

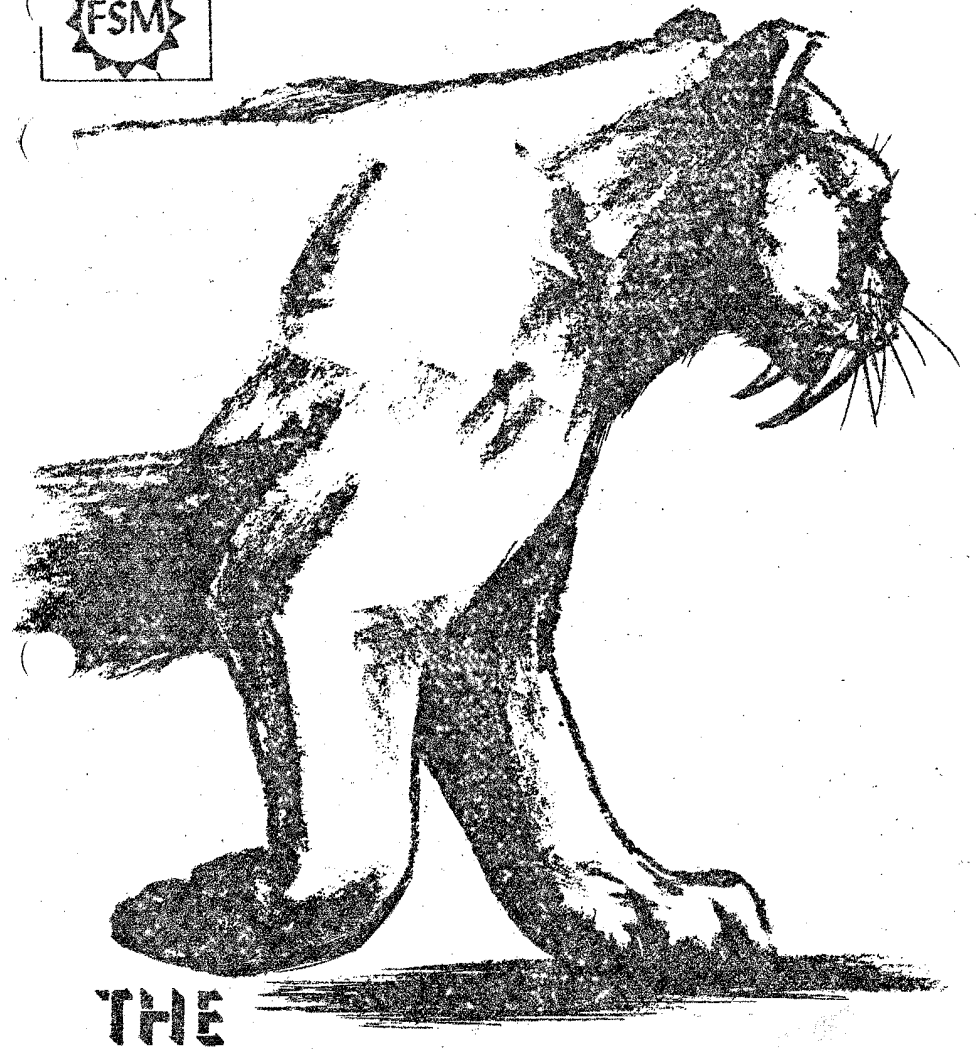
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The PLASTER JACKET is a newsletter. Questions, announcements, and other communications are solicited from all readers. Information of general interest will be included in future issues.

It is our intent to produce this series at the rate of six issues per year. We hope to add as many genuinely interested paleontologists as possible to our mailing list. If you are interested, please send your name and address to the PLASTER JACKET. These issues are distributed free of charge to all interested people.

This public document was promulgated at an annual cost of \$2500 or \$0.17 per copy to circulate authoritative material on Florida paleontology and to foster communication among enthusiasts of this subject.

THE PLASTER JACKET
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THE PLASTER JACKET

THE FLORIDA STATE MUSEUM

HOT SPOTS FOR NORTH AMERICAN
PLEISTOCENE FOSSIL MAMMALS
and how they got that way

by

Dale Guthrie

It is a well-known truism that the chances are infinitesimally small of any particular organism leaving traces of itself on the earth long after it has died. Even the traces of large mammals that lived as recently as during the emergence of Man -- the Pleistocene -- leave us with a very incomplete knowledge of what they were and the kinds of lives they lived. Reconstructing the paleo-communities and their ecological relationships is one of the goals in paleontology, but to do this one needs large collections of well preserved specimens.

