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Excavations at Natural Trap Cave

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INTRODUCTION

Among the more important questions addressed by students of earth history are those that relate to climatic change. This is especially true of change that has taken place during the last two million years of the "Ice Age." It is not an accident that a great deal of effort has been directed towards the Late Pleistocene, and our knowledge of Late Pleistocene environmental parameters has increased markedly in the past few years. However, our knowledge of these changes is still incomplete, and we still have some uncertainty about the cause and nature of Late Pleistocene climatic change, its possible relationship to large mammal extinction, and the establishment of the modern distribution of fauna and flora in North America. Natural Trap Cave in the Big Horn Basin gives us an excellent opportunity to examine a record of these events extending from Late Pleistocene to Recent times.

The presence of fossils in Natural Trap Cave has been known for some time. In 1970 L. L. Loendorf made a small collection. In 1971 Loendorf accompanied by W. B. Vincent and G. Middaugh excavated under the entrance, and additional work was done in 1972. This work was partially reported by Rushin (1974). Since then, excavation has been conducted jointly by the University of Missouri at Columbia and the University of Kansas.

The Late Pleistocene fauna of Wyoming is not well-known. Only a few other sites, including Little Box Elder Cave (Anderson, 1968, 1970; Kurten and Anderson, 1974), Bell Cave (Zeimens and Walker, 1974), Horned Owl Cave (Guilday, et al., 1967), and Chimney Rock Animal Trap (Hager, 1972) have been published (Fig. 1). Anderson (1974) summarizes the fauna from these sites and other Late Pleistocene localities in adjacent states. The Hell Gap site (Roberts, 1970) and numerous other published archaeological sites also provide information on the Late Pleistocene through Early Holocene of Wyoming. Almost all of these published sites are clustered in the southeastern corner of the state. Natural Trap Cave is the first major Pleistocene locality to be developed in northern Wyoming, and the recovery of over 20,000 specimens representing a wide variety of vertebrates has established it as one of the major Late Pleistocene sites in North America.

One of the chief goals of excavation at Natural Trap Cave has been to provide information regarding the interpretation of archaeological sites and their distribution in the Natural Trap region. Husted (1969) reports that human occupation in the immediate vicinity of the Trap began between 7,000 and 8,000 years ago. Frison, Wilson, and Wilson (1974) demonstrate continuous cultural development in the Big Horn Basin between 1,000 and 11,000 years ago. These two sources together list more than 50 archaeological sites, many of them already excavated, whose interpretation could be affected by paleontological data from Natural Trap Cave.

