came a considerable stream when the bit was withdrawn. Gas expulsion, indicated by bubblings, continued for 5 minutes or more. The age at the boring level was 58 years. The outer 4 inches of core was apparently sound.

The gas pressure in a hollow hickory tree blew a 2-inch section of wood out of the end of the increment-borer bit. This tree was 11 inches in diameter at breast height, 14 at the boring level.

It is to be noted that these trees, like those mentioned by Abell and Hursh, were all dicotyledonous Angiosperms, and all defective. Except for the last-mentioned all the manifestations above recorded were observed in the morning. The trees in which such phenomena occurred constituted a relatively small proportion of those bored, but no precise figures on this phase of the study are now available.

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CATFISH FEEDING ON THE EGGS OF THE HORSESHOE CRAB, LIMULUS POLYPHEMUS

THE horseshoe or king crab, *Limulus polyphemus*, is very common along the gulf coast of southern Florida. It lives in mud or sand just below low tide level, and never leaves this except in early spring when in great numbers it comes inshore to spawn in the sand near high water mark. The female in the lead, followed by one or more males, excavates a shallow hole in the sand in which the eggs are deposited and covered with milt. The eggs are about 2 mm in diameter, are pale Nile-green in color, are laid singly and are not protected by any gelatinous mass or capsule. They hatch within three to six weeks, after which time the young may be seen making their way to deeper water.

Early in April, 1930, while collecting mollusks on a sandy flat near the mouth of the Caloosahatchee River, my attention was attracted by a great commotion involving a considerable area of shallow water. Here were hundreds of spawning *Limulus* attacked by other hundreds of catfish which were voraciously and joyously devouring the eggs as fast as deposited. Each spawning female king crab and her attending males were surrounded by many catfish in groups which may perhaps best be described as "bouquets" or "rosettes." These catfish stood almost vertically on their heads, with their tails out of water, whipping the surface of this into a maelstrom in their ecstasy of feeding. Crabs and catfish were pushed and shouldered about by other fish circling about the groups in a determined effort to reach the feast. Literally hundreds of both horseshoe crabs and fish were concerned in this phenomenon which was watched until the rising tide made further observation impossible.

But one other observation (and it an incomplete one) of this kind seems to be on record, and it as far back as 1897. In the *American Naturalist* for this year (vol. 31, p. 347–348) H. C. Warwell records his observations on "Eels Feeding on the Eggs of *Limulus*." He states that in 1892 or 1893, in the latter part of May he was walking about dusk along the Kickemuit River between Warren and Bristol, Rhode Island, when he noticed many king crabs or "horse-feet" as he calls them, crawling on the sandy bed of the river. Here are his own words:

> The tide was high, and they [the "horse-feet"] had come in from the outside, as is their habit at high water. What attracted my attention the most was the fact that, as they lay there on the river bottom, many eels had worked their way into the clefts between their heads and abdominal regions, and were apparently feeding. Some of the eels were very large, and made a strange sight with their heads under the shell [of a crab] and their tails sticking out sideways. Sometimes two or three were under one horse-foot, and if I had had an eel spear I could have caught a good mess. I have since wondered what the eels were eating. Sometimes I think it might have been something on which the horse-feet were feeding; but my uncle, who was with me, said that they were after the spawn; and I have since come to the conclusion that he was right, for it was the spawning season, and the eels were only gathered around the large female horse-feet.

In the light of my observation it would seem to be clear that the eels were feeding on the eggs of the horseshoe crabs, and that at the breeding season the eggs of these crabs are preyed on extensively by predatory fishes

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THE LACK OF CORRELATION BETWEEN ANEMIA AND THE PELLAGRA-LIKE SYMPTOMS IN RATS[1]

IN a recent article Bliss[2] has presented evidence claiming to show that pellagra as it exists in humans, and black-tongue of dogs—which is considered to be analogous to human pellagra—are both due to iron deficiency. He points out that pellagra is more prevalent among women than among men, resulting possibly from the loss of iron by women in menstruation. He calls attention to the fact that the foods rich in vitamin G and in the black-tongue preventive factor are almost without fail rich in iron—liver, egg yolk, beef and yeast. Further, he states that in Goldberger's work "those diets which prevented or cured black-tongue in dogs are just those to which had

[1] Published by permission of the director, Journal Article No. 61 (n. s.).
[2] Sidney Bliss, SCIENCE, 72: 577, 1930.

been added syrup iodid of iron USP." This was added to improve the mineral composition of the diet. The author states that the results of iron therapy have been studied by him on fifty-one cases of human pellagra and they are of an encouraging nature. Moreover, he has been able to cure black-tongue in dogs by giving iron intravenously.

