hemoglobin, and mean corpuscular hemoglobin concentration may vary as much as three times the standard deviation within 7 days. The mean reticulocyte value is comparable to that of Krumbhaar.[5] The mean value and the wide variations in the number of leucocytes compare favorably with the findings of Mayerson[6] and the compilation of Scarborough.[7] Our statistical analysis agrees closely with that of Wintrobe.[1] In agreement with previous reports for the dog,[1] we noted no significant differences between the erythrocyte count, hemoglobin, volume of packed red cells, reticulocyte percentage, and leucocyte count of the male and female dogs studied.

Summary. The results of 251 determinations of the red blood cell count, hemoglobin, volume of packed red cells, mean corpuscular volume, hemoglobin, and hemoglobin concentration, reticulocyte percentage and leucocyte count of 34 normal dogs are recorded. No significant sex differences for these values were observed.

9352 P

Study of Peripheral Circulation by Means of an Alternating Current Bridge.

HUBERT MANN.

When the electrical conductivity of any part of the body is measured by means of an alternating current bridge it is found that this conductivity shows a rhythmic variation synchronous with the pulse. This phenomenom which can be observed in any accessible part of the body, offers a method of studying the peripheral circulation. For experimental purposes a single finger, generally the right index finger, has been chosen as the subject of this investigation.

The experimental set-up is as follows: 2 strips of cotton gauze or thin metal foil are applied to the finger after moistening with a salt solution or an electrically conducting paste or jelly, care being taken that the gauze or foil does not constrict the finger or impede the circulation. One of these electrodes is placed near the tip and the other near the base of the finger. Through these strips the finger is then connected to an alternating current bridge. This bridge, instead of having the customary earphones, is connected to an ampli-

[5] Krumbhaar, E. B., *J. Lab. and Clin. Med.*, 1922, **8**, 11.

[6] Mayerson, H. S., *Anat. Rec.*, 1930, **47**, 239.

[7] Scarborough, R., *Yale J. Biol. and Med.*, 1930, **3**, 359.

fier and the output of the amplifier after rectification actuates a recording galvanometer. A change in the electrical conductivity of the finger is thus recorded.

Care is taken that the patient's hand and arm are in a comfortable position with the fingers relaxed and free from constriction or any discomfort. During the course of the experiment a current of about one volt and one milliampere passes through the right index finger. This current does not give rise to any sensation or to any objective changes even after several hours' continuous application.

The curves obtained are not due to variation in contact resistance between the finger and the electrode. This is evident from the fact that when the electrodes are made of gauze soaked in salt solution and applied loosely to the finger, the same curve is obtained as when the electrodes are made of metal foil. Variations in the electrical conductivity of the finger, as recorded by this instrument, seem to be due solely to circulatory factors. When the circulation in the finger is stopped by a blood pressure cuff on the upper arm the instrument then records a level base line without rhythmic variations (Fig. 1). If the blood pressure cuff is deflated slowly the instrument begins to record small waves when systolic pressure is reached and these waves increase in amplitude, reaching their maximum when the pressure in the cuff approaches the diastolic blood pressure.

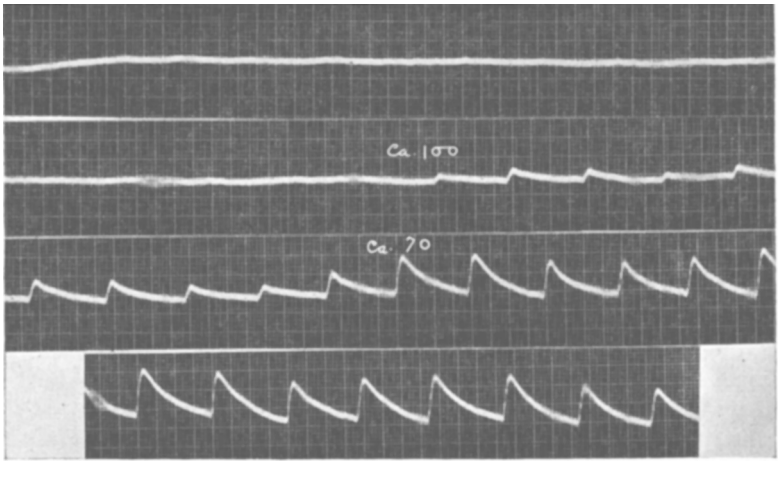

FIG. 1.

Continuous record taken from the right index finger while a blood pressure cuff was attached to the right upper arm. The pressure in the cuff was gradually lowered. The curve begins to appear as a small rhythmic wave when the pressure in the cuff reaches systolic blood pressure and the curve attains its maximum height when the pressure in the cuff approximates diastolic blood pressure. An upstroke in the curve indicates decreased impedance in the finger.

