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PALYNOLOGY OF THE SUSIE UNIT #1 WELL, NORTH SLOPE, ALASKA

by

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SUMMARY

Thirty-four samples of well cuttings were examined microscopically. Standard maceration procedure was employed. This included HF and HCl treatment, followed by oxidation with Schulze's reagent and neutralization with KOH. Floatation with ZnBr was alwo employed and staining was accomplished with safranin Y.

Palynomorphs are fairly abundant and preservation is reasonably good down to sample 9750-60. Below this point carbonization seems to have taken its toll. Palynomorphs are rare and preservation is poor in the lower samples, making identification difficult. Those well preserved spores that are present in the lower part of the well are obviously uphole contaminants.

The possibility that these rocks may simply be devoid of palynomorphs and that the carbonized fragments are allochthonous (reworked from older sediments) has been considered but ruled out. Some of the carbonized palynomorphs are recognizable as Mesozoic dinoflagellates and thus are thought to be indigenous to the sediment. There is, however, evidence of recycling of this Mesozoic carbonized debris throughout the upper portion of the well. Depth of burial is thought to account for the carbonization.

The depositional environment is thought to have been marine from 4250 feet down to T.D., with possibly a non-marine interval between samples 6210-20 and 6800-10. The upper section, down to sample 3800-10, is thought to be non-marine.

The well is thought to bottom in Jurassic rocks. The boundary between the Lower and Upper Cretaceous is postulated between 7250 and 7500 feet and the Cretaceous-Tertiary boundary between 1750 and 2300 feet.

AGE DETERMINATIONS

Figure 1 shows the ages, and thus a gross zonation, determined by this rather cursory palynological investigation. Age determinations are extremely difficult to make for the samples of the lower part of the well. Land-derived pollen and/or spores are lacking or are rare in these samples and preservation is poor due to carbonization of the organic matter. Figure 9, plate 2, illustrates this kind of preservation,

No evidence of Paleozoic sediments was encountered in this well. Some dinoflagellate cysts, which are presumed to be indigenous to the samples and which resemble taxa previously encountered in Mesozoic sediments, date the lower portion of this well as Jurassic-Cretaceous.

Sample 120-50 -- This sample is practically barren. *Quercus*, *Pinus*, *Osmunda*, *Sphagnum*, and *Smilax* are the only plant genera represented. This hints at a boggy environment and probably Pleistocene or Holocene age. A non-marine environment is postulated, since there are no marine organs present. Fungus spores, however, are present. One carbonized dinoflagellate is thought to be associated with carbonized wood fragments and thus reworked from older sediment.

Sample 500-10 -- Spores are abundant and well preserved. There is no evidence of marine organs. The palynomorph assemblage is dominated by *Quercus*, pteridophytes*, and *Taxodium*. The percentage relationships are shown graphically in figure 2. The abundance of *Taxodium* (12%) and the presence of monosulcate grains (probably palm and *Liriodendron*) and *Sequoia* (figure 1, plate 1) indicate a very mild warm-temperate climate and point to an Early Tertiary age, probably Eocene.

* *Sphagnum*, a bryophyte, is arbitrarily included.

Sample 1000-10 -- Spores are abundant and preservation is good. The assemblage of this sample differs somewhat from that of sample 500-10 (see figure 2). However, the lower *Quercus* count may not be significant, since it may simply be attributable to a moister environment. An increase from 19% (sample 500-10) to 31% in "exotics," on the other hand, may be significant. By "exotics" I mean warm-temperate angiosperms, such as *Myrica*, *Nyssa*, *Carya*, *Ulmus*, *Fagus*, and *Juglans*, which are grouped under the label WTA in figure 2, plus *Taxodium*, *Sequoia*, monosulcates, and *Podocarpus*. The environment of deposition is thought to be non-marine and the age Eocene.

Sample 1500-10 -- Spores are abundant and preservation is good. The "exotics" comprise 41% of the total spore count and thus the climate is presumed to have been warmer than that of sample 1000-10. The appearance of *Gleichenia* and *Rugutriletes*, two prominent constituents of Late Cretaceous spore assemblages, may also be significant. *Podocarpus maximus* is present (figure 3, plate 1) and this species is considered to be characteristic of the Fort Union (Stanley, 1965). The environment of deposition is non-marine and the age is thought to be Paleocene.

