terval when the pyruvic acid content decreased from 5.75 to 3.58 mg %. In another experiment the lactic acid rose 0.4 mg % while the pyruvate concentration fell 2.54 mg %. This is in accord with the findings of Flock, Bollman, and Mann[7] that sodium pyruvate incubated with blood does not cause any change in lactic acid content.

It has been reported[2] that potassium cyanide increases the magnitude of the disappearance of pyruvate due to a potentiation of cocarboxylase action. However, as we have already demonstrated, the disappearance of pyruvate does not depend upon cocarboxylase content. Furthermore, the addition of the same amount of cyanide (final concentration of 0.5% sodium cyanide) to standard solution of pyruvate or to serum as well as to blood containing added pyruvate results in an almost complete disappearance of pyruvate. This may occur either from polymerization of the pyruvate or from cyanohydrin formation.

Conclusions. 1. The disappearance of pyruvate added to blood *in vitro* is caused by the blood cells and not the serum. 2. Hemolysis of the cells by saponin or freezing increases the speed and extent of this reaction. 3. The extent and rapidity of the reaction is not altered by Vitamin B_1 deficiency of the cell donor, nor by the addition of cocarboxylase to the cells *in vitro*. 4. Anaerobiosis has no effect on the reaction. 5. The reported effect of cyanide upon the reaction is due to an artefact. 6. The pyruvate which disappears is neither decarboxylated nor changed to other ketonic acids or lactic acid.

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Electro-Magnetic Measurement of Blood Flow and Sphygmomanometry in the Intact Animal.

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The electro-magnetic method of measuring blood flow[1] has been discussed in detail in previous publications.[2, 3] In this communication we wish to describe a modification which we believe to be

[7] Flock, E., Bollman, J. L., and Mann, F. C., *J. Biol. Chem.*, 1938, **125**, 49.

[1] Kolin, A., PROC. SOC. EXP. BIOL. AND MED., 1936, **35**, 53.

[2] Katz, L. N., and Kolin, A., *Am. J. Physiol.*, 1938, **122**, 788.

[3] Kolin, A., PROC. SOC. EXP. BIOL. AND MED., 1941, **46**, 235.

Additional references may be found in 3.

more widely applicable to studies in vascular physiology since it permits blood flow measurements in the recovered animal over an extended period of time* and combines with it a method of sphygmomanometry.

The principle of this method is based on the fact that an electromotive force is induced in the stream of blood as it moves across a magnetic field. This e.m.f., which is proportional to the rate of flow, is amplified and photographically recorded. With the exception of the magnet the apparatus utilized in the present modification is the same as described in reference 3.

In the present modification a small snugly fitting rubber sleeve (R:Fig. 1) containing the pick up electrodes is implanted about the given vessel using sterile precautions. The wound is closed and the animal is permitted to recover. Thereafter blood flow measurements may be performed in the intact animal by placing the desired part in the gap of a large a.c. electro-magnet. The size and shape of the magnet which we employed permitted observation in anesthetized animals in somewhat unnatural positions. However, with a suf-

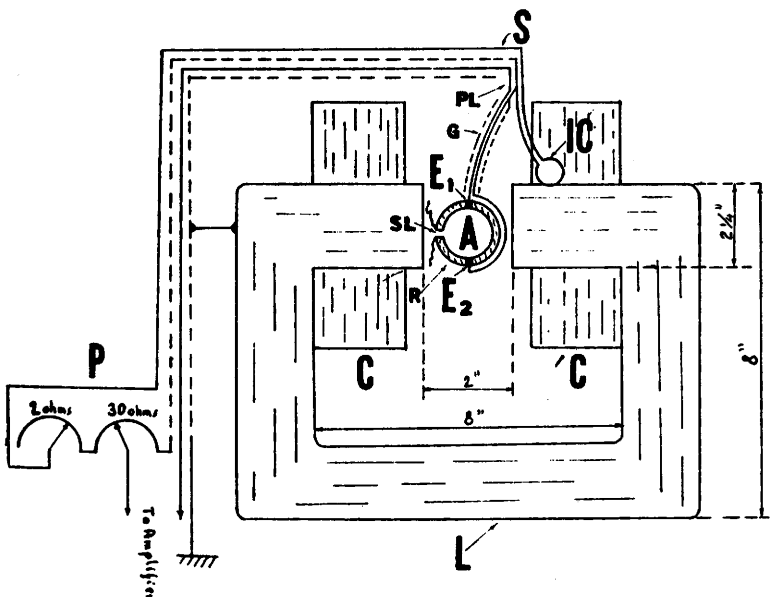

FIG. 1.
Cross-section of electro-magnet and potentiometer circuit. P: compensating potentiometer. CC: coils. L: laminated iron core. IC: induction coil. S: insulated wire. R: pick up sleeve (greatly exaggerated in size). A: artery. E_1 and E_2: electrodes. SL: slit. G: grounded, flexible shield. PL: location of plug.

* Thus far our experiments were terminated after a period of 3 days because of thrombosis on subsequent handling of the vessel.