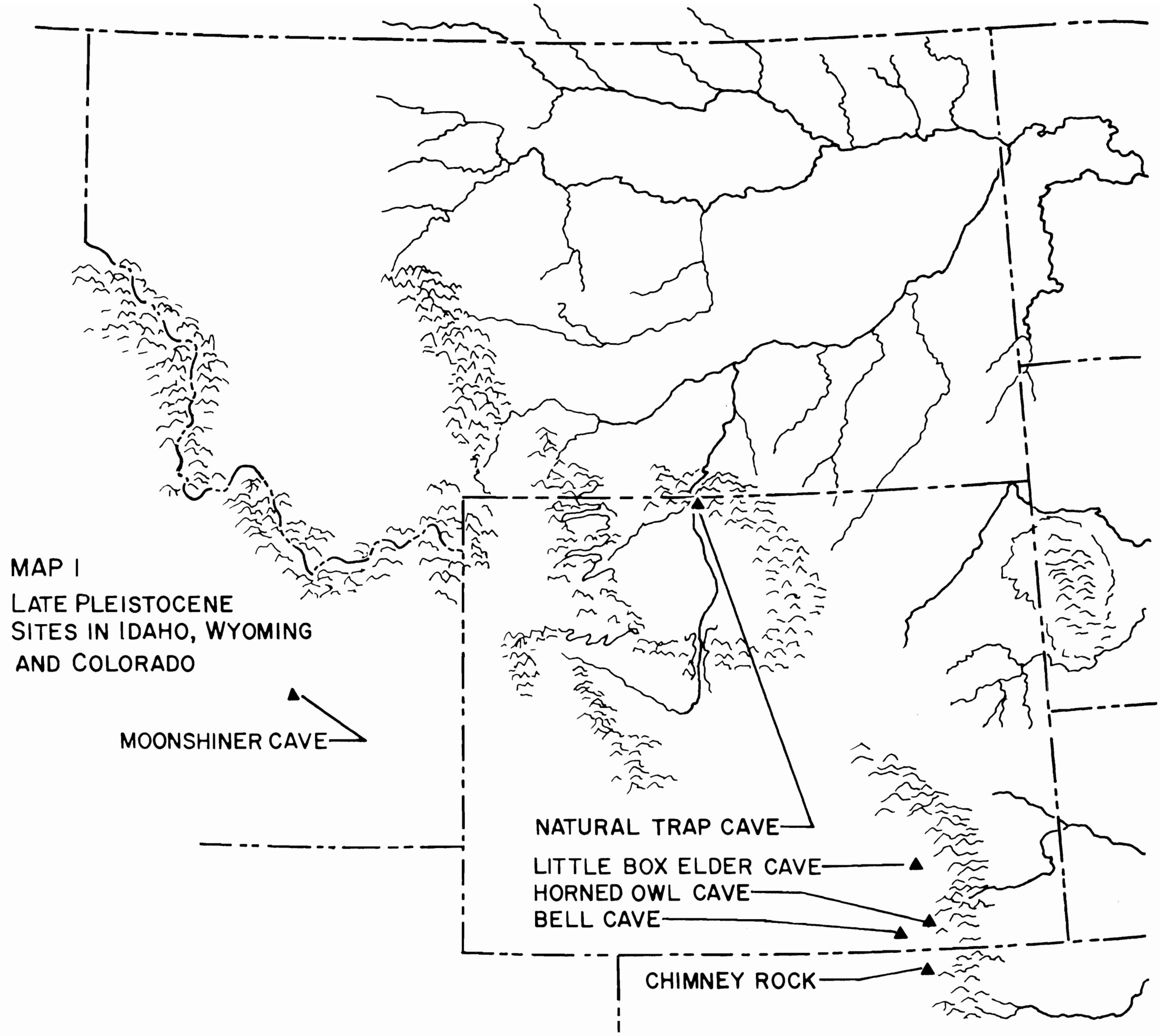

Figure 1. Index map showing the location of Natural Trap Cave and other similar sites (modified from Anderson, 1974).

Loendorf (1973) produced a model of human seasonal transchumance in the area based upon examination of some 300 sites scattered over five ecological zones. In order of decreasing altitude, these are Sub-alpine, Conifer Slopes, Juniper Breaks, Grasslands, and Drylands. Natural Trap is in the middle of these, the Juniper Breaks, and hence has been in an ideal locale to sample floral and faunal progressions as the ecological zones shifted elevations with advance and retreat of the glacial margin. Figure 2 shows the predominant vegetation in each of these zones today.

Although the Trap is not an archaeological site *per se*, early excavation from there (Rushin, 1974) produced two artifacts: a biface from the floor and a putative atlatl shaft from a woodrat nest. It is entirely conceivable that artifacts may be recovered in phoretic context with skeletons of large ungulates such as bison, camel, horse, and mammoth, which were hunted by man and have been recovered from archaeological contexts elsewhere. Natural Trap Cave is located in the northwest flank of the Big Horn Mountains in Section 28, T. 58 N., R. 94W., northeast of Lovell, Big Horn County,