Sample 1750-60 -- Spores are abundant and well preserved. The assemblage resembles that of sample 1500-10. The percentage of "exotics" has increased to 49. *Sequoiapollenites paleocenicus* (figure 2, plate 1) is present and it has been found in the Paskapoo Formation of Alberta and the Fort Union of South Dakota (Snead, 1969, and Stanley, 1965, respectively). *Sphagnum regium* (figure 4, plate 1), reported from the Paleocene of Siberia and the Fort Union of South Dakota (Stanley, 1965), and *Podocarpus maximus* are also present, indicating a Paleocene age for this sample. The environment is thought to be non-marine.

Sample 2300-10 -- Spores are abundant and well preserved. The assemblage is characterized by typical Late Cretaceous genera, such as Aquilapollenites, Gleichenia, and Proteacidites (see figure 2). Aquilapollenites rectus, A. dentatus, and A. fusiformis were described from Upper Cretaceous rocks of Alaska (B. Tschudy, 1969). Cycadopites giganteus and Wodehouseia spinata (figures 5-7, plate 1) were described from the Upper Cretaceous of South Dakota (Stanley, 1960). Wodehouseia spinata has become a Late Cretaceous marker. The presence of these species leads me to postulate a Maestrichtian age for this sample. There is no evidence of marine organisms.

Sample 2750-60 -- This sample contains well preserved spores in abundance. Aquilapollenites is conspicuous due to its abundance and by virtue of being represented by a new species (figures 8 and 9, plate 1). This species is large and spinose and to my knowledge has not been reported in the literature. Also present is A. senonicus (figure 10, plate 1), which is limited to the Maestrichtian and Campanian (B. Tschudy, 1969), and Wodehouseia spinata. There is no evidence of marine organisms. A Maestrichtian age is postulated for this sample.

Samples 3250-60 and 3800-10 -- Spores are rather sparse in these two samples. Polypodiidites senonicus is present and thus the samples should be no older than Santonian (Ross, 1949). A Campanian age thus is attached to this interval. There is, however, a suite of Maestrichtian spores present, including species of Aquilapollenites, Momipites, Lycopodiumsporites, and Osmundacidites. If these spores are indigenous, that is, not uphole contaminants, then this interval could be Maestrichtian rather than Campanian. There is no evidence of marine organisms.

Samples 4250-60, 4750-60, 5250-60 -- Spores are fairly abundant in these samples. Cingulatisporites circularis and Anemia striosporites are present and they are restricted to the middle Senonian (Weyland & Krieger, 1953, and Rouse et al, 1971, respectively). The dinoflagellates Deflandrea rectangularis (figure 1, plate 2) and D. belfastensis have also been reported from middle Senonian rocks (Eisenack & Klement, 1964). A middle Senonian age thus is pretty well established for this interval and, since the samples above appear to be Campanian in age, this interval is thought to be Santonian. Some uphole contamination is evident by the presence of Aquilapollenites, Momipites, Taxodium, Wodehouseia, and Betula pollen. The lower Upper Cretaceous, that is, the Cenomanian, Turonian, Coniacian, and Santonian, is a sequence with which I am not too familiar. A suite of spores, strangers to me but assignable to such genera as Rugutriletes (figure 11, plate 1), Leptolepidites (figure 12, plate 1), Osmundacidites, Pilosporites, Sphagnumsporites, and Lycopdiumsporites, is present in these samples and this suite thus may well fit into this gap in my knowledge. A strange dinoflagellate, assignable to Gymnodinium (figure 2, plate 2), is also present. The samples of this interval contain well preserved dinoflagellates and thus are marine.

Sample 5750-60 -- This sample is essentially barren. Besides some uphole contaminants (Castanea, Chenopodium), there is, however, a diagnostic hystrichosphere present, Hystrichosphaeridium readei (figure 3, plate 2). The sample thus is probably marine and no younger than Cenomanian (Sarjeant, 1967).

Sample 6210-20 -- This sample contains Verumonoletes morulus and Dacrydium fluens, species that have been reported from the Cenomanian (Pierce, 1961). There is no evidence of marine organisms. Uphole contamination accounts for the presence of Momipites, Aquilapollenites, Taxodium, Engelhardtia, Castanoa, and Tilia. The age is thought to be Cenomanian.

