curately and probably less traumatically (*5*). Excessive heat (over 125° C) or too frequent baking shortens the life of the catheter. The only alternative to occasional baking, when the catheter finally becomes too limp to control, is the use of a stylet to lend sufficient stiffness for controlled insertion, as described above.

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A Modified Photoelectric Apparatus for Permeability Studies[1]

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For a number of years the author has been using a photoelectric technique for measuring the permeability of erythrocytes similar to that described by Parpart (*3*). Most of the experiments have involved hemolysis studies of chicken erythrocytes. Since the rate of hemolysis may be influenced by a number of different factors (e.g., Jacobs, *2*) it was decided to use swelling measurements only as an indication of permeability changes. The author has experienced much more difficulty in obtaining measurable light changes when chicken erythrocytes swell, however, than when mammalian erythrocytes are used.

It was thought that perhaps greater sensitivity could be obtained using light of a wave length corresponding to the region of the spectrum which is maximally absorbed by hemoglobin. Consequently, the light was passed through a green filter[2] before going through the erythrocyte suspension. This, however, decreased the light transmission to such an extent that the current produced by the photronic cell was too small to give a measurable deflection of the galvanometer. A photoelectric call and amplifier were substituted for the photronic cell with satisfactory results. A photograph of the photocell-amplifier unit[3] is shown in Fig. 1 and a diagram of the circuit, in Fig. 2.

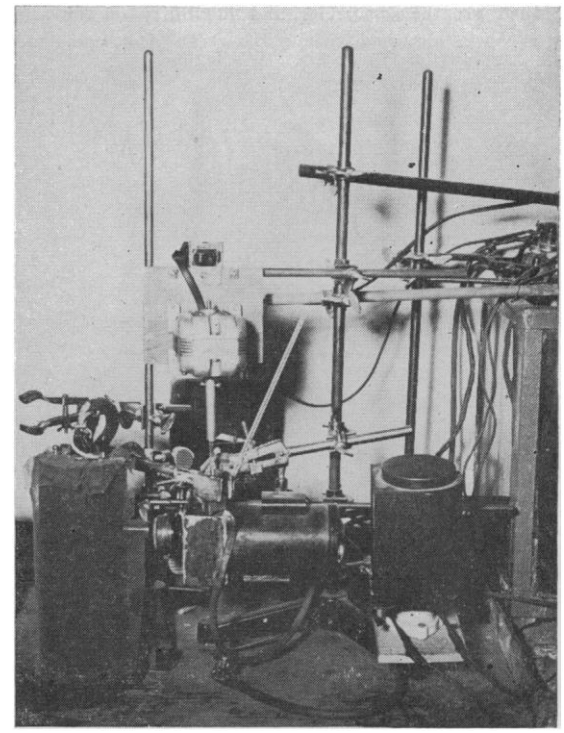

FIG. 1

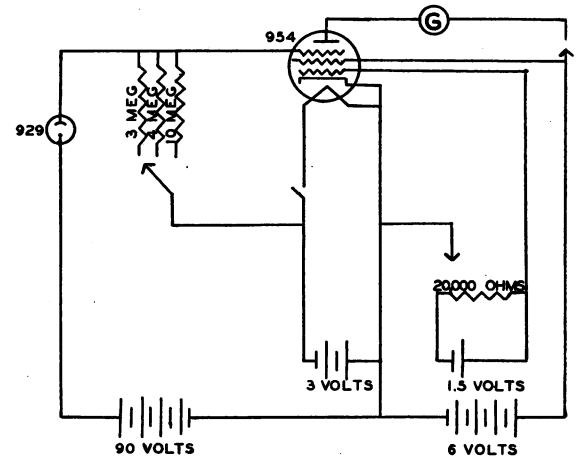

FIG. 2

[1] This work was made possible by grants from the U. S. Public Health Service and from the Faculty Research Fund of the University of Oklahoma.

[2] Corning glass filter #4010, which has maximum transmission at 525 mμ.

[3] The author is indebted to Hans Weltin, Department of Physics, University of California, Santa Barbara, for the design and construction of this unit.

Much greater sensitivity and flexibility of the apparatus can be obtained without the green filter, using more

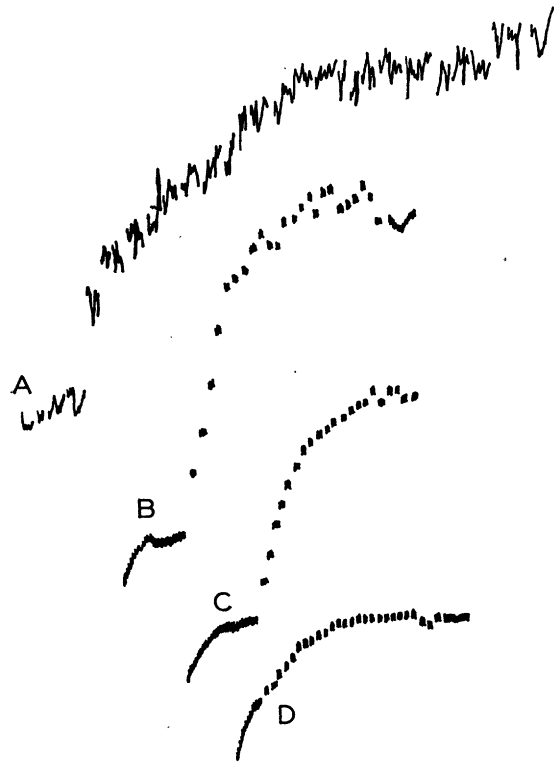

FIG. 3. The effect of concentration on swelling of chicken erythrocytes in 0.3 M glycerol in Ringer Locke. A—0.15 cc of blood; B—0.18 cc of blood; C—0.20 cc of blood; D—0.10 cc of blood (medium sensitivity on amplifier).

concentrated erythrocyte suspensions. It can be seen from the circuit diagram that the amplifier has three degrees of sensitivity. In addition, an Ayrton shunt is placed in the galvanometer circuit which adds another means for varying the sensitivity.

Figs. 3 and 4 illustrate the performance of the apparatus when used without the filter. In obtaining Figs. 3A, B, and C and 4B the shunt was set to give next to maximum sensitivity and the amplifier to give maximum

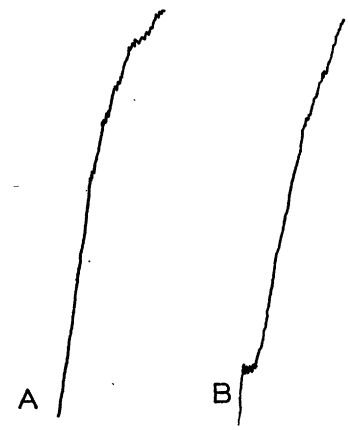

FIG. 4. The swelling of human erythrocytes in 0.3 M glycerol in Ringer Locke. A—0.06 cc of blood (medium sensitivity on amplifier); B—0.10 cc of blood (maximum sensitivity on amplifier).

sensitivity. Figures 3D and 4A were obtained with the shunt on next to maximum sensitivity and the amplifier on medium sensitivity. Figure 3 shows the effect of varying the concentration of chicken blood added to 10 cc of 0.3 M glycerol in Ringer Locke. The first 15 sec are recorded; readings were then taken at 15-sec intervals. In spite of the difference in deflection with the different concentrations, half of the total deflection in each instance is reached in approximately 1¼ min. Figure 4 is a continuous recording of the swelling of human erythrocytes in 0.3 M glycerol in Ringer Locke. In both A and B the deflection was too great to record the complete curve on the camera. A comparison between Figs. 3 and 4 demonstrates the greater galvanometer deflection which can be obtained using mammalian erythrocytes.

Fig. 5 is included to illustrate a possible source of error

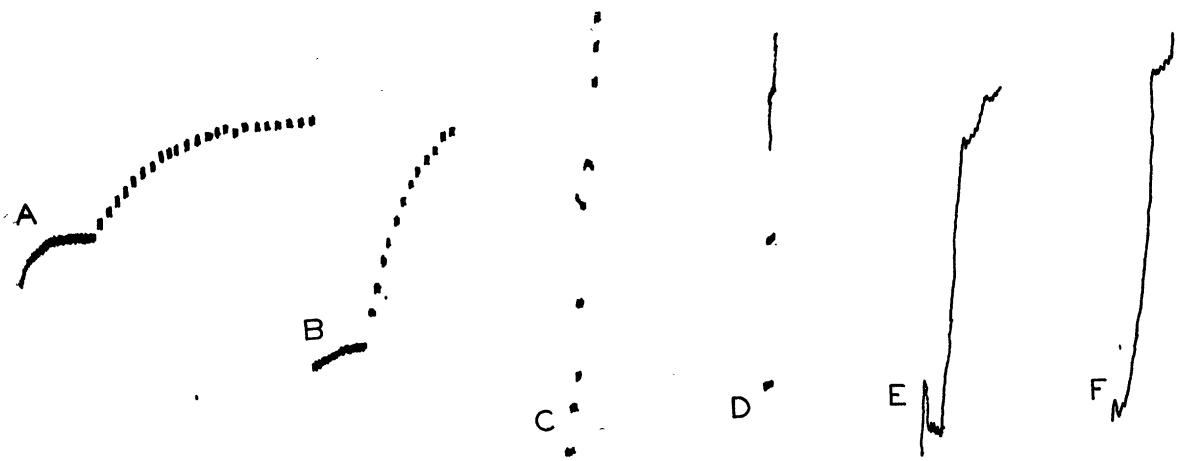

FIG. 5. The effect of standing at 37° C on the amount of galvanometer deflection obtained with chicken (A–D) and human (E, F) erythrocytes swelling in 0.3 M glycerol in Ringer Locke. A—0 hrs; B—3 hrs; C—6 hrs; D—19 hrs: E—½ hr; F—12 hrs.

