the presence of HCl and HF failed to show any sign of the species CH, CH_3Cl, CH_3F, C_2H_2, and HCN, although their spectra are favorable for observation if they are present in concentrations greater than one part per million (*17*). This confirms the observation of Kuiper (*20*) regarding molecular abundances of hydrocarbons. It is also consistent with the instabilities of these compounds in an anhydrous, oxidizing, hot environment (*4*).

If the interaction model applies, the atmosphere of Venus differs fundamentally from those of Earth and Mars. For example, the most important constituents of Earth's atmosphere result from reactions of the type (*21*)

$$\text{organisms} \rightleftarrows O_2\ (\text{gas})$$
$$\text{organisms} \rightleftarrows CO_2\ (\text{gas})$$
$$H_2O\ (\text{liquid}) \rightleftarrows H_2O\ (\text{gas})$$

Constituents in the atmosphere of Venus derive from more fundamental reactions (reactions 1, 3, and 4). Furthermore, the classical concept of degassing has less applicability on a hot planet, for, although the atmospheric constituents may well have originated within the interior (or from a trapped primordial atmosphere), their excess accumulation in the atmosphere would be prevented by back reactions. Thus absorption is as important as degassing. These deductions are totally incompatible with certain current models on atmospheric evolution. Thus Dayhoff *et al.* (*22*) attempted to trace the evolutionary history of the atmosphere of Venus from its primordial state by reference to the system C-H-O without consideration of the effects of heterogeneous reactions such as (1a) and (1b). However, if the atmosphere is derived by chemical interaction with a lithosphere composed largely of silicates and oxides, then any evolutionary scheme must take account of these compounds.

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Thorny-Headed Worm Infection in North American Prehistoric Man

Abstract. *Examination of ova and parasites from coprolites of probable human origin revealed eggs of the phylum Acanthocephala. Specimens were gathered from Danger Cave in Utah, an area heavily populated with definitive rodent hosts for the Acanthocephala species* Moniliformis clarki. *It is postulated that prehistoric man developed Acanthocephala infection by ingesting the arthropod intermediate host, or that he was a victim of false parasitism by ingesting the whole rodent.*

Analysis of ancient, dried feces (coprolites) provides a rich source of information regarding certain dietary habits of prehistoric man (*1–3*). Although parasitological examination of various mummies, coprolites, and latrine deposits from the Old World has revealed eggs from a variety of trematodes and cestodes, as well as protozoan cysts (*4*), such analyses have been generally unrewarding in the New World with a few exceptions. Eggs of the genus *Diphyllobothrium* were recovered from a Peruvian midden coprolite dated between 3000 and 1000 B.C. (*1*). A mummified Inca child approximately 450 years old contained eggs of *Trichuris trichiura* and cysts of the protozoan *Entamoeba* (*4*). Eggs of *Enterobius vermicularis* were recovered from a coprolite about 1000 years old from Mesa Verde, Colorado (*5*). In addition, remains of lice, mites, and ticks—all possible ectoparasites of man—have been described (*3, 5*). Recognition of this biological material is possible after immersion of the dried specimen in a 0.5 percent aqueous solution of trisodium phosphate for 72 hours, a method introduced by Van Cleave and Ross for reclaiming dried zoological specimens and applied to the examination of coprolites by Callen (*6*). Specimens thus reconstituted are remarkably identical in morphology to their living counterparts.

Danger Cave, in Utah, was a site of inhabitation by early man during the ten millennia from the time of regression of the Wisconsin glacier to the beginning of the Christian era. The cave was filled with cultural debris, including coprolites, to a depth of 11 feet (3.3 m). The debris was separated into five sequential segments: D–I (D, Danger Cave) to D–V, with D–I the oldest and D–V the youngest levels (*7*). Radiocarbon dating of samples of charred bat guano, rat dung, charred twigs, and uncharred sheep dung (D–I only) yielded the following dates: 9503 B.C. ± 600 years for D–I; 7839 B.C. ± 630 years for D–II; 1869 B.C. ± 160 years for D–IV; and A.D. 20 ± 240 years for D–V. The D–III level was not carbon dated. Coprolites were found in all levels, being most abundant in the more recent. They were ascribed to human origin on the basis of content, color, and form; the properties of turning the immersing fluid a dark brown color and, in some specimens, emitting a distinctly fecal odor after several days in 0.5 percent trisodium phosphate (*1, 3*) were also indicative of human origin. Human coprolites contain a mixture of diverse plant material, bone, and charcoal ingredients, a feature which distinguishes them from coprolites of other mammals (*3*).

Iodine and saline preparations of small samples of reconstituted coprolite specimens were made for microscopic ova and parasite examination, just as is done with fresh feces in the modern clinical laboratory. Twenty specimens from D–V, six from D–IV, nine from D–III, and five from D–II constituted the survey. No protozoan parasites were encountered. In three of twenty specimens from D–V and one of six specimens from D–IV levels, eggs of the phylum Acanthocephala were found (Figs. 1 and 2) (*8*). All eggs were remarkably similar in form and size, and showed identical staining properties by iodine. No other species were identified.