While it is not safe to assume that the height of the recorded curve is directly proportional to the blood flow through the finger, it seems obvious that variation of the blood flow through the finger produces variation in the recorded curves, and that there is a positive correlation between the height of the recorded curve and the volume of the peripheral circulation.

This correlation is evident in experiments with drugs whose peripheral circulatory action is well known. Nitroglycerin: 1/100 grain under the tongue: produced a rapid, marked increase in the height of the curve in all 5 individuals tested. Smoking had the opposite effect. Ergotamine tartrate: 1 mg. injected intramuscularly: produced a gradual decrease in the amplitude of the curve, the maximum effect occurring about one hour after injection. Fig. 2 illustrates some of the characteristic curves.

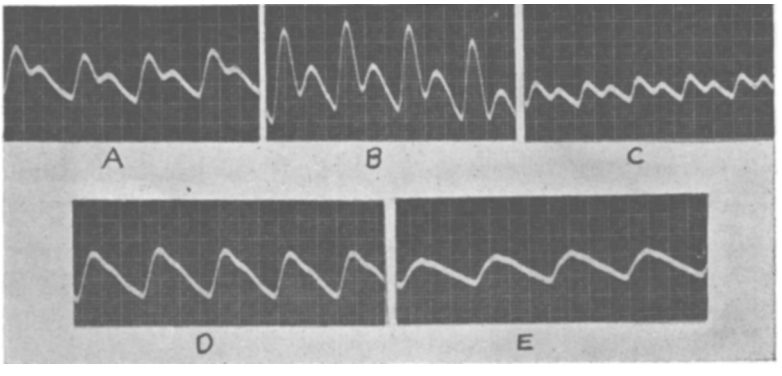

FIG. 2.
A— shows a curve taken from the right index finger of a normal adult. B— is a record from the same finger 10 minutes after 1/100 mg. of nitroglycerine under the tongue. C— is a record of the same patient immediately after smoking the first morning cigarette. D— is a record taken from the right index finger of a normal adult. E— is a record of the same finger 50 minutes after the intramuscular injection of 1 mg. of ergotamine tartrate.

It will be noted that the curves in Fig. 2 show not only changes in height but also changes in shape. Curves A and D were both made from the right index fingers of apparently normal adults and, although of about the same height, show very different shapes. Curve B shows a characteristic shape which is produced regularly by nitroglycerine. In all the curves recorded, the change which occurred in the finger with each pulse beat was an increased capacitance and a decreased resistance. Of these 2 effects, the capacitance effect was by far the more pronounced. Because of the complexity of the physical and mechanical elements involved, the evaluation of

the significance of the shape of the curves can not as yet be published. Suffice it to say that the phenomena observed are constant and easily reproducible so that the evidence at hand indicates that the electrical changes in the finger provide a new and useful method for studying circulatory changes.

Summary. The alternating current bridge offers a method of studying the peripheral circulation, and of recording changes produced by physiological and pharmacological agents.

9353 P

Leucocytic Infiltration of Irradiated Mouse Sarcoma 180.

ROBERT CHAMBERS AND C. G. GRAND.*

From the Department of Biology, Washington Square College, New York University.

In tissue cultures of the Crocker Mouse Sarcoma 180 a pronounced difference was found in the numbers of blood granulocytes which migrated from explanted fragments of tumors irradiated *in vivo, in vitro,* and of untreated controls.

The tissue culture method affords a ready means of detecting the presence of leucocytes in a given tissue. The polymorphonuclear leucocytes are the first cells to migrate from the explant into the surrounding plasma medium and, if present in large numbers, form cloud-like masses extending beyond the periphery of the explant within a few hours after incubation. This method was recently used as one of the means of determining the accumulation of leucocytes in various mouse tumors which had been injected with starch.[1]

The tumors used were growths which had developed for about 10 days after subcutaneous inoculation. Their size varied from about 5 to 8 mm. in gross diameter. Sarcoma 180 is a rapidly growing tumor which spontaneously undergoes partial necrosis. In selecting fragments for tissue culture, care was taken to note whether they were from necrotic or from non-necrotic regions for comparisons with irradiated or non-irradiated specimens.

Studies were also made of a large number of histological sections of tumors removed at hourly intervals after irradiation. These were compared with untreated tumors of similar ages and also with tumors irradiated after extirpation.

* Aided by the International Cancer Research Foundation, Philadelphia, Pa.

[1] Chambers, R., and Grand, C. G., *Am. J. Cancer,* 1937, **29**, 111.