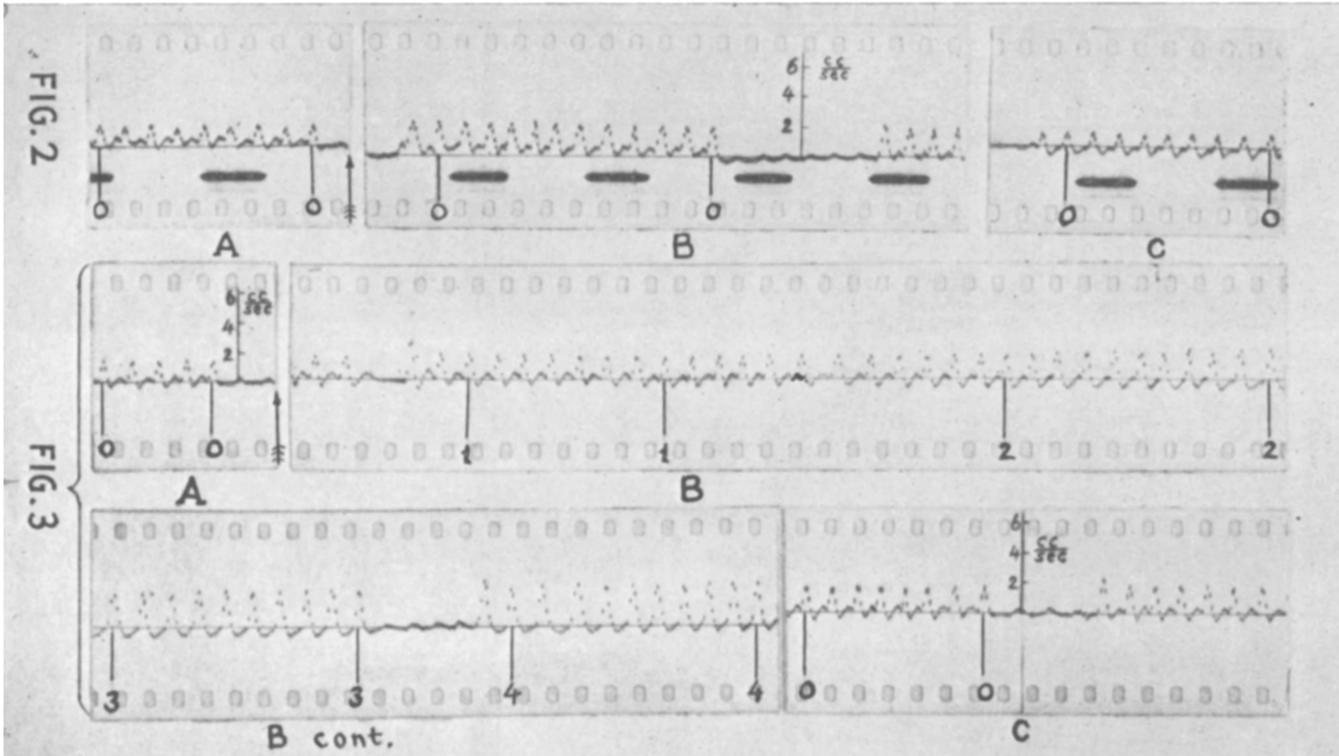

FIG. 2. Effect of 60 γ of adrenalin on femoral flow (given intravenously). Time intervals 2.4 sec. (Table I.)

FIG. 3. Effect of 25 mg of papaverin on femoral flow (given intravenously). Film speed the same as above. Arrows indicate injection of the drug. (Table I.)

ficiently large magnetic gap properly arranged animals could be placed in comfortable positions and blood flow could be recorded without resorting to anesthesia.

Method. The blood velocity is recorded with a cathode ray oscilloscope. Its deflection is linearly proportional to the rate of flow. Since the changes of flow are followed without inertia one can easily distinguish between the systolic and diastolic velocities (Figs. 2 and 3). The recorded curve consists of dots which are spaced at intervals of 1/60 of a second when the magnet is fed with a 60 cycles a.c. A greater continuity of the record can be obtained either by slowing down the recording film[3] or by using an alternating magnetic field of a higher frequency.

The calibration of the instrument reading in terms of cc/sec was performed in all cases by perfusing the excised blood vessel with blood and measuring the outflow with a graduate and stop watch. For observation of relative changes of blood flow a calibration is unnecessary. The average flow during a given time interval can be determined by planimetry.[2] The area of the curve below the base line, corresponding to zero flow, is to be considered as negative.

The method was also adapted for simultaneous determination of blood pressure[†] by placing minute rubber cuffs, patterned after the fashion of the sphygmomanometer, on either side of the pick up sleeve. The air pressure within the cuffs is measured and raised until the systolic flow pulsations disappear in the oscilloscope. The corresponding manometer reading gives the systolic blood pressure. We compared pressure readings as obtained by this method in the left femoral artery of a dog with pressures determined simultaneously in the cannulated right femoral artery and found the results to check within 3%.