Members of the phylum Acanthocephala are unique in several respects (*9*). The phylum consists of one class and three orders, is exclusively parasitic, and utilizes birds, fish, and mammals as definitive hosts. Only two species, *Macracanthorhynchus hirudinaceous* and *Moniliformis dubius*, within the order Archiacanthocephala, have been implicated in human disease, and both are

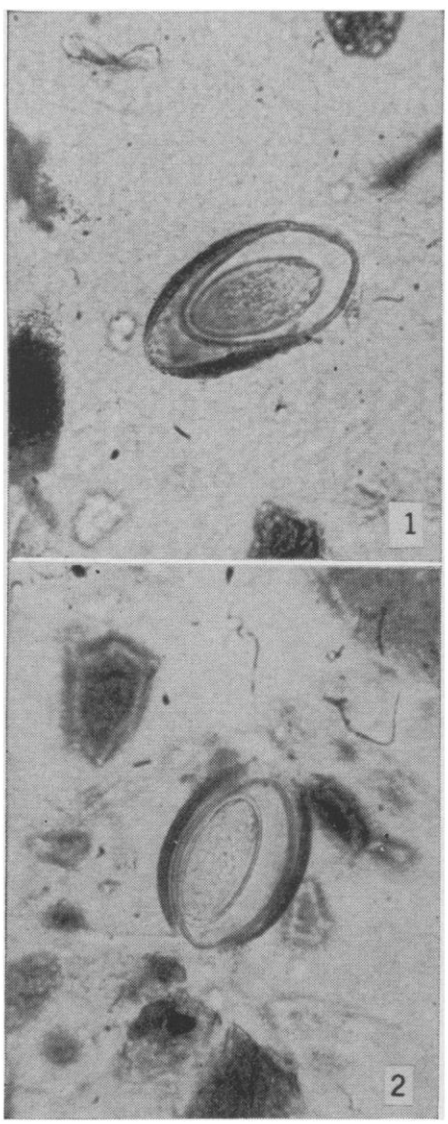

Fig. 1. Acanthocephala egg emerging from protective shell found in coprolite from Danger Cave level IV (1869 B.C. ± 160 years). The egg measures 73 by 44 μ (dimensions between outer membranes excluding the shell). Fig. 2. Egg within thick shell found in D–IV coprolite. The egg measures 72 by 46 μ (dimensions between outer membranes excluding shell).

cosmopolitan in distribution. *Macracanthorhynchus hirudinaceous*, or giant thorny-headed worm, is a helminth parasite of swine (peccary) and, occasionally, of the dog and monkey. It was reported once as occurring in a human in 1859 on postmortem examination of a 9-year-old child in Prague (*12*). In the life cycle of *Macracanthorhynchus hirudinaceous*, the egg is ingested by scarabaeid beetles or their grub. The beetles serve as the intermediate host where the infective larval stage develops.

The definitive host of *Moniliformis dubius* is primarily the rat; beetles and cockroaches serve as intermediate hosts. Human infestations have been reported from Sudan, Italy, and British Honduras (*12*). In Utah near Danger Cave, the closely related form *Moniliformis clarki* occurs today (*10*). The intermediate host is the camel cricket *Ceuthophilus utahensis*, and definitive hosts include a variety of small rodents (*11*). Other insects probably act as intermediate hosts and the adult form probably occurs in other mammals, although examination of coyotes in the area has not revealed infestation (*11*). Species differentiation is not possible from the morphological characteristics of the eggs; still, it is likely that the eggs from the Danger Cave coprolites are *Moniliformis clarki*.

Infestation in man by *Moniliformis clarki* has not been reported. Nevertheless, a few inferences may be drawn. Historically, aboriginal peoples commonly ate insects, and no doubt prehistoric man did the same. Larval grub forms, crickets and grasshoppers (*13*), and probably beetles and cockroaches were an integral part of the diet. Small animals, including rodents, are known to have been eaten whole (*13*). Thus, aboriginal people could have served as a definitive host by ingesting the arthropod intermediate host, or they may have been victims of false parasitism as a result of eating parasitized rodents. Since the definitive host for *Moniliformis clarki* is not specific, a large natural host reservior existed in a variety of vertebrates in the vicinity of Danger Cave, including man.

In what manner Acanthocephala infection affected community health and individual life expectancy remains speculative. The worm is armed with a formidable proboscis which burrows into the intestinal wall causing diarrhea, weight loss, anemia, emaciation, and, not uncommonly, death from perforation in the host (*9*). In the only recorded experimental infection in man with *Moniliformis dubius* (1888), symptoms of severe abdominal pain, diarrhea, exhaustion, somnolence, and tinnitus were produced 19 days after ingesting several larvae (*12*). Cure was effected by administration of male fern extract (*Aspidium filixmas*) within 2 days. Thus, unlike parasitism by the more common helminths—*Ascaris lumbricoides, Enterobius vermicularis*, or *Trichuris trichiura*—Acanthocephala infection probably affected individual health and had lethal potentialities.

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Glass-Transition Temperature of Water

Abstract. *The glass-transition temperature of water* (T_g) *has been calculated by use of the Tammann-Hesse viscosity equation with the viscosity equal to* 10^{13} *poise at* T_g. *The derived value of* T_g, *162 ± 1°K, is significantly higher than previous estimates.*

Yannas (*1*) has commented on the importance of the glass-transition temperature T_g of water in meteorological and other investigations; he reported an estimate of this value based on volumetric measurements of glycerol-water solutions. I here report an alternate