

## THE FINDING OF EGGS OF *DIPHYLLOBOTHRIUM* IN HUMAN COPROLITES (4,100 – 1,950 B.C.) FROM NORTHERN CHILE

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*Twenty six coprolites from an archaeological site in the province of Iquique, northern Chile, were examined for parasites.*

*Coprolites were found in two excavation units, I and II (Tiliviche site), dated respectively at 5,900 B.C. to 4,110 B.C. and 4,110 B.C. to 1,950 B.C., and identified as of human origin. Only at the unit II coprolites containing helminth eggs identified as *Diphyllobothrium pacificum* were found.*

*The presence of this tapeworm, a parasite of the American Sea Lion, in human coprolites, points to a diet which included marine fishes and provides information on the antiquity of infection by *Diphyllobothrium pacificum*. It is interesting to note that Baer (1969) suggests the presence of this tapeworm in pre-Columbian populations when diagnosing the first human cases in today's population in Peru.*

The finding of helminth eggs in archaeological material like faeces dropped in caves or rock shelters (Callen & Cameron, 1960; Fry, 1977; Ferreira, Araújo & Confalonieri, 1980; Araújo, Confalonieri & Ferreira, 1980; Araújo, 1980), inside mummified bodies (Ruffer, 1910; Szidat, 1944; Pizzi & Schenone, 1954; Ou Wei, 1973; Allison et al., 1974; Cockburn, Millet & Scott, 1977; Confalonieri, Araújo & Ferreira, 1981) or in cesspits (Taylor, 1955; Specht, 1963) allow a better understanding of the origin and further dissemination of parasitic infections.

These data, which provide information on both human and animal parasites, although still sparse, define a new line of paleopathological research – paleoparasitology.

As authors have been challenged by methodological problems, experimental models devised for the study of morphological variations caused by the desiccation of organic matter have recently been tried (Fry, 1977; Zimmerman, 1978; Conghlin, 1980).

Moreover, the presence of parasites, especially the highly pathogenic ones, is an important factor influencing some ancient populations and its adaptation to certain life strategies or local resources, acting as a selection pressure.

This paper deals with coprolites collected in the north of Chile by one of us (L.N.) in which operculated eggs of helminths were found.

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## MATERIAL AND METHODS

Twenty six samples of coprolites were collected from the archaeological site of Tiliviche 1-B, in the arid province of Iquique, northern Chile, 40 km from the coast and at an altitude of 950 m. This is a large camp site with 4,332 m<sup>2</sup> partially covered by superficial fireplaces.

The samples were collected from two excavation units (I and II) 30 m apart, representing the nuclear sections of the camp in which a more intensive use was noticed. At unit I the cultural remains revealed the typical indicators of the Tiliviche Complex: foliaceous or lanceolate stone artifacts, milling implements and the typical fishhooks made of snail shells. The beginning of the occupation was about 7,810 B.C. (S.I. - 3,116). The first deposits containing organic remains from "quebrada" environment as well as coprolites have been dated from 5,900 B.C. (Gak 6052) to 4,110 B.C. (S.I. - 3,114).

The presence of similar components at unit II shows that the camp is "in totum" part of a homogeneous population, although the absence of shell-made fishhooks suggests that this unit could have had a more recent occupation. Two cross-datings can be used to assess the relative datings of this unit: the beginning of the occupation was about 4,110 B.C. (S.I. - 3,114) and the end about 1,950 B.C. (N - 3773). The second dating corresponds to a preceramic cemetery at a distance of 200 m from the unit, recently studied by Nuñez & Staden (1982), which demonstrates that the last occupation associated with coastal resources lasted until 2,000 B.C.

It is remarkable the high frequency of marine species consumed when the first adaptation to the microenvironment of "quebrada" was produced. Later, the exploitation of sea resources maintains its importance although more diversified by an increase in the consumption of plant species. The site reveals a dynamic occupation pattern where the first groups settled communications between the seashore and the oases in the interior, which were occupied intermittently. These movements reached the shores of Pisagua and Camarones, where dense human concentrations adapted to the coast developed. These were the first human occupation sites reported for the fertile coast of the arid north of Chile.