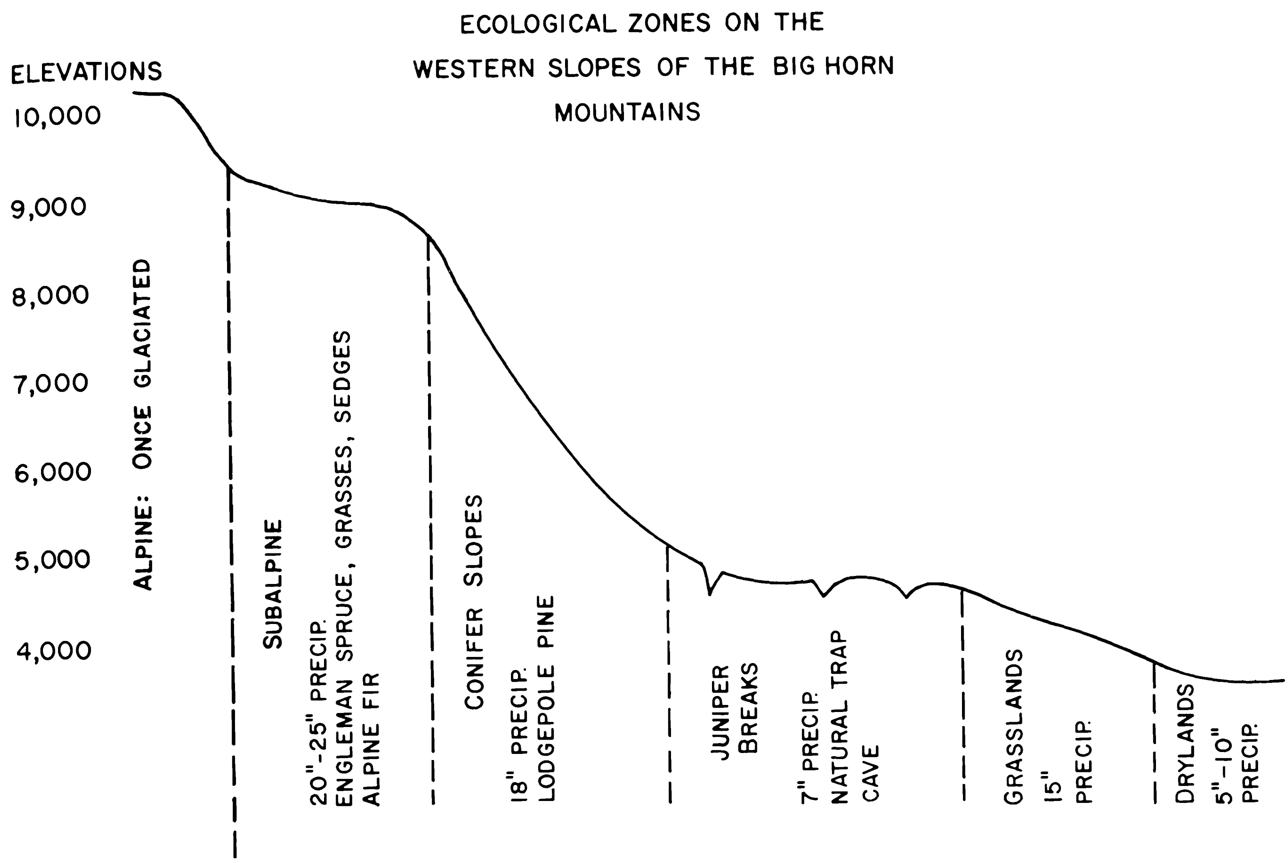

Figure 2. Ecological zones on the western slopes of the Big Horn Mountain.

Wyoming. It is a breached cave chamber in the Madison Limestone (Mississippian in age). There are considerable numbers of other karst features in the Madison around Natural Trap Cave, and we are continuing exploration of the area. Natural Trap Cave occurs on a plateau-like feature called Little Mountain at an elevation of 4,560 feet. The site is presently surrounded by a short grass/sagebrush steppe. The cave is bell-shaped and around 85 feet deep (Fig. 3). The surface opening is oval and measures approximately 12 by 15 feet. The cave floor is about 120 feet in diameter. Sediment within the cave consists of limestone rock fall derived from within the cave and silt brought from the surface by running water. The sediments form serially deposited layers.

Until September 1973, when it was gated and closed off by the Bureau of Land Management, the cave was an open trap for any unwary animal. The cave entrance is hidden from view until the observer is virtually at its edge and is located directly on one of the few game trails leading from Little Mountain. The cave has only one entrance, so there is no possibility of escape for an animal that might survive a fall into it.

The cave could not have been used as a den for large carnivores, nor was it suitable for human occupation; the hazards of ingress and egress, a mean temperature of 42 degrees Farenheit in the hottest month, and a relative humidity of 98 percent mitigate against human comfort. Thus there was no cultural filter to bias the species represented and no human or animal disturbance of the naturally deposited remains.

Figure 4 illustrates the areas excavated from 1972-1975. At least three-eighths of the remaining floor is covered by breakdown from the cave roof and is considered unexcavatable. The areas excavated in 1974 were chosen by a random sample after the cave floor was mapped and gridded in five-foot squares. This non-biased sampling procedure indicated that some areas were very rich in bone deposits and other areas have none at all. (The 1972 location was selected by C. J. Rushin; the 1973 location was selected by Loendorf.)

Each five-by-five foot excavation unit was dug by troweling in six-inch levels. However, the natural strata are so obviously different in color and/or texture of soil that it was possible to see them in the wall profile. Figure 5 is a profile of the major units excavated in 1975.

