

The composition¹ of the air at time of filling is of course the same as the normal atmosphere, but immediately after the cut fodder is ensiled, absorption of oxygen by the plant tissues begins and continues until all of the free oxygen in the air spaces is consumed by the respiratory processes of the plant. This direct absorption of oxygen is nearly, but not quite, counterbalanced by the evolution of carbon dioxide, as a portion of the oxygen combines to form other by-products. An analysis of the air even within twenty-four hours often shows no free oxygen. The nitrogen of the air is unaffected by these plant processes.

Within a short time gas begins to be given off, and continues at an increasing rate for a day or so, then gradually diminishes. The gas so evolved is largely CO₂, but is mixed with the residual nitrogen of the contained air. This CO₂ is the result of intramolecular rather than direct respiratory processes, and as the oxygen required for this change is derived from the tissues of the plant, the volume of gas in the silo is increased by the amount of CO₂ formed. The evolved CO₂ is therefore a measure of the intramolecular respiration. The evolution of this gas marks an actual and unavoidable loss in the organic matter of silage. This source is operative so long as life exists in the plant cells, but when the cells die, gas from this source is no longer given off.

When the gases of a silo are measured, either by volume or by absorption of the CO₂, the production of gas is found to be very rapid for the first few days, and then to diminish quickly in a manner somewhat comparable to the evolution of heat previously referred to. It soon reaches (two weeks or so) a rate that continues with slight fluctuations for some months. Such a rate of gas evolution can only be intelligently interpreted by assuming that most, at least, of the CO₂ evolved is the result of processes inherent to the plant cell, and not to fermentative action set up by organisms which must have developed subsequent to the ensiling of the fodder.

In fact, it is the presence⁵ of this carbon dioxide gas which is the principal perserving agent in the silage. The escape of this gas from the silo will immediately start decay. Usually mold does not affect more than the mere surface of the silage and this acts as a seal to prevent the air from decaying the silage to a greater depth. The amount of carbon dioxide developed⁶ in a silo filled with immature corn may reach 75 per cent. of the total gases present, the chief remaining gas being the nitrogen of the air.

"The conditions favorable for a maximum evolution of carbon dioxide is an immature corn cut into fine pieces and placed in the silo at intervals" (as the daily filling with nightly interruptions).

Fatal asphyxia from carbon dioxide has been reported under the following somewhat similar conditions: among vintners, distillers, brewers, yeast makers, in the holds of grain vessels and in peat pits. But a very great danger exists also in every silo unless precautions are taken. These consist in keeping the doors immediately above the level of the silage open, or in having unhinged doors which fall in as the silage settles below them, while the absence of a roof (which is said not to be necessary) would permit prevailing winds to draw off gases by suction action. The gas can be driven out easily by using an open umbrella, bunch of hay, or leafy branch of a tree to promote diffusion. When any doubt exists, the effects on a lantern flame should be noted.

In case of accident, the Meltzer apparatus, recommended by the Committee on Resuscitation from Mine

Gases,⁸ would appear to be the best of the mechanical devices available.⁹

We desire to thank Dr. O. O. Fordyce, superintendent of the Athens State Hospital, his staff, and others for their kindly efforts in facilitating investigations. A complete report of this investigation including necropsy findings will be given in the *Monthly Bulletin* of the Ohio State Board of Health for October, 1914.

KALA-AZAR

A CASE REPORT FROM CHINA

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The economic significance and pathologic and clinical course of kala-azar have been studied and described by many observers in Africa, India and the Mediterranean littoral. Its recognition in China, however, is of comparatively recent date, and data are yet insufficient to estimate its economic significance there. It is safe to assume that the disease will be found as serious a problem in China as in other countries where it is endemic. For the present it is most essential that complete and reliable data be secured on the question of prevalence and distribution of kala-azar in China. As the infective agent of the disease is known, and as it is transmitted by bedbugs, rats and perhaps other vermin, and finally as the endemic section of China corresponds in latitude and somewhat in climate to a considerable part of the United States, studies of kala-azar in China may prove to have a direct value in sanitary and quarantine administration of the United States in the future. It is not the purpose of this report to review the clinical or natural history of kala-azar, or to present descriptions which are easily accessible in standard texts. It is desired to report one case outside the endemic zone established for China by Cochran, and to call attention to a disease which in the future may be of practical as well as of academic interest to American physicians.

