Repeated Hb and RBC determinations on the blood of 5 Mallard ducks, which at first sampling exhibited a considerable range, revealed that those ducks having Hb and RBC values at the extreme ends of the range tended to approach, over a 60-day period, the mean for the group (see Fig. 1).

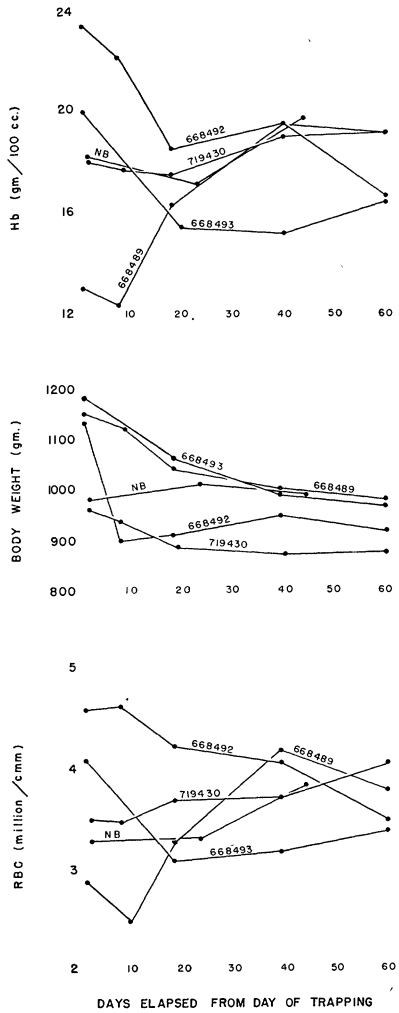

FIG. 1. Changes in Hb, body weight, and RBC count, in 5 Mallard ducks over a 60-day period.

It would therefore appear that, while no significant differences exist in the Hb of the ducks studied, considerable variation, even within a group, obtains in the RBC count. Thus, the Greater Scaup has about the same Hb concentration as the Mallard, yet possesses significantly fewer red blood cells. On the other hand, the Redhead not only possesses a Hb concentration similar to that of the Mallard, but its RBC count corresponds closely also to that of the dabbling ducks.

The writers started with the initial premise that an increased oxygen-carrying capacity of the blood would be of adaptive value to the diving ducks, which characteristically swim long distances under water, and that this increased oxygen capacity might be reflected in a higher Hb concentration and RBC count. Our findings reveal, however, that neither the Hb concentration nor the RBC count can be correlated with the locomotor habits of these two groups of birds.

References

1. BECK, R. C. *Laboratory manual of hematologic technic.* Philadelphia: W. B. Saunders, 1938.
2. MAGNER, W. *A textbook of hematology.* Philadelphia: Blakiston, 1938.
3. SNEDECOR, G. W. *Statistical methods.* (4th ed.) Ames: Iowa State College Press, 1946.

Liver Damage by Desoxycorticosterone[1]

E. S. Sinaiko and H. Necheles

Department of Gastro-Intestinal Research,[2] Medical Research Institute of Michael Reese Hospital, Chicago

In work on experimental production of gall-bladder disease we found that all dogs treated with desoxycorticosterone acetate[3] showed pathological changes in the liver.

Seven normal mongrel dogs (4 males and 3 females) of an average weight of 10–12 kg each received a daily intramuscular injection of desoxycorticosterone acetate, 5 mg in oil, for 5 days. After a 5-day interval, 25 mg of the drug in oil was given intramuscularly to each dog. Seven to 10 days later the animals were sacrificed and autopsied immediately. Six of the dogs had 1% salt water to drink, and one had tap water.

There were 9 control dogs. Five were untreated, and the other four (2 males and 2 females) were given the peanut oil solvent of the desoxycorticosterone intramuscularly, in the same schedule and quantity as the 7 dogs receiving the desoxycorticosterone in oil. These 4 dogs also received 1% saline to drink. Seven to 10 days after the last injection of peanut oil these dogs were sacrificed and autopsied immediately. The 9 control dogs (untreated or injected with peanut oil) appeared healthy and normal. At autopsy, all organs were normal grossly, and the animals appeared to be in good nutritional condition. The histologic examination of the organs of all animals reported in this paper was performed by our pathologist, Dr. O. Saphir. The organs of the untreated control dogs, including the liver, were found to be histologically normal. In the control animals injected with peanut oil and with only salt water to drink the organs

[1] Aided by a grant from the John D. and Fannie K. Herz Fund.

[2] The Department is in part supported by the Michael Reese Research Foundation.