Samples 6600-10, 6700-10, and 6800-10 -- Palynomorphs are sparse in this interval and no age-diagnostic fossils were found. No marine organisms were encountered, except one hystrich and it is probably recycled from older rocks along with some specimens of Cycadopites and Anemia that are Aptian and older. There is also evidence of uphole contamination. Aquilapollenites, Sequoia, Taxodium, and Myrica pollen is thought to come from younger rocks.

Sample 7250-60 -- This sample contains the dinoflagellate Diconodinium arcticum and the fern spore Striatites striatus (figure 4, plate 2) and thus should be Cenomanian in age (Manum & Cookson, 1964, and Pierce, 1961, respectively). The sample is marine. Some uphole contaminants are present, including Taxodium, Aquilapollenites, and Ulmipollenites.

Sample 7500-10 -- This sample contains some well preserved dinoflagellates and thus the environment of deposition is marine. Cicatricosisporites aralica and and Sphagnumsporites antiquasporites (figure 5, plate 2) point to an Albian age for this sample (Brenner, 1963). On the other hand, the presence of Lycopodium fastigioides and Hemitelia mirabilis (figure 6, plate 2) indicate a Cenomanian age (Couper, 1953, and Bolkhovitina, 1953, respectively). The latter two species, along with specimens of Aquilapollenites that are also present, could be uphole contaminants.

Samples 7750-60, 8250-60, and 8760-70 -- These samples contain well preserved dinoflagellates and thus the environment is thought to have been marine. Dicodinium dispersum, D. pelliferum, Microdinium ornatum, and Gonyaulax apionis (figure 7, plate 2) are indicative of an Albian age (Sarjeant, 1967). The spore species Monosulcites elongatus, Acanthotriletes levidensis, Vitreisporites pallidus, Gleicheniidites senonicus, and Podocarpidites potomacensis substantiate this dating (Panella, 1966; Brenner, 1963; and Balme, 1957). Pollen grains of Aquilapollenites, Sequoia, Taxodium, Myrica, Carya, and Fagus are thought to be introduced from uphole.

Sample 9250-60 -- This sample contains no diagnostic palynomorphs. Some well preserved pollen grains, representing the genera Sequoia, Glyptostrobus, Corylus, and Alnus, are indicative of uphole contamination. Some carbonized dinoflagellates present are thought to be reworked from older rocks.

Sample 9750-60 -- There is no evidence of uphole contamination in this sample, but some carbonized dinoflagellates are indicative of recycling of sediment. A well preserved assemblage of palynomorphs is present and it is thought to be indigenous. The dinoflagellates Scriniodinium campanula (figure 8, plate 2), Gonyaulax orthoceras, and G. jurassica make this sample no older than Hauterivian and no younger than Aptian (Eisenack & Klement, 1964). Long-ranging Cretaceous spores belonging to such genera as Classopollis, Polypodiisporites, Sphagnumsporites, and Gleicheniidites tend to support this date. This sample is marine.

Sample 10,500-10 -- Only carbonized dinoflagellates are present in this sample. There is no evidence of uphole contamination. The sample is marine. The presences of the dinoflagellate Gonyaulax helicoidea, among others, makes this sample no younger than Aptian (Sarjeant, 1967).

Sample 10,750-60 -- This sample contains only carbonized dinoflagellates. No uphole contaminants are present. Two dinoflagellate species, Odontochitina operculata and Gonyaulax orthoceras, make this sample no younger than Albian and no older than Hauterivian (Singh, 1964).

Samples 11,240-50; 11,760-70; and 12,600-10 -- This interval is devoid of diagnostic palynomorphs. Among the carbonized dinoflagellates found is Gonyaulax jurassica (figure 9, plate 2), a species that ranges into the Albian (Singh, 1964) and thus is not of great help in dating this interval. The interval is definitely marine. A diverse and well preserved assemblage of uphole contaminants tends to obscure indigenous palynomorphs. This assemblage contains specimens of Momipities, Taxodium, Myrica, Alnus, Corylus, Carya, Fagus, and Juglans and thus must be derived from Tertiary rocks way uphole.

