of alkaline treatment, have been shown (*17*). Maize is also deficient in the essential amino acids lysine and tryptophan (*16*).

The iron content of maize is relatively low and less than 5 percent of this iron is absorbed by the human body (*18*). The availability of iron in foods taken with maize is also decreased (*19*). In addition, maize contains large quantities of phytic acid in the outer covering of the grain (*20*). Experimental evidence shows that phytic acid, an iron chelating agent, adversely affects the absorption of iron by making it unavailable for metabolism (*21*). Thus populations subsisting on a maize diet with little or no animal protein are in a critical position with regard to meeting their iron needs. Young children, because of their rapid growth, are particularly susceptible to adverse effects.

Among inhabitants of environments similar to that of Canyon de Chelly, where maize constituted over 75 percent of the diet, porotic hyperostosis reaches a high incidence of 83 percent (*15*). A high incidence of porotic hyperostosis (74 percent) is also found among Peruvian Indians with a similar diet (*10*). Comparisons of the incidence of porotic hyperostosis between canyon bottom inhabitants and other southwestern Indian groups living in sage plain areas where iron and animal protein were plentiful show the differences to be highly significant (*15*). Ten fish species, 41 mammal species, 52 bird species, and 77 plant species have been reported to exist in the sage plain areas (*22*). Children from canyon areas have an incidence of porotic hyperostosis ranging from 64 percent at Inscription House, Arizona, to 88 percent at Canyon de Chelly, Arizona. The incidence ranges from 15 to 18 percent among the sage plain groups at Navajo Reservoir and Gran Quivira, New Mexico.

The porotic hyperostosis found in ancient skulls of Peru and Yucatan has been described by Moseley (*3*) as the result of iron deficiency anemia. It is of interest that in this kind of bony change, iron therapy produces very slow results, if any. There is a documented case where treatment with iron produced no noticeable evidence of healing; the bony changes remained unaffected (*23*).

Of particular interest is the fact that the child under study was on a cradleboard. If the association is interpreted correctly, the child may have been crippled, mentally retarded, and, perhaps, unable to participate in normal infant behavior. Because of the unusually high incidence of porotic hyperostosis among these prehistoric American natives, we suggest that such findings merit further interdisciplinary investigation.

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Microfossils in *Conophyton* from the Soviet Union and Their Bearing on Precambrian Biostratigraphy

Abstract. *Silicified specimens of the Vendian (late Precambrian) "index fossil"* Conophyton gaubitza *from South Kazakstan contain a diverse assemblage of well-preserved cyanophytic and apparently eukaryotic algae, the first stromatolitic microbiota to be reported from the Soviet Union. Unlike the stromatolites in which they occur, the microorganisms that apparently built this form of* Conophyton *did not become extinct at the end of the Precambrian.*

Conically laminated stromatolites of the group *Conophyton* Maslov are among the most distinctive and widespread of biogenic structures occurring in Precambrian strata. Although they are especially abundant in the Early and Middle Riphean (between about 1700 ± 50 and 950 ± 50 million years ago), the range zone of fossil members of the group extends from the pre-Riphean into the Vendian, terminating near the close of the Precambrian (*1*). Indeed, and although living examples of *Conophyton* are known from modern hot spring environments (*2*), the apparent absence of such stromatolites from Phanerozoic rocks—coupled with their abundance in Precambrian sediments and their readily identifiable morphology—has led several workers to regard fossil *Conophyton* as a Precambrian "index fossil" (*1, 3, 4*) with the top of its range zone being one of two features suggested as defining the Precambrian-Paleozoic boundary (*5*, p. 37). The reliability of stromatolites as time-stratigraphic indicators, however, seems open to question; stromatolite form can be influenced markedly by physical aspects of the environment (*4*), factors that are neither time-restricted nor subject to unidirectional change. Moreover, limited data are available regarding the composition and evolution of microbial communities involved in formation of fossil stromatolites (*6*). Thus, it remains to be established whether differing types of coeval stromatolites were formed by differing microbiotas, or whether a singular community might have produced different stromatolites in different environments. Similarly, although "uncommon filaments" exhibiting "generally poor preservation" have been detected in a *Conophyton* of Early Riphean age (*7*), diverse, well-preserved microfossils have not previously been reported from such stromatolites. Thus, there has been little evidence to suggest whether fossil *Conophyton* was produced by the same mechanisms as its modern analog (*2*) or to indicate whether the occurrence of such fossil forms might reflect the presence of an atypical, and possibly Precambrian-restricted, biologic group. The

fossil biocenosis here described, to the best of our knowledge the first stromatolite-building microbiota to be reported from the Soviet Union, provides new insight into these problems.

Silicified specimens of *Conophyton gaubitza* Krylov were obtained from the Chichkan Formation (Karoy Group) in the Maliy Karatau Ranges (Shabakti River Valley) about 12 km southeast of Zhanatas, South Kazakstan. Microfossils were first discovered in petrographic thin sections of stromatolites collected by Yu.K.S.; subsequently, similar fossils were detected in an isotype of the stromatolite described by Krylov (*8*), collected in the same area by S. K. Chekhovich. The Chichkan sediments are of assured Precambrian age; they stratigraphically underlie, by more than 500 m, hyolithid- and hyolithelminth-containing basal Cambrian (Tommotian) strata, and are apparently correlative with Siberian deposits that underlie a glauconitic sandstone dated at about 600 million years (*8*). Both in the Maliy Karatau Ranges and in the Tien-Shan Ranges of Kirgizia, about 200 km to the south, the Chichkan stromatolites occur 100 m or more above carbonates of the uppermost Upper Riphean [700 to 800 million years in age (*9*)], and in both ranges *C. gaubitza* occurs together with the stromatolites *Linella avis* and *Patomia ossica*, an assemblage widely regarded (*1*, *4*, *8*, *10*) as restricted to the Vendian (between 675 ± 25 and 570 ± 10 million years ago). Thus, the material here studied is from the late Precambrian (Vendian), and is probably about 650 million years in age.

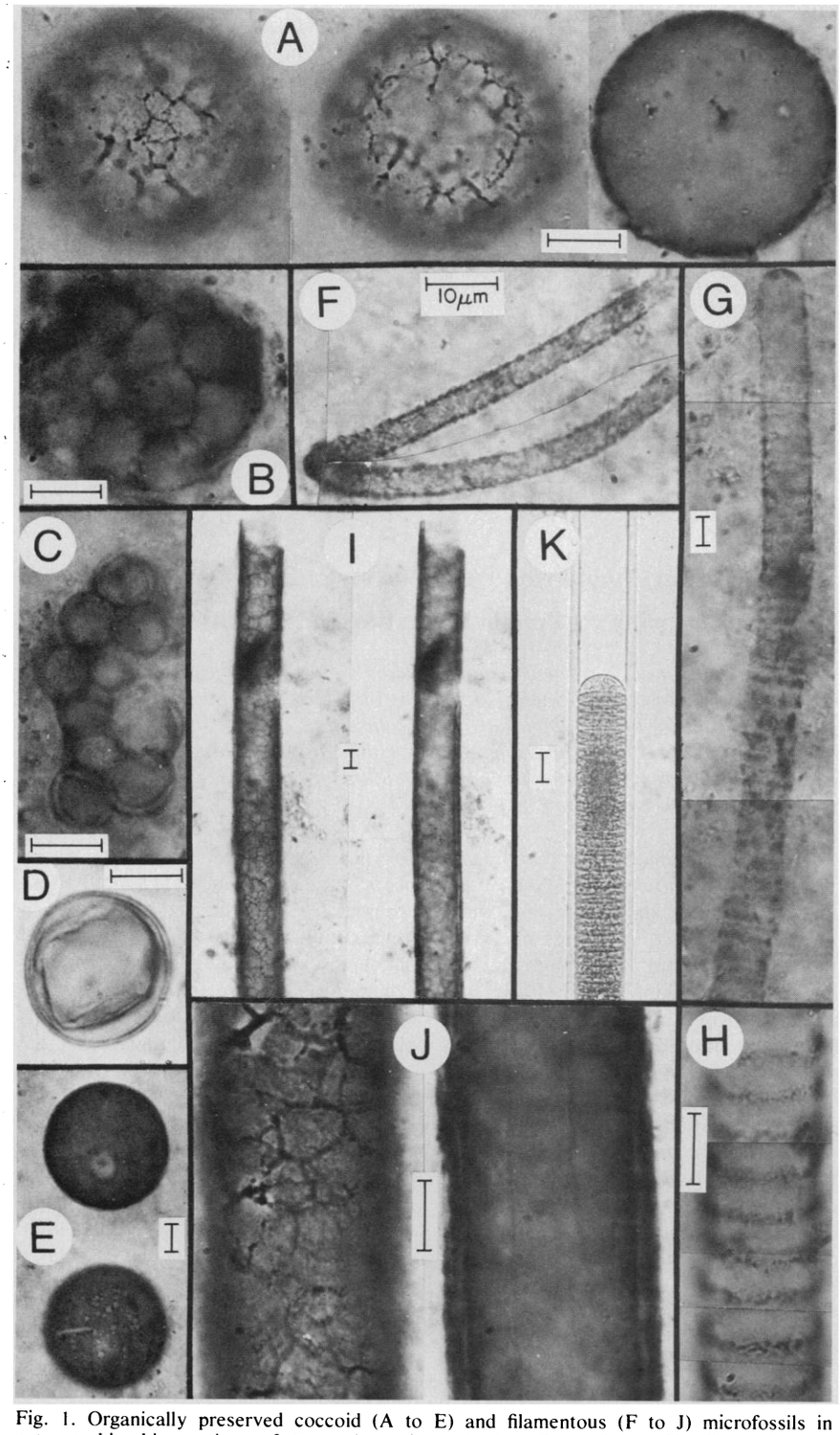


Fig. 1. Organically preserved coccoid (A to E) and filamentous (F to J) microfossils in petrographic thin sections of *C. gaubitza* from the late Precambrian (Vendian) of South Kazakstan. Lines for scale represent 10 μm; parts F, G, and H are photomontages; parts A, E, I, and J show surface textures (produced during preservation and diagenesis) and medial optical sections of single specimens. Note the similarity in sheath thickness and morphology and in the shape and size of medial and terminal cells between the broad fossil filaments (G to J) and the modern oscillatoriacean *Lyngbya majuscula* Harvey ex Gomont (K).

In the Shabakti River region, the 110-m-thick Chichkan Formation is composed of a sequence of finely laminated siltstones with interbeds of chert, dolomite, tuff, and fine-grained glauconitic sandstone. Carbonaceous cherts are distributed throughout the sequence, occurring in lenses, in breccias, and in prominent, commonly stromatolitic, beds. The 0.5- to 1.5-m-thick chert bed containing *C. gaubitza* occurs about 35 m above the base of the formation. The stromatolites, closely packed within the bed and oriented with their axes approximately parallel to the bedding (*11*), are subcylindrical in shape, 5 to 20 cm in diameter and up to 1.5 m in length. They contain (by weight) 0.05 to 0.3 percent organic matter, a relatively small portion (less than one-tenth) of which occurs in the form of structurally preserved, permineralized, organic microfossils (Fig. 1); the majority of the organic matter is finely particulate, disseminated throughout the fine-grained quartz matrix but concentrated in well-defined conical laminae generally less than 150 μm (but up to 250 μm) in thickness. Some of the stromatolites contain multiple axial zones (Fig. 2, A and B), an organic-rich region characteristic of *Conophyton* that is formed by the peaks of successive laminae. Like much of the Chichkan Formation, the *C. gaubitza* horizon appears to have been deposited in a relatively shallow-water, marine setting (*8*, *9*).

Four principal types of microfossils oc-

cur in *C. gaubitza*: (i) solitary algal unicells (Fig. 1, A, D, and E), 5 to more than 70 μm in diameter (Fig. 3), the most abundant component of the microbiota (450 ± 75 cell/cm^3 of rock); (ii) colonial unicells (Fig. 1, B and C), 5 to 15 μm in diameter, of rare occurrence (about one colony of 10 to 20 cell/cm^3 of rock); (iii) narrow (3 to 7 μm in diameter) tubular filaments (Fig. 1F), tens of micrometers in length, of intermediate abundance (120 ± 30 filament/cm^3 of rock); and (iv) broad oscillatoriacean sheaths (Fig. 1, I and J) and trichomes (Fig. 1, G and H), comparable in morphology to modern *Lyngbya* (Fig. 1K), that are of large dimensions (up to 30 μm broad and 900 μm long) and of rather common occurrence (75 ± 20 filament/cm^3 of rock).

The size range and pattern of size distribution exhibited by unicells of the assemblage (Fig. 3) indicate that several, and probably many, algal taxa are represented. The small dimensions and ensheathed nature of the colonial unicells suggest cyanophytic (chroococcalean) affinity. More than half of the unicells measured in *C. gaubitza*, however, are larger than all but a few taxa of coccoid blue-green algae (*12*); many of these cells (including individuals nearly 50 percent larger than known prokaryotes) are probably of eukaryotic affinity (chlorophycean or rhodophycean or both). The unicells, randomly distributed throughout the stromatolites, appear to be chiefly planktonic in origin; with the exception of colonial forms, there is no evidence of in situ cell division, and none of the forms appears to have played a major role in mat formation.

Like the unicells, the narrow filaments, apparently the discarded sheaths of filamentous cyanophytes, occur throughout the stromatolites; both they and the broad oscillatoriaceans tend to occur singly, rather than in an interwoven fabric, and both are commonly oriented subparallel to the circumference of organic-rich laminae. Size data (Fig. 4) suggest that two taxa of *Lyngbya*-like filaments are probably represented. Unlike other members of the assemblage, however, these broad oscillatoriaceans appear to be nonuniformly distributed (Fig. 2); study of transverse and medial longitudinal sections of three specimens of *C. gaubitza* (a total area of 240 cm^2) shows that such filaments are rare in axial zones (only 2 of 170 filaments were detected in the central 20 percent of specimens with well-preserved axial laminae) but are abundant toward the stromatolite periphery, with about two-thirds of the filaments occurring in the outermost 40 percent of the structures. Although it

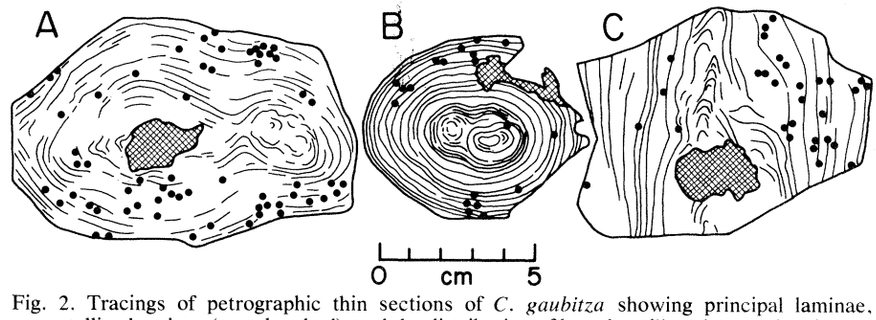


Fig. 2. Tracings of petrographic thin sections of *C. gaubitza* showing principal laminae, recrystallized regions (crosshatched), and the distribution of broad oscillatoriacean sheaths and trichomes (solid circles) in transverse (A and B) and medial longitudinal sections (C). Part A, showing an isotype (Geological Institute of Moscow No. 4285/36, specimen No. 0164/63) of the specimen described by Krylov (*8*), is oriented such that the upper surface of the inclined stromatolite is at the top.

seems unlikely that this pattern of distribution is a result of differential preservation, further studies are needed to establish whether it is of general occurrence.

This newly discovered Precambrian microbiota is of interest for the following reasons.

1) The presence of virtually identical microbiotas in the four specimens of *C. gaubitza* studied suggests (but does not prove, since the specimens are all from the same geographic region) that this form of stromatolite may have been produced by a single type of microbial community (*13*). Although this specific community has not been detected elsewhere in the geologic record, members of the assemblage were apparently not restricted to *Conophyton*; microfossils of very similar morphology, occurring as monospecific assemblages or in association with microorganisms not detected in *C. gaubitza*, occur in noncolumnar stromatolites of comparable age (*6*).

2) Microfossils are also known from a silicified *Conophyton* of Early Riphean age (*7*). The stromatolite-forming filaments of this Australian assemblage appear to have been quite narrow (< 3 μm); thus, although similar in dimensions to the microorganisms that produce modern *Conophyton* (*2*), they differ markedly from the filaments in *C. gaubitza*. More generally, available data indicate that filamentous, stromatolite-building microorganisms exhibited a gradual, but substantial increase in cell (and sheath) diameter during the Proterozoic (*14*); forms comparable to the *Lyngbya*-like filaments of *C. gaubitza* are unknown prior to the Late Riphean. There now seems sufficient evidence, both direct and indirect, to conclude that *Conophyton* was built by different microbiotas at different times [see (*2*)]. It is thus interesting to note that in described forms of fossil *Conophyton* the ratio of the thickness of dark laminae (originally organic-rich) to that of contiguous light laminae increased markedly during the Proterozoic (*3*). Although it has been speculated (*3*) that this trend might reflect a relative increase in abundance of algae (and thus in photosynthetic efficiency) per unit mass of stromatolite, data summarized above seem to confirm an alternative suggestion (*10*) that the trend is more plausibly explained as re-

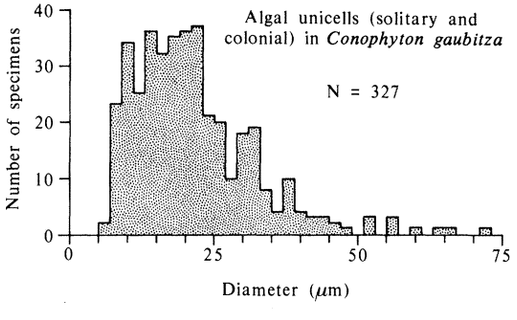
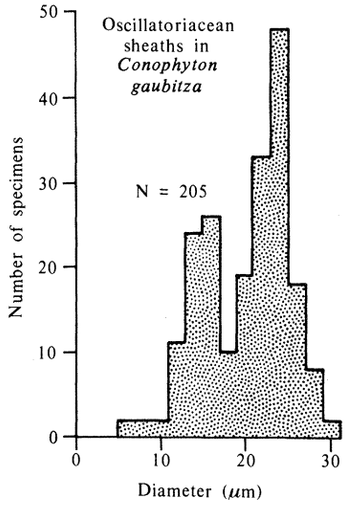


Fig. 3 (left). Histogram showing the size distribution of algal unicells measured in petrographic thin sections of *C. gaubitza*. Fig. 4 (right). Histogram showing the size distribution of broad oscillatoriacean sheaths measured in petrographic thin sections of *C. gaubitza*.



flecting the evolution of mat-forming filaments of increasingly larger diameter.

3) Walter *et al.* (*2*) have postulated that gliding motility, phototaxis, and interfilament cohesion are the essential characteristics that enable cyanophytes to form the conical laminae of modern *Conophyton*. As evidenced by the prevalence of discarded, empty sheaths (and naked trichomes) in *C. gaubitza*, it seems probable that oscillatorian gliding and phototaxis (or other tactic response) played a similar role in the formation of fossil conical laminae. Although there is little evidence in *C. gaubitza* of interfilament cohesion, the preserved filaments are moderately to heavily ensheathed; such cyanophytes secrete copious mucilage, a factor possibly required for formation of the resilient, relatively high amplitude, peaked, and often ridged mats of *Conophyton*. In addition, the apparently differential distribution of filament types in *C. gaubitza* could be of significance; the broad oscillatoriaceans (and associated mucilage) may have provided structural support on flanks of the growing stromatolites while, in a manner similar to that postulated for modern *Conophyton* (*2*), relatively narrow, more active, rapidly gliding taxa were dominant in crestal zones.

4) The microorganisms in *C. gaubitza* are generally quite similar to those known from other microbiotas of comparable age. There is no evidence to suggest that fossil *Conophyton* was produced by an atypical stromatolitic community or by taxa that became extinct at the close of the Precambrian. On the contrary, many of the *C. gaubitza* filaments seem virtually identical in morphology to living cyanophytes (Fig. 1), a similarity well-illustrating the evolutionary conservatism characteristic of such prokaryotes (*15*). With regard to the demise of *Conophyton*, and as Awramik (*16*) was apparently first to suggest, it seems possible that such stromatolites may have been excluded from the Phanerozoic by the advent of grazing metazoans (*17*), especially if early invertebrates were limited in distribution to (or were particularly abundant within) permanently submerged settings of the type in which *Conophyton* most commonly occurs (*18*).

5) In recent years there has been a marked increase of interest in the possible use of stromatolites for global biostratigraphic zonation of the Precambrian. Although many aspects of such zonation remain open to question, available data seem to establish that some Proterozoic stromatolites had limited range zones and that assemblages of stromatolites therefore changed ("evolved") through time (*1, 3, 4, 10*). However, because few well-preserved microbiotas have previously been reported from relatively complex, stratigraphically useful stromatolites, the presumed biologic bases of these changes have yet to be defined. In light of the results here reported, it seems likely that it will soon prove feasible to determine whether differing types of coeval complex stromatolites were formed by differing microbial communities, whether the microorganisms themselves can provide a reliable basis for biostratigraphic correlation (*14*), and whether the evolution of such organisms was the causative factor resulting in the evolution of stromatolites.

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Vasopressin and Oxytocin Are Depleted from Rat Hypothalamic Nuclei After Oral Hypertonic Saline

Abstract. *Vasopressin and oxytocin were measured by radioimmunoassay in rat posterior pituitary and microdissected hypothalamic areas after 3 and 10 days of oral 2 percent sodium chloride in place of drinking water. There was a significant decrease in concentration of both hormones in posterior pituitary and in specific areas of the hypothalamus. Supraoptic, paraventricular, and arcuate hypothalamic nuclei and the retrochiasmatic area had decreased concentration of one or both hormones following hypertonic saline, while hormone concentration in the suprachiasmatic nucleus and median eminence was unaffected.*

Vasopressin and oxytocin have traditionally been thought to originate in neuronal cell bodies in supraoptic and paraventricular nuclei of the hypothalamus and to be transported along axons to the posterior pituitary for storage and release in response to physiologic stimuli (*1*). Dehydration is a potent stimulus for release of vasopressin and probably also oxytocin, as continued dehydration causes marked depletion of posterior pituitary stores of biologic activity of both hormones (*2*). Determination of the effect of dehydration on vasopressin and oxytocin in individual hypothalamic nuclei has been difficult because of the complex structure of the hypothalamus. Using a recently devised technique for microdissection of individual hypothalamic nuclei (*3*) and radioimmunoassay, we have found vasopressin in six of 32 microdissected hypothalamic areas (*4*). Here we report the effect of oral hypertonic saline on vasopressin and oxytocin concentration in these six areas.

Twelve male Wistar rats with an average weight of 261 g were divided into two groups of six rats each. One group was