

A detailed discussion of these investigations will appear in the Anthropological series of the American Museum of Natural History, New York City.

## THE PRODUCTION IN DOGS OF A PATHOLOGICAL CONDITION WHICH CLOSELY RESEMBLES HUMAN PELLAGRA

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The nutritional diseases designated as beri beri, scurvy and pellagra are currently believed to be induced by a deficiency in the diet of some undefined but essential constituent or constituents. From the experimental standpoint the pigeon is peculiarly sensitive when the diet fails to provide a sufficiency of these unknown but essential food substances, and polyneuritis develops. The symptoms of polyneuritis in birds closely resemble those of beri beri in man. The guinea pig has proved to be especially susceptible to scurvy. On the other hand, pellagra in the ordinary laboratory animals is rarely mentioned.

We have accomplished the experimental production in dogs of a diseased condition which closely resembles human pellagra. The characteristic phenomena are readily evoked by feeding these animals a diet consisting of boiled (dried) peas, cracker meal and cotton seed oil, or lard. The ingestion of suitable quantities of meat causes the symptoms of disturbed nutrition to disappear. On the other hand, if the amount of meat contained in a selected mixed diet is insufficient, the same evidences of abnormality may be exhibited. The symptoms appear in varying periods of time which may be altered by changes in the character of the diet.

The onset of the symptoms is generally very sudden. Usually the first abnormal manifestation in dogs is a refusal to eat, and cursory examination reveals nothing to account for the loss of appetite. The animal lies quietly in its pen and is apathetic. After continued refusal to eat for a day or two, the mouth of the dog presents a peculiar and characteristic appearance, in that the inner surface of the cheeks and lips, and the edges of the tongue, are so covered with pustules as to give the impression of a mass of rotten flesh. The odor from the tissues is foul. The mucous lining of the mouth comes away in shreds when stroked with absorbent cotton. Intense salivation exists. The teeth remain normal. A bloody diarrhoea is present, attempts at defecation being very frequent, and resulting in the passage of little more than a

bloody fluid of foul odor. In some cases the thorax and upper part of the abdomen may contain many pustules one half an inch in diameter and filled with pus organisms. No other skin lesions are prominent. Death usually results without any particularly striking features.

In some instances convulsions constitute a distinctive symptom which may or may not be manifested simultaneously with the abnormal symptoms already described.

At autopsy two types of conditions are recognizable. In the animals presenting foul mouth and bloody diarrhoea the chief interest centres in the lower bowel and in the rectum which exhibit an intense hemorrhagic appearance. With those animals dying rapidly from convulsions the only visible abnormality of the alimentary tract is the presence in the duodenum of one or more large ulcers.

The detailed data of the investigation which will be published elsewhere justify the following summary and conclusions:

Dogs fed upon a diet consisting of boiled (dried) peas, cracker meal and cotton seed oil, or lard, rapidly develop symptoms indicating abnormal nutrition. This condition eventually terminates in death. Previous to the development of the pathological manifestations the dogs are usually in nitrogen balance and exhibit excellent food utilization. The nitrogen partition of the urine is normal when compared with that of animals maintained upon the same level of nitrogen intake.

The pathological symptoms at times can be made to disappear and the normal condition of nutritional rhythm can be re-established by the addition of meat to the dietary.

In the production of the symptoms it is immaterial whether the transition from a diet containing meat to one of vegetable origin is sudden or gradual. The final outcome is the same in both cases.

The intake of a large quantity of peas is less detrimental than smaller amounts.

In the development of the pathological condition the level of nitrogen intake as such plays little or no rôle.

The typical symptoms may be induced in dogs, but with much greater difficulty, when a diet containing meat, cracker meal and lard is fed in appropriate quantities. For the production of the diseased condition the meat intake must be reduced to a certain undefined minimum. Under these circumstances less than fifty per cent of dogs exhibit pathological symptoms and these may appear in periods of two to eight months.

From the facts enumerated the conclusion seems tenable that the abnormal state may be referred to a deficiency of some essential dietary

constituent or constituents presumably belonging to the group of hitherto unrecognized but essential components of an adequate diet.

In the essential features the pathological manifestations described in this investigation closely resemble those which may be observed in human pellagra.

### THE COMPLETE ENUMERATION OF TRIAD SYSTEMS IN 15 ELEMENTS

By F. N. Cole, Louise D. Cummings, and H. S. White

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If any set of 15 points are joined by all the possible 105 connecting lines, then these may be combined in sets of three to form 35 triangles. The marks or 'elements' designating the three vertices are a sufficient description of any one triangle, and a list of all 35 triangles constitutes a 'triad system on 15 elements.' Two such sets of triangles are essentially alike if a renaming of its points turns the one list into the other; if that cannot be done, the two lists or systems are essentially different. How many essentially different triad systems can be formed of a given number of elements, is a question of much difficulty, never before answered when the number of elements is 15 or more. For 13 elements there are but 2 different systems, for 9 or 7, only one. The present paper shows that for 15 elements, there are exactly 80 different systems. This conclusive result is established by Mr. Cole.

Three years ago the dissertation of Dr. Cummings increased the number of known triad systems on 15 elements from 10 to 24, and furnished a definite method for comparing systems and verifying their difference or equivalence. All the new systems found by Miss Cummings contained a 'head'—a triad system on 7 of the 15 elements, while one exceptional system among the 10 previously known was 'headless,' a system constructed by Heffter. But all of them admitted groups of transformation into themselves, and it was suspected that the possession of a group might be a necessary property of triad systems. Mr. White takes the group for a starting-point; finds seven types of substitutions, one or more of which must occur in the group; and constructs all the distinct triad systems for each of those seven typical substitutions. This gives as a gross result 83 systems. By two methods, that of Miss Cummings (by sequences) and one introduced by Mr. White (by trains) these are tested, duplicates are eliminated, and the net result is found to be 44 systems. Of these, exactly 23 exhibit heads and are equivalent to those in Miss Cummings' list, while 21 are headless, including the one such (Heffter's) previously