After as complete a survey as could be made, Cochran¹ mapped out as the endemic area for China the section bounded on the south by the Yangtze River, and including that part of the provinces of Kiangsu, Anhwei and Hupeh lying north of the river, the eastern half of Hupeh and Honan, the southern half of Chihli including Peking, and all of Shantung. Reference to a map will show the relation of this area in latitude to the United States. A considerable similarity also exists in the matter of climate. Outside of the area indicated, Cochran obtained but two positive reports, from Wuchang and Kiukiang, respectively, which are on the south bank of the Yangtze.

The present case is reported from Changsha, the capital of Hunan, 200 miles south and west from Hankow and Wuchang, on the Siang River, which is a tributary of the Yangtze.

The patient, an unmarried Chinese man of 28 years, was admitted to the medical service of the Red Cross Hospital, Feb. 26, 1914, where he remained until his death, April 20, 1914. He was a boatman by trade, a native of Yuen Kiang on the upper Yangtze River near Ichang. He came to Changsha less than a year before his admission to the hospital. His father, an opium addict, died of dysentery at the

5. Erf, Oscar: *The Silo for the Dairy*, pp. 13 and 27.

6. King, F. H.: *Influence of Close Packing of Corn in the Silo*, etc., 18th Ann. Rep., Wisconsin Agric. Sta., 1901, p. 202.

7. Quoted from letter under date of Sept. 30, 1914, from R. H. Shaw, chemist, Bureau of Animal Husbandry, Dairy Division, Washington, D. C.

8. Technical Paper No. 77, U. S. Bureau of Mines, August, 1914.

9. Resuscitation from Mine Gases, editorial, THE JOURNAL A. M. A., Sept. 26, 1914, p. 1117.

1. Cochran: *Jour. London School Trop. Med.*, 1912, ii, Part 3, p. 179.

age of 42. His mother survived him. Of four brothers all were living and well. Two years before, one of his fellow boatmen developed a disease similar to his own and later a second boatman died with symptoms such as the patient presented on admission.

Except for measles in childhood, the patient was always in excellent health previous to the onset of the condition for which he sought hospital relief. This illness began five years before with severe abdominal pain, diarrhea and blood-streaked stools. The condition had persisted with periods of exacerbation and amelioration. His complaints on admission were anasarca, most marked in the peritoneum, shortness of breath and general debility. Physical examination showed a young man of medium height, very emaciated, markedly icteric, with a dry, elastic, hot skin. There were extreme abdominal distention and umbilical protrusion. The icterus was notably greenish and of universal distribution. The pulse was 100, soft, weak and regular. The fingers were somewhat clubbed and cyanosed, and the capillary circulation was poor. The conjunctivae were greenish-yellow.

The mouth and throat were normal. The deep cervical, axillary, inguinal and epitrochlear glands were easily palpable and of moderate hardness. The neck was severely emaciated and a venous pulse was observed in both external jugulars. In the lungs the left apex was dull, with high-pitched respiration, prolonged expiration, increased vocal fremitus, and crepitant râles. The right apex showed slight dullness, high-pitched respiration, prolonged expiration and crepitant râles after coughing. Elsewhere in the lungs the respiration inclined to the bronchial type. Breath-sounds were lost anteriorly and posteriorly at the level of the sixth rib. Below this point posteriorly there was flatness with deep tympany on heavy percussion.

The apex-beat was visible in the third left interspace, $3\frac{1}{2}$ inches from the median line. In character it was heaving and diffuse. Palpation corroborated the location. A blowing, rather harsh systolic murmur was heard at the apex and transmitted to the axilla. A very harsh systolic murmur was heard also at the aortic and pulmonary areas. The valvular and muscular quality was fairly good.

The abdomen was enormously distended, tympanitic between the lineae semilunares, and flat outside these lines. The spleen was enlarged a hand's breadth below the costal margin. The liver was not enlarged. The lower extremities, especially the feet, were very edematous. Reflexes were normal.

