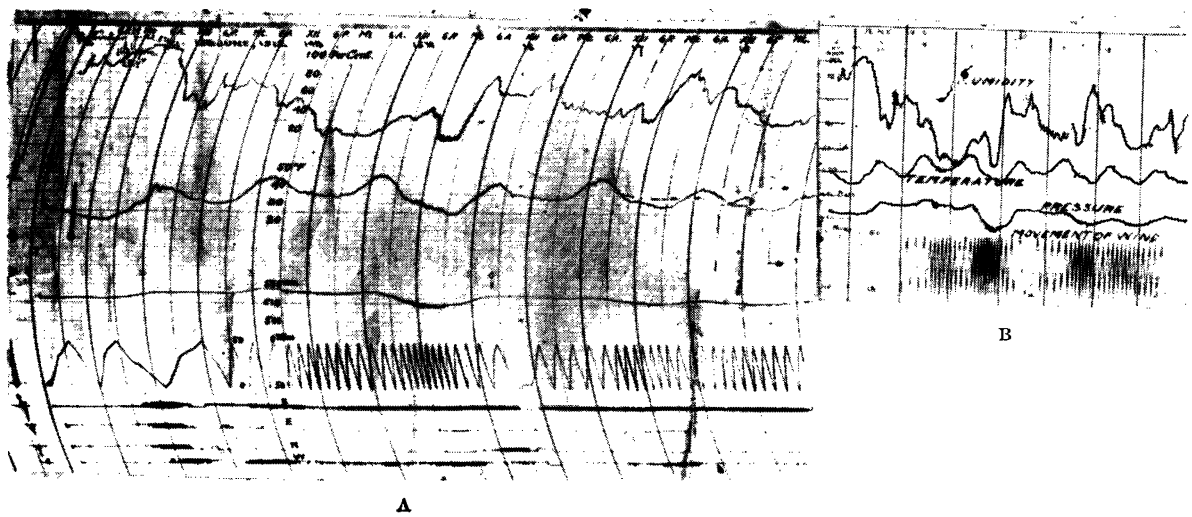

FIG. 3. Record by meteorograph on Mt. Rose, Nevada. *A*, photograph of original; *B*, a copy by the special pantograph, in one operation for each of the 4 elements: (1) Curved ordinates are changed to rectilinear, (2) Fahrenheit degrees to Absolute, (3) millimeters to millibars, (4) the time scale of 60 mm in 24 hr to 30 mm for the same period; (5) necessary corrections are applied.

a light chain connecting the bar N with the drum L over which it is wound; tension on the chain is maintained by a weight N^1. The stylus is caused to follow the outline of the original figure, and the copy is made simultaneously, in ink, by movements of the cylinders and carrier controlled by milled heads on the drums K or M and L.

When both graph and original figure are in rectilinear coordinates and the scales of the graph must be different from those of the original, the stylus and the pen are attached to separate carriers (E or S), one of which is supported by the bar O suspended adjustably from N. When curved ordinates of an original figure are copied as rectilinear, the stylus is attached directly to O, as shown in Fig. 1, where a diagram, T, is copied.

As indicated by dotted outlines in Fig. 1, the bars N and O can be placed in almost any convenient position on the upright P, and the ratio of movement of one bar to that of the other adjusted accurately. Accuracy of movement of the cylinders is secured by adjustment of the plate C^1 so that chains E and F are parallel between the rollers C^2 and the bar D. Since movements of cylinders and mechanisms are controlled by weights, there are no errors caused by looseness of bearings; backlash between pinions and crown gears is prevented by a separate weight V.

The instrument described occupies a space 1 m square, or about that necessary for a precision pantograph; larger or smaller models of the same accuracy can be produced at approximately the same cost. Paper 40 × 50 cm, or the belt mentioned (which may be several meters in length), can be used for originals and copies, and graps can be made from values read from text or tables without intermediate plotting on coordinate paper.

The operator of this instrument is comfortably seated facing the recording mechanisms, all adjustments of which are within easy reach, and all movements are controlled by means of two of the milled heads K, L, and M.

References

1. FERGUSSON, S. P. *Am. Met. J.*, Aug. 1895, 116.
2. ———. *Tech. Bull. No. 83 Exp. Sta. Univ. Nevada*, 1915.
3. GUTSELL, J. S. *Science*, 1949, **110**, 403.
4. WAINERDI, H. R. *Science*, 1950, **111**, 289.

A Miniature Pressure-recording Device

Otto H. Gauer and Erich Gienapp

Aero Medical Laboratory,
Air Materiel Command, Dayton, Ohio

The extensive use of intracardiac catheterization for diagnostic purposes and special problems in physiology stimulated the development of a manometer sufficiently small to permit its introduction into the circulatory system. From the theoretical point of view it is advantageous to reduce the dimensions of a manometer. Cutting down the mass of the moving parts actually improves the recording properties by increasing the natural frequency. In most elastic manometers for blood pressure measurements, the greatest part of the effective mass resides in the cannula and its connections. This condition is completely eliminated by putting the recording element at the tip of the instrument. Moreover, such a pressure pickup that is in direct contact with the pressure avoids artifacts due to, and corrections necessary for, the hydrostatic columns in the fluid-filled tubes that connect the circulatory system with commonly used external manometers.

A disadvantage of such a system is the necessity for using an amplifier. Among the various possibilities of constructing such a miniature manometer, the principle of a differential transformer, first outlined by Wetterer (*3*), seemed best suited to give a system having excellent recording properties with a minimum of amplification.

