Furthermore, it is known that the degree of "blacking," *i.e.*, the intensity and depth of color of the streak, varies directly with the alumina content of the clay. Since the value of high alumina clay is determined by its refractory quality and since this is dependent largely upon the alumina content, the depth of color of the dark streak is a valuable aid in estimating the quality of the clay. In practice a grader observes the "mark" made by the tool or his grading hammer, and quickly noting the fracture, texture and oolites present in the clay, sorts it into first grade, second grade or burley with a speed and accuracy that are surprising. An estimation of the alumina content to within 5 per cent. is regularly made, and under favorable conditions car-load quantities and even larger of one grade may be supplied with still less variation.

Although, upon a cursory examination, the test as outlined above might seem crude and undependable, its practicability is more evident after a review of some of the factors involved. Diaspore and burley clay are made up of the mineral diaspore, which contains 85 per cent. Al_2O_3, and a bonding matrix that is kaolin-like, its alumina content being in the neighborhood of 40 per cent. The hardness of diaspore is 6.5–7 (Dana), whereas that of kaolin is 2–2.5. It is evident that diaspore will scratch or cut steel, and that the kaolin-like matrix will not. Hence, the higher the diaspore content of the sample the more marked its abrasive action will be, the darker the streak of steel and the higher the alumina content. The clay functions both as a hardness element and as a streak plate. Quantitatively, clay containing 60 per cent. alumina and above will usually retain a mark, whereas that below 60 per cent. only packs or crushes to a slightly darker color and does not cut steel. An intense black to blue-black color is left upon clay running over 70 per cent. in alumina.

It might also be noted here that the clays higher in silica break with a more typical conchoidal fracture, those lower in silica with a more hackly break, similating, in this respect, the rhyolite-basalt fracture contrast. While the writer does not wish to indicate that the cause of the conchoidal fracture lies entirely in the high silica content he does wish to show that a relationship is suggested, and he points out the analogy to the igneous rocks because of its lithologic interest. A fuller discussion of the various means used in grading the high alumina clays of Missouri is published in *Brick and Clay Record,* October 8, 1929.

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SPECIAL ARTICLES

AN AQUEOUS EXTRACT OF THE SUPRARENAL CORTEX WHICH MAINTAINS THE LIFE OF BILATERALLY ADRENALECTOMIZED CATS

IT is a well-established fact that in cats and dogs bilateral adrenal extirpation results in death within a short time, generally within eight to ten days. The animals exhibit a train of symptoms which has come to be recognized as typical of adrenal insufficiency. Experiments have shown, moreover, that death is due to removal of the cortical portion of the suprarenal complex and not to interference with, or loss of, the medulla or adrenalin-containing portion.

Administration of adrenalin to bilaterally operated animals has been repeatedly tried but without success, since animals so treated derive no benefit from the injections and die with characteristic symptoms of adrenal insufficiency. We have made numerous attempts to prolong the life-span of adrenalectomized cats by injections of adrenalin, employing various dosages, but in no case have we noted any improvement in the condition of the animals or been able to prevent the onset of symptoms.

During the past two years the writers have concentrated their efforts upon the cortex of the suprarenal and have prepared and tested a large number of different cortical extracts and have used over three hundred and fifty cats in the experiments. Varying degrees of activity were obtained from several of the preparations, and one lipid fraction revealed a considerable degree of potency. A brief report of the early work was published in the abstracts of the American Society of Zoologists.[1] Since the abstract was written, however, the lipid fraction was further fractionated and an aqueous preparation obtained which shows greater potency than the original lipid extract. This fraction is prepared in the following manner.

The suprarenal glands (beef) packed in ice are received from the slaughterhouse within twenty-four hours after the death of the animals, and the cortex dissected as free as possible from extraneous fat and medullary tissue. The ground cortical tissue is extracted at room temperature successively with 95 per cent. ethyl alcohol and 80 per cent. ethyl alcohol for varying periods of time, usually about three or four days, although we have obtained active extracts from material stored in 95 per cent. ethyl alcohol at room temperature for three weeks. The extractives are

[1] *Anatomical Record,* 44: 225, 1929.