The advice of Dr. R. Levine, of the Department of Metabolism and Endocrinology, is acknowledged gratefully.

[3] Desoxycorticosterone acetate and its oil solvent were furnished through the courtesy of Ciba Pharmaceutical Products, Inc.

were normal with the exception of a slight cloudy swelling of the liver in 2 of the 4 dogs.

The dogs treated with desoxycorticosterone showed no recognizable effects of the injections, except that they appeared to be more excitable than the control dogs. At autopsy the animals were found to be in a good state of nutrition. Grossly, the only consistent finding was engorgement of the livers of the treated dogs. Microscopic findings in the livers of the dogs treated with desoxycorticosterone were as follows:

No. 1: Marked hyperemia; absence of liver cord cells in the central zone; numerous areas of focal necrosis throughout; accumulation of pigment in the Kupffer cells.

No. 2: Marked hyperemia; numerous areas of focal necrosis and severe fatty degeneration of parenchymal cells; recent bile stasis.

No. 3: Marked hyperemia with foci of recent hemorrhage; focal necrosis, essentially central throughout, as in dogs Nos. 1 and 2; severe fatty degeneration of cord cells.

No. 4: Regions of central focal necrosis and severe fatty degeneration of the liver cord cells; generalized hyperemia and foci of recent hemorrhage throughout.

No. 5: Massive hyperemia and marked pigmentation of the liver cells; numerous areas of periportal fibrosis. This animal received no salt in its drinking water.

No. 6: Very severe acute necrosis of the liver with absence of normal architecture. In one section there is a hyaline, and an organizing thrombus in the portal vein.

No. 7: Fatty degeneration; some cloudy swelling around the central veins; no evident necrosis.

Other organs were affected less consistently and are noted in Table 1. Briefly, the following changes were found: cloudy swelling of heart, gall bladder (*4*), kidneys, and adrenal cortex, hyperplasia and edema of lymph nodes, and hyperemia, pigmentation, and myeloid hyperplasia of the spleen.

In his extensive work with desoxycorticosterone Selye (*3*) does not mention liver changes. Ellinger (*1*) reported that desoxycorticosterone protected mice against the liver damage following irradiation with X-rays. We were able to find only one report in the literature in which liver damage was associated with treatment with desoxycorticosterone. Forster, *et al.* (*2*) described findings in a boy with adrenal insufficiency who for two years received large amounts of desoxycorticosterone plus extra salt in his diet. According to the autopsy report, "the radiating pattern of the liver cords was lost completely. The cytoplasm of the liver cells was diffusely reticulated and vacuolated." Microscopic examination of the remaining organs showed no histopathological changes except in the brain. In order to investigate the

TABLE 1

PATHOLOGICAL FINDINGS IN ORGANS OTHER THAN THE LIVER

Dog No. and sex	Drinking water	Heart	Kidney	Adrenal	Spleen	Gall bladder	Pancreas	Lymph node
1, M	1% saline	Cloudy swelling	0	Hyperemia	Marked pigmentation with hemosiderin	Serosal edema extending into muscularis	Hyperemia	Chronic lymphoid hyperplasia with pigment as in liver and spleen
2, M	"	0	Cloudy swelling	Distinct cloudy swelling of zona glomerulosa and fasciculata	0	0	0	Same and hilus edema
3, M	"	0	Cloudy swelling	0	Hyperemia and pigmentation, myeloid metaplasia, hypersplenism	0	0	0
4, M	"	0	Cloudy swelling	0	0	0	0	0
5, F	Tap water	0	0	0	Marked pigmentation with hemosiderin	Serosal edema extending into muscularis	0	Chronic lymphoid hyperplasia with pigment as in liver and spleen
6, F	Saline	0	0	Hyperplasia of cortex	0	Hyperemia of submucosa	Small area of necrosis	0
7, F	Other organs not autopsied							

lethal factors in this case, they performed experiments in 4 rats, 7 rabbits, and 1 dog. These animals were treated with large doses of desoxycorticosterone but with no excess salt, the rats for 87 days, the rabbits for 15–183 days, and the dog for 70 days. The dog received 5 mg of desoxycorticosterone daily by subcutaneous route. The microscopic findings in the dog were as follows: foamy hepatic cells with collections, in the portal area of plasma cells, eosinophiles, polymorphonuclear leucocytes and phagocytes containing brown pigment. Sections of other organs were found to be normal, except for moderate degeneration of the renal tubules. In 3 rabbits the livers disclosed a diffuse sprinkling with eosinophiles, and in the other 2 rather severe fatty changes. The livers of the rats seem to have been normal.

