Echinococcus multilocularis in a Beef Cow from the Middle West

The report by Leiby and Olsen [*Science* **145**, 1066 (1964)] of finding the adult tapeworm *Echinococcus multilocularis* in red foxes in Ward County, North Dakota, stimulates me to record an observation made in May 1958. I received from the federal inspector at Mason City, Iowa, a shipment of beef livers from cattle slaughtered in that city and infected with *Echinococcus*. Among them was one with a typical alveolar cyst, which contained viable scolices of *E. multilocularis* (Fig. 1).

It is quite likely that other cysts and adult worms of this species have been encountered in this country but not recognized; it is again suggested that old material be re-examined for such occurrences. It is quite likely that *E. multilocularis* is not uncommon in wild and domestic animals in central northern United States and may also occur throughout the Mississippi Valley. With Thompson, I infected locally caught *Microtus cinnamomeus* with *E. multilocularis* from the fox; one of the necessary intermediate hosts is therefore present. Other species of voles, shrews, and field mice can act as intermediate hosts as well as can rats and house mice. Sylvatic hydatid infections with *E. granulosus* and *E. multilocularis* occur in other states besides Alaska and also in many parts of Canada.

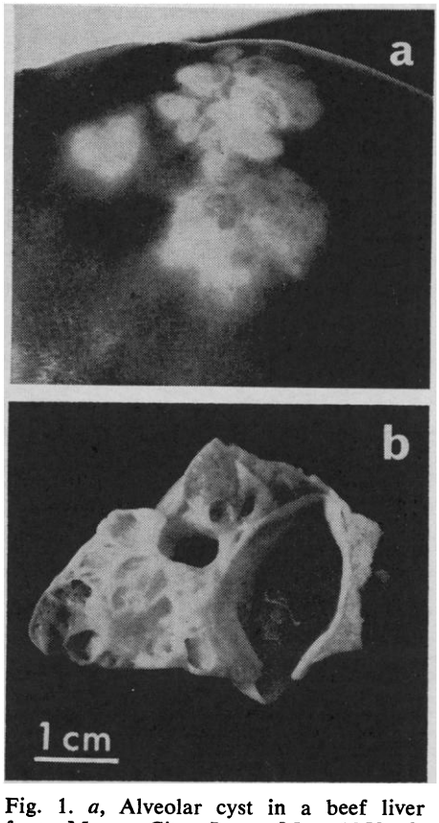

Fig. 1. *a*, Alveolar cyst in a beef liver from Mason City, Iowa, May 1958; *b*, cross section of a part of the cyst.

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Pollen from Alaska and the Origin of Ice Ages

From a study of pollen evidence from the Seward Peninsula and the arctic coastal plain of Alaska, Colinvaux (*1*) recently concluded that the Arctic Ocean must have been frozen over as long ago as 14,000 and probably as long ago as 18,000 years. Because our ice age theory (*2*) postulated that the Arctic Ocean was open from the beginning of the Wisconsin stage to 11,000 years ago, when it froze, Colinvaux concluded that his evidence contradicted this theory.

However, in our modified theory (*3*) we recognize that continental glaciation culminated about 18,000 rather than 11,000 years ago. Further, on the basis of new and more complete data on the thermal history of the oceans (North Atlantic in particular) we conclude that the Arctic Ocean would have frozen over much earlier than the culmination date of a glacial stage and well before 18,000 years ago.

According to our modified model, the open Arctic Ocean is necessary as a source for the snow that initiates glaciation. After growth of the ice sheet to some critical size, the larger source of precipitation available from the south in North America would have been responsible for the spreading of the ice sheet to about the 40th parallel. Initiation of the ice sheet from the north and the importance of a large source of moisture from the south is illustrated by the Pleistocene history of Siberia where glaciation was restricted to the Arctic marginal area of the continent. The desert of central Asia and the mountain barriers to the west and south effectively throttled the flow of moist air from lower latitudes and restricted the growth of glaciers.

We note in our modified model that the decreasing interchange of Arctic with Atlantic waters because of lowering of sea level plus the global cooling resulting from the primary and secondary effects of widespread glaciation would prevent the Arctic from maintaining an ice-free surface throughout a glacial stage. We also note that once formed, the Arctic ice would quickly freeze to a much greater thickness than it has at present, because of the lowered temperatures of inflow from the Atlantic. Although it is not possible for us to give a precise timing to the sequence of events, the Arctic must have remained open long enough to establish an ice sheet large enough to draw upon moisture from the south. At present, rather than negate our theory, the data and conclusions of Colinvaux actually support it in its modified form.

There is some further question regarding the correlations of Colinvaux's pollen data. His use of pollen as an index fossil on the basis of similar climatic affinities seems questionable. Unless it is known that the climatic histories of the Alaskan coastal plain and the Seward Peninsula were very similar, there is some risk in correlating zones *J* and *K* of the coastal plain with zone *H* of Imuruk Lake on the Seward Peninsula.

We would prefer not to specify the glacial temperature levels for the Alaskan coastal plain. Colinvaux noted that a reasonable amount of time—at least 4000 years—must be allowed for a climatic change to affect vegetation. By the time the effect of an open Arctic might have become manifest, the edge of the coastal plain would have migrated a considerable distance seaward as sea level declined over the shallow Alaskan shelf. Any evidence of direct effects of an open ocean are probably submerged.