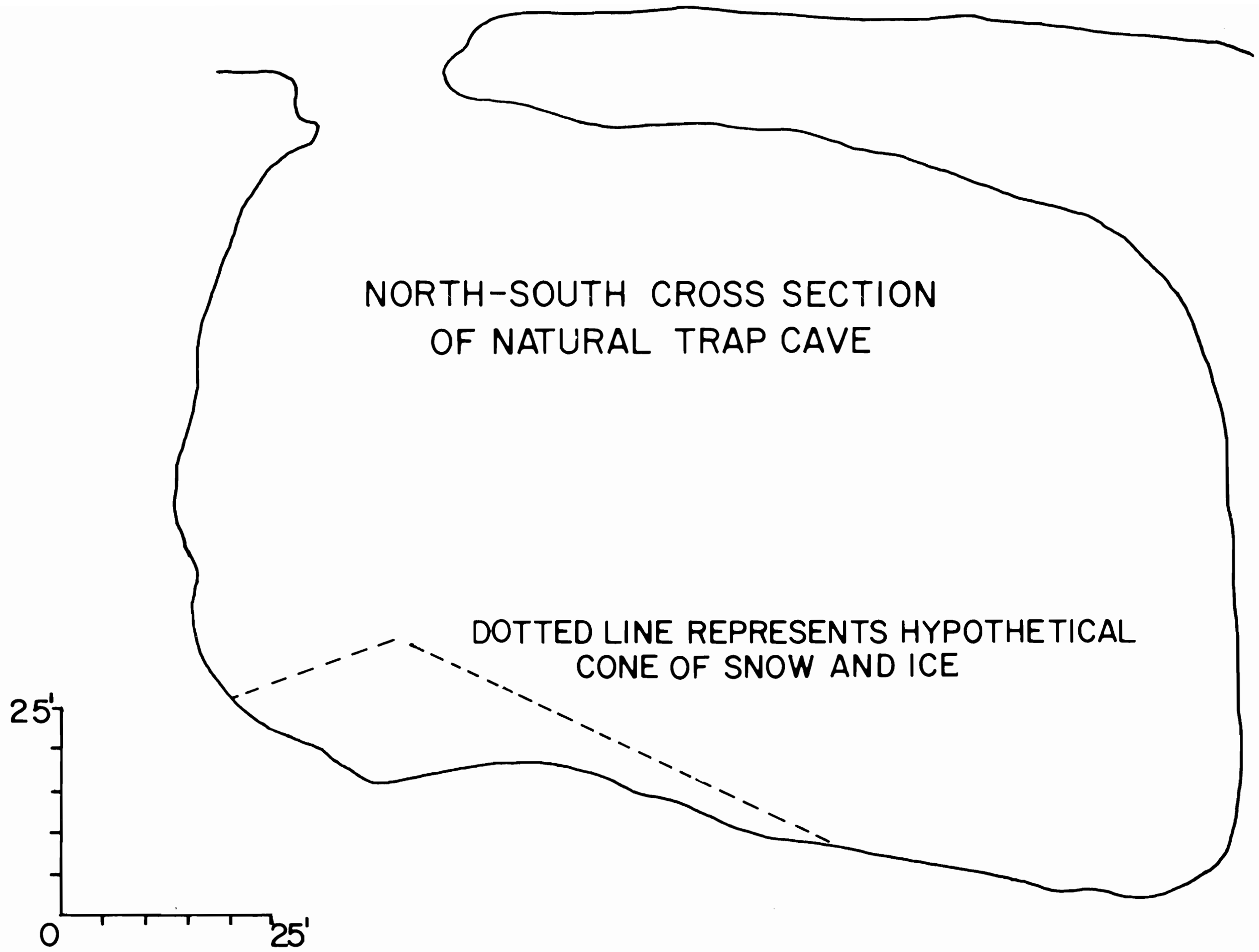

Figure 3. North-south cross-section of Natural Trap Cave.

By applying modern archeological field methods to this site we were able to maintain a much greater control over specimen provenence than is often obtained in paleontological sites. This greatly facilitated understanding of the depositional relationships of the individual animals and also the species composition of the biomass "sampled" by the Trap at any one time. Figure 5 shows the stratigraphic relations of several species of megafauna encountered in 1975.

The large animals encountered were easily discerned from the matrix. However, in order to insure complete recovery, the matrix was sifted through a quarter-inch screen. At least one and sometimes two 12 x 12 x 6-inch samples of matrix were removed en bloc from the northwest corner of each artificial layer of each excavation unit and waterscreened through a fine mesh hardware cloth screen. This procedure yielded the bulk of the microfauna recovered.

As articulated, bones were exposed *in situ,* identified, photographed, drawn, and mapped so that their relationships to each other were recorded. This procedure indicated that particular kinds of bones were being found together; those bones whose shapes made it easy for them to roll or slide downhill had migrated to the periphery of the talus slope below the Trap entrance. Some bones were found buried in a slanting position where they were lying against a piece of roof fall or were lying on a contact zone between what had been a talus slope and a stratum of secondary deposition (see Fig. 5). Other bones were found to have been buried in a horizontal position. These were usually at least semi-articulated and represented primary deposition of a complete animal on a flat surface. These were 5-6 feet deep and had been deposited in a time of relatively little weathering of the cave roof.