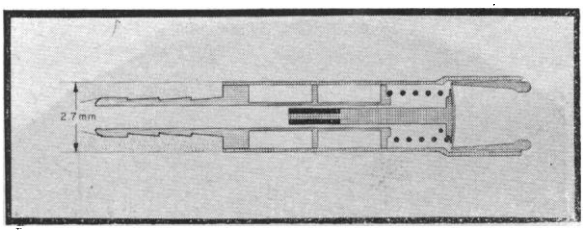

FIG. 1. Miniature manometer. Horizontal hatching, core with two chambers for the transformer coils; vertical hatching, casing; diagonal hatching, ring holding the sealing rubber membrane. Crosshatching, piston; black dots, coil spring; black rectangles, soft iron. Dotted area, catheter. Over-all length of metal tip, 12 mm; largest diameter, 3 mm.

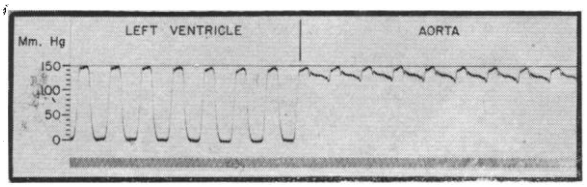

FIG. 2. Pressure record (⅛ scale) taken while catheter was pulled from left ventricle of an intact dog into the aortic root.

After trying numerous designs of pressure-sensitive elements, the authors agreed on one very similar to Wetterer's original, although smaller, sturdier, and simpler to handle. With two years of continuous use and improvement, this manometer has been developed into a rugged and dependable instrument.

The all-metal pickup fits on a No. 8 Cournand catheter. Its construction may be seen in Fig. 1. The movable part is the piston (crosshatching). It consists of a 0.6-mm brass rod carrying on one end a plate of 2.1 mm diameter and on the other end a small piece of soft iron. It is held in position by a steel spring (black dots) and is activated by the pressure on the plate. The steel spring determines the elastic properties of the manometer. A sheet of condom rubber seals the unit. This sealing membrane is easily fixed in place by means of a precisely fitting brass ring (diagonal hatching). The elongation of the casing (vertical hatching) beyond the membrane has a double function. It houses the sealing device and also protects the membrane from direct contact with the walls of the beating heart, which may cause artifacts. The core (horizontal hatching) accommodates the differential transformer. The iron part of the piston acts as an armature. According to its position, it determines the relative coupling of the transformer sections.

This differential transformer is connected to the bridge circuit of a carrier amplifier. A one-knob balancing device permits correction for the capacitance introduced by an extension cord, which may be placed between the amplifier and the pickup. In our experiments a 30-ft extension cord was used. The pickup with the bridge circuit can be incorporated in most commercially available carrier amplifiers with only minor changes, provided these furnish frequencies in the audible range (*ca.* 1,000–15,000 cps) having a reasonably pure sine form. The simple two-stage amplifier especially built for the unit has an oscillator adjusted to 9,000 cps.

The over-all performance of the miniature manometer may be summarized as follows:

1. Natural frequency of 1,000 cps in fluid.
2. Damping ratio, .34.
3. Maximum sensitivity, 50 ma/100 mm Hg.
4. Linear response between −50 and +250 mm Hg.
5. Static calibration is achieved with a mercury manometer by applying suction at the rear end of the catheter. This feature allows calibration of the sterile catheter and control of sensitivity during the measurement without touching the tip or removing the catheter from the vessel.
6. A two-knob amplifier (zero adjustment and sensitivity) provides high stability.

Fig. 2 is an example of a pressure record while the tip of the catheter was pulled from the left ventricle of an intact dog into the aortic root (recording galvanometer Heiland Type C). The record was taken in collaboration with Ellis, Essex, and Wood, of the Mayo Clinic, in tests on the adaptability of the unit for clinical work (*1, 2*).

A modification with the coil spring and sealing device replaced by a corrugated membrane is being tested. Detailed information will be given elsewhere.

References

1. ELLIS, G., *et al.* *Am. J. Physiol.*, 1949, **159**, 568.
2. ELLIS, E. J., GAUER, O. H., and WOOD, E. H. *Proc. Staff Meet., Mayo Clinic*, 1949, **25**, 49.
3. WETTERER, E. *Z. Biol.*, 1943, **101**, 332.

The Use of Thick Paper for Chromatography[1]

J. Howard Mueller

Department of Bacteriology and Immunology, Harvard Medical School, Boston, Massachusetts

Yanofsky, Wasserman, and Bonner (*1*) have recently described the use of a special heavy grade of filter paper for large-scale paper chromatography. They recommend Schleicher and Schuell filter paper No. 470-A, but state that separation is not as good as on thinner paper. Attempts in this laboratory to apply the procedure to the separation of a mixture of peptides readily confirmed this fact and indicated that for our purpose the separation achievable with this paper was hopelessly inadequate. Essentially, No. 470-A is blotting paper and is highly bibulous. Using secondary butyl alcohol containing formic acid and ethyl formate, about 90% saturated with water,[2] the solvent advances on this paper at the rate of about 17 cm/hr, a rate so rapid that there is little opportunity for selective mobilities to become manifest.

This rate can be greatly retarded by the simple expedient of attaching a strip of Whatman No. 1 paper to one edge of the thick sheet, overlapping 1–2 cm. The two

[1] Aided by a grant from the Commonwealth Fund.

[2] A slight modification of a solvent suggested by Lyman C. Craig, of the Rockefeller Institute.