account the difference in the a_0 and b_0 unit cell dimensions which exists between the silicon-oxygen sheet and the slightly smaller aluminum-hydroxyl (gibbsite) sheet. These sheets fit together to make up the so-called 1:1 structural unit of the clay minerals in the kaolin group. As Pauling (*5*) first pointed out, the slight misfit of the sheets should tend to produce a curvature of the unit in the (001) plane. However, in the mineral kaolinite, $(OH)_8Al_4Si_4O_{10}$, the distance between adjacent 1:1 units is small and the tendency of the sheets to curve is inhibited by the "stretching" effect that the oxygen ions in the silicon-oxygen sheet of one unit have upon the opposing hydroxyl ions in the gibbsite sheet of the adjoining unit. As a result, the typical hexagonal-shaped crystals of this mineral are planar. In endellite, $(OH)_8Al_4Si_4O_{10} \cdot 4H_2O$, on the other hand, because of the presence of interlayer water, the distance between opposing oxygen and hydroxyl ions of adjacent 1:1 units is appreciably greater than in kaolinite. Since the stretching effect is small, the difference in lattice dimensions of silicon-oxygen versus gibbsite sheets exists

FIG. 4.

and curvature results, giving tubular crystals. Measurements of the inner diameters of the tubes pictured in the electron micrographs yield values which are of the same order of magnitude as those obtained by calculations based on the structural considerations. An article describing this research on the kaolin minerals and the resulting structural implications will appear shortly in the *American Mineralogist*.

This structural explanation of the tubular crystals of endellite led to the conclusion that similar conditions might exist in other minerals. The necessary structural requirements are: 1) a sheet structure of the 1:1 type in which one sheet has slightly different dimensions from the other in the plane of the sheet, and 2) bonds between the 1:1 units which are not sufficiently strong to overcome this discrepancy by stretching the ionic lattice on the bottom of one unit to fit the spacing of the ions on the top of the opposing unit. John W. Gruner suggested to the senior author (*4*) that a study of serpentine with the electron microscope might yield significant results. Warren and Hering (*6*) and Aruja (*1*) have shown that antigorite and chrysotile possess layered structures of the 1:1 type. In addition a discrepancy in lattice dimensions exists between the magnesium-hydroxyl (brucite) sheet and the silicon-oxygen sheet which are joined to form the structural unit in these minerals.

Thus a general structural analogy exists between the serpentines and minerals of the kaolinite group. More specifically, differences in the x-ray patterns and dehydration characteristics of kaolinite and endellite are analogous to differences that exist between antigorite and chrysotile.

Electron microscope pictures such as those reproduced here bring out the striking resemblance between the unusual tubular crystals of endellite and chrysotile. Continued research on this problem is being supported by the Office of Naval Research.

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Eperythrozoon suis n. sp. and *Eperythrozoon parvum* n. sp., Two New Blood Parasites of Swine[1]

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A blood parasite of the genus *Eperythrozoon* recently has been observed in swine by Splitter and Williamson (*3*). The organism was found associated with the disease entity of swine known as "ictero-anemia" or "anaplasmosis-like disease."

Animal inoculation studies have established the organism as a new *Eperythrozoon* species, and the name *Eperythrozoon suis* has been given it. Another species has been identified, but observed only under experimental conditions. This organism has been designated as *Eperythrozoon parvum*. David Weinman of the Yale University School of Medicine, and Rue Jensen, Colorado A. and M. College, have concurred in the identity of these organisms as species of the genus *Eperythrozoon*. The presence of two separate species in swine has been established on the basis of differences in morphology

[1] Contribution No. 112, Department of Veterinary Medicine, Kansas State College.

and pathogenicity of the parasites, and by cross-inoculation studies.

E. suis is a large *Eperythrozoon* containing somewhat more chromatin material than other species of this genus. A ring structure which averages about 0.8 μ in diam is the principal form of this extracellular parasite. At the height of parasitic attacks very large ring and discoid forms are present. These vary in size from 1 μ to 2.5 μ. Many of the large ring forms are of distorted shapes, and exhibit an irregular distribution of the chromatin at various points about the ring. Discoid forms appear as flat, solid chromatin masses. Coccus, rod, and various budding forms are also observed. The organisms are usually found upon the erythrocytes, and may be so numerous as to cover the red blood cells completely. Morphological changes occur within a few minutes in citrated or oxalated blood samples. Coccus and rod forms predominate in samples so treated.

E. parvum is observed primarily as small coccus forms and occasional ring structures. The rings are approximately 0.5 μ in diam, and the coccus forms are somewhat smaller. This parasite has displayed a tendency to accumulate in large numbers upon individual erythrocytes, even when very rare in the blood smear. According to Weinman (*4*) this organism is very similar in appearance to *E. dispar*.

Animals used in inoculation studies were held in fly-proof stalls. At least 30 days were allowed following splenectomy or experimental inoculation to determine the presence or absence of parasitic infection. All animals inoculated, with the exception of mice, were injected intravenously with citrated blood.

Four splenectomized pigs which had relapsed with *E. parvum* only, with no ill effects, were injected with blood from a known carrier of *E. suis*. *E. suis* appeared in all four pigs after an incubation period of from two to five days. Acute eperythrozoonosis was evidenced by an acute, febrile, ictero-anemia which developed in each animal. Two subsequently succumbed to the infection. Conversely, two splenectomized pigs that had recovered from acute, clinical infection with *E. suis* were infected with *E. parvum*. A heavy parasitic infection developed, following incubation periods of seven and ten days, but no symptoms or blood damage ensued. One pig known to be susceptible to both parasites was infected with both upon experimental inoculation. In mixed infections *E. suis* has rapidly displaced *E. parvum*.

The two swine species were differentiated from *E. wenyonii* and *E. ovis* by inoculation of heavily infected blood into a susceptible calf and lamb. Both animals remained negative for 30 days, and were then proved susceptible by infecting each with its own *Eperythrozoon* species. Conversely, a susceptible splenectomized pig remained free of parasites following injection of pooled blood heavily infected with *E. wenyonii* and *E. ovis*. Fifty-eight days later the animal was experimentally infected with both *E. suis* and *E. parvum*, the former organism producing an acute ictero-anemia.

Differentiation of the swine species from *E. coccoides* and *E. varians* was accomplished by the intraperitoneal injection of mice with blood heavily infected with the swine parasites. One Swiss white mouse and two local white-footed deer mice of the species *Peromyscus maniculatus*[2] were used, the rodents having first been proved susceptible following splenectomy. All three remained negative for sixty days. Differentiation from *E. dispar* of the vole has not been undertaken. The failure to infect closely related rodents suggests that the *Eperythrozoon* species of swine are not closely related to *E. dispar*.

Splitter and Williamson (*3*) and Splitter (*1*) have demonstrated that *E. suis* is the causative organism of a sporadic disease of swine occurring in the Midwestern United States, which has been known as "ictero-anemia" or "anaplasmosis-like disease." Specific therapy has been obtained with neoarsphenamine (*2*). *E. suis* and *E. parvum* have been found to be common blood parasites of swine in northeastern Kansas.

[2] Identification by H. T. Gier, Department of Zoology, Kansas State College.

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Procedure in Dose Distribution Measurement of 25-Mev X-Rays[1]

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In the preparation of the 25-Mev betatron in the College of Medicine for human therapy (*1*) and animal experimentation, extensive measurements of depth-dose and isodose distributions have been made under a variety of conditions. Two general techniques have been employed, one based on small ion chamber measurements and the other on x-ray film density response.

The ionization measurements were made in a water-filled phantom shown in Fig. 1. This phantom had a front window of taut Nylon sheet (0.003 in. thick) to facilitate measurements close to the surface. The position of the ion chamber in the phantom was remotely controlled by selsyn motors from the control room of the betatron building. The driving selsyns in the control room also acted as indicators of the precise location of the ion chamber. Size No. 1 selsyns have proved entirely satisfactory in operation and precisely position the ion chamber to within ½ mm of the position indicated in the control room. Cylindrical and flat ion chambers have been employed. The diameter and height dimensions of the cylindrical chamber were 5 mm, with a central collection

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