Some strata such as number 4 in Figure 5 were composed

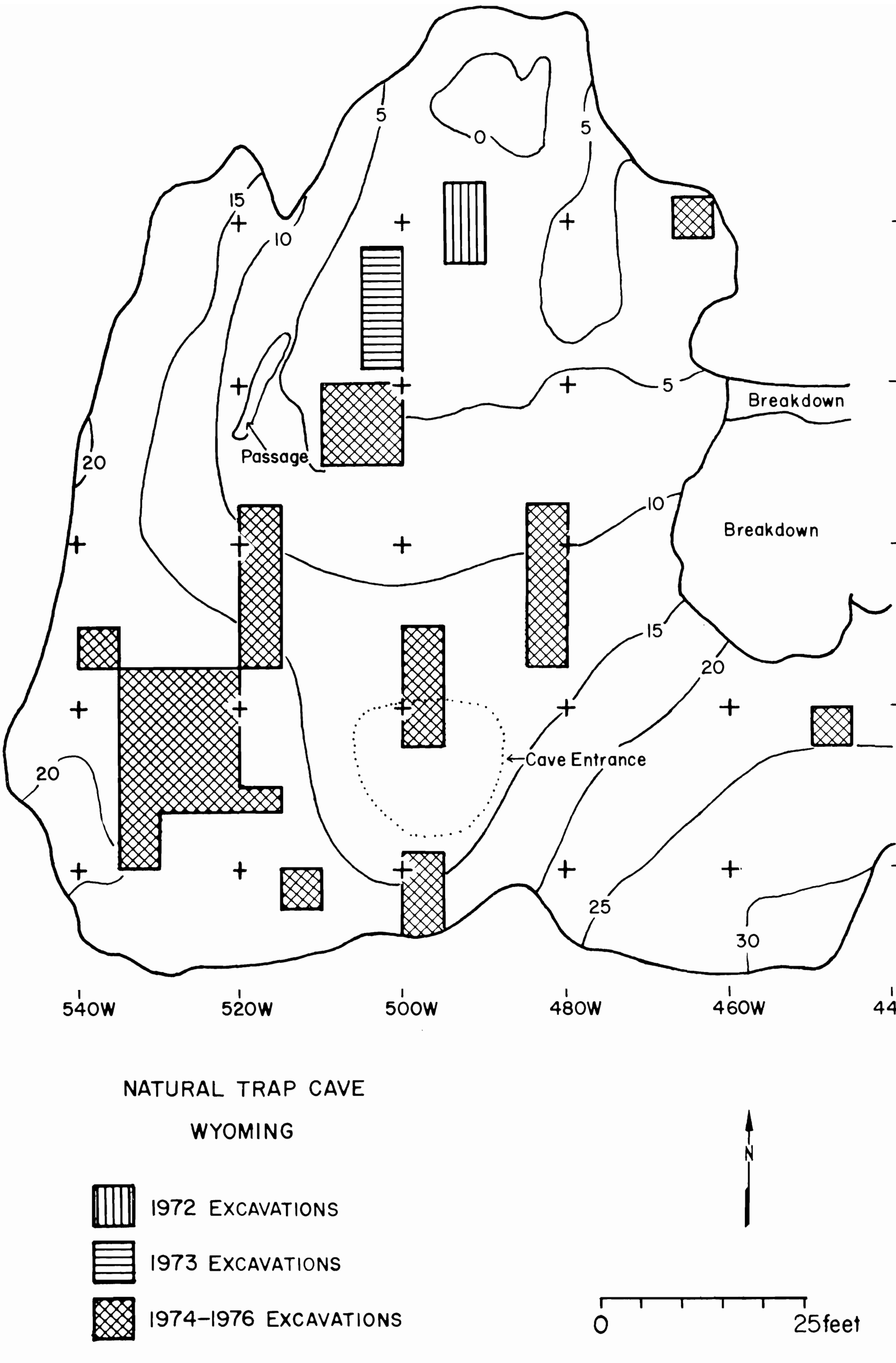

Figure 4. Map of the floor of Natural Trap Cave showing the areas excavated.