concentrated separately in partial *vacuo* at a low temperature and the residues thoroughly extracted with benzene. The benzene is removed in partial *vacuo* at a low temperature and the lipoidal residue extracted with acetone. The acetone-soluble material, after removal of the acetone in a similar manner, is distributed between 70 per cent. ethyl alcohol and low-boiling petroleum ether. The alcoholic phase is washed repeatedly, the petroleum ether washings combined and the petroleum ether removed by distillation. The residue is again subjected to the distribution procedure. The petroleum ether washings are washed with 70 per cent. alcohol. The alcohol is removed as before, and to the aqueous concentrate sufficient distilled water is added to obtain the desired volume. In the present study we have arbitrarily made the dilution so that 1 cc represents 30 gm of freshly dissected cortical tissue. The extract is clarified and sterilized for subcutaneous injection by filtration through a Seitz filter. The solid content of this extract varies between five and ten milligrams per cubic centimeter. The extract is not entirely adrenalin free.

Present knowledge of the functional significance of the suprarenal cortex is so vague and uncertain that the only reliable criterion for testing the activity of a cortical extract is its effect upon the life-span of adrenalectomized animals. The criterion is severe and requires much time and effort, but at any rate it is an excellent index of potency.

All cats, both controls and extract-treated, were given uniform treatment. They were treated with a vermifuge upon first admittance to the laboratory—a necessary precaution since many animals in the vicinity of Princeton are heavily infested with hookworm—kept in thermostatically heat-regulated rooms, fed identical diets and operated by the same individual. At least seven days intervened between removal of right and left adrenals.

The average life-span of twenty-five bilaterally adrenalectomized control cats (untreated) was seven days; the maximum survival period of any animal in the control series was fourteen days; the minimum survival was four and one half days. Twenty-four hours following the second operation the first injection was given. Each animal received subcutaneously 0.5 cc to 1.0 cc of extract per kilogram of body weight daily.

Animals so treated remain in perfectly normal condition forty to fifty days, and can not be distinguished from normal unoperated cats. They eat, play, fight with one another and keep themselves sleek and clean. Most of our animals have shown weight increases during treatment. We have sacrificed several of our animals on the fiftieth day of survival in order to search for accessory adrenal tissue, but in no case have we found anything, despite the most exhaustive search.

In our earlier work with the lipid fraction which was injected in oil subcutaneously, considerable difficulty was experienced in keeping our animals much beyond forty or forty-five days, owing to accumulation of oil under the skin and abscess formation. The animals' coats became rough, the hair fell out in patches and their weight gradually declined. None of these difficulties have arisen in the experiments when the aqueous preparation of the original lipid fraction was employed.

The interesting point is that all healthy double operated animals survive and remain in normal condition when treated with the extract. Just how long cats so treated will survive we are unable to say at present, since our longest surviving animals are now in their eightieth day and in excellent condition. The experiments, however, justify the conclusion that we have successfully extracted from the suprarenal cortex of beef an active hormone which maintains the life of bilaterally adrenalectomized cats.

A detailed account of the various experiments will be published shortly.

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THE PRE-OLIGOCENE STRATIGRAPHY OF PORTO RICO

A RECENT geological survey of northeastern Porto Rico shows that the stratigraphic sequence suggested by Carlotta J. Maury in SCIENCE for December 20, 1929, needs emendation, at least so far as the formations which lie unconformably beneath the Oligocene-Miocene coastal plain are concerned.

According to Dr. Maury, rocks of Eocene, Upper Cretaceous and possibly Lower Cretaceous ages are present. She regards the La Muda limestone as one of the youngest pre-Oligocene horizons, placing it in the Upper Eocene; and a similar, if less precise, position was given it by D. R. Semmes in 1919[1] on the basis of a small and inconclusive micro-fauna. The writer's structural studies have developed the fact that the bed lies stratigraphically beneath the Upper Cretaceous formations which Maury calls the Fajardo and Cape San Juan limestones.

Both Maury and E. T. Hodge[2] believe that the limestone south of Cidra lies at, or near, the base of the Porto Rican section, and they both place it tentatively in the Lower Cretaceous. This formation, however,

[1] D. R. Semmes, "The Geology of the San Juan District, Porto Rico," "Scientific Survey of Porto Rico and the Virgin Islands," Vol. I, pp. 74–75, 1919.

[2] E. T. Hodge, "The Geology of the Coamo-Guayama District, Porto Rico," *idem*, pp. 132, 192–193, 1920.