Sample 12,800-10 -- This sample contains carbonized dinoflagellates. One dino resembles Gymnodinium dabendorfense, a species reported from Valangian rocks (Sarjeant, 1967), but I can't be sure of the identification. The sample is marine.

Samples 12,960-70; 13,050-60; and 13,160-70 -- No diagnostic palynomorphs were found in this interval so that dating was not possible. Carbonized dinoflagellates are present, however, making the interval marine. Uphole contaminants are also present in this interval, among them are specimens of Tsuga, Alnus, Corylus, Momipites, and Taxodium.

Sample 13,490-500 -- This sample contains carbonized dinoflagellates and hystrichospheres, indicating a marine environment of deposition. One dinoflagellate cyst resembles Imbatodinium villosum, a species reported from Upper Jurassic rocks (Evitt, 1969). Some well preserved spores representing Betula, Momipites, Taxodium, and Gleichenia indicate that uphole contamination occurred.

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PLATE 1

Polaroid Photomicrographs of Palynomorphs

Figure 1. Sequoia sp., sample 500-10, 40 microns.

2. Sequoiapollenites paleocenicus Stanley 1965, sample 1750-60, 30 microns.

3. Podocarpus maximus Stanley 1965, sample 1500-10, 63 microns.

4. Sphagnum regium Drozhastichich 1961, sample 1750-60, 28 microns.

5. Wodehouseia spinata Stanley 1960, sample 2300-10, 62 microns.

6. Wodehouseia spinata Stanley 1960, sample 2300-10, 60 microns.

7. Wodehouseia spinata Stanley 1960, sample 2300-10, 61 microns.

8. Aquilapollenites sp., sample 2750-60, 80 microns.

9. Aquilapollenites sp., sample 2750-60, 96 microns.

10. Aquilapollenites senonicus (Mtchedlishvili) Tschudy and Leopold 1969, sample 2750-60, 35 microns.

11. Rugutriletes sp., sample 4750-60, 47 microns.

12. Leptolepidites sp., sample 4750-60, 75 microns.

PLATE 2

Polaroid Photomicrographs of Palynomorphs

Figure 1. Deflandrea rectangularis Cookson and Eisenack 1962, sample 4750-60, 118 microns.