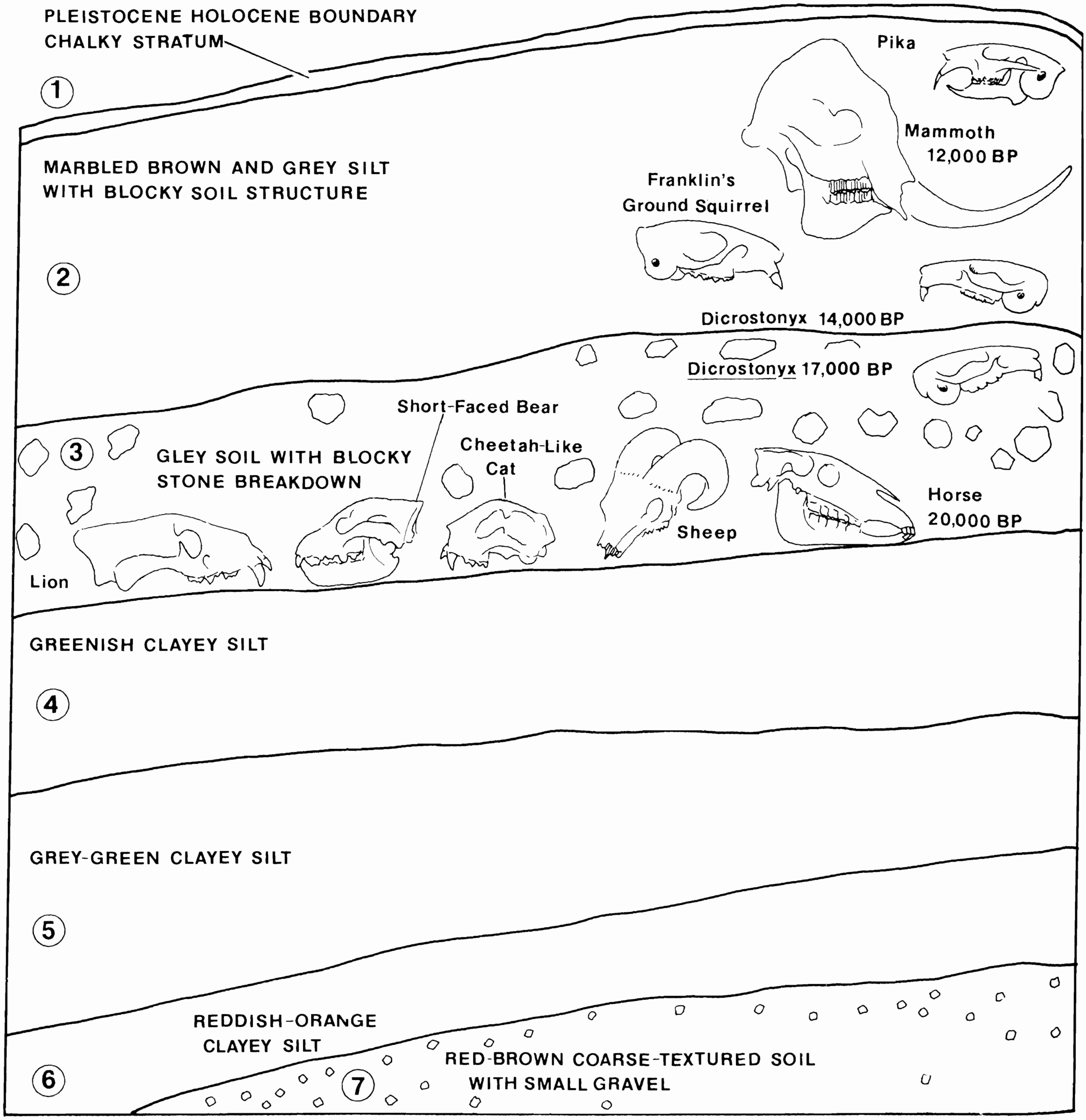

Figure 5. Profile of the deposits in Natural Trap Cave with the levels numbered.

largely of roof fall, ranging from gravel to cobbles in size, indicating active weathering of the cave roof. Most bone in this stratum had been damaged by the falling rock. Stratum 5, by contrast, was quite free from roof fall, and the bone was in excellent condition. Banding, gravel lenses, erosional surfaces and bone taphonomy all indicate that running water was the primary agent in deposition of the stratigraphic units. According to Albansese (unpublished) "Silt and clay constitute the bulk of the cave sediments. Much of this material was probably derived from the Amsden formation and introduced through the roof opening. The silt size particles consist of quartz (60 percent ±), orthoclase (25 percent ±), and plagioclase (10 percent ±) plus minor amounts of hornblende, chlorite (?) and biotite. These minerals are not usually present within the Madison limestone but would be expected to occur in the Amsden. The same reasoning applies to the clay fraction of the cave sediments."

Seven major strata (with four minor, unillustrated) are shown in Figure 4. They dip to the north between 29° and 25°. The first is a thin, chalky layer marking the Pleistocene/Holocene boundary (Albanese, personal communication).

Stratum 2 is marbled brown and grey with a blocky structure. It contains Mammoth (12,000 BP near the top, and 14,000 BP at the bottom of the stratum), pika, ground squirrel, and collared lemming.

Stratum 3 is a "gley" structure with mottled blue and orange clay matrix with large blocks of (ca. 152mm diameter) limestone breakdown. This is the major bone-bearing stratum and contains horse, camel, bison, sheep, wolf, bear, lion, and cheetah-like cat, in addition to collared lemming. It is dated at 17,620 BP (horse bone collagen) near its top, and 20,170 BP (sheep bone collagen) at its bottom.

Stratum 4 is greenish, fine-textured, clayey silt containing bighorn sheep, wolverine, weasel and tree squirrel remains. All underlying strata appear to be sterile of bone deposits.

Stratum 5 is a grayish-green, fine-textured, clayey silt.

Stratum 6 is a reddish-orange, clayey silt of coarser texture.

Stratum 7 has a reddish-brown, coarse texture with small diameter gravel. This stratum overlies large blocky breakdown from the cave roof which may mark the bottom of faunal deposits.

In spite of the lack of biological disturbance few bones are in articulation indicating that there has been short distance transport by gravity and water. Normally in breached caves of this sort animal remains are deposited on a cone of accumulation directly under the opening, but in Natural Trap Cave the floor under the opening is depressed and the chief fossil-bearing deposits are some 30 feet to the north of the opening and 5 feet upslope. This presents a problem as to how the bones were transported to this position. One possible solution is to postulate a large sedimentary cone of accumulation that eroded away after the Pleistocene. However the dip of strata within the cave does not reflect the existence of such a cone.