Five samples of coprolites from these sites were analyzed before by Hall (Nuñez & Moragas, 1978) and the consumption of local Cactaceae (*Opuntia* sp) toasted in fireplaces was noted. Fish remains from the Pacific Ocean and from the local rivers demonstrated the combined use of resources; the presence of particles of charcoal as well as of quartz confirms the use of large fireplaces and the milling instruments recovered during excavations.

The coprolites were rehydrated in a 0.5% trisodium phosphate solution for 72 hours (Callen & Cameron, 1960) and then subject to sedimentation following the method of Lutz (1919), and finally examined at the microscope.

## RESULTS

Operculated helminth eggs (Fig. 1) were found in 4 of the 26 samples. The 4 coprolites (Fig. 2) were from the unit II, dated from 4,110 to 1,950 B.C. Fifty-three eggs were measured and the average length and width were  $53.63 \pm 2.82 \mu\text{m}$  and  $39.42 \pm 5.64 \mu\text{m}$  respectively.

## DISCUSSION

The presence of particles of charcoal and quartz in the coprolites, the toasted food remains and the colour of the rehydrating solution strongly suggest their human origin.

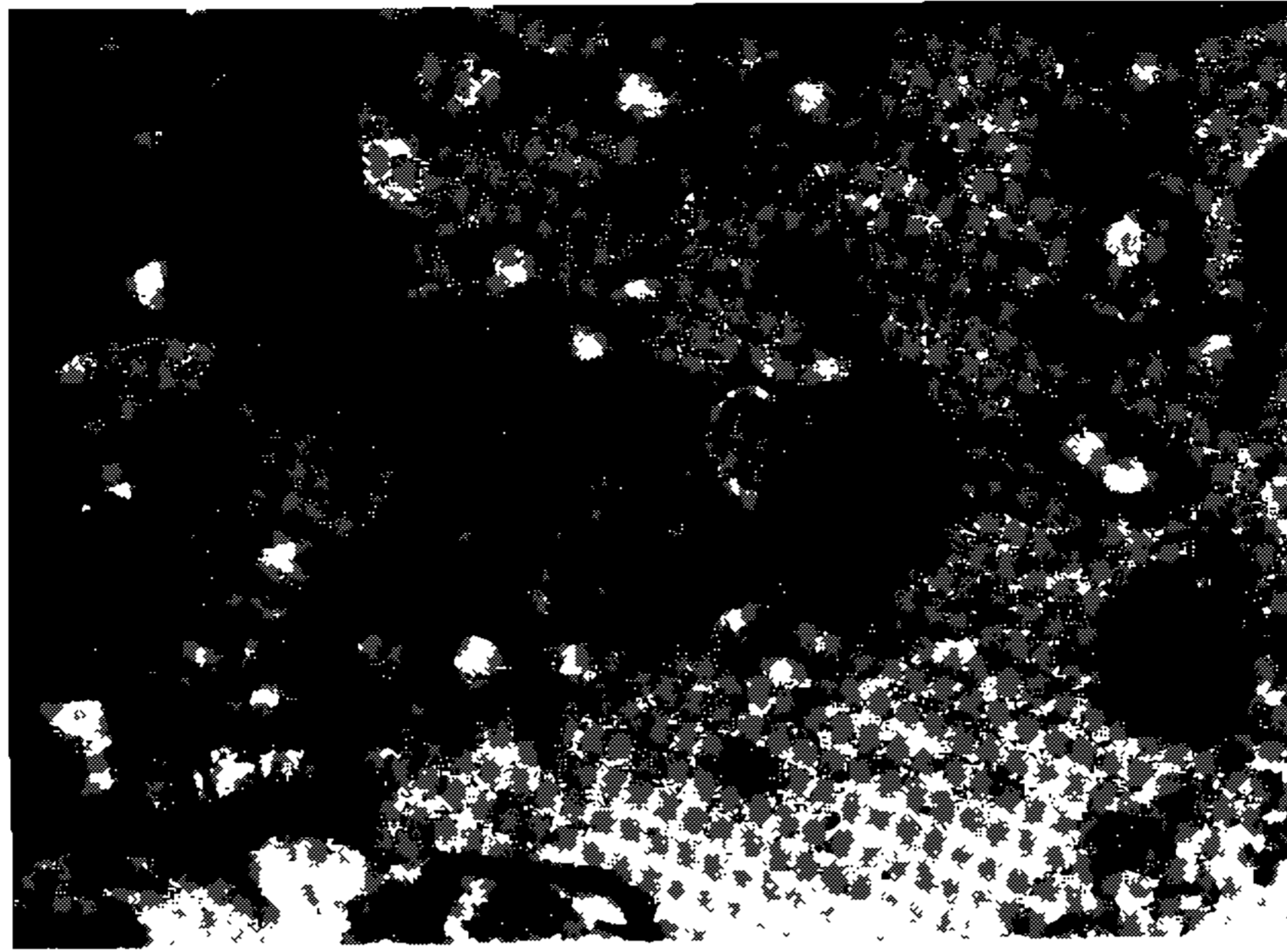


Fig. 1 – Egg of *Diphyllobothrium pacificum*. 400X.

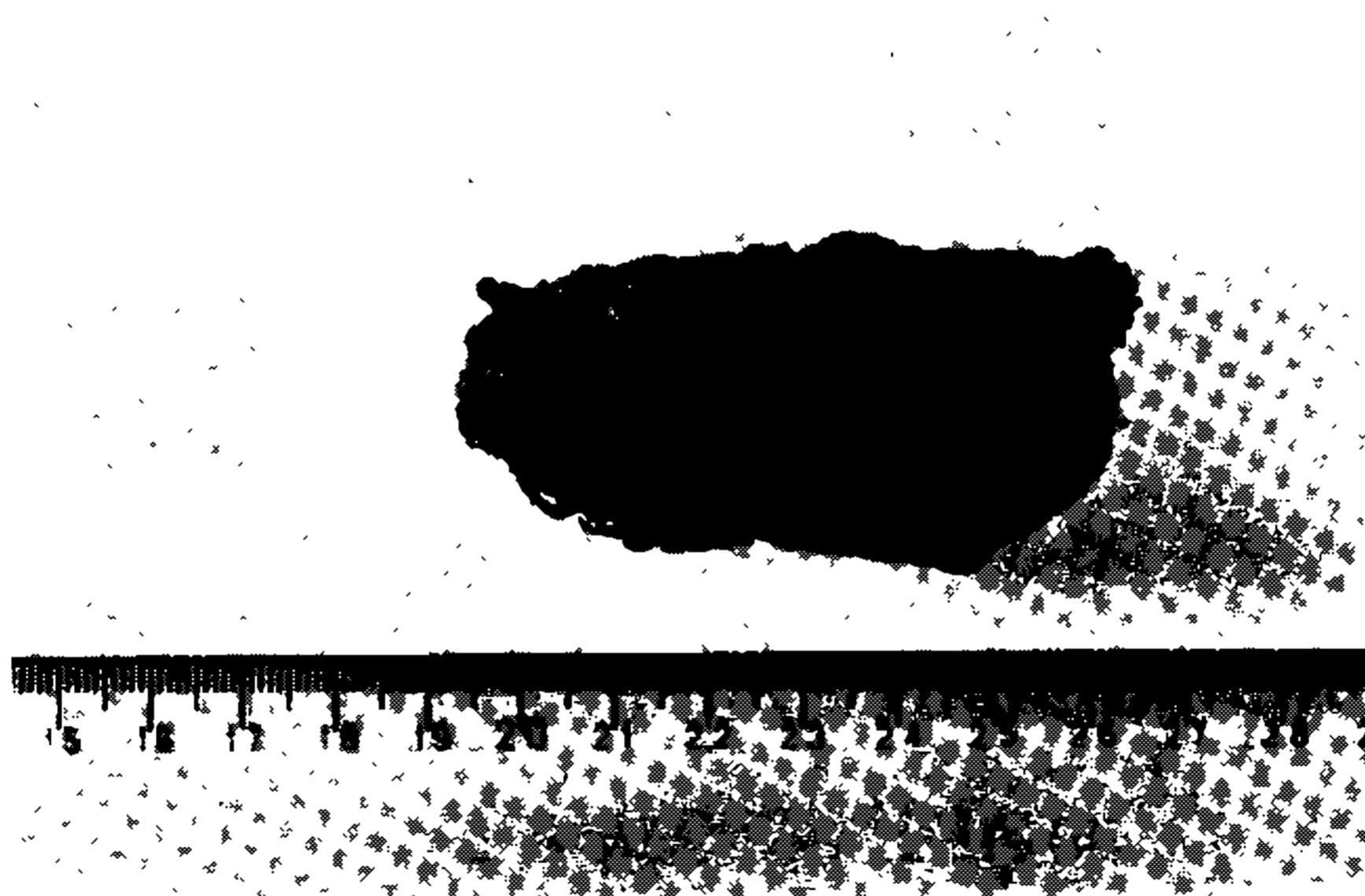


Fig. 2 – Human coprolite from Tiliviche in which *D. pacificum* eggs were found.

