

Hookworms and the peopling of America

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The occurrence of certain parasites in human groups from different regions has been used to study the geographical origin of both hosts and parasites. The presence of hookworm infection in an isolated tribe in remote regions of Paraguay led to speculations about its origin, since the prehistoric migrations through the Behring Land Bridge could not have brought the parasite, which needs for its maintenance a temperature of about 22°C in the soil. It was then proposed that only transpacific migrations of Asiatic populations could have brought the parasite to America. This discussion dates back to the beginning of this Century and it was only with recent paleoparasitological findings that it arose again. This paper is a review of hookworm findings in archaeological material and suggests possible routes followed by their hosts to reach the New World.

Key Words: hookworms in archaeological material; paleoparasitology; peopling of America.

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The hookworms of man, *Ancylostoma duodenale* and *Necator americanus*, have a different geographical distribution. *A. duodenale* is found in subtropical climate, up to 52° N, since the larvae in the soil needs a temperature higher than 20° C to develop; *N. americanus* is found in tropical climates where soil temperatures reach 25-28° C (Brumpt, 1958). Nevertheless there are mixed infections with both species in certain regions, but with the predominance of one or the other (Miller, 1979).

The centers of dispersion of the human infection by *N. americanus* were considered as being the African

continent, south of the Sahara, and Southern Asia. *A. duodenale* infection was found among natives of Northern Africa, Southern Europe and Northern Asia, including Japan (Manter, 1967).

The introduction of both hookworms in America was considered, till recently, a consequence of European colonization, and later of Asiatic migration, responsible for *A. duodenale* infection. The African slave trade introduced and dispersed *N. americanus* infection (Smillie, 1922; Beaver, 1964).

At the beginning of this Century the discovery of a nearly pure infection of *A. duodenale* in Paraguayan Indians, living in relatively isolated conditions, lead Darling (1921) and Soper (1927) to question their origin. The *A. duodenale* - *N. americanus* ratio was 13:1, the opposite rate of infection of the white population of that country. Both authors suggested that *A. duodenale* infection dated from precolumbian times, and could have only reached South America with its hosts, by transpacific migrations of Asiatic populations. The cold climate along the route from Siberia to Alaska, crossing the Behring Land Bridge, would not permit the maintenance of the parasite life cycle.

This question was discussed later by Manter (1967) and Fonseca (1972) and it was suggested that, if *A. duodenale* infection existed in precolumbian South America, it had originated with Japanese fishermen that arrived in Ecuador about 3000 BC; *N. americanus* could also have been brought by Southeastern Asian migrants circa 200 BC, as stated by Estrada and Meggers (1961) and Meggers and Evans (1966), based on archaeological artifacts. Manter (1967) concluded that, while the presence of the parasite may never be proved, it was illustrative of how certain parasites indicate the past history of their hosts. However it has to be noted that the study of parasite infections in primitive and isolated populations was not so reliable, since the minor contact with the colonizers in a recent past could have infected the natives.

It was only with the advent of paleoparasitological research that these hypothesis could be discussed again. After the finding of helminth eggs in coprolites from archaeological sites, dated by the radiocarbon method, it was possible the study of parasite paleobiogeography and to identify their centers of dispersion.

Hookworm infection seems to have been a common infection in South American past, as it has been found in four archaeological sites. The first record was by Allison et al. (1974) who found *A. duodenale* adults attached to the intestinal mucosa of a Peruvian mummy from 900 BC. Ferreira et al. (1980) found *Trichuris trichiura* and hookworm eggs and larvae in human coprolites collected in sedimental layers of an archaeological site in Minas Gerais, Brazil, dated from 3490 ± 120 to 430 ± 70 years by radiocarbon. Later, the same parasites were also found in coprolites collected from a mummified body from the same site and dating (Ferreira et al., 1983). Araújo (1987) found hookworm eggs in human coprolites also from Minas Gerais, Brazil, dated from 4905 ± 90 to 1325 ± 60 years. The oldest dating for hookworm eggs in human coprolites are from the archaeological site of Boqueirão do Sítio da Pedra Furada, Piauí, Brazil, which is 7230 ± 80 years old (Ferreira et al., 1987).