The sexual organs showed a peculiar hermaphroditic arrangement, which is worthy of report, although it had no bearing on the disease in question. The penis was infantile, more resembling a hypertrophied clitoris. The urethra was patent to the extremity of the penis, but there was present also a hypospadias with a comparatively small aperture at the bulbous portion of the urethra. Urination took place both through the hypospadiac aperture and through the penile urethra, sometimes concurrently, sometimes interchangeably. A rudimentary vaginal pouch was present, with well-marked labia majora, rudimentary labia minora and with its floor slightly deeper than the normal location of the hymen. The testicles were small, soft, and retracted into the inguinal canals, from which they could be drawn down into the labia majora. The inability at the time the patient died to secure a necropsy prevented examination of the internal structure and histologic examination of the testicles. The pubic hair was not abundant and covered a triangular area. No hair was on the face or in the axillae. The mammae were typically masculine. The expression, voice and general demeanor were feminine.

Death occurred in toxemic coma after an illness of five years and after two months in the hospital. The icterus steadily increased and during the last month the splenic tumor enlarged and became markedly tender. At no time was hepatic enlargement observed. The ascites, icterus and lack of hepatic hypertrophy indicated rather a considerable degree of cirrhotic contraction. The temperature remained fairly normal with an occasional rise to 38 degrees. The pulse ranged between 70 and 90, and the respiration from 20 to 25.

Clinical laboratory reports were as follows: Examination of feces on admission showed a whitish semisolid specimen, with no mucus or blood. *Ankylostoma* ova were present. Subsequent examinations were the same with the addition at times of a small amount of blood. Except for an occasional trace of albumin, the urine was normal. Blood examination, March 10, six weeks before death, showed 3,800,000 red cells, 70 per cent. hemoglobin, (color index 0.94), white blood-cells 3,200. The ratio of white to red cells was 1:1,187. Smears stained by the Leishman modification of the Romanowski method, out of 200 cells counted, gave a differential white cell-count of polymorphonuclears 60 per cent., large lymphocytes 15 per cent., small lymphocytes 10 per cent., eosinophils 1 per cent., mononuclear and transitional forms 14 per cent. The stained red blood-cells were somewhat pale, and included many poikilocytes, macrocytes and microcytes. The *Leishmania donovani* was found, two in one leukocyte. A blood examination one month before death showed a further reduction of red cells to 2,300,000, hemoglobin 70 per cent., white cells 3,000. The differential count was unchanged. The red cells, however, showed a progressive anemia, having more macrocytes and microcytes, numerous poikilocytes and many normoblasts, as well as irregular staining and granular degeneration.

According to the method recommended by Cochran, superficial lymph-nodes were twice excised from the inguinal regions under local anesthesia, and smears from them examined for *Leishmania*. In both cases numerous suspicious and atypical bodies were found in the lymph-cells, but no clear-cut, positive picture was obtained. This is perhaps to be explained by the advanced stage which the disease had attained.

Treatment was symptomatic throughout, except that the *Ankylostoma* was eliminated with thymol. The peritoneum was drained three times and 10,300, 10,000 and 10,500 c.c. of ascitic fluid, respectively, were withdrawn. Death occurred after thirty-six hours of delirium and coma, with extreme jaundice and myocardial failure.

The diagnosis of kala-azar in this case is based on the finding of two of the *Leishmania donovani* in a leukocyte of the peripheral blood, and is supported by the occurrence of numerous atypical bodies in lymphatic gland-cells obtained a few weeks before death, by the clinical history and appearance of the patient, by the blood-picture and by the elimination of other possible causative agents for the disease. The duration of the disease, the patient's age, and his knowledge of other similar cases are in correspondence to the diagnosis. It is to be noted that this case originated near Ichang on the Upper Yangtze River, and reached its development at Changsha, both points well out of the area which has to date been considered endemic for China. The pulmonary lesions represented an intercurrent affection due essentially to the patient's chronic illness with its depleting and exsanguinating course.

As already mentioned, kala-azar is found to flourish in China in an area corresponding in latitude and to a great degree in climate with a considerable portion of the United States. As the disease is carried by bed-bugs and perhaps other vermin, its introduction into the United States might at any time prove serious, and its spread might be rapid. Suspicious cases are easily recognized clinically by the splenic tumor and blood-picture, and all such cases should be examined for the presence of the *Leishmania* on which valid diagnosis rests.

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Caution.—For truth itself has not the privilege to be spoken at all times and in all sorts.—Montaigne.