Most of the large assemblages from the North American Pleistocene come from three major areas of the country that were especially conducive to the preservation of large mammal remains. These areas are located on the three major corners of the continent, and Florida is one of them. The other two are the famous La Brea Tar Pits in Southern California and the frozen muck beds in Alaska. Each has preserved its past in quite different ways and through completely different means. Here I propose to compare Florida with the other two in a general discussion of how large mammal fossil are preserved.

One of the first preconditions of becoming a fossil is to be shielded from the forces that destroy bone, as bone remains comprise most of the mammalian fossil record. A few of these forces are obvious -- marked temperature fluctuations, physical abrasion, acidic soil, aerobic bacteria or other aerobic microorganisms, and of course mammals who chew on bone. Escaping these usually requires some form of burying, especially in the right medium. It is with this concept that the

story of the unique features of the three rich Pleistocene fossil fields begins.

Several times during the Pleistocene much of North America was covered by a gigantic continental ice sheet. These glacial periods alternated with warmer times, called interglacials, when there were only small mountain glaciers in the Northwest. During the glacials no large mammals lived on the ice sheet, so there were no mammals to be fossilized. The mammal remains from the interglacials were usually lost as the moving ice sheet scoured and ground all traces of the past from the landscape. Consequently we cannot expect to find traces of Pleistocene mammals over the vast glaciated portions of Canada and the northern United States. The same is true just south of the ice sheet where soils are fairly acidic and not conducive to bone preservation (farmers add lime to their fields to "sweeten" the silt). In the mountain regions the bones have to be transported by water or other means to permanent depositional sites -- so mountain species are rare as fossils, as bones are fairly fragile and seldom survive transportation over long distance. In the arid southwest, conditions are optimal in many respects for desiccation and preservation, but water to erode and cover the decaying carcasses is intermittent at best, hence most are leached away and destroyed before they are covered. All these places produce Pleistocene fossil mammals, but one has to look for them in very special situations -- such as caves, or filled-in gulleys. It is not a simple matter for an amateur to go out and return with a number of Pleistocene mammals.

So what makes Southern California, Interior Alaska, and Florida different? What do they have in common? Let us examine them individually in that order.

THE LA BREA TAR PITS OF SOUTHERN CALIFORNIA

The La Brea Tar Pits are a unique fossil locality. Much has been written about these natural traps. The "tar", actually natural petroleum, seeps up from beneath the surface and permeates the soil, standing in thick sticky pools. Although the pools were shallow, their consistency was so taffy-like that animals racing into them inadvertently or stumbling onto them in the night became so bogged down in the mire that they could not escape. One can imagine them struggling



FIGURE 1. SQUIRREL MIERED IN TAR SEEP

d finally dying of starvation or thirst -- and then beginning to rot. Whether attracted by the alarm calls or the odors of the bloating carcass (bison, camel, horse, or whatever), scavengers gathered quickly for meal to be had for the taking. The fossils show that many of the scavengers were in turn trapped in

the tar, as remains of vultures, saber-toothed cat, lions, and dire wolves are even more numerous than those of the herbivores. Subsequently some of these animals decayed and sank beneath the shallow surface of the sticky tar. The tar acted as a natural preservative, preventing further scavenging, decay, or physical destruction. Once the carcasses were beneath the surface, the trap was reset for the next unfortunate who stumbled unwittingly into the goo, and in turn that carcass lured other scavengers for an easy meal and so the cycle continued. As generation after generation contributed their unfortunates to the tar pools, the bones began to accumulate in great quantities. By the time of their discovery they were veritable packaged collections, each well preserved in the now compacted tar.

THE FROZEN MUCK BEDS OF ALASKA

All of the early explorers passing through Alaska mention the profusion of darkly-stained fossils of large mammals coming from the river bank and sea-cliff exposures. Vitus Bering, the explorer for whom the strait was named, found many mammoth bones coming from the shores adjacent to Siberia -- just south of Kotzebue at a place he called Elephant Point, which still carries the same name. To this day a collector can walk the same beaches after a storm and find mammoth bones in abundance. Most of the interior valleys in Alaska are also extremely fossiliferous. Few canoe trips are made down the interior rivers without seeing fossil bones of horse, bison, and mammoth. The collections of the American Museum of Natural History bulge with mammal fossils taken from Alaska during the gold mining operations from the 1930's to 1950's.