2. Gymnodinium sp., sample 5250-60, 35 microns.

3. Hystrichosphaeridium readei Downey, Sarjeant and Williams 1961, sample 5750-60, 100 microns.

4. Striatites striatus Pierce 1961, sample 7250-60, 75 microns.

5. Sphagnumsporites antiquasporites (Wilson and Webster) Brenner 1963, sample 7500-10, 25 microns.

6. Hemitelia mirabilis Bolkhovitina 1953, sample 7500-10, 35 microns.

7. Gonyaulax apionis Cookson and Eisenack 1962, sample 7750-60, 98 microns.

8. Scriniodinium campanula Gocht 1959, sample 9750-60, 105 microns.

9. Gonyaulax jurassica Deflandre 1938, sample 11,240-50, 94 microns.

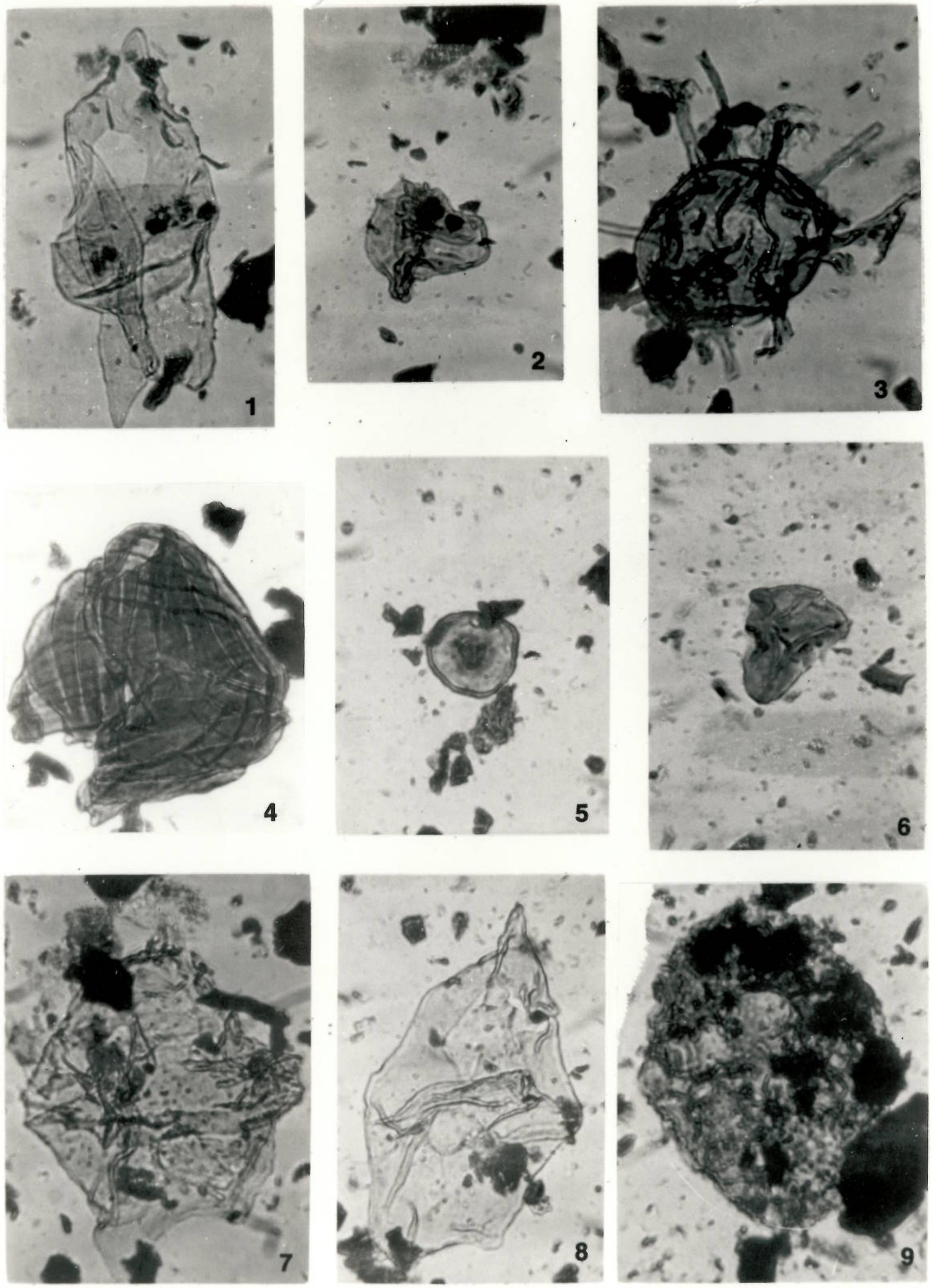

PLATE 2

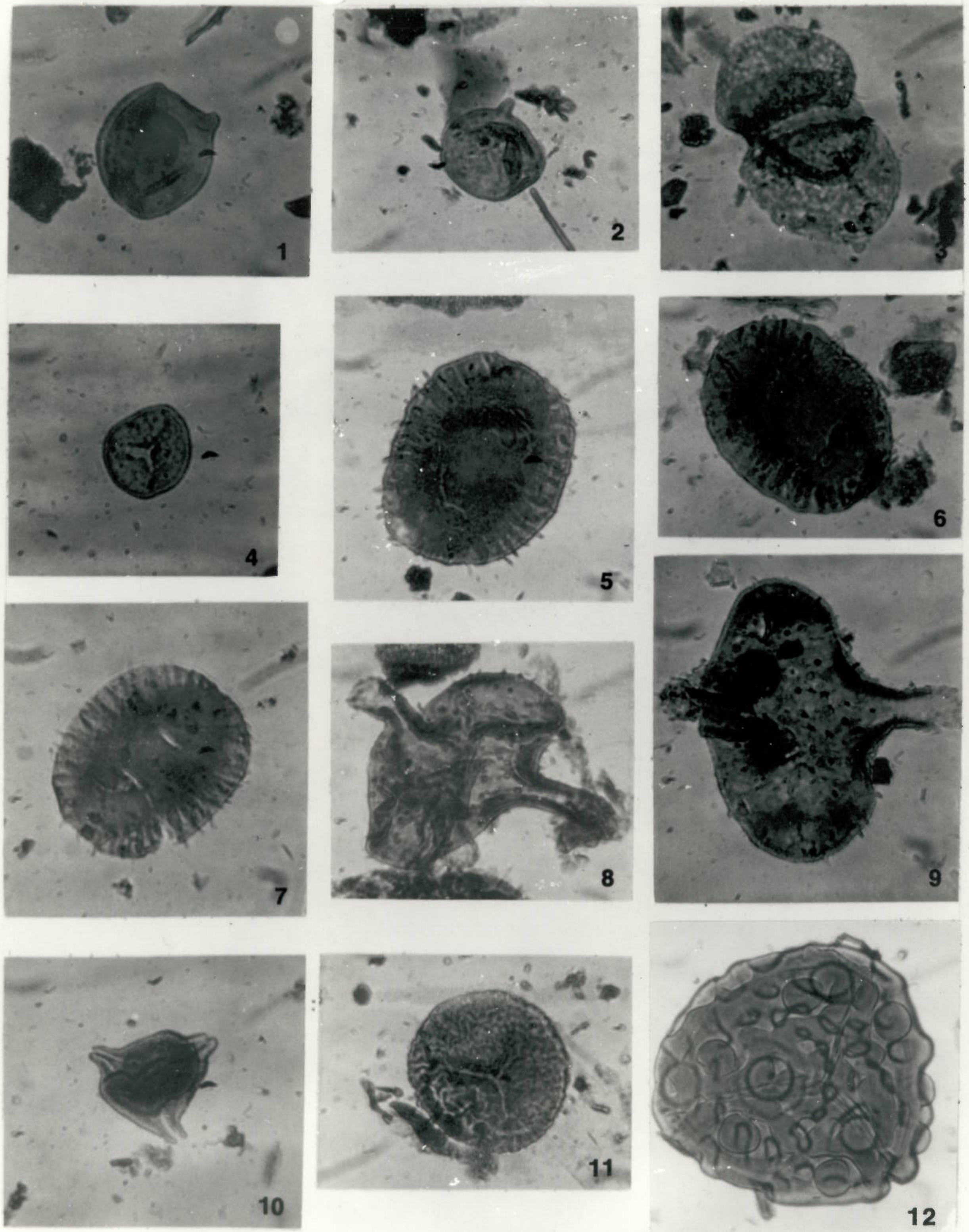

PLATE 1

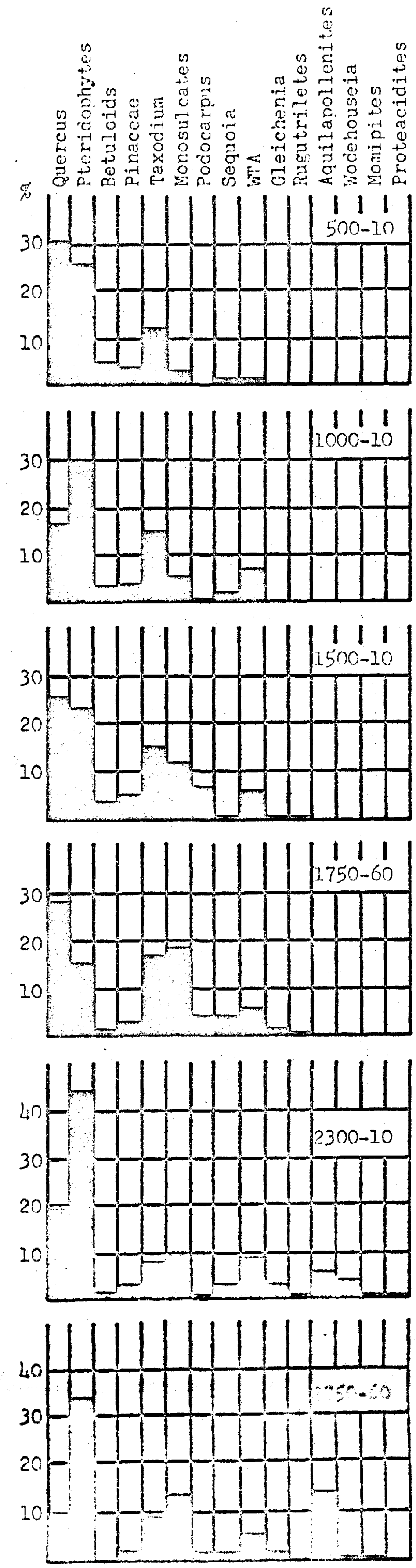

Figure 2. -- Bar graphs of the 500-2760 interval, showing relative abundance of major spore groups.

