given amplification setting and capsule, and remained constant from day to day.

To record blood pressure, the Clark Capsule was filled with airless mineral oil on the side attached to a 3-way stopcock and connected to an arterial needle or a cardiac catheter, in order to maintain a continuous fluid system, (sodium citrate or saline solutions in the capsule produced enough electrolysis so that the balance of the bridge became unstable). The bridge was balanced and the zero lines recorded at the beginning and end of each tracing taken. This procedure prevents errors in base line which might be made due to voltage drop, resistance changes, or drifts. Usually, when the base line did change due to one of the above factors, the deflection was of small magnitude. The Clark Capsule can be attached very closely to either the intraarterial needle or the cardiac catheter without need for lead tubing.

A Sanborn Cardiette was attached to the recording oscillograph using the amplifier of the Cardiette and one of the galvanometers in the oscillograph, for simultaneous recording of the ECG with the pressure tracings. Tests on conduction as measured by simultaneous recording of a pressure wave and ECG impulse showed a lag of .005-.01 second for the pressure wave as compared to the ECG. Similar tests on the Hamilton apparatus showed a lag of .01 second.[4]

TABLE I.

		Hamilton	Electrical
Arterial mm Hg	Systolic	166.8	166.1
	Diastolic	108.2	107.7
	Mean	133.0	133.0
Right Ventricle mm Hg	Systolic	30.0	30.8
	Diastolic	6.96	7.12
	Mean	11.5	12.0
Pleural mm Hg	Max.	+1.6	+1.4
	Min.	—3.0	—2.0
	Mean	+0.5	+0.6
Mask mm Hg	Max.	9.0	10.0
	Min.	2.0	2.0
	Mean	4.0	5.0

Pressure tracings (brachial artery and pulmonary artery) and ECG lead II taken simultaneously on a cardiac case with left bundle branch block and an irregular heart beat, are shown in Fig. 1, D.

The pressures were carefully measured beat by beat as recorded by the electrical and Hamilton methods simultaneously for 12 consecutive corresponding heart beats as shown in Fig. 1, A and B. The 2 systems were connected for simultaneous recordings by the use of a modified 3-way stopcock. A comparison was also made of pleural and mask pressures on the 2 systems. Inspection of Fig. 1, A and B, shows the general shape of all tracings on the 2 systems to be quite similar. The average quantitative values for the 2 systems are shown in Table I.

When the electrical system was cut off there was no significant change in the Hamilton recording either in shape of tracing or pressure values, as shown in Fig. 1, C.

It is beyond the scope of this report to discuss whether the blood pressure tracings obtained through the cardiac catheter and intraarterial needle are true records of pressure variation within the heart cavity and large arteries. Pressure tracings whether recorded with the electrical pickup or a Hamilton type may be modified by (a) artifacts due to movement of the tip of the catheter or of the catheter itself within the heart, (b) small volume changes in the catheter

[4] Cournand, A., Motley, H. L., Himmelstein, A., Dresdale, D., and Richards, D. W., Jr., PROC. SOC. EXP. BIOL. AND MED., 1946, **63**, 148

due to its deformability, and (c) low damping frequency of the entire hydraulic system ranging from 12 to 40 cycles per second. The volume change in the Clark Capsule is slightly larger than in the Hamilton type of capsule, for a given pressure alteration. This might affect slightly the form of the pressure tracing. In so far as can be determined by comparison with the Hamilton, however, the Clark Pressure Capsule appears to be adequate for the purpose of measuring systolic, diastolic and mean blood pressures (Fig. 1).

The advantages of the electrical recording device are: (a) the indefinite use of the capsule membrane, (b) the constancy of the linear calibrations, (c) the ease of rapid adjustment of the amplification in order to meet any pressure range, as required by displacement of the catheter from right ventricle to the right auricle, etc., (d) the absence of lead tubing, (e) the more rapid recordings and (f) better control of the base lines. The disadvantages are: (a) the slightly larger volume change required in the Clark Pressure Capsule per unit of pressure change, as indicated above, (b) the high cost of the electrical amplification equipment as used in this study. The apparatus as described here for amplification has a much wider range than is necessary for blood pressure recordings. By further modification of this type apparatus, to meet the special needs of blood pressure recording, it should be possible to overcome these disadvantages.

Summary. 1. The Clark Capsule, an electrical pressure pickup device, has been found satisfactory for recording blood pressures from the right heart, pulmonary artery, systemic arteries, pleural and mask pressures in man, when used with a suitable amplification and recording device.

2. The tracings recorded with this apparatus compare closely with those obtained simultaneously with a Hamilton manometer system.

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Evidence that Virus of Herpes Simplex Does Not Cause Vincent's Angina of the Tonsil.*

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The etiological role of the virus of Herpes Simplex in acute infectious gingivostomatitis has been established.[1] Not infrequently the Plaut-Vincent spirochete and the fusiform bacilli are also present, perhaps as secondary invaders, and prior to proof that the virus of Herpes Simplex was responsible, the spirochete-fusiform bacilli were regarded by some as causal. Thus, the disease was often called Vincent's gingivostomatitis.

It seemed worthwhile to investigate whether or not the virus of Herpes Simplex had any underlying causal role in Vincent's tonsillar angina. Each patient studied had a typical unilateral, craggy, yellowish ulcerated tonsil with membrane and foul odor. There was local adenopathy and low, if any, fever. Many Vincent's spirochetes and fusiform bacilli were seen on smear; no β-hemolytic streptococci or *C. diphtheriae* were cultured and no evidence of syphilis or infectious mononucleosis demonstrated.

Twelve young British soldiers (18 to 35 years of age) had the above typical picture.

* Work done while serving with the American Red Cross Field Hospital Unit, Salisbury, England, 1941-1942.

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