Since the parasitic forms were very well preserved and could be easily identified as helminth eggs the question remains of their distinction from the operculated eggs of human helminths. This is restricted to the Trematodes or the Pseudophyllidean cestodes.

The morphological aspects and the knowledge of the parasitic fauna of the region point to the genus *Diphyllobothrium*. This diagnosis is reinforced on the basis of the feeding habits of the population and the suitable ecological conditions.

Neghme, Donckaster & Silva (1950) described the first autochthonous case of *Diphyllobothrium latum* infection in Chile.

Other cases have then been found (Sapunar & Orellana-Alcade, 1965; Reys, Doren & Iuzunza, 1972) in the region of the lakes in southern Chile.

Baer et al. (1967) described the human infection by *D. pacificum* on the Peruvian coast.

On northern Chile, human cases of *D. pacificum* infection have been also diagnosed (Atias & Cattan, 1976; Sagna et al., 1976). In this species infection results from the ingestion of marine fish as opposed to freshwater fish in *D. latum* infection. Some cases were associated with nausea and abdominal pain which relieved after feeding but other ones were asymptomatic. Cattan et al. (1977) found *D. pacificum* in the South American sea lion (*Otaria flavescens*) from the coast of Chile and one of the hosts studied had an intestinal obstruction caused by several specimens of the tapeworm.

Baer et al. (1967) stressed the diagnostic value of the egg size in differentiating the species. They stated: "The eggs (*D. pacificum*) are thick-shelled, operculated, measuring 40 to 60  $\mu\text{m}$  in length and 36 – 40  $\mu\text{m}$  in diameter; they are thus considerably smaller than those of *D. latum* with which they cannot be confused".

The measurement of our specimens, the reported geographical distribution of the infection, and the feeding habits of the prehistoric population studied lead us to the conclusion that the eggs found are from *D. pacificum*.

It is interesting to note that Baer (1969) pointed to a possible infection by *D. pacificum* in prehistoric population during his studies of the recent infection by this parasite on the coast of Peru.

*Diphyllobothrium* eggs have been described in archaeological material from other places.

Callen & Cameron (1960) studied coprolites from Huaca Prieta (3,000 – 1,200 B.C.) on the coast of Peru (8°S), and observing objects similar to *Diphyllobothrium* eggs they concluded: "There is a strong presumption that these objects actually are eggs of a species of *Diphyllobothrium*".

Jansen & Over (1962), at an archaeological site from 100 B.C. to 500 A.D. at northern Germany, found *D. latum* eggs among other parasites.

Szidat (1944) analyzed the intestinal contents of two bodies from Prussia, a girl (600 B.C.) and a man (500 A.D.), and found in the latter poorly preserved objects similar to the eggs of *D. latum*, besides eggs of *Ascaris lumbricoides* and *Trichuris trichiura*.

These data provide information on the antiquity of infections by *Diphyllobothrium* species and relate it to the habits of primitive food collecting populations which utilized fish in their diet.

## RESUMO

Os autores realizaram exame parasitológico de vinte e seis coprólitos encontrados em um sítio arqueológico no norte do Chile, Província de Iquique.

O material foi colhido em duas unidades de escavação, I e II (sítio Tiliviche) datados respectivamente de 5.900 a.C. a 4.100 a.C. e 4.110 a.C. a 1.950 a.C. e identificados como de origem humana.

Na unidade II foram observados ovos de helmintos diagnosticados como de *Diphyllobothrium pacificum*. Esse achado nos informa sobre a antiguidade da infecção,

bem como sobre os hábitos alimentares dessas populações, uma vez que a contaminação se dá por ingestão de peixes marinhos.

É interessante assinalar que Baer (1969), ao descrever pela primeira vez a infecção humana por esse cestódeo em populações atuais do Peru, sugere a sua presença nas populações pré-colombianas.

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