which must be carefully considered in making measurements of swelling.[4] In a preliminary paper (*1*) it was pointed out that untreated chicken erythrocytes, after standing for several hours at 37° C hemolyze more rapidly than they do during the first few hours at this temperature. Fig. 5A–D illustrates that the galvanometer deflection increases as chicken erythrocytes stand at 37° C. At zero time the whole swelling curve can easily be recorded on the 12-cm bromide paper, but several hours later the deflection of the galvanometer becomes so much greater that only the first portion of the curve can be recorded. Figs. 5E and F show that no comparable change is observed when human erythrocytes stand at 37° C.[5]

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Comments and Communications

Blood Changes Due to Ammonia Inhalation?

We have read the recent article by Schmidt and Vallencourt entitled "Changes in the Blood Following Exposure to Gaseous Ammonia" (*Science*, November 19, p. 555). There are several serious errors apparent in this work which should be pointed out.

At the meeting of the American Public Health Association in Boston last November, we presented results of a study involving 30-min exposures of 7 human subjects to 500 ppm of anhydrous NH_3 gas. A description of the data was submitted for publication in October 1948 and will soon appear in a scientific journal.

A concentration of 500 ppm was used; therefore our results can be compared to those of Schmidt and Vallencourt. We selected ½-hr exposures since Henderson and Haggard (*Noxious gases*, New York: Reinhold, 1943, p. 126) reported that the maximum allowable concentration for a ½- to 1-hr exposure is 300 to 500 ppm.

All 7 subjects experienced irritation of the nose and throat immediately, and, in some, the irritation persisted for as much as 24 hrs. It is surprising that the subject reported in Schmidt and Vallencourt's paper did not experience marked irritation of the nose and throat after 4 hrs' exposure to a mean concentration of 545 ppm.

The authors failed to report the details of the exposure chamber and the subject's activity during the exposure. It seems unusual to maintain a gas concentration so well in an ordinary room unless the dilution rate is close to the rate of gas evolution. Since only two air analyses were made over a period of 4 hours and these were "grab samples" (L. Silverman, *Industrial air sampling and analysis*, Chem. and Tox. Bull. No. 1, Pittsburgh: Industrial Hygiene Foundation, 1947), it is quite possible that the actual concentration may have varied widely.

The values presented in the authors' Table 1 may be questioned in several respects. The most serious discrepancy appears to be in the blood-NH_3 (mg %) values (column 3). If one assumes a minute volume of 20 l[1] and an ammonia concentration of 545 ppm (mean of two determinations made by the authors) and, finally, that all ammonia is retained in a blood volume of 5 liters, then the values shown below are obtained. These results neglect ammonia conversion to other nitrogenous compounds and are presented below in comparison to the authors' values.

TABLE 1

Time (hrs)	Authors' NH_3 (mg %)	Calculated NH_3 (mg %)
Normal	00.0	00.0
1	12.1	8.7
2	21.9	17.4
3	27.9	26.2
4	36.4	34.9

From this table, it appears that the authors have found more ammonia than could theoretically be retained. Possible explanations might be either greater respiratory minute volume or lower blood volume, but these could hardly vary widely enough to explain the discrepancy. The invalidity of the assumption that all inhaled ammonia is retained is evident from our data, which show that the amount of ammonia retained decreases with time until after 30 min only 20 to 30% of the inhaled concentration is absorbed, as measured by frequent exhaled-air analyses. The data on blood ammonia presented by Schmidt and Vallencourt are rendered even more incredible by reference to Peters and Van Slyke (*Quantitative clinical chemistry* Vol. 1, 2nd ed. Baltimore: Williams and Wilkins, 1946). The method used was apparently not accurate enough to detect normal levels of blood ammonia, which, with proper methods, is of the order of 0.004 to 0.05 mg % (reported by Schmidt and Vallencourt: 00.0 mg %). It is well known that ammonia concentrations multiply rapidly in drawn blood unless rigid precautions are taken. On the other hand, the blood level *in vivo* is kept very near to 0 by the extraordinary efficiency with which ammonia is converted to amide nitrogen in the tissues and to urea in the liver. Ammonium salts are readily absorbed from the gastrointestinal tract; however, even large doses evoke but a slight transitory rise in blood ammonia, the ammonia being rapidly excreted as urea. Administration of 10 to

[1] This represents the mean value of sedentary subjects exposed to 500 ppm in our study and represents the increase produced by NH_3 over normal values of 8–12 liters.

[4] Bacteriologically sterile techniques were observed except during the few minutes when the actual swelling measurements were made.

[5] All records were obtained using a recording camera placed 1 m from a Leeds and Northrop Type R galvanometer with a sensitivity of 0.003 μa/mm at 1 m and a period of 3 sec. A Kipp and Zonen torsion string galvanometer has also been used with satisfactory results. The temperature was 37° C in all cases. Figures 3–5 are tracings of the photographic records.