We conjecture that the taphonomic relationships of the fauna at this site occurred due to the former presence of a cone of snow and ice. Present summertime temperature in the cave is only 42°F, and other caves in the immediate vicinity at slightly higher elevations still contain ice year-round. During the Pleistocene, conditions could have been favorable for the existence of a snow cone directly under the cave's vertical entrance. Animals falling onto such a cone could slide laterally some distance from their center of impact.

Even very large animals such as *Mammuthus, Camelops,* and *Bison* have been encountered 30 feet laterally from their presumed center of impact, and Mammoth remains were encountered five feet higher than the present basin-shaped impact area directly below the cave entrance. The basin is due to erosional processes which have removed sediments during the past 12,000 years. However, it is stratigraphically evident that these sediments did not rise above the level of the present cave floor in the area of major excavation which now lies between the 15- and 20-foot contour intervals. Only a snow cone could have allowed such lateral displacement of fauna without concomitant stratigraphic evidence for sedimentary deposits sloping up to the center of impact. The East-West profile along the 480N line shows virtually level strata (Fig. 4).

Sediments within the cave have been searched for pollen, but so far such pollen as has been recovered is poorly preserved. A more useful index to the Pleistocene vegetation around Natural Trap Cave has been provided by P. S. Wells who has studied nearby Pleistocene woodrat middens. Although the analysis of these middens is not yet complete, Wells has documented the presence of some spruce on Little Mountain in the Late Pleistocene. However, spruce is a rare member of the plant community sampled by the middens and it seems likely that it was restricted to the slopes, while the top of the plateau may have been open with a plant cover similar to that found in the high Alpine meadows of the modern Big Horns.

A fairly good suite of microfauna has been recovered although the microfauna is not as abundant as it is in many other caves. This is apparently due to the fact that Natural Trap Cave was not used as a Pleistocene owl roost, a situation that was probably responsible for the large numbers of small bones in other caves. There are abundant small bones in the Holocene strata. Included with these are abundant remains of ravens and it seems likely that ravens were the agent for the introduction of many small mammals to the cave. Small mammals from Late Pleistocene strata include: *Ochotona* (pika), *Lepus* (jackrabbit), *Sylvilagus* (cotton-tail rabbit), *Marmota* (marmot), *Eutamias* (chipmunk), *Peromyscus* (field mouse), *Neotoma* (woodrat), *Microtus* (vole), and *Dicrostonyx* (collared lemming). Pika are usually considered indicative of spruce forest, while the collared lemming has been used as evidence for tundra. However, due to the absence of permafrost features in the cave (Albanese, personal communication) and other members of the tundra community (Rangifer, Ovibos, etc.), we presently interpret the lemming as a rare inhabitant of a vegetation similar to the steppe tundra described by Guthrie (1968) for the Late Pleistocene in Alaska.

The open nature of the Late Pleistocene vegetation on Little Mountain is also evident in the large mammals. These include: *Canis* sp. (wolf), *Vulpes vulpes* (fox), *Arctodus simus* (short-faced bear), *Mustela* sp. (weasel), *Martes* sp. (martin), *Gulo gulo* (volverine), *"Felis" trumani* (extinct cheetah), *Panthera atrox* (American lion), *Equus (Hemionus)* (extinct ass), *Equus (Amerihippus)* (Andian horse), *Equus* sp. (unidentified extinct horse), *Camelops* (extinct camel), extinct cervid, undetermined antilocaprid, *Bison* sp. (extinct bison), *Ovis catclawensis* (extinct mountain sheep), and *Mammuthus* sp. (mammoth). All of these forms except *Vulpes, Martes, Gulo* and the cervid are highly cursorial, open-country forms. The forest forms are among the rarest members of the fauna and are thought to have been only occasional visitors to the immediate vicinity of the trap. Thus, they are "secondary" species in the trap area biome (Hoffman, 1976).

The cursorial nature of the large mammal fauna is emphasized by the presence of abundant remains of the American cheetah, *"Felis" trumani.* Studies conducted since the first recognition of cheetah-like cats in North America (Martin, et al., 1977) have shown that these cats are an early side branch of cheetah evolution that had been developing in North America since the Blancan. They were widely distributed but are only rare members of faunas except in Natural Trap Cave where they may be the most common predator represented. Although these cats are somewhat more robust than the living cheetah, it seems unlikely that they often took very large animals, with the antilocaprid, long-legged sheep and possibly the small extinct ass as likely prey. The North American lion, *Panthera atrox,* is also a highly cursorial cat with elongated limbs and enlarged nares (Martin and Gilbert, in press). It too is a pursuit predator and probably concentrated on the horses and the camel. *Arctodus simus,* the short-faced bear, is long-limbed and more carnivorous in dental morphology than are living bears. It and the wolves can be added to the list of pursuit predators. Interestingly enough, dire wolves appear to be absent, while wolves of modern aspect are quite abundant. The reverse is true of most other sites from south of the continental ice sheet. Almost all of the large herbivores are long-legged. This is especially true for the extinct sheep, *Ovis catclawensis.* This species is not only much larger than the living bighorn but the legs are also more elongated, adapting this form more for steppes and open country than for the high rocky habitat associated with the living species. It is however not surprising that this should be the case with the Pleistocene sheep as the mountain habitat presently occupied by bighorns must have been occupied by montane glaciers during most of the Pleistocene.