Offhand one would not expect mammals to preserve easily in Alaska, for the soil is acidic, there is little rain and few good depositional environments. However fossils are easily preserved because much of the ground is frozen, and the silts that are not frozen "muck" is, then, another unique deposit containing

large Pleistocene mammals. In Alaska covering an animal up with silt is equivalent to putting it in a refrigerator, or in extreme instances, a freezer. This greatly increases a living animal's chances of becoming a fossil.

Like Southern California, Alaska also had its natural traps. Beneath the soil in many areas are large ice lenses, caused by the winter cracking of the ground when the temperatures are extremely low. The water trickles down into these deep cracks during the spring melt, where it is frozen during the winter. Through the years these ice lenses build up into large triangular-shaped ice masses called ice wedges. When a break in the insulating cover of vegetation occurs, the masses melt leaving a deep pit known as a thermokarst. Sometimes they remain as holes, or if they fill up with water, begin the formation of a "thaw lake".

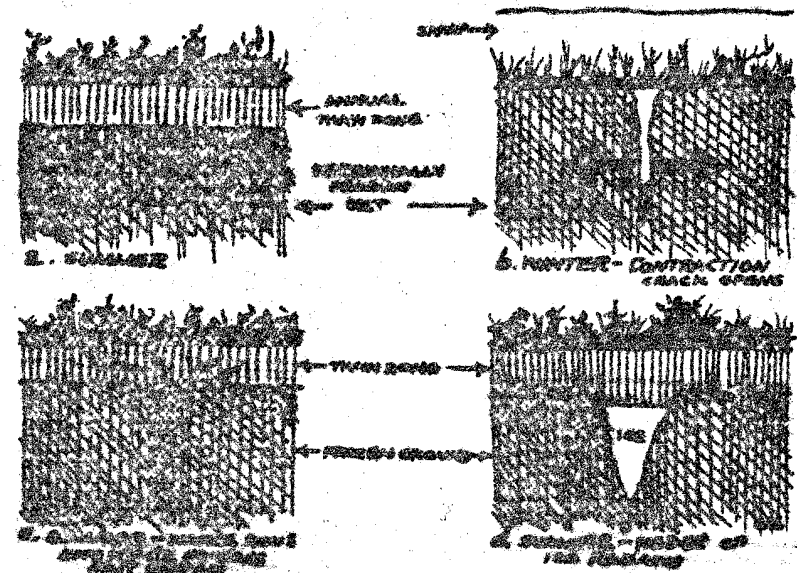


FIGURE 2.- Formation of ice wedges.

When they remain as holes, mammals often fall into them and become trapped. As the bottom and sides of the pit are still cool, decay is prolonged and occasionally the animals are covered by detritus or slumped material and frozen before the soft tissue has had a chance to decay. Many of these frozen mummies have been found, still stinking from partial decomposition as they were when they were originally frozen. In some the stomach contents are still identifiable and some of the parts are in good enough shape to be eaten.