Fig. 1 shows diagrammatically the a.c. magnet with the rubber sleeve, R, placed around an artery A (greatly exaggerated in size) and the compensating potentiometer, P. The rest of the circuit is exactly as described previously.[3] The peak value of the magnetic field strength was 500 Oersted. The coils, CC, consisted of 300 turns each and passed 9 amperes when connected in parallel to the 50 volt terminals of a step down transformer. I C is a small coil which supplies the compensating voltage across the potentiometer, P. The potentiometer is placed next to the amplifier several yards away from the magnet. The connections to the potentiometer are made through a single conductor, S, and an "air-plane cable" whose grounded outer conductor is indicated by dotted lines. The voltage

† Technic devised by J. L. Weissberg.

picked up by the electrodes E_1 and E_2 is conducted to the amplifier by 2 insulated flexible wires which terminate in a small plug, PL. We used enameled cotton covered wires which were held together by a coating of "Vultex". A grounded spiral G (1.8 mm external diam) wound of thin copper wire was placed around the lead wires. A coating of "Vultex" was applied to its outside as well as to the rubber sleeve, R, so that all metal parts were thoroughly imbedded in rubber. The sleeve, R, is a section of a catheter about 4 mm long. The contact electrodes, E_1 and E_2, were made by removing the insulation at the end of the lead wires and threading them through 2 stitches into the wall of the rubber tubing. The slot S L was closed by tying the silk threads attached to its edges. We prepared sleeves of various sizes for different diameters of the artery A which is slightly compressed when the sleeve is tied around it.

Pharmacological Illustrations of the Method.‡ Figs. 2 and 3 represent the velocity curves obtained from the left femoral artery of a 50-lb dog after intravenous nembutal anesthesia 1½ days after the implantation of the pick up and compression units. The base line corresponding to zero flow was checked from time to time by occluding the artery with a compression cuff distal to the pick up sleeve. Owing to incomplete occlusion there were small systolic peaks in the base line. The base line was consequently plotted in coincidence with the diastolic level. Average flows were obtained by planimetry of sections of an enlarged record (Table I).

The effect of intravenous injection of 60 gamma of adrenalin is shown in Fig. 2.§ Initially there is a marked increase in velocity, due to augmented cardiac output, resulting in a 46% rise in peripheral

TABLE I.

Section of record	Avg peripheral flow, cc/sec	Avg regurgitation, cc/sec	Avg forward flow, cc/sec	Approx. time intervals, sec
Fig. 2A;00	.67	negligible		Betw. 2A and 2B: 30
” 2B;00	.98	”		” 2B and 2C: 90
” 2C;00	.07	.12	.19	” 3A and 3B: 20
” 3A;00	.36	negligible		” 3B and 3C: 60
” 3B;11	.41	”		
” 3B;22	.40	.05	.45	
” 3B;33	.50	.14	.64	
” 3B;44	.84	.04	.88	
” 3C;00	.62	negligible		

‡ Identical experiments were performed with exposed vessels using a small magnet (Feitelberg, not published).

§ Sections A of Fig. 2 and 3 represent normal flow before the injection of the drug. The arrows indicate the moment of injection. The time intervals between the sections of the record are listed in Table I.

blood flow (Fig. 2 B). During the following phase peripheral vasoconstriction apparently results in a marked elastic recoil of the blood, causing a diastolic regurgitation. The resultant average peripheral flow is thus reduced to 10% of the normal (Fig. 2 C). The contour of the velocity curve is obtained by joining the *upper edges* of the individual dots. The area corresponding to negative flow is, therefore, not as great as might appear at the first glance.

The intravenous injection of 25 mg of Papaverin (Fig. 3) is followed by an almost immediate rise in peripheral blood flow reaching a maximum of 230% of the normal (Fig. 3 B, Sec. 44) and persisting at an elevated level for an appreciable period of time (Fig. 3 C). Fig. 3 B shows an interesting gradual change of the diastolic contour of the flow tracing which indicates a transient diastolic regurgitation of short duration. But, as Table I shows, the average flow remains above normal even in those sections where the regurgitation is greatest.

In the beginning of record 3 B there is a noteworthy prolongation of the diastolic interval which is followed by a vigorous systolic thrust.

Summary. A modified electro-magnetic flow meter has been described which may be applied to investigation of a wide variety of cardiovascular problems involving flow and pressure measurements in intact animals.

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New Media for the Growth of *Bartonella bacilliformis.*

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Liquid, semi-solid and solid media, tissue cultures, and developing chick embryos have been utilized for the growth of *Bartonella bacilliformis.*[1-5] Of these media, the semi-solid leptospira medium of

[1] Noguchi, Hideyo, and Battistini, Telémaco S., *J. Exp. Med.*, 1926, **48**, 851.

[2] Samper, Bernardo, and Montoya, Juan Antonio, *Rev. Fac. Medicina de Bogotá*, 1940, **9**, 197.

[3] Jiménez, J. F., PROC. SOC. EXP. BIOL. AND MED., 1940, **45**, 402.

[4] Pinkerton, Henry, and Weinman, David, PROC. SOC. EXP. BIOL. AND MED., 1937, **37**, 587.

[5] Jiménez, J. F., and Buddingh, G. John, PROC. SOC. EXP. BIOL. AND MED., 1940, **45**, 546.