Three horses occur in the cave, but by far the most abundant is a small, stilt-legged form probably referable to *Hemionus.* Two other horses are much rarer members of the fauna and one of these is referable to the subgenus *Amer-hippus* which was originally described on the basis of a South American horse, *E. (Amerhippus) andean. Amerhippus* has previously been recognized in North America on the basis of some of the horse material from Rancho La Brea.

Camelops and *Mammuthus* are not common in Natural Trap Cave although several individuals of each have been recovered. Interestingly, browsing forms like the American mastodon, *Mammut americanum,* the forest muskox, *Symbos cavifrons,* or the ambush predator, *Smilodon,* have not yet been found in Natural Trap Cave, thus providing additional evidence for the open nature of the flora. The total fauna bears a strong resemblance to the fauna associated with the steppe tundra in Alaska (Guthrie, 1968) which is itself mostly a northern extension of the western montane fauna that occurred south of the continental ice and which is characterized by *Camelops, Arctodus simus,* and *Panthera atrox.* This fauna apparently occupied a suite of montane conifer parklands which may have varied somewhat in floral content but was a generally uniform floral type over a vast area. It seems likely that many of the grasses in this parkland were C_3 grasses (Wells, 1976). Approximately 10,000 years ago those parklands disappeared and were replaced by deserts and treeless steppes of the sort that are so extensive in the present western United States. Within the modern steppes, the dominant grasses are presently C_4 grasses. Apparently a similar floral turnover occurred on Little Mountain and the latest record of extinct animals that we presently have from there date from 12,000-11,000 years B.P.

Apparently on Little Mountain and elsewhere the end of the Pleistocene was marked by the establishment of climatic conditions similar to those found in the same areas today. Without exception this change has resulted in a decrease in animal diversity both through redistribution of taxa and through extinction. It would appear that floral diversity within a given area was reduced as well although extinction was not a factor with plants. In general Pleistocene communities can be characterized as being more heterogeneous and complex than are the communities occupying the same regions today. This greater complexity is likely due to decreased seasonality (Taylor, 1965; Holman, 1976) during the Pleistocene. It appears that seasonality of the modern type became established in North America about 10,000 years ago, and at this time the complex Pleistocene floral assemblages broke up to form less heterogeneous biomes, resulting in the expansion of the prairie and deciduous forests. Animals adapted to these habitats, such as *Bison* and *Antilocapra* in the prairie, became abundant and widely distributed at this time. The animals which became extinct were either so adapted to the Pleistocene biomes that they could no longer survive or were dependent on the northern component of these biomes and could not follow them north for some reason. It is also possible that though some of these animals could live in the new biomes, they could not successfully compete with those animals which were already adapted to the expanding habitats. We might also expect that the reduction in the heterogeneity of environments at the end of the Pleistocene resulted in a corresponding decrease in faunal diversity.

The cause of the break up of the complex Pleistocene biotas we assume to be increased seasonality. This mechanism would have world-wide effects and would be applicable to both the Pleistocene and Tertiary extinctions. Seasonality effects would be reduced as one approaches the equator, and equatorial areas might well act as refugia for some animals. North America has only a small area in southern latitudes and is therefore a natural "extinction trap." Mountainous areas might also maintain somewhat more complex biotic assemblages and act, at least, as temporary refugia. Mountains would also have a buffering effect in which climatic changes requiring hundreds of miles of latitude could be achieved in a few hundred feet change in elevation.

It seems likely that the animals which became extinct at the end of the Pleistocene were adapted to habitats which ceased to exist in North America and that their extinction was due to habitat destruction on a massive scale. This hypothesis implies that we are presently living under the same climatic conditions which resulted in the extinction of the large Pleistocene mammals.

Whatever the cause of this great extinction, change in world weather patterns in the last few years has called to our attention the need for a basic understanding of the causes of climatic change. However, this is not a problem that lends itself to conventional laboratory approaches. In a sense, the world must be our experimental apparatus. Many of the changes we wish to examine take place over time spans greater than the life spans of the observers. We can only understand these events by examining their effects on the past environments of many widely scattered geographic localities. It seems possible that a thorough understanding of past climatic events may permit us to anticipate future changes. At the very least, it would give us a standard of reference against which to evaluate the impact of our civilization on world climate.

Natural Trap Cave is an area where the events of the past 20,000 years have not previously been studied. The time span of the Trap covers such important events as the last glacial advance, the extinction of the Pleistocene megafauna, and the establishment of modern ranges of plants and animals. Its excavation and study will fill in a few more of the gaps which currently prevent us from adequately understanding those important events.

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