panel of examiners is established by the association for this purpose. Attendance is required for one week each at an elementary, an advanced and a specialized course approved by the association. As a final test a candidate must submit a thesis on museum work and a concrete example of curatorial work. Candidates must have three years experience in a museum or art gallery before the diploma is awarded. Fee for registration is 10s 6d and for taking the diploma one guinea.

DISCUSSION

CORTIN AND TRAUMATIC SHOCK

A NOVEL explanation of the "secret" of traumatic or secondary shock has recently been published in SCIENCE by a group of investigators from the Biological Laboratory of Princeton University.[1] The physiologic phenomena associated with death from adrenal cortex insufficiency have been compared with those found in traumatic shock. The analogy is a close one, as the authors have shown in a list of 32 particulars. Fundamentally, both conditions are characterized by a diminution in the volume of circulating blood, with a failure of the blood-diluting mechanism. The suggestion is made that "the signs and symptoms of adrenal insufficiency, and of traumatic or secondary shock, are possibly due to one and the same thing, namely, failure of the blood volume and blood-diluting regulator mechanism, the adrenal cortex." Because the "adrenalectomized animals, in the absence of the cortical hormone, are apparently unable to draw fluid back into the blood stream through the capillary walls" the writers suggest that "the accepted view that the osmotic power of the blood colloids is the chief factor involved in compensation needs further investigation."

There is only one dissimilarity among the 32 particulars which the writers have listed showing the analogy between adrenal insufficiency and traumatic shock. This discrepancy, as they point out, is the fact that in adrenal insufficiency the blood sugar is low, while in traumatic shock it is normal or elevated. They promise a discussion on this point at some future time. It seems possible, however, that this discrepancy may be of more moment than is realized at first glance. That the secretion of the adrenal cortex exerts a profound influence on the storage and utilization of carbohydrates has been realized for some time. The prepotent function of the cortex of the adrenal is considered by Britton and Silvette[2] to be the regulation of carbohydrate metabolism. They have found that the glycogen in the liver and muscles is lower after adrenalectomy than in extreme inanition, severe exhaustion, after strychnine convulsions or after exposure to cold. They state that "moreover, the muscle glycogen and blood glucose in cases of hepatectomy are not depleted more thoroughly than in animals showing more or less severe symptoms of adrenal insufficiency." It is therefore recognized that the glycogen stores and the blood glucose level are reduced in adrenalectomized animals. If the blood glucose level is reduced by insulin, as shown by Drabkin and Edwards in 1924,[3] certain physiologic reactions occur which are very similar to changes which the investigators have found to occur after adrenalectomy. In insulin hypoglycemia there is an actual loss of blood volume and a considerable concentration of the blood. These animals also show a decline in blood pressure and death from insulin "shock." Is it possible that the death from adrenal insufficiency may result primarily from the alterations in the carbohydrate metabolism which secondarily exert some influence on the blood hydration rather than through some hypothetical control over the mechanism of fluid exchange?

Some interesting experiments are reported by the authors to "test the relation between failure of the cortex and traumatic shock" and the results to them are "highly suggestive." Traumatic shock was produced in adrenalectomized dogs. Administration of cortin promptly resuscitated the dying animals. Control experiments were performed which demonstrated that a similar trauma did not produce shock in normal dogs. Such an experiment is very convincing proof that cortin is a specific therapeutic agent for the shock which is associated with the absence of cortico-adrenal hormone. But quite as specific is the glucose which is injected into animals in insulin shock. No one believes that traumatic shock and insulin shock are due to the same mechanism.

Again, other experiments were performed in which "profound surgical shock was induced in normal dogs by double adrenalectomy at one sitting. Immediately following completion of the operation, the blood pressure was normal." At this point the question may be raised as to their criteria of "profound surgical shock" resulting from operations at the close of which the blood pressure was *normal*. If such animals received cortin they recovered and were normal in 2 to 3 days. Dogs similarly "shocked" and not injected with hormone invariably died within 48 hours. The investigators have clearly demonstrated that the cortico-adrenal hormone is a specific therapeutic agent

[1] W. W. Swingle, J. J. Pfiffner, H. M. Vars, P. A. Bott, W. M. Parkins, SCIENCE, 77: 58, January 13, 1933.

[2] S. W. Britton and H. Silvette, *Am. Jour. Physiol.*, 100: 701, 1932.