Recent reviews of helminthological findings in archaeological material (Wilke and Hall, 1975; Fry, 1977; Reinhard et al., 1987), do not mention the presence of hookworms in prehistoric deposits in Europe. However hookworms disease was a well known problem in ancient times in the Old World. Hoeppli (1959) published a discussion about diseases in ancient populations based on old documents, such as Hipocratic texts and the Ebers Papyrus, and mentions hookworm disease, characterized by hidropsy, anaemia, and geofagy, in ancient Rome, Greece and Egypt.

The peopling of the Americas was a matter of argument since the Europeans discovered that it was inhabited (Laming-Emperaire, 1980). Since the writings of Hrdlicka (1915) the Behring Land Bridge was accepted as the main route of migration of Asiatic populations from Siberian regions. Rivet (1928) proposed an alternative route by transpacific migrations from Polynesia to America. This was supported later by archaeological findings of similar artifacts in both continents (Meggers and Evans, 1966).

More recently transatlantic migrations, from Europe and Africa were suggested by Kehoe (1962; 1971), Greenmam (1963), Alcina-Franch (1969) and Kennedy (1971). Laming-Emperaire (1980) stated that these contacts may be dated from 20,000 years.

Another possible route to America is the migration over the Antarctic continent from Australia and South Africa (Mendes-Correa, 1928; Hester, 1966).

With recent findings of archaeological sites in North and South America with datings older than those previously admitted for prehistoric migration (Reeves, 1985; Bryan, 1986; Simpson et al., 1986; Guidon and Delibrias, 1986; Dillehay, 1986), new facts were added to the issue of the time of arrival of man in America.

For the introduction of hookworm infection in the New World to be possible, the sea routes are the only ones to be considered. It would be impossible for the parasite to survive in the cold climate of the pole, by the way of Behring. The slow speed of migrating hunter-gatherers, who were not in search for a new habitat, lasted a few generations (Mather, 1954), and the climate would act as a "filter" for some of the infectious diseases (Stewart, 1960).

After the evidence of hookworm infection in precolumbian times dated from 900 BC in Peru (Allison et al., 1974) and from 3490 ± 120 to 430 ± 70 years in Brazil (Ferreira et al., 1980; 1983), it was proposed that its introduction in the New World occurred by means of transpacific migrations (Araújo et al., 1981; Horne, 1985; Nozais, 1985). This is in accordance with transpacific contacts at 3000 BC based on the archaeological artifacts studied by Meggers and Evans (1966).

But the discovery of the infection at 7230 ± 80 years in Brazil (Ferreira et al., 1987) is a new fact and two possibilities can be raised. First the transpacific contacts dates from before 7230 years BP (Before Present) and the paleoparasitological data indicates that archaeological research in the Pacific coast of South America may reveal more remote relations with Asiatic population than is known today. Second, if transatlantic migrations were responsible for the hookworm infection in South America, the neolithic people coming from Europe or North Africa introduced the parasite.

It is also to be noted that paleoparasitological data show that navigation technology had been known to man for more than 7230 years.

It is interesting to note that together with hookworm infection two other prehistoric helminth infections, found in human coprolites in America,

support these hypothesis: *Trichuris trichiura* (Pizzi and Schenone, 1954; Ferreira et al., 1980; 1983; Reinhard et al., 1987), and *Strongyloides stercoralis* (Hall, 1972; Fry, 1980; Reinhard, 1985).

Paleoparasitology is now a research field that can elucidate the past History not only about infectious diseases in ancient people, but also concerning the beginning of peopling of continents.

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A ocorrência de certos parasitos em grupos humanos de diferentes regiões tem sido usada para o estudo da origem geográfica tanto da população humana como de seus parasitos. A presença da ancilostomose, em tribos isoladas de regiões remotas do Paraguai, levou a especulações sobre a sua origem, uma vez que as migrações pré-históricas pelo caminho de Bering não poderiam ter sido responsáveis pela introdução do parasito que necessita, para sua manutenção no solo, de temperatura em torno de 22°C. Propôs-se então que somente migrações transpacíficas de populações asiáticas poderiam ter introduzido o parasito na América.

Esta discussão data do início do século e somente com os recentes achados da paleoparasitologia foi retomada novamente.

Este trabalho é uma revisão sobre o encontro de ancilostomídeos em material arqueológico e sugere possíveis rotas seguidas pelos hospedeiros para alcançar o Novo Mundo.

Unitermos: ancilostomídeos em material arqueológico; paleoparasitologia; povoamento da América.

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