The correlation between the iron and the vitamin G content of certain foods is striking. In addition to the above-mentioned foods it is known that spinach, leaves of velvet beans and soy beans, pig's liver and even the Minot and Murphy liver extract are good sources of the vitamin. However milk which is a rich source of vitamin G is relatively low in iron, and molasses, which forms a staple article of diet among poor farmers in the South, is rich in iron.

Whether or not the vitamin which prevents the pellagra-like condition and promotes growth in rats is identical with a factor preventing human pellagra has not been determined. Aykroyd[3] recently has shown that maize contains about as much vitamin B_2 (G) as rice and millet, as measured by the rat-growth method, but people who live largely on rice are not pellagrous, while the disease is prevalent among maize-eating peoples.

In this laboratory we have been conducting experiments to determine the vitamin G (B_2) content of some foods and of various preparations. Rats were used, and the basal diet contained ferric citrate in such amounts that there was present 0.29 mg of iron in each gram of diet. In every litter of animals used for experimental work one rat was maintained on the basal diet alone as a negative control, and the food consumed by these animals even when sick was rarely less than 1.5–2 grams daily. Out of thirty-three of these negative controls only three have failed to show evidence of dermatitis in eight weeks. In most cases the condition was evident in three or four weeks. None of the animals gained more than ten grams in eight weeks, and the majority lost from five to ten grams. From this evidence it would seem that the animals were deficient in vitamin G (B_2). Throughout the experimental period, moreover, the animals were housed in metal cages and in many cases the iron was exposed. In addition, the loose screen bottom of the cage was raised above the pan by means of an iron ring. While no copper was given as such it seems possible that from the cages and from the salts used in the diet sufficient copper may have been present to satisfy the needs of the animals.

In order to satisfy ourselves on this point, however, six animals were given 0.5 mg of iron and 0.1 mg of copper daily six days a week as $FeCl_3$ and $CuSO_4$ solutions, respectively, as recommended by Steenbock.[4] Three of the animals had been maintained for ten weeks on the experimental diet alone, and they were in a very poor condition. The other three were young rats which had just been depleted of their store of the vitamin. The solutions were given as the only supplement to the basal diet and they were well eaten; and when given in addition to the iron and presumably copper present in the diet would seem to have been sufficient to prevent anemia. In neither group, however, was there any improvement due to iron therapy. The rats which had severe dermatitis did not improve and the second group began to show evidence of vitamin G (B_2) deficiency in about four weeks. In no case was there a gain in weight such as was seen in the experiments reported by Steenbock and which might have been expected had the animals been anemic.

It seems probable therefore that if human pellagra and black-tongue of dogs are shown to be iron deficiency diseases, the pellagra-like symptoms which manifest themselves as a result of vitamin G (B_2) deficiency in rats are not analogous to the other conditions.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A LIGHT FILTER FOR MICROSCOPES

IN microscopes there are two points where light filters can be introduced without being imaged and yet produce equal filtering power throughout the field. These positions are known as the entrance pupil and the exit pupil. The entrance pupil is the aperture of the substage condenser where the iris diaphragm is located. The exit pupil is better known as the Ramsden disc and is in the position the eye occupies when looking through the microscope. Either position is correct for a filter, but because of certain disadvantages in placing the filter at the exit pupil, all standard filters are made to occupy the entrance pupil. The disadvantages in locating the filter at the exit pupil are that it cuts down the eye distance; the filtering density must be greater to cause the same value of light filtration; and any dirt, scratches, etc., on the filter are more easily seen and may be quite annoying. A filter located at the entrance pupil has none of these disadvantages but is in an exceedingly

[3] W. R. Aykroyd, *Biochem. Jour.*, 24, No. 5, 1479, 1930.

[4] E. B. Hart, H. Steenbock, J. Waddell, and C. A. Elvehjem, *Jour. Biol. Chem.*, 77: 797, 1930.