[3] D. L. Drabkin and D. J. Edwards, *ibid.*, 70: 273, 1924.

for the shock which is associated with absence of the adrenals, but they have not reported experiments in which the effect of cortin has been assayed in traumatic shock. Always when they produced shock the adrenals were absent. Shock was never produced when the adrenals were present. They conclude, "the idea that the adrenal cortical hormone might prove of benefit in the treatment of human traumatic shock is advanced merely as a suggestion. Adequate proof can only come through clinical trial." Since it is known that deficiency of the cortico-adrenal hormone results in a lowering of the glycogen and blood glucose levels and since it is known that if the blood glucose level is reduced by insulin, there is a reduction in blood volume with blood concentration, the suggestion that the function of the adrenal cortex is the regulation of blood volume and blood dilution seems unnecessary. Although the analogy between deficiency of cortico-adrenal hormone and traumatic shock is a close one, no convincing evidence has been presented that the two conditions have a common etiology or that the cortical hormone is of benefit in the treatment of shock.

NORMAN E. FREEMAN
MASSACHUSETTS GENERAL HOSPITAL
BOSTON

THE ASSOCIATION OF TERMITES WITH FUNGI

A SURVEY of the fungi associated with *Kalotermes minor,* a dry-wood termite, *Reticulitermes hesperus,* the common western subterranean termite, and *Zoötermopsis angusticollis,* the large damp-wood termite, has been made.

Fungi were found to be associated with each of the fifteen colonies of *K. minor,* twelve colonies of *R. hesperus* and twelve colonies of *Z. angusticollis* studied. They were isolated (1) from the exterior of the termites, (2) from the gut of the termites, (3) from the fecal pellets of *K. minor* and *Z. angusticollis,* (4) from the "frass" with which *R. hesperus* plugs up abandoned galleries, (5) from the wood of the inner surface of the termite burrows, and (6) from the wood 1 to 2 mm below the surface of the walls of burrows. Henceforth, in speaking of the isolation of a fungus from a termite colony, this designation is used to include not only the termites themselves, but also their fecal pellets, the frass and the wood enclosing their burrows.

Representatives of thirty-three genera of fungi and twenty undetermined fungi were isolated from the colonies of the three species of termites. A somewhat smaller number of fungi was associated with *K. minor* than with *R. hesperus* or *Z. angusticollis,* seventeen genera of fungi and four undetermined fungi being isolated from twelve colonies of *K. minor* as compared to twenty-five genera and eight undetermined forms from twelve colonies of *R. hesperus* and twenty-two genera and three undetermined forms from twelve colonies of *Z. angusticollis.*

The average number of fungi isolated from ten cultures made from each of twelve colonies of each of the species of termites was 4.91 for *K. minor,* 8.75 for *R. hesperus* and 7.25 for *Z. angusticollis.*

A smaller amount of fungous growth was present in the colonies of *K. minor* than in those of *R. hesperus* or *Z. angusticollis.* Furthermore, the wood containing the *K. minor* colonies usually showed little structural injury from fungous attack, while that enclosing the *R. hesperus* and the *Z. angusticollis* burrows usually showed decay. This is undoubtedly due to the fact that the wood containing the colonies of *K. minor* was drier and, therefore, less favorable to the growth of wood-destroying fungi.

Penicillium and *Trichoderma* were the genera of fungi most frequently isolated from the colonies of each of the three species of termites. There was no evidence of any specific relation between any fungus and a given species of termite.

Termites were placed upon pure cultures of a fungus, and were found capable of transporting large numbers of fungous spores and hyphae on their legs and bodies. Subsequent dissection revealed many entire and fragmented spores and a few fragments of hyphae of the fungus in the gut of the termites.

Fungi were more abundant on the inner surface of termite galleries than in the wood below the surface of gallery walls, only four cultures out of fifteen taken from wood 1 to 10 mm from the galleries of a colony of *K. minor* being positive as compared to sixteen positive cultures out of seventeen taken from the surface of gallery walls.

Twelve cultures made from the heartwood of a pole uninfested by termites were all negative. Seventeen out of twenty-seven made from the sapwood were also negative. In a termite-infested pole, of the same kind of wood and having a similar history of use, fourteen cultures taken at intervals throughout the diameter of the pole from wood adjacent to termite galleries were all positive. The same two fungi which were isolated from the wood near the exterior of the first pole were common throughout the diameter of the second pole in and near the termite galleries. Nine other fungi were also present in the termite-infested pole.

It seems evident, then, that termites may introduce fungi which were not previously present in the wood and that they may aid in the spread through the wood of these and of those already present.

The results of this investigation indicate that con-