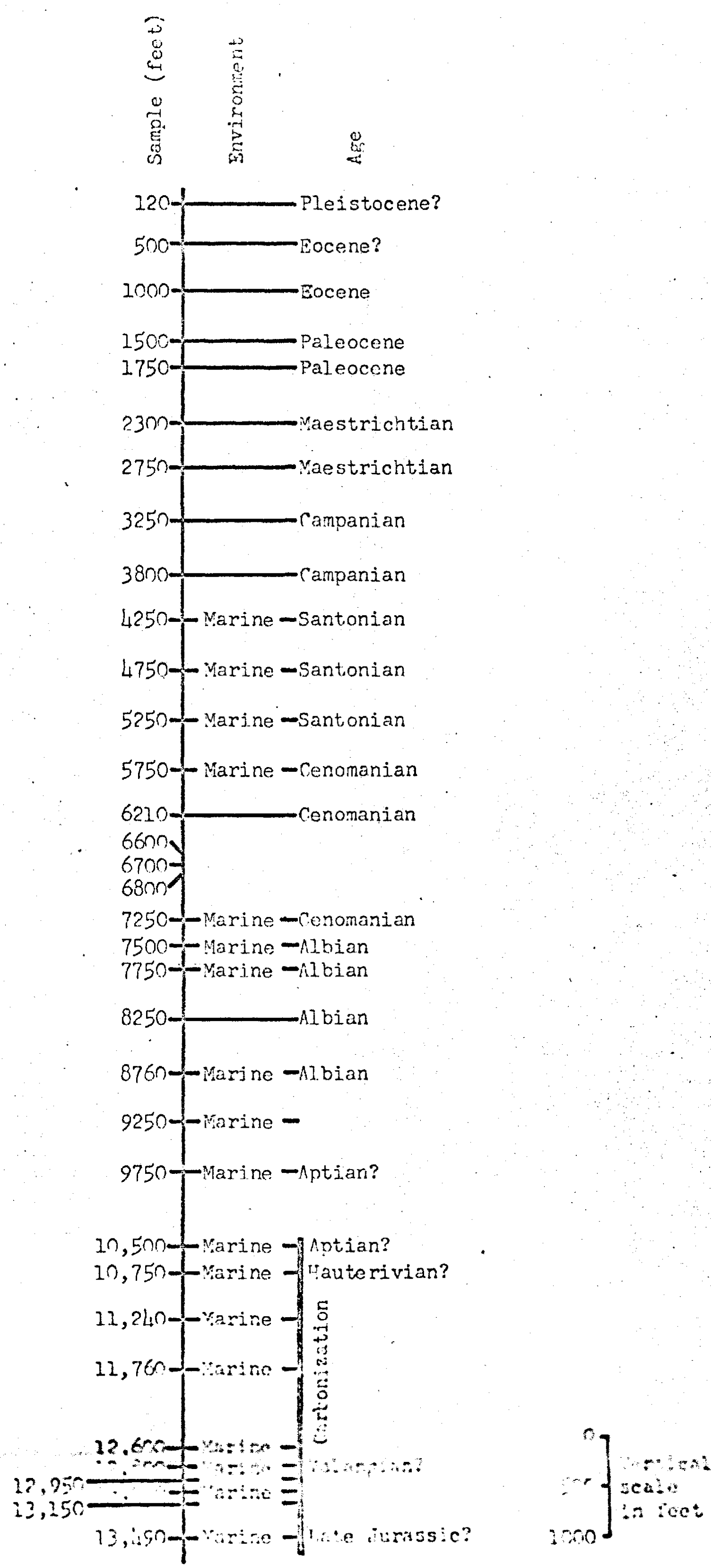

Figure 1. -- Graph of Susie Unit #1 well,

showing samples, environment, and ages.