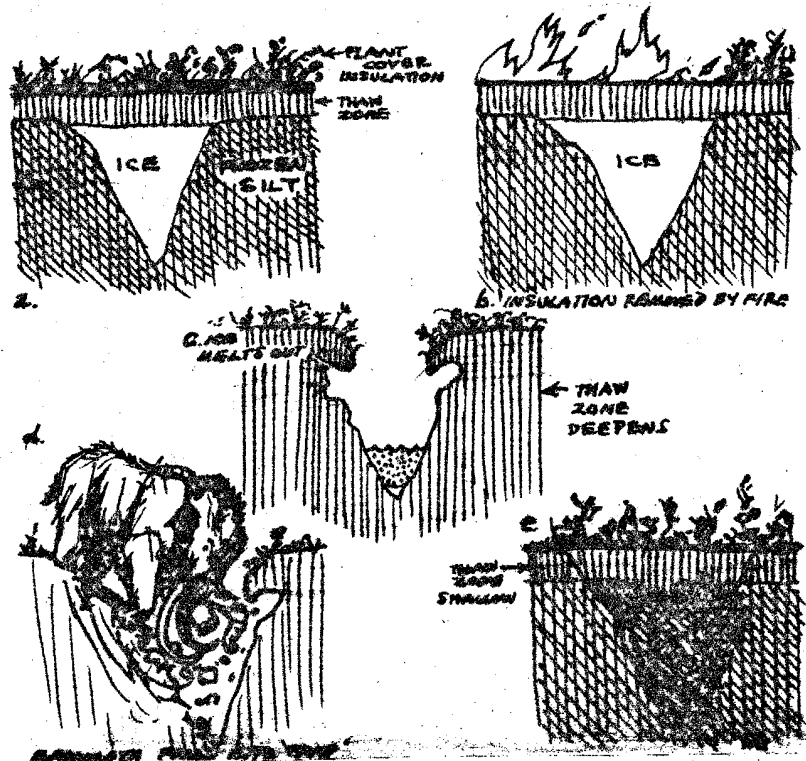


FIGURE 3.- Ice wedge thermokarst trap.

In addition to thermokarst pits, the summer thaw zone slips gradually down the slope of the hills sliding on the yet frozen layers. This phenomenon, called solifluction, results in the incorporation of

bones, insects, and plant material which eventually end up as a dark frozen "muck". The muck fills the valley bottoms with a deep deposit that is bisected by streams removed by miners to get at the gold in the underlying gravels, exposing the fossils.

FLORIDA PLEISTOCENE DEPOSITS

It has been said that no fossil vertebrate field in the world exceeds the richness of Florida's Pleistocene deposits. This is particularly true for mammals. Three key features contributed to the preservation of so many of the Pleistocene mammals in Florida, though all of these relate to a central phenomenon. The first feature is the fact that the Tertiary limestone that makes up the bedrock of Florida is highly soluble in ground water. The movement of ground water has produced many caves, underground streams, and irregular surface patterns. The thin crust separating the surface from these caves or underground streams often breaks through, especially during times of drought when the hydrostatic pressure -- and hence support -- is decreased. Like the La Brea tar pits and the Alaskan thermokarsts, these become natural traps into which animals fall and die. The second feature, which intensifies the first feature by enlarging the karst pits and caves, is the high rainfall that immediately soaks through the sandy soil and erodes the limestone. Probably even more important than the place of deposition is the nature of the matrix in which these carcasses are entombed, which brings us to the third feature. The water from the limestone is alkaline and reacts almost neutrally with bone, which is also alkaline, and through time fills the cavities left by the soft organic material and even replaces with lime some of the bony material itself. Thus the alkaline water is one of the chief elements responsible for Florida's rich Pleistocene fossil deposits.

In most parts of the world animals falling into

streams stand but a slight chance of becoming fossilized because of the leaching and decaying properties of the water medium. To become preserved in most streams a bone must be buried rather rapidly in the bottom silt or a mud bar -- and even then it may decompose because of the wrong chemical and biological conditions. Offhand one might think that in Florida decomposition would be so rapid and complete that fossils would never occur. The hot and humid weather and profusion of scavengers and microorganisms results in extremely rapid decomposition of a dead mammal. However, though the soft parts are rapidly destroyed, the bones of any mammal dying in an aquatic environment are preserved for a long time by the limey water. Thus even streams are likely places for animals to become fossilized in Florida. One particular fossil locality in Florida, the Reddick site near Ocala, Marion County, illustrates graphically how different situations produced by the solution of limestone encourage fossilization. The movement of ground water along joints in the limestone eventually produced an underground stream that became a cave when the water table later fell below the level of the cavity. Many cave-dwelling species such as bats died and left their remains on the cave floor, and owls roosting in the cave regurgitated their pellets of mouse, bird, shrew, and mole skeletons onto the floor. This process continued until eventually the fossiliferous deposit accumulated to over half the cave volume. At this point the roof of the cave began to collapse and formed a karst trap. Now exposed to the open, large mammals fell into the hole and their skeletons began to fill the remaining portion. During all this time the alkaline water kept the fossils in excellent condition. Eventually the karst pit filled up and became a pond, as evidenced by the fact that the upper layers of the cave are packed with turtle and alligator skeletons.

