FIELD & LABORATORY

Volume XXV April-July, 1957 Numbers 2-3

Correlation by Insoluble Residues in the Austin Chalk of southern Dallas County, Texas

Thomas Ellis Williams

ABSTRACT

A partial composite section totalling 300 feet was constructed for the Upper Cretaceous Austin Chalk through correlation of overlapping portions of some of the larger incomplete sections. The correlations were effected primarily by insoluble residues in conjunction with thicknesses and weathering profiles.

Bar graphs based on insoluble percentages indicate that the formation is composed of the following principal lithologic types: marly limestone, marlstone-limestone, limy marlstone, and marlstone. These are variably distributed vertically and to a lesser degree laterally. The subdivisions of lower chalk, middle marl, and upper chalk are a function of the proportions in which the basic lithologic types are present in these portions of the column.

Based on insoluble residue correlations, composite sections of approximately 100 feet each were constructed for the basal lower chalk, the lower chalk–middle marl, and the middle marl–upper chalk contact. The intraformational contacts are both conformable and transitional.

The use of insoluble residue determinations to correlate incomplete sections is an effective, but exceedingly time-consuming procedure. Correlations are most readily made with proximate sections 30–40 feet or more, but the number of such sections in any given area is limited. The method is not recommended as a readily applicable technique for construction of a detailed stratigraphic section of the Austin Chalk in Dallas County.

The lower chalk, middle marl and upper chalk members of the Upper Cretaceous Austin Chalk are well exposed in southern Dallas County; the lower chalk is particularly well exposed along the White Rock Escarpment. The very gentle dip (approximately 40 feet per mile) in conjunction with low relief provides, however, few continuous stratigraphic sections in excess of 40 feet. Although a tripartite division has been employed in mapping the Austin in the Dallas area (Bryan, 1953; Overmyer, 1953; Ingels, 1957; Reaser, 1957; Watkins, 1954), the units have no type sections and have not as yet been accorded formal recognition.

It was thought that despite the lack of continuous exposures, a composite section could be constructed through correlation of overlapping portions of some of the larger exposed sections. Because of the similarity of lithologies between individual sections (interbedded chalks and marls), the physical description of the rock types was supplemented with determinations of their insoluble content.

The field work was conducted in the summer and fall of 1956. The writer acknowledges the advice and assistance of Dr. James E. Brooks, Dr. Arthur Richards, and Dr. David

L. Clark of the Department of Geology, Southern Methodist University. Thanks are also due to J. J. C. Ingels and D. F. Reaser, graduate students at Southern Methodist University with whom the writer collaborated in the measurement of several sections.

Procedure

Sections were measured with tape and hand level. Each unit was measured to the nearest inch, and samples were collected from all units. Colors were determined by use of the National Research Council Rock Color Chart, and are given in Munsell numerical designations on the graphic sections.

Samples were collected at representative levels within individual units, and each sample was thoroughly mixed prior to weighing, in an attempt to attain maximum sample uniformity. A standard sample weight of 100 grams was employed in all insoluble residue determinations. The samples were dissolved in dilute technical grade hydrochloric acid, washed, filtered, dried, and reweighed to determine the percentage of insoluble material.

All residues were examined with a hand-lens and many were checked with a binocular microscope; they were composed almost solely of clay-sized particles.

Stratigraphy and Sedimentary Characteristics of the Austin Chalk

The Austin Chalk in southern Dallas County is part of a broad band of Upper Cretaceous rocks which crop out near the inner edge of the Gulf Coastal Plain and dip gently to the east toward the Tyler Basin. In the area of study, the Austin Chalk is underlain disconformably by the Eagle Ford Shale and overlain conformably by the Taylor Marl (Smith, 1955, p. 17) ; both are included in the Gulfian Series of the Upper Cretaceous. According to the Dallas Petroleum Geologists (1941, p. 43), the Austin Chalk may be divided into four members (descending from 4 to 1) :

4. Chalk with interbedded thin layers of marl and calcareous shale....180′
3. Marl and calcareous shale with interbedded thin strata of chalk....220′
2. Chalk with interbedded thin layers of marl and calcareous shale....200′
1. Pebbly marl or chalk containing materials reworked from the Eagle Ford) (maximum thickness observed).... 4′

In an effort to ascertain whether or not the members of the Austin Chalk are characterized by certain lithologies, as represented by percentage of insolubles, bar graphs were plotted for each member. These graphs, based on relatively representative composite sections, show the cumulated thickness of each lithologic type. Thus for any given insoluble percentage the total measured footage for the member is shown. The graphs indicate that the Austin Chalk is composed of several principal compositional types which are variably distributed vertically and to a lesser degree laterally. The sub-divisions of lower chalk, middle marl, and upper chalk are a function of the proportions in which the basic lithologic types are present in those portions of the column.

The color of the fresh rock appears to be influenced by the position of the ground-water table. Specimens may have a bluish hue if collected along a stream bed, or 6-8 feet below ground level in fresh road cuts; they are also rather soft. When collected above the water table, or if allowed to dry, they are commonly neutral in color; medium gray to white, and are somewhat harder. Several such specimens failed to regain the bluish gray color despite immersion in water over a period of several days. The irreversibility of the change suggests that it may be due to oxidation of organic matter (Gignoux, 1950, p. 7). Limonitic staining from the weathering of marcasite concretions further complicates accurate color determinations.

Grain-size in all types is uniformly aphanitic. Although many of the beds contain an abundance of fossil fragments, the writer encountered but few of what might be considered good fossil localities. The best preserved fossils are *Exogyra ponderosa,* collected in float and in situ in the beds immediately below the middle marl-upper chalk contact. However, in Cretaceous rocks at least, fossil localities and well exposed sections rarely coincide.

Lower Chalk.—The lower chalk is underlain disconformably by the Eagle Ford Shale and overlain conformably by the middle marl. The change from the lower chalk to the middle marl is gradual and extends over a 15-foot interval indicated on Plate 1 as a transition zone.

The principal lithologic type of the lower chalk is that of a marly limestone[1] ranging from 8% to 12% insoluble. It is relatively resistant to weathering and forms prominent ledges in outcrop. The existence and thickness of these ledges, which appear as single beds in fresh outcrops, is largely a function of the degree of weathering. Such "beds" may be as much as five feet thick in relatively fresh exposures (e.g., freshly-spalled resistant ledges) yet grade laterally into several "beds" at the weathered ends of the same outcrop. This is particularly noticeable in new road cuts through the White Rock Escarpment. In other words, the rock is sufficiently homogenous so that the fine variations in the vertical distribution of solubles and insolubles which produce "beds" on weathered surfaces are not apparent on fresh surfaces.

The rock is white to medium light gray when fresh (and dry) ; it is frequently weathered light-tan due to limonitic staining from weathered marcasite concretions. When beds in the 8–12% insoluble range occur adjacent to each other, those having the larger insoluble content are generally the less resistant.

Beds whose insoluble contents are grouped around 15% and 20% (marlstone-limestones) are the next most common lithologies. In the weathering profile, both types are usually more or less recessed, although they are somewhat prominent when situated between beds having a greater insoluble content. They range from very light gray to light gray, with the color-intensity within that range being more or less directly proportional to insoluble content. The beds weather to shaly flakes that spall more or less parallel to the outcrop surface, and show little or no relation to the bedding.

The horizontally fluted appearance of weathered outcrops, prevalent in the lower chalk and upper chalk, is due largely to the presence of soft, thin (2–3″) beds of limy marlstone (insoluble content of 25–35%) ; higher values are not uncommon.) They generally weather yellowish to light olive-gray. When wet they are soft and somewhat plastic.

[1]In the application of rock names to the various basic lithologies of the Austin Chalk, this paper follows Correns' scheme as presented by Pettijohn (1957, fig. 99, p. 410). The terminology has been somewhat modified in accordance with the recommendations of Rodgers (1954, p. 228) as regards the use of the terms limestone and marlstone versus chalk and marl. The term marlstone is herein applied to indurated sedimentary rocks consisting dominantly of well-mixed argillaceous and calcareous matter, each forming at least a quarter of the mixture. Further subdivisions are in accordance with Correns' scheme as shown in Plate 1.

Such units are very easily weathered and form deep indentations. Their true color appears to be heavily masked by limonitic staining. In a fresh road cut across the White Rock Escarpment, one such seam could be traced laterally from a weathered zone into unaltered bed rock where it was somewhat more resistant, colored medium gray, and completely lacking in clay-like aspect.

Middle Marl.—The middle marl is underlain conformably by the lower chalk and overlain conformably by the upper chalk. Smith (1955, p. 14) describes the middle marl-upper chalk contact as "an abrupt change in lithology from predominantly chalky marl beds below, to hard chalk beds 1–5 feet thick with thin interbeddings of marl or chalky marl above." However it is not felt that the use of the word "abrupt" is justified, and the middle marl-upper chalk contact is herein considered transitional.

The middle marl is composed of interbedded units of three major types; a marly limestone and two marlstone-limestones. The marly limestone is essentially the same type which comprises most of the lower chalk (although it has a slightly higher insoluble content—13%) and exhibits similar lithologic properties. The marlstone-limestones are both gray to very light gray; many beds possess a yellowish hue in response to limonitic staining but are of equivalent color value (NRC, 1948). One is 16–18% insoluble and the other 20–23% insoluble; the latter appears to be the predominant units in the middle marl. The 16–18% insoluble beds form many of the more resistant units along with the marly limestones. This is of importance in demonstrating that the relative clay content (and hence relative resistance to weathering and erosion) is the controlling factor. As a result of the increased clay content and consequent decreased resistance to weathering, the best exposures of the middle marl are more or less restricted to the outer bends of stream meanders and very recent road cuts.

Upper Chalk.—The upper chalk is underlain conformably by the middle marl and overlain conformably by the Taylor Marl (Smith, 1955, p. 17). However, immediately to the south in northern Ellis County, there is the beginning of a disconformity (Reaser, 1957, p. 14) which increases in magnitude southward (Stephenson, 1937, p. 138).

Observations on the lithology of the upper chalk are restricted to approximately the lower 40 feet. This portion cannot be considered typical of the unit as a whole. Smith (1955, p. 1) states:

"It was found that the upper chalk is divisible into two lesser units . . . lower 136 feet is composed of hard chalk marl beds with thin interbeddings of marl or chalk marl . . . the upper 60 feet of the 'upper chalk' is a chalk marl transitional between the Austin and Taylor . . ."

The principal lithologic unit of the upper chalk in sections studied in this report is a marly limestone with insoluble content ranging from 10–14%. It is white to very light gray when fresh and appears to possess a characteristic subconchoidal fracture (this fracturing property has been observed, however, in rocks of similar insoluble content in the lower chalk). The upper chalk also contains thin limy marl interbeds and gently indented marlstone-limestone units similar to those of the lower chalk (30–35% insoluble and 20–25% insoluble, respectively). The rather close lithologic similarity between the lower chalk and the lower portion of the upper chalk suggests a common mode of origin under similar depositional conditions.

Results

In an effort to test the method of correlation by insoluble residues, five sections were measured along the White Rock Escarpment in the Cedar Hill area. The distance along the strike between the northernmost and southernmost sections is approximately four miles; the maximum distance across strike 1.5 miles. Three of the sections are correlated as shown in Plate 1. Although the correlation does not demonstrate an exact bed-for-bed equivalency, the general similarity of the lithologic sequence in conjunction with the relation of the sections to the underlying Eagle Ford contact indicates their essential equivalence.

Plate 1 also shows what is believed to be a valid correlation across the contact between the lower chalk and middle marl. To place these sections at least approximately in the local stratigraphic column, the contact has been arbitrarily placed in the middle of a transition zone, 200 feet above the base, using the 200-foot thickness figure for the lower chalk given by the Dallas Petroleum Geologists (*op. cit.* p. 3). Sections 9, 37, 40, and 48 were measured along a 2.5-mile stretch of Ten Mile Creek which drains roughly perpendicular to the regional strike. The area has been somewhat faulted, but the relation between topography and regional dip (as best as can be determined in consideration of the poor topographic control for the area) is consistent with the lithologic evidence for equivalency. Section 48 was measured on a tilted fault block (graben) situated immediately upstream of Section 40. The correlation between Sections 9, 37, and 40 was made within a 15-foot interval, here termed the transition zone (see Plate 1, 194′–209′). In further supsport of the belief that the aforementioned interval represents the contact zone, is the stratigraphic relationship within a well-developed scour and fill structure in Section 37. The scour is in the lower chalk and the fill is composed of very typical middle marl.

The section showing the middle marl-upper chalk contact (Plate 1, Section 29) is believed to be both reliable and typical; similar sections have been measured at two other localities and a reasonably good bed-for-bed correlation exists between the three sections. The correlation is based on the 415′–432′ interval which has been observed to be persistent along strike for as far as six miles. The two sections cited by Smith (Sections 15 and 22, 1955, p. 10, fig. 1) as being representative of the effectiveness of the "bedding plane" correlation method lie within this portion of the column. Smith (1955, p. 12; p. 14) placed the contact between the middle marl and upper chalk at what corresponds to the 420′ level of Plate 1, a decision which is consistent with the observations of the writer. The 1.5′ bed immediately below the contact serves as an excellent marker-bed, and for this reason has been arbitrarily selected as the uppermost bed of the middle marl. It is characteristically indented, maintains a remarkably uniform thickness over a wide area, and typically supports a limited amount of vegetation. As in the case of the contact between the lower chalk and middle marl, the middle marl-upper chalk contact was placed 420′ above the base of the Austin on the basis of the approximate thickness figures for the subdivisions of the Austin given by Dallas Petroleum Geologists (*op. cit.* p. 3).

Conclusions

The use of insoluble determinations to correlate incomplete sections within the Austin Chalk, and thus construct a composite stratigraphic section proved to be an effective, though time-consuming procedure. Correlations are most readily made with sections of 30-40 feet or more; use of sections of lesser magnitude materially reduces the certainty of the correlation. Unfortunately, the number of such sections in any given area is limited. Consequently, I was not able to prepare a complete columnar section in the area of study.

Correlation by insoluble residues appears to be most effective between rather closely spaced sections along major streams which trend roughly perpendicular to the regional strike (e.g., Ten Mile Creek). Stream beds provide exposures which have weathered to an optimum degree and possess characteristic weathering profiles. Such sections are usually exposed in their entirety with a minimum of cover since they are swept clean periodically by floods. (This is in contrast to road cuts, which are frequently covered with debris before sufficient time has elapsed to enable normal weathering processes to subdivide the outcrop into a maximum number of units.) Exposure of large tracts of bed rock along parts of the stream facilitates the detection of complications arising from faulting.

In an objective evaluation of the method, it must be noted that it is exceedingly time-consuming. Sections must be studied in detail and measured carefully. The presence of scour and fill structures may obscure the true stratigraphic succession and units as thin as two inches can prove to be significant. It is not unusual to measure several duplicate sections prior to effecting a correlation. Consequently correlation by insoluble residues does not appear to be a readily applicable technique in the construction of a stratigraphic section for the Austin Chalk in Dallas County.

REFERENCES CITED

BRYAN, WILSON, 1953, Geology of the Oak Cliff quadrangle, Dallas County, Texas, Field and Laboratory, v. 21, pp. 34-43.

CHEATUM, B. N., 1951, Geology of the Mountain Creek Lake area, Dallas County, Texas, Unpublished Master's Thesis, University of Oklahