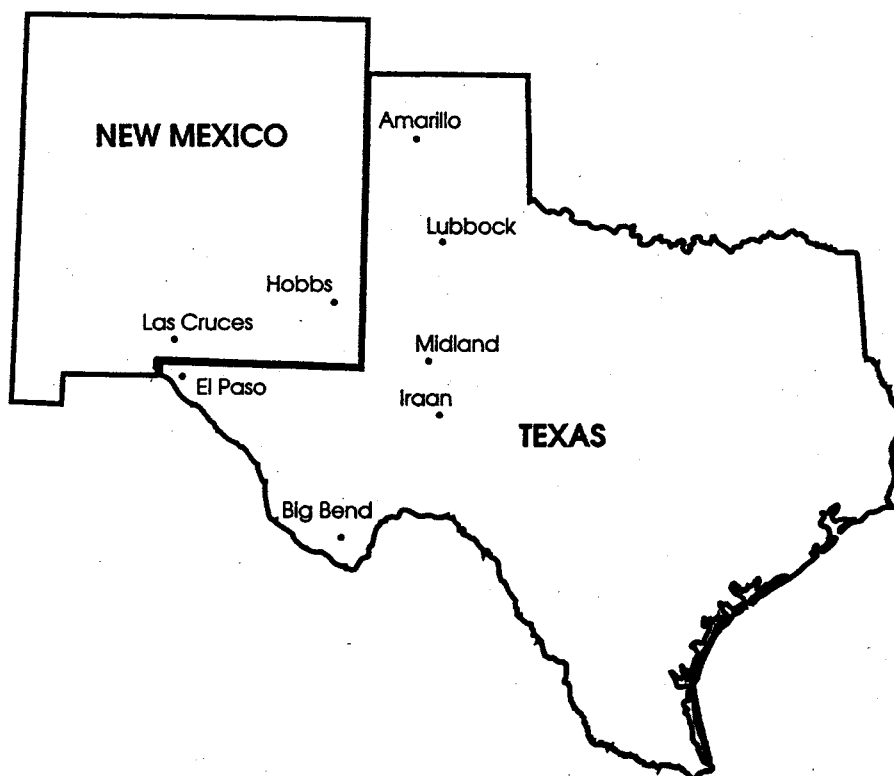


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# **Corroboration of Sangamonian Interglacial Age of Artifacts at the Valsequillo Archeological Area, Puebla, Mexico, by means of paleoecology and biostratigraphy of Chrysophyta Cysts**

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## **ABSTRACT**

Paleoecology and biostratigraphy of Chrysophyta cysts from four closely related samples directly associated with artifact bearing horizons in the Valsequillo area south of Puebla, Mexico, are consistent with a Sangamonian *sensu lato* (ca. 80,000 - 220,000 yr BP) age determined on the basis of diatom paleoecology and biostratigraphy for the same four samples in a previously published study. A Late Glacial or Postglacial age for two of the samples is precluded by the presence of *Outesia membranosa* and *Cysta* spp. (Cyst types 5, 11, and 14) all of which have known, long stratigraphic ranges and extinctions before the end of Sangamonian time (*i.e.*, before the last Ice Age).

## **INTRODUCTION**

For over a century American archeologists repeatedly have ignored the reports (*e.g.*, Reichelt 1899, 1900; Armenta Camacho 1978; Steen-McIntyre et al. 1981; Cremo and Thompson 1993; and VanLandingham 2000) of the great antiquity of humans in the Valsequillo archeological sites south of Puebla, Mexico. Various investigators of diverse cultures, institutions, trainings, religions, affiliations, etc. have provided sophisticated biostratigraphic, micropaleontologic, high tech, radiometric, and tephrochronologic studies which are in essential agreement that some Valsequillo-Puebla artifact bearing horizons are Pre-Wisconsinan (> 80,000 yr BP) in age. Pichardo (1997) epitomized the great controversy over the ages of the artifacts from the strata in the Valsequillo region of Mexico and made a plea for re-examination and better assimilation of the information on those strata.

Archeologists who insist on maintaining that Postglacial Clovis Man is the oldest North American human or that humanity first arrived in North America in late Wisconsinan (*i.e.*, <22,000 yr BP) times are going to find it more and more difficult, if not impossible, to try to discredit the rapidly growing body of evidence (*e.g.*, VanLandingham 2000 and the cyst biostratigraphy herein) which indicates a much earlier first arrival.

In the present study, computer data synthesis was used in the form of CEFCARS (continuous extinct fossil chrysophyte age reference system), a comprehensive retrieval program based on the stratigraphic ranges of approximately 600 known extant and

extinct Chrysophyta stomatocyst taxa and CAESARS (continuous algal ecological spectral analysis reference system) described by VanLandingham 1987, 1990, 2000).

CAESARS is a comprehensive, computerized retrieval program based on about 3,000 publications from which over 4,000 common and widely occurring algae (including Chrysophyta cysts and Protista) taxa are categorized into nine physical, chemical, and occurrence spectra each of which is subdivided into four or more categories (see Table 1). Categories of each spectrum are based on theoretical and natural observations found in various published works which are discussed in detail by VanLandingham (1982, 1987). Information from new references is used continuously to update CAESARS. Most terminology used in the categories of the spectra is self explanatory or in common use, but Lowe (1974) and VanLandingham (1982) give detailed descriptions of each category and spectrum. A series of histograms can be made (Figure 1) by calculating the percentage of each taxon in each sample and totaling the percentages of all taxa in each category. These spectral categories and/or histograms have proven to be ideal as a standard of ecological and paleoecological comparison for various algal and diatomaceous samples from all over the world (Collingsworth et al. 1967; Duthie and Rani 1967; VanLandingham 1968, 1970, 1976, 1982, 1987; Messina-Allen and VanLandingham 1970; Robbins and Hohn 1972; VanLandingham and Jossi 1972; Abbot and VanLandingham 1972; Lowe 1974, etc.). One of the advantages of a comprehensive algal data synthesis like CAESARS is that the general and specific habitat spectra in conjunction with the nutrient and saprobian spectra can be helpful in determining if a species or taxon is absent from an assemblage because of lack of suitable physical habitat or because of adverse water chemistry.

## DESCRIPTION OF SAMPLES

The paleoecological and environmental conditions in this investigation were interpreted by means of CAESARS and were based on microscopical examinations of 137 cysts (stomatocysts) representing 43 taxa of the Division Chrysophyta (Table 2 and Figure 2) from the following three classes of samples.

1. Middle to Upper Pleistocene (Sangamonian Interglacial or equivalent) age, Valsequillo (Puebla) region of Mexico:

CAS 191090 - Material collected and described by Hugo Reichelt in 1899 (1900) from the Dorenberg Skull (an ancient human from Puebla, Mexico); slide prepared by Friedrich Hustedt in 1949; contains some of Hustedt's type material (obtained from Reichelt) of *Surirella antiqua* in the California Academy of Sciences (CAS) H. E. Sovereign Collection of microscope slides (see Figure 3).

VL 1972 - Collected February 1, 1930, by G. E. Sierloff from the north side of the Río Atoyac, 75 miles southeast of Mexico City and 9 miles south of the railroad in Ciudad Puebla, Mexico; CAS G. Dallas Hanna Diatom Collection No. 2221.

VL 2082 - Collected September 23, 1997, by Virginia Steen-McIntyre from the

town of Buena Vista Tetela on the north side of the Valsequillo Reservoir, at the base (120-130 cm. from the surface) of the Hueyatenco Ash; repository at CAS.

VL 2083 - Collected September 24, 1997, by Virginia Steen-McIntyre from the town of Buena Vista Tetela on the north side of the Valsequillo Reservoir, at the base of the "Buena Vista Lapilli" (35-40 cm. from the surface). "Superhydration curve (for water in glass vesicles) essentially equal to Hueyatenco Ash and to Yellowstone Tephra dated 251,000 yrs."; repository at CAS.

2. Middle to Upper Pleistocene (Sangamonian or equivalent) age, United States.

VL 1904 - Collected October 28, 1988, by Sam L. VanLandingham from SW 1/4 SW 1/4 SW 1/4 sec. 30, T. 42 N., R. 55 E., Elko County, Nevada, 1.5 miles northwest of bridge over the North Fork of the Humboldt River; from a stratigraphic position near the top of the Hay Ranch Formation or equivalent (Middle Pleistocene); repository at CAS.

3. Modern, Recent or Postglacial age, state of Puebla and adjacent regions, Mexico:

VL 854 - Obtained from General Biological Supply House Inc., Chicago, Illinois, 1966; No. 6, cleaned diatomite (Postglacial) from the Ciudad Tlaxcala area, Tlaxcala state, Mexico; repository at CAS.

CAS 181014 - Collected by F. W. T. Kincaid, Summer, 1933; modern water sample from Lake Xochimilco, Distrito Federal, Mexico; elevation 7,400 ft.; repository at CAS, H. E. Sovereign Collection slide 181014, accession No. 600350.

VL 2084 - Collected September 23, 1997, by Virginia Steen-McIntyre from town of Buena Vista Tetela at the same location as sample VL 2083 (but higher in the stratigraphic section than VL 2083) from top 5 cm. of *modern* soil which rests on top of "Buena Vista Lapilli"; repository at CAS.

## RESULTS AND CONCLUSIONS

Only five of the nine diatom bearing samples investigated by VanLandingham (2000) had Chrysophyta cyst assemblages suitable for paleoecological analysis and comparison by CAESARS: VL 1972, VL 2082, VL 2083, VL 1904 and VL 2084. The remaining four samples were unsuitable because of: insufficient cysts (*i.e.*, CAS 181014 and VL 854), insufficient percentage of extant Chrysophyta taxa upon which to base modern ecological observations and comparisons (*i.e.*, CAS 191090), and absence of an analysis of Chrysophyta cysts by Duthie and Rani (1967), who investigated only the diatoms in their study (*i.e.*, Don #6). CAESARS analysis of the five suitable cyst assemblages in the present study (Figure 1) compared favorably with CAESARS analysis of the nine diatom assemblages from the same corresponding samples described in figures 1 and 2 of VanLandingham (2000).

CAESARS analysis of cyst assemblages demonstrated that all five of the samples in Figure 1 were fairly similar to each other in some categories, such as epiphytic (specific habitat spectrum) and oligohalobous indifferent (halobion spectrum), and that the categories (e.g., Winter in the seasons spectrum and eutrophic in the nutrient spectrum) in sample VL 2084 fit well within the ranges of category variation among the other four samples. In spite of this, the various categories of the nine spectra of CAESARS were very similar in the first four samples (VL 1972, VL 2082, VL 2083, and VL 1904), all of which are Sangamonian in age and in general are very different paleoecologically from VL 2084 which is considerably younger than the other four.

In respect to all samples in classes 1 and 2 which are shown in Figure 1, the class 3 sample (VL 2084) is less developed in the following categories: (1) acidophilous and indifferent (pH spectrum); (2) katharobic (saprobian spectrum); (3) oligotrophic (nutrient spectrum); (4) halophobous (halobion spectrum); (5) rheophilous (current spectrum); (6) epipellic (specific habitat spectrum); and (7) oligothermal (temperature spectrum). On the other hand, when compared with the four samples of classes 1 and 2 in Figure 1, the single class 3 sample (VL 2084) is more developed in: (1) alkaliphilous (pH spectrum); (2) weak mesosaprobic and oligosaprobic (saprobian spectrum); (3) limnophilous (current spectrum); (4) lakes & ponds and rivers & streams (general habitat spectrum); (5) planktonic (specific habitat spectrum); (6) Spring and Summer (seasons spectrum); and (7) eutermal, stenothermal and eurythermal (temperature spectrum).

While the indications of Adam and Mahood (1981), Smol (1986) and CAESARS that Chrysophyta cysts are widely distributed primarily in freshwater environments of low to moderate pH evidently are true, it is also true that there are abundant cases of such cysts within fossil diatom assemblages which are characteristic of deposition in environments around pH 7 (indifferent or circumneutral) to strongly alkaline (Zeeb et al. 1996). Analysis of diatoms by CAESARS from the Valsequillo area (VanLandingham 2000) demonstrated that none of the nine samples in that investigation were associated with acidic (acidophilous) environments of deposition and all but one of those samples (Don # 6) were further examined for paleoecological analysis (by CAESARS) using Chrysophyta cysts in the present study. However, cysts were rare or absent in samples VL 854 and CAS 181014 (Table 2) which were determined (by means of diatom assemblages) to be deposited under extremely alkaline conditions, whereas, in the remaining six samples (CAS 191090, VL 1972, VL 2082, VL 2083, VL 1904, and VL 2084), cysts were most abundant in samples VL 2083 and VL 1904 which were deposited under the least alkaline conditions as determined by using both diatoms and cysts in CAESARS (compare pH spectra of figures 1 and 2 in VanLandingham (2000) with Figure 1 in the present study).

Cysts from the Postglacial (or Recent) sample VL 2084 displayed a much stronger development in the Summer and eutermal categories than cysts from those same categories in any of the older (Sangamonian) samples (VL 1972, VL 2082, VL 2083 and VL 1904) (see Figure 1). These cyst assemblages indicate that environments of deposition associated with sample VL 2084 were much warmer than those associated with any of the older (Sangamonian) samples in Figure 1. This conclusion also is

supported by the diatom assemblages from these same five samples (compare with figures 1 and 2 in VanLandingham 2000). Moreover, greater development of cysts in the oligothermal category of samples VL 1972, VL 2082, VL 2083, and VL 1904 than in that same category in VL 2084 denotes a cooler environment of deposition in the first four samples than in the fifth and last sample (Figure 1).

Although samples VL 2083 and VL 2084 are close lithostratigraphically and are from exactly the same geographical site, their biostratigraphic ages and environments of deposition are considerably different. Sample VL 2083 is from the "Buena Vista Lapilli" lying directly beneath the 5 cm of modern soil (from which sample VL 2084 was taken), and its cyst paleoecology is much more similar to that of samples VL 1972 and VL 2082 (from different but nearby sites) and VL 1904 (from a very distant site) than that of sample VL 2084 (Figure 1). That the paleoecological correlations of cyst assemblages from samples VL 1972, VL 2082, VL 2083, and VL 1904 would correspond with correlations of these same samples on the basis of stratigraphic ranges of their cysts is highly significant and would attest to a Sangamonian age (like the diatoms described in VanLandingham 2000). The cyst paleoecology and biostratigraphy of sample VL 2084 demonstrate that this sample was deposited in a much different, younger environment than the Sangamonian environments of VL 1972, VL 2082, VL 2083, and VL 1904.

CEFCARS confirmed a Sangamonian age for the samples in classes 1 and 2 (see Figure 4) and a Postglacial or younger age for the class 3 samples, none of which had extinct cysts (see Table 2). A detailed report on the important marker fossils and biostratigraphy of the diatoms and cysts of these Valsequillo samples will be treated in a forthcoming publication. An age no older than Sangamonian (ca. 80,000- 220,000 yr BP) for samples VL 1972, VL 2082, VL 2083, and VL 1904 is denoted by the presence of the following extinct taxa (Table 2) which are not known in deposits older than Sangamonian age: *Clericia argentina* v. *platensis*, *C. mangini* v. *pyriformis*, *Cysta carinalis* and *Outesia perlifera*. Furthermore, the latest known first occurrences of the following extant taxa in deposits younger than Illinoian Glacial age (ca. 220,000 - 430,000 yr BP) also denote an age no older than Sangamonian for samples VL 2083 and VL 1904: *Clericia spinigera* sensu Frenguelli (1929, nec al.), *Cysta areolata*, *C. macrospinosa*, and *Outesia sphaerica*. An age no younger than Sangamonian for samples VL 2082, VL 2083, and VL 1904 is indicated by the presence of *Archaeomonas punctata*, *Clericia stephanopyxiformis*, Cyst types 5, 11, and 14 (of VanLandingham 1964), *Outesia membranosa*, and Stomatocyst # 9 (of Zeeb et al. 1996), all of which apparently became extinct before the beginning of the last ice age or Wisconsinan glaciation (ca. 80,000 yr BP) (Figure 4).

Paleoecology and biostratigraphy of the Chrysophyta cysts from the four class 1 samples (CAS 191090, VL 1972, VL 2082, and VL 2083) associated with artifact bearing horizons in the Valsequillo area south of Puebla, Mexico, are consistent with a Sangamonian (ca. 80,000 - 220,000 yr BP) age determined on the basis of diatom paleoecology and biostratigraphy by VanLandingham (2000) for the same four samples.

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TABLE 1. Description of Spectra and their Categories.

# **pH SPECTRUM**

- Acidobiontic** - occurring below pH 7 with optimum development below pH 5.5.
- Acidophilous** - occurring around pH 7 with optimum development below pH 7.
- Indifferent** - occurring near pH 7.
- Alkaliphilous** - optimum development above pH 7 but occurring around 7.
- Alkalibiontic** - occurring above pH 7.
- Unknown or other** - undesignated category to accommodate generalities or characteristics which cannot be referred directly to the other categories in the spectrum. (Note: this explanation applies to all "Unknown or other" categories in other spectra below.)

# **SAPROBIEN (SAPROBIAN) SPECTRUM**

- Polysaprobic** - occurring characteristically in the predominance of reduction and cleavage processes, because of absence or low content of oxygen and because of carbon dioxide and a relatively high content of nitrogenous and putrescible nutrient substances (characteristic of high hydrogen sulphide) (high dissolved organic nutrients) = **Saprobiontic** - organisms occurring only in most heavily polluted waters.
- Mesosaprobic** - occurring characteristically with decomposition and oxidation widely present and with decomposition products of protein, ammonia salts, etc. (moderate dissolved organic nutrients).
  - $\alpha$  (**Strong**) - occurring characteristically where self putrefaction takes place rapidly.
  - $\beta$  (**Weak**) - occurring characteristically where self purification takes place less rapidly.
- Oligosaprobic** - characteristic of clean water, associated with termination of mineralization and all aggressive processes of self purification (low dissolved organic nutrients).
- Saprophilic** - occurring generally in organically polluted waters but occurring also in other communities.
- Saproxenous** - occurring primarily in biotypes other than the organically polluted ones but occurring also in the presence of organic pollution.
- Katharobic** - characteristic of waters that have not been exposed to dissolved organic nutrients or waters in which dissolved organic nutrients are very low or absent. = **Saprophobic** - organisms which are not capable of thriving in organically polluted water.

# **NUTRIENT SPECTRUM**

- Polytrophic** - characteristic of extreme eutrophic conditions.
- Eutrophic** - characteristic of waters rich in dissolved inorganic or mineral nutrient materials.
- Mesotrophic** - characteristic of water intermediate in dissolved inorganic or mineral nutrient materials.
- Oligotrophic** - characteristic of waters poor in dissolved inorganic or mineral nutrient materials.
- Dystrophic** - characteristic of waters rich in humic materials and with distinct oxygen consumption.

# **HALOBIAN SPECTRUM**

- Euhalobous or Polyhalobous** - marine forms, 30 to 40 o/oo salt content.
- Mesohalobous** - brackish water forms, ca. .5 to 30 o/oo salt content.
  - $\alpha$  (**Strong**) - NaCl minimum about 10 o/oo.
  - $\beta$  (**Weak**) - NaCl content about .5 to about 10 o/oo.
- Oligohalobous** - widespread in freshwater, about 0 to .5 o/oo salt content.
- Halophilous** - common in freshwater but not uncommon in slightly "brackish" water.
- Indifferent** - freshwater forms proper.
- Halophobous** - characteristic of chloride deficient waters.

**Euryhalobous or Euryhaline** - having a broad tolerance for salt concentrations, often encompassing 2 or more large spectral designations.

#### CURRENT SPECTRUM

**Limnobiontic** - forms characteristic only of stagnant waters.

**Limnophilous** - forms with their optimum development in stagnant waters but which also may be found in running waters.

**Indifferent** - forms common in both running and stagnant waters.

**Rheophilous** - forms with their optimum development in running waters, but which may be found in standing waters also.

**Rheobiontic** - forms characteristic only of running waters.

#### GENERAL HABITAT SPECTRUM

**Benthic** - organisms living on the bottom of a body of water.

**Lentic** - living in standing water.

**Lakes** - characteristic of large inland bodies of water, and **Ponds** - characteristic of small bodies of standing water.

**Bogs or Swamps** - characteristic of soft, wet, or marshy ground.

**Lotic** - living in running water.

**Crenophilous (general)** - occurring in spring waters in general.

**Crenophilous (thermal)** - occurring in hot springs.

**Rivers & Streams** - occurring in larger and smaller bodies of running water that have more or less continuous geographical expression.

**Aerophilous or Terrestrial** - organisms occurring above water, in the air or soil.

**Estuarine** - characteristic of areas where brackish-marine and fresh waters mix.

**Littoral** - organisms living in relatively shallow areas, close to shore or banks.

**Neritic** - occurring typically above the continental shelf (close to shore).

**Oceanic** - occurring typically over the deeper regions of the oceans.

**Eurytopic or Euryecious** - occurring in a wide variety of habitats or environments.

#### SPECIFIC HABITAT SPECTRUM

**Planktonic or Pelagic** - organisms of relatively small size which have either very small powers of locomotion or else none at all and which drift, subject to waves, currents and other water motion (**Planktonic**); or organisms living above the bottom of the body of water (**Pelagic**).

**Euplanktonic** - normally suspended in the water, distribution is current dependent.

**Tychoplanktonic** - normally associated with periphytic or terrestrial habitats but often suspended in the water.

**Periphytic (Aufwuchs)** - microorganisms attaching to rocks, objects, plants, etc.

**Epipellic** - occurring on mud.

**Epilithic** - occurring on rock.

**Epiphytic** - occurring on plants.

**Other Periphytic** - occurring on animals (epizooic) or wood, etc.

#### SEASONS SPECTRUM

**Winter** - optimum growth during winter.

**Spring** - optimum growth during spring.

**Summer** - optimum growth during summer.

**Fall** - optimum growth during fall.

#### TEMPERATURE SPECTRUM

**Euthermal** - warm-water forms usually occurring at temperatures > 30 degrees C.

**Mesothermal** - temperate-water forms usually ranging from 15 to 30 degrees C.

**Oligothermal** - cold-water forms usually occurring between 0 and 15 degrees C.

**Stenothermal** - occurring over a temperature range not > than 5 degrees C.

**Metothermal** - occurring over a temperature range from 5 to 15 degrees C.

**Eurythermal** - occurring over a temperature range of 15 degrees C or greater.

	CAS 191090	1 VL 1972	2 VL 2082	3 VL 2083	4 VL 1904	5 VL 854	6 CAS 181014	7 VL 2084
<i>Carnegia armata</i> .....	1			9				
<i>C. complexa</i> (=Clericia obtecta sensu Frenguelli 1925) .....	1			1	2			
<i>C. cristata</i> .....					1			
<i>C. frenguelli</i> .....					1			
<i>C. willingtoniensis</i> .....				1	3			
<i>Chromulina minuta</i> (=Cysta minima) .....		3	3	6	3			3
<i>Chrysostomum minutissimum</i> .....					1			
<i>Clericia spinigera</i> sensu Frenguelli 1929 nec al. ....					1			
<i>Cysta areolata</i> .....					1			
<i>C. carinifera</i> (=Cyst type 19) .....				3				3
<i>C. compressa</i> .....				5				
<i>C. macrospinosa</i> .....				1				
<i>C. microspinosa</i> (=Cyst type 2) .....		2	1	1	1			3
<i>C. sp.</i> .....					3			
<i>C. teres</i> .....				4	2			
<i>C. vermicularis</i> .....		2	2	3				1
Cyst type 16 .....								1
<i>Dinobryon cylindricum</i> (=Cysta curvicollis) .....		1						
<i>D. pediforme</i> (=Cysta globata) .....			2	10	1			1
<i>Mallomonas radiata</i> (=Cysta crassicollis) .....								2
<i>Ochromonas granularis</i> (=Cysta modica) .....								1
<i>O. nannos</i> (=Cysta brevis) .....				1				
<i>Outesia laevis</i> .....			2		2			
<i>O. sphaerica</i> .....				1				
<i>O. torquata</i> .....			1	1	1			
<i>Uroglena americana</i> (=Cysta aperta) .....	1	1			1			
<i>U. sonaica</i> .....				2	4	1		
TOTAL EXTANT CHRYSOPHYTA CYSTS	3	9	11	49	28	1	0	15
<i>Archaeomonas punctata</i> .....					1			
<i>Carnegia coronata</i> (=Unidentified stomatocyst 10) ....				1				
<i>C. forcipata</i> .....				1				
<i>Clericia argentina</i> v. <i>platensis</i> .....				1				
<i>C. mangini</i> v. <i>pyriformis</i> .....			1					
<i>C. spinigera</i> (non Frenguelli 1929) .....	1							
<i>C. stephanopyxiformis</i> .....					1			
<i>Cysta carinalis</i> .....		1						
<i>C. crassipocula</i> .....	1							
<i>C. scrobiculata</i> (=Cyst type 26) .....		1		1				
Cyst type 5 .....			1					
Cyst type 11 .....				1				
Cyst type 14 .....				1				
<i>Outesia membranosa</i> .....				1				
<i>O. perlifera</i> .....				2				
Unidentified stomatocyst 9 .....					4			
TOTAL EXTINCT CHRYSOPHYTA CYSTS	2	2	2	9	6	0	0	0
TOTAL CHRYSOPHYTA CYSTS	5	11	13	58	34	1	0	15

Table 2. Total extant and extinct Chrysophyta cysts in the three sample classes. Class 1 = CAS 191090, VL 1972, VL 2082, and VL 2083. Class 2 = VL 1904. Class 3 = VL 854, CAS 181014, and VL 2084. Notice that class 3 samples have no extinct taxa.

FIGURE 1. Spectral histograms based on Chrysophyte cyst taxa percentages.

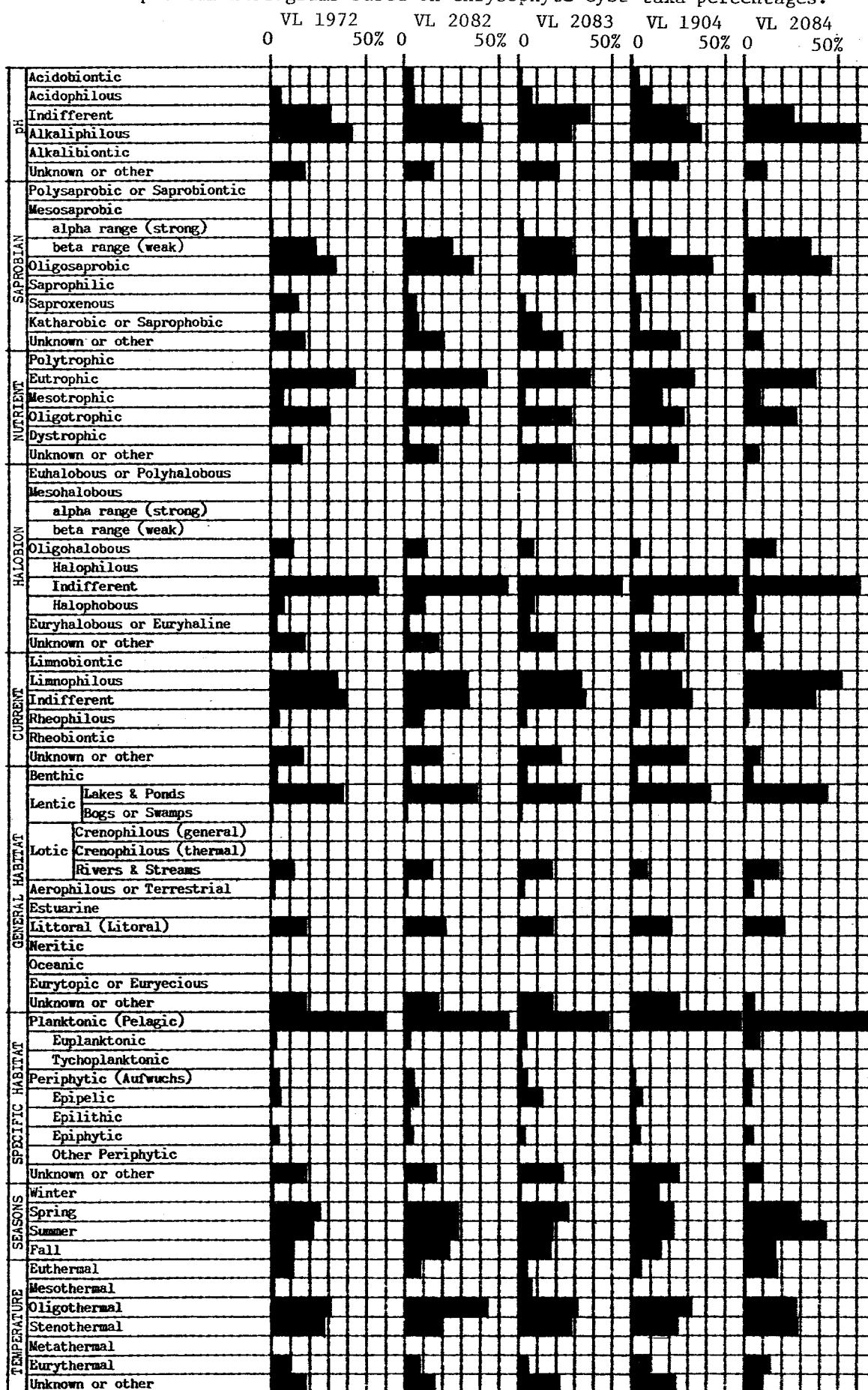
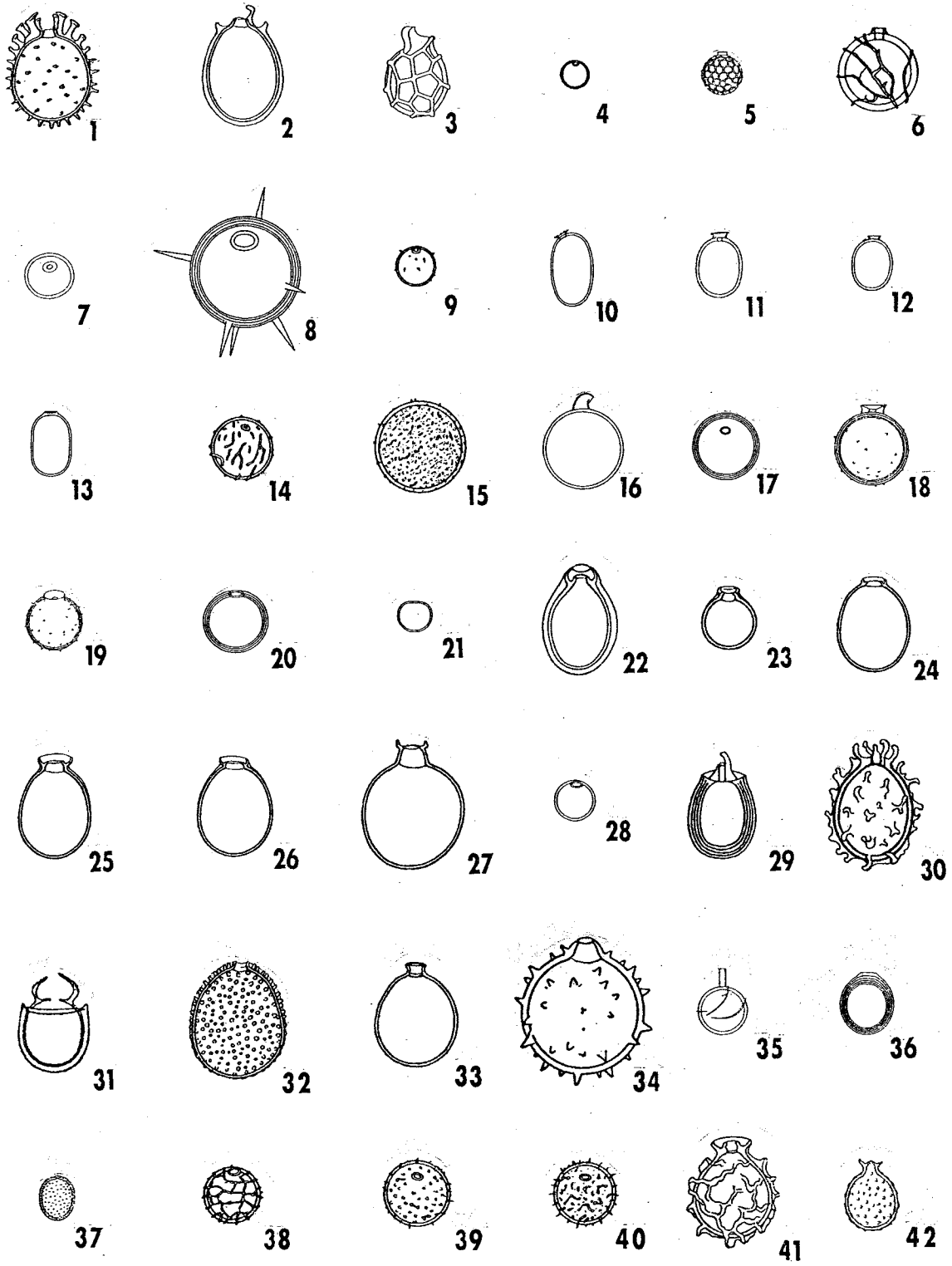


Figure 2. Extant and extinct Chrysophyta cysts from class 1 samples (CAS 191090, VL 1972, VL 2082, and VL 2083) of the Valsequillo Archeological Area. All magnifications are X 1000. 1-29 are extant and 30-42 are extinct. 1, 2, 22, 30, 31, and 34 are from Frenguelli (1925); 3-5, 7-8, 10-13, 16-21, 28, and 35-37 are from Nygaard (1956); 6, 9, 14-15, 29, and 38-40 are from VanLandingham (1964); 23 and 27 are from Frenguelli (1939); 24-26 and 32 are from Frenguelli (1935); 30 is an original from sample VL 2083; 33 and 42 are from Frenguelli (1955); and, 41 is from Frenguelli (1932). 1. *Carnegie armata*; 2. *Carnegie complexa* (= *Clericia obtecta* sensu Frenguelli 1925); 3. *Carnegie willingtoniensis*; 4. *Chromulinaminuta*; 5. *Cysta areolata*; 6. *C. carinifera* (=Cyst type 19 of VanLandingham 1964); 7. *C. compressa*; 8. *C. macrospinosa*; 9. *C. microspinosa* (=Cyst type 2 of VanLandingham 1964); 10-13. *C. teres*; 14. *C. vermicularis* (= Cyst type 6 of VanLandingham 1964); 15. Cyst type 16 of VanLandingham 1964; 16. *Dinobryon cylindricum* (= *Cysta curvicollis*); 17. *D. pediforme* (= *Cysta globata*); 18-19. *Mallomonas radiata* (= *Cysta crassicollis*); 20. *Ochromonas granularis* (= *Cysta modica*); 21. *O. nannos* (= *Cysta brevis*); 22. *Outesia laevis*; 23. *O. sphaerica*; 24-27. *O. torquata*; 28. *Uroglena americana* (= *Cysta aperta*); and, 29. *U. sonaica* (= Cyst type 24 of VanLandingham 1964). 30. *Carnegiacoronata* (= Unidentified Stomatocyst # 10 of Zeeb et al. 1996); 31. *C. forcipata*; 32. *Clericia argentinav. platensis*; 33. *C. mangini* v. *pyriformis*; 34. *C. spinigera* (non Frenguelli 1929); 35. *Cysta carinalis*; 36. *C. crassipocula*; 37. *C. scrobiculata* (= Cyst type 26 of VanLandingham 1964); 38. Cyst type 5 of VanLandingham 1964; 39. Cyst type 11 of VanLandingham 1964; 40. Cyst type 14 of VanLandingham 1964; 41. *Outesia membranosa*; and, 42. *O. perlifera*.



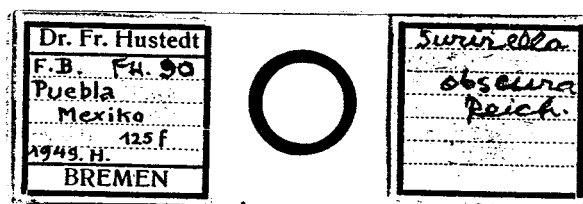


Figure 3. Glass microscope slide (CAS # 191090) prepared from a cut of a diatom (and Chrysophyta cyst) bearing sample (attributable to Hugo Reichelt) taken from inside the Dorenberg Skull (an ancient human) from the area of Puebla, Mexico (Reichelt 1900). Chrysophyta cysts from this slide are listed in Table 2. This slide contains two extinct Chrysophyta species, *Clericia spinigera* (non Frenguelli 1929) and *Cysta crassipocula*, in addition to 10 extinct taxa of diatoms (7 of which evidently are not known to have any Post-Sangamonian occurrences). Note authenticated label and writing of Fr. Hustedt, a close colleague of Reichelt from whom the sample cut for this slide was obtained. On this slide is found some of Hustedt's type material of *Surirella obscura* Reichelt ex Hustedt, a *nom. nov.* for the later homonym, *Surirella antiqua* (non Pantocsek) originally described by Reichelt (1900). Hustedt (1913, plate 295, figure 3) clearly indicated this diatom species was found in material from "(Mexiko, Schädel Dorenberg) (Reichelt)". This same slide contains topotypes of the following two extinct fossil diatoms which are not known in sediments younger than Sangamonian age: (1) *Navicula dorenbergii* Reichelt described by Heiden (1903, plate 243) and Hustedt (1966, figure 1681) as being from "menschlichen Schädels aus der Umgebung von Puebla, Mexiko"; and, (2) *Pinnularia subflexuosa* Hustedt (1934, plate 389) described from "Puebla, Mexiko" (see also Simonsen 1987, plate 389). Other slide preparations by Hustedt and Reichelt of diatom (and cyst) material taken from the Dorenberg Skull are known at: (1) Friedrich-Hustedt-Arbeitsplatz für Diatomeenkunde, Institut für Meeresforschung (BRM), 2850 Bremerhaven, Am Handelshafen 12, Germany; (2) Henri F. van Heurck Collection, Natuurwetenschappelijk Museum, Koninklijke Maatschappij voor Dierkunde van Antwerpen Natuurhistorisch Museum, Koningin Astridplein 26, B-2000, Antwerpen, België; and (3) Department of Marine Biology and Limnology, Section Marine Botany, University of Oslo, Blindern, Oslo 3, Norway. The slide shown above was described by Mahood (1978, p. 343). Assemblages from CAS 191090 and 73SM19 (obtained at the Hueyatlaço Archeological Site south of Puebla, Mexico, from Unit E of Cynthia Irwin-Williams described by Steen-McIntyre et al. 1981) occur in the C-P (Centric-Paucity) zone of VanLandingham (1990, 2000), and both assemblages have very similar Pennate to Centric Diatom ratios (81:1 for the former and 83:1 for the latter), as well as very similar diatom and cyst paleoecological and biostratigraphic profiles. Moreover, both assemblages contain extinct, age diagnostic diatoms and Chrysophyta cysts. This close correlation combined with the fact that *Coscinodiscus marginatus* (a common marine diatom) is very rarely found in non-marine deposits and is found in both CAS 191090 and 73SM19 (both of which are clearly non-marine) amounts to a diagnostic signature (or "fingerprint") for the two samples. It is significant that: (1) CAS 191090 was made from a sample that came from the Dorenberg Skull, (2) the 73SM19 (=VL 2120) sample contains bifacial tools from Unit E of Irwin-Williams, and (3) both samples are of Sangamonian age (based on diatom and cyst biostratigraphy) and indicate an age of > 80,000y BP for Puebla Man.

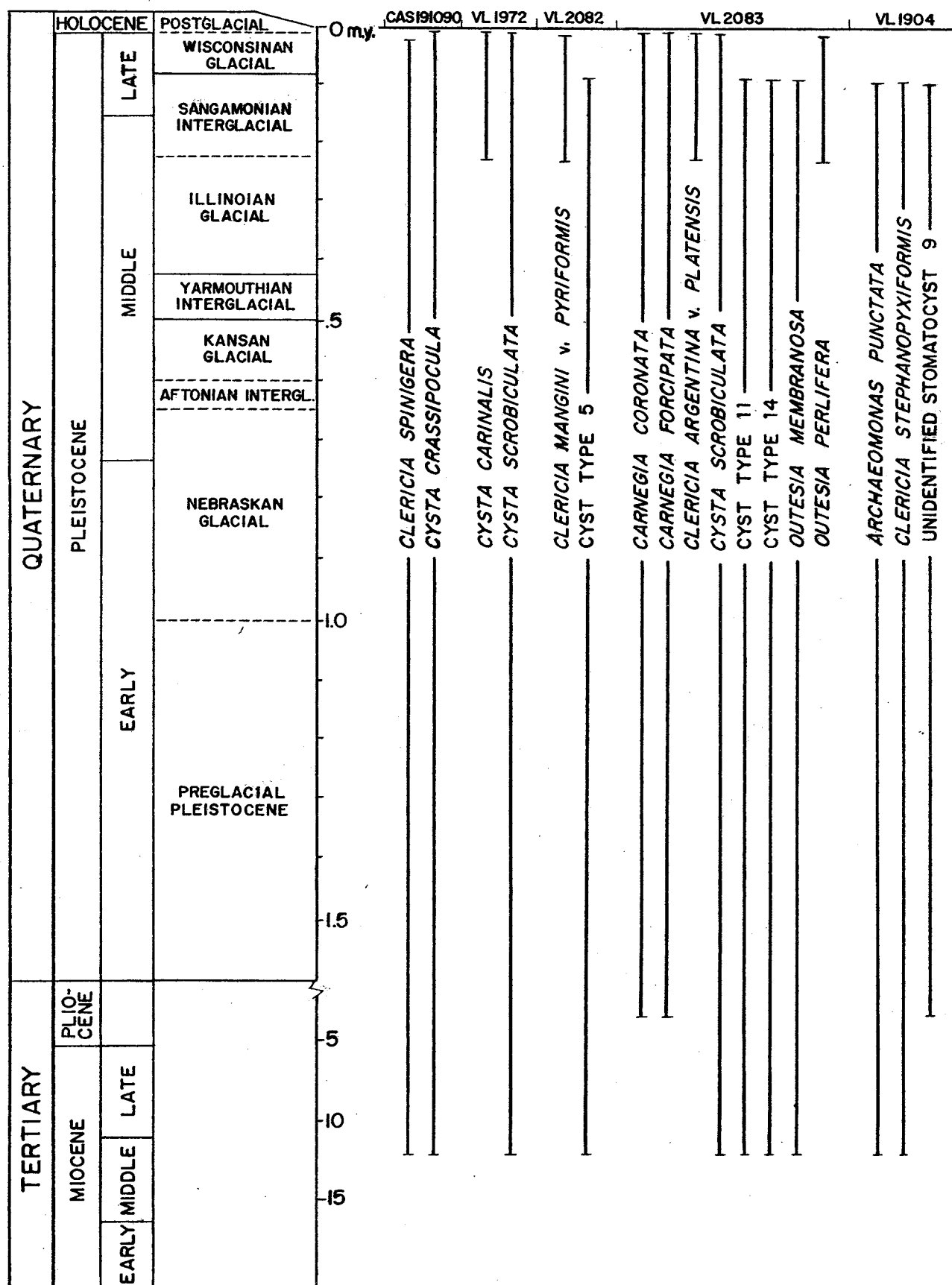


Figure 4. Extinct cyst taxa from samples of class 1 (CAS 191090, VL 1972, VL 2082, and VL 2083) and class 2 (VL 1904). NOTE: class 3 samples had no extinct taxa.