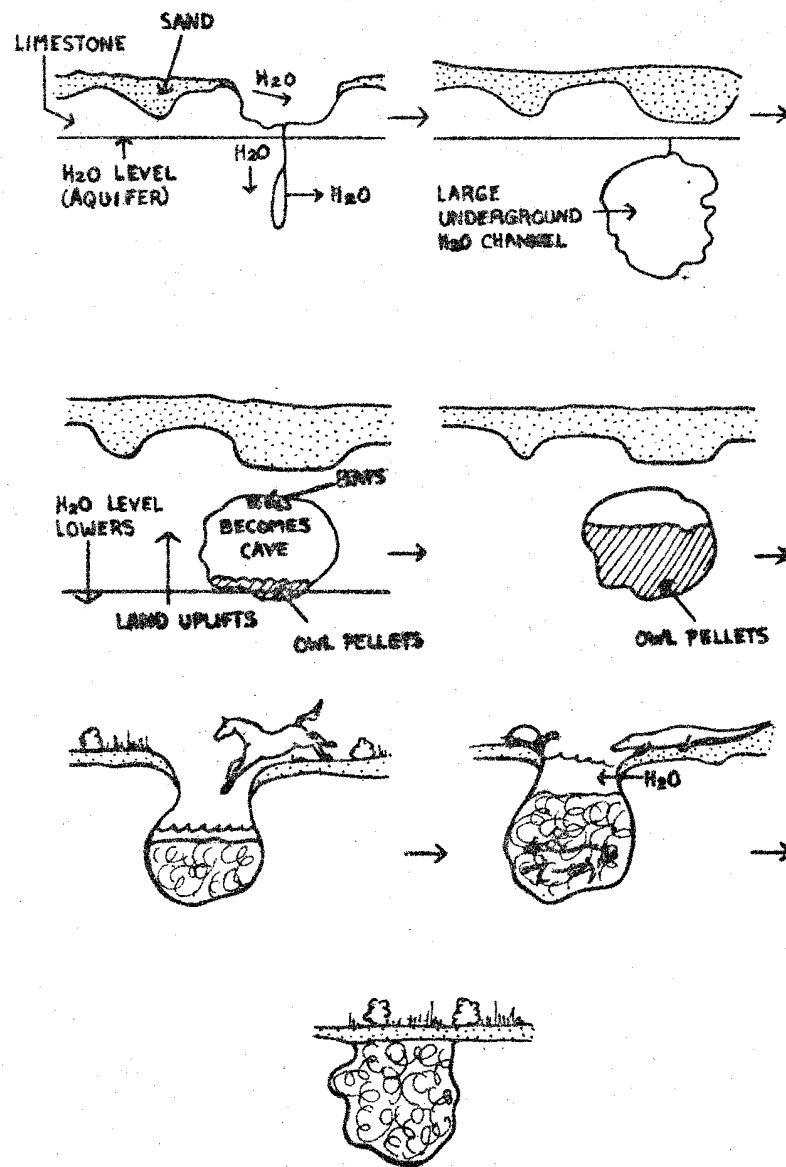


FIGURE 4.- Florida cave-sinkhole fossil traps.

The solution chamber made a comparatively comprehensive fossil collection. The first stage was a cave that produced volumes of small mammals; the second stage was a karst trap that produced large mammal fossils; the third stage was a filled-in pit forming a pond that preserved aquatic herps. Reddick illustrates how preservation conditions can bias the choice of which animals are to be preserved and which are not. Fortunately Florida has had (and still does, as long as it retains its wildlife and wild waters) conditions that leave a good accessible record of the past in good condition.

Another interesting comparison between California, Alaska, and Florida is the general similarities of faunas but quite different types of biases involved in the relative proportion of each component in the assemblage.

The similarity of large mammal faunas is remarkable when one considers the distances involved and the variables of temperature, moisture, and seasonality. The ungulate faunas were all much the same -- bison, horse, camel, and mammoth -- and though different species were involved, their ecological position or mode of life appears to be about the same. Their carnivores were also remarkably similar -- a large lion-like cat, a saber-tooth cat, a large canid, bears.

Why such a close resemblance? The habitats must have also been much more similar than their positioning on the continent would suggest. Southern California, from what we know, must have been a dry grassland with scattered woodlands. Florida also was a kind of grassland, probably a moist savannah with mixed woodlands. Alaska had a tundra-steppe form of plant community, that is, a grassy, dry, herbaceous tundra. Therefore, the common feature appears to be a grassland or savannah habitat. The three major grazing stocks occupying

grasslands all over North America during the Pleistocene were mammoth, horse, and bison. Each area developed grazing species adapted to their specific environments, yet the overall community structure of herbivores remained fundamentally the same. The large carnivores, of course, followed suit, as their food resources were essentially the same in the three areas. Specialized large-mammal element gave each of the three areas a unique character; for example, the large edentates in Florida (although claws of the tree sloths have also been found in Alaska).

An interesting feature to emerge from a comparison of the three areas is how the environment of deposition in each region distorts the fossil record, or how the fossil assemblage deviates from the "true life" assemblage. I have already mentioned the famous disproportion of carnivores and scavengers in the La Brea tar pits. As most of the Florida fossils were laid down in an aqueous medium, the assemblage is heavily in favor of aquatic vertebrates -- alligators, manatees, and the ubiquitous and abundant turtle and tortoise scutes. In Alaska "high-country" animals, such as sheep, are virtually absent as fossils, yet we know they were there from the few fossils that have been found. The deposits in Alaska vary significantly in their proportions of horse, bison, and mammoth, depending on altitude. Unlike the tar pit faunas and to some extent the Florida fossils, the Alaskan specimens show evidence of extensive scavenging; bones are chewed, and are in very disproportionate numbers to their ratio in the body -- the more fragile ones are missing or very fragmentary. The Alaskan material, unlike the La Brea or Florida specimens, must often have remained for long periods on slit exposed to scavengers. This scavenging undoubtedly affected the ratios of different species preserved, as bones of large species are more resistant to destruction, and other species have delicate bones that are easily destroyed.

Comparisons of the fossil assemblages from the three areas is a lesson in how useful fossil assemblages can be in reconstructing the fossil community. The preservation biases inherent in almost any area, and the way these biases differ markedly in character from one region to another, pointedly illustrates the caution with which reconstructions must be attempted.

NEWS

At the suggestion of one of our avid readers we shall include in this issue a comprehensive list of all PJ's to date. If anyone does not have a number(s) they would like to have, be sure to write and ask for it.

- No. 1.-- CENOZOIC SHARKS OF FLORIDA.
Norman Tessman.
- No. 2.-- FOSSIL SKATES AND RAYS OF FLORIDA.
Elizabeth Wing.
- No. 3.-- THE FOSSIL SNAKES OF FLORIDA.
Walter Auffenberg.
- No. 4.-- FOSSIL PROBOSCIDEANS OF FLORIDA.
S. David Webb.
- No. 5.-- FOSSIL CROCODILIANS OF FLORIDA.
Walter Auffenberg.
- No. 6.-- WHAT IS A PLASTER JACKET?
Walter Auffenberg.
- No. 7.-- FOSSIL BONY FISHES FROM FLORIDA.
Camm Swift and Elizabeth Wing.
- No. 8.-- AQUATIC RODENTS OF THE FLORIDA PLEISTOCENE.
Robert A. Martin.

- No. 9.-- FOSSIL HORSES OF FLORIDA.
John Waldrop.
- No. 10.-- NEWS NOTES.
- No. 11.-- FOSSIL LAND CARNIVORES OF FLORIDA.
Norman Tessman.
- No. 12.-- FOSSIL BISON FROM FLORIDA.
Jesse S. Robertson.
- No. 13.-- FOSSIL XENARTHANS OF FLORIDA.
S. David Webb.
- No. 14.-- FOSSIL VERTEBRATE DEPOSITS IN FLORIDA.
Thomas H. Patton and S. David Webb.
- No. 15.-- FOSSIL SIRENIA OF FLORIDA.
Roy H. Reinhart.
- No. 16.-- FOSSIL TURTLES.
Walter Auffenberg.
- No. 17.-- FOSSIL PECCARIES OF FLORIDA.
S. David Webb.
- No. 18.-- NEWS NOTES.
- No. 19.-- COIN FOSSILS AND STONE LENTILS IN THE EOCENE ROCKS OF FLORIDA.
Graig D. Shaak.
- No. 20.-- HOT SPOTS FOR NORTH AMERICAN PLEISTOCENE FOSSIL MAMMALS -- AND HOW THEY GOT THAT WAY.
Dale Guthrie.