The changes we have observed in dogs resemble more nearly those reported in the human by Forster, *et al.* (*2*) than their findings in the dog and in the rabbits. This may be explained by the fact that their patient received additional salt while their experimental animals did not. In our dog No. 5, which received no additional sodium chloride, pathological findings in the liver were less pronounced. We feel that the periportal fibrosis found in this dog was not caused by the desoxycorticosterone, but that it may have existed before the experiment.

Thus, pathological changes in the liver were found in each of 6 dogs given desoxycorticosterone and sodium chloride. The changes in the livers consisted of focal and diffuse necrosis (essentially central), fatty degeneration, hyperemia, hemorrhage, and accumulation of pigment. One dog that had received desoxycorticosterone and no salt in his drinking water showed fewer pathologic changes, namely, massive hyperemia and marked pigmentation of the liver cells. Control dogs, receiving only peanut oil by injection and sodium chloride to drink, showed some cloudy swelling or no changes in the liver, and untreated dogs showed no pathologic changes in the liver.

It is generally conceded that noninfectious liver necrosis is due to two main factors, nutritional deficiencies or toxic substances. We feel that the effects of desoxycorticosterone on the livers of our dogs were of a toxic nature, and that the toxic effect was enhanced by the additional salt administered. The doses of desoxycorticosterone given to our dogs were relatively large, but the case of Forster, *et al.* demonstrates that overdosage of desoxycorticosterone can happen in the human and can result in severe and fatal consequences.

References

1. Ellinger, F. *Science,* 1946, **104**, 502.
2. Forster, F. M., Cantarow, A., Herbut, P. A., Paschkis, K. E., and Rakoff, A. E. *J. clin. Endocrinol.,* 1946, **6**, 77.
3. Selye, H., and Hall, C. E. *Arch. Path.,* 1943, **36**, 19; Selye, H. *Textbook of endocrinology.* Montreal, Canada: Univ. Montreal, 1947. P. 850.
4. Sinaiko, E., and Necheles, H. (To be published.)

The Use of an Electrolytic Injector as a "Compensating Device" in Electrophoresis

P. Johnson and E. M. Shooter

Davy Faraday Research Laboratory,
Royal Institution, 21 Albemarle Street, London, W. 1

Some form of compensation device is usually essential for experiments requiring migration over path distances greater than the actual length of the cell or for attempting electrophoretic separations of proteins. The so-called compensation device is an instrument designed to produce a very small flow of the bulk of the liquid in

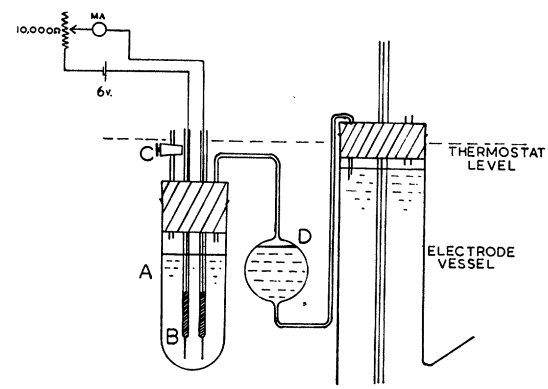

FIG. 1. Diagrammatic form of the electrolytic compensator.

the Tiselius U tube in the opposite direction to the migration of the protein boundary, thus enabling the boundary to be held stationary or even moved in the reverse direction. The design of such a device has followed chiefly two main principles. First, Tiselius (*4*) obtained the displacement of the bulk liquid by slowly dropping a plunger into one of the open electrode vessels of his original apparatus. Longsworth and MacInnes (*2*) later introduced the motor-driven syringe for use with the electrophoresis apparatus which had one closed electrode vessel. A modification of the first principle enabled Svensson (*3*) to use a plunger instrument in the apparatus with both electrode vessels closed. The electrolytic injector to be described here is suited to the original apparatus of Tiselius with both electrode limbs open, or to the modification containing one closed electrode vessel.

The principle of electrolytic injection has been applied in many fields (e.g. *1*) since it was first described, and it remains only to give some indication of one form of the apparatus which may be used for compensation in electrophoresis. The closed vessel, A (Fig. 1), contains approximately $\frac{N}{10}$ H_2SO_4 (or any suitable electrolyte solution) and two platinum electrodes, B (wire of 0.5-mm diameter or foil), sealed in glass tubing to provide external mercury cup contacts. A capillary tap, C,