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References and Notes

1. P. Colinvaux, *Science* **145**, 707 (1964).
2. M. Ewing and W. L. Donn, *ibid.* **123**, 1061 (1956).
3. "A Theory of Ice Ages III," by W. L. Donn and M. Ewing, has been presented in lectures and seminars and distributed rather widely for prepublication criticism.
4. The U.S. Steel Foundation supported the research related to this report, which is Lamont Geological Observatory (Columbia University) Contribution No. 768.

14 September 1964.

Donn and Ewing accept the pollen evidence as indicating that the Arctic Ocean was frozen during the period 18,000–11,000 years ago, but they consider that this need not confute their theory, since a modified version provides for the Arctic Ocean's freezing over before 18,000 years ago. My coastal plain record (*1*) did not reach the time when they now believe the Arctic Ocean to have been open, although the much longer record from Imuruk Lake (*2*) presumably does so. Donn and Ewing consider that the Imuruk Lake record cannot be sufficiently well correlated with events on the coastal plain for it to be used to infer the coastal climate. They point out, quite rightly, that such correlation cannot be done by using pollen as an index fossil.

It is apparent that I failed to make clear that correlation between the two sites is based on radiocarbon dating, not on the use of index fossils. The dated samples show that vegetation and hence climatic changes at the two sites have been parallel for the last 14,000 years, and allows a strong presumption that they were so in earlier times also. From this it could be concluded that the cold zone *J* of the Imuruk Lake sequence, which continued until more than 30,000 years ago, would be represented on the coast by the even colder zone 0. The Arctic Ocean, on this reasoning, must have been ice-covered since a time too remote to be dated by the radiocarbon method. Since the publication of my paper, I have been sent two more samples from Point Barrow (*3*), which enable this conclusion to be tested.

Table 1. Pollen analysis of two samples from drill cores taken at Point Barrow.

Taxon	Grains counted (No.)	
	Sample I—1384	Sample I—1394
Alnus	1	2
Betula	3	1
Picea	2	1
Salix	4	1
Ericaceae *sim.*	1	
Cyperaceae	279	198
Gramineae	56	21
Artemisia	19	*
Caryophyllaceae	5	
Ranunculaceae	9	1
Cruciferae	11	1
Chenopodiaceae	1	
Valeriana capitata	*	
Koenigia islandica	*	
Saxifragaceae		3
Polypodiaceae		1
Sphagnum	1	3

* Taxon noted in searching the slide.

The two samples are of organic sediments recovered in deep-drill cores, and have radiocarbon ages as follows:

Sample I—1384	25,300± 2300	years ago
Sample I—1394	>36,300	years ago

The samples have the disadvantage that they were probably reworked prior to final deposition, but this is not too serious for our purpose since we are interested in their age rather than their stratigraphic position. Pollen analysis (Table 1) shows that these samples belong to the coastal plain pollen zone 0. The fact that the pollen spectra can be clearly classified in this zone (*4*) argues strongly that the deposits, even if reworked, have not been mixed with pollen-bearing strata of widely different ages. The prevalence of zone 0 pollen spectra at Point Barrow 25,000 and more than 30,000 years ago confirms the conclusions drawn from the Imuruk Lake study.

In Fig. 1 the data are summarized and placed on a temporal scale. They suggest very strongly that the Arctic Ocean has been continually frozen for the last 30,000 years. They also suggest that earlier pollen zones at Imuruk Lake can be used to predict the state of the Arctic Ocean. For a period which possibly spans two complete glacial cycles (*2*) the Imuruk Lake pollen record indicates a climate in northern Alaska which has never been warmer than that now prevailing. It seems likely, therefore, that the Arctic Ocean has not been open at any time during this long period.

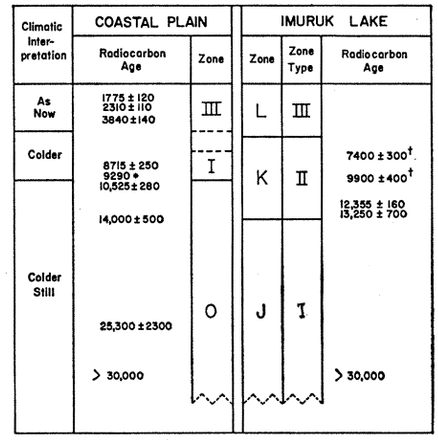

Fig. 1. The coastal plain pollen zones correlated with the top three zones of the 12-zone pollen sequence from Imuruk Lake (*2*), on the basis of radiocarbon dates. The diagram has been drawn on a linear time scale. * Mean of four radiocarbon dates. † These two dates were determined on material from the Imuruk Lake terrace. The remaining Imuruk dates are from the lake-sediment core.

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References and Notes

1. P. Colinvaux, *Science* **145**, 707 (1964).
2. ———, *Ecological Monographs* **34**, 297 (1964).
3. The samples were collected by J. Brown; radiocarbon dating was done by Isotopes Inc. of Westwood, New Jersey. Their origin and significance are discussed by Brown in an unpublished manuscript. He concludes that the coastline was near the site of the 25,300-year sample at the time of deposition. I thank Brown for providing me with these interesting samples, which are some of the fruits of the drilling program undertaken by the U.S. Army Cold Regions Laboratory.
4. P. Colinvaux, in preparation.
5. I wish to note that the samples from Point Barrow described in (*1*) were collected from borings in a small area, but were not taken from one boring as my wording "successive borings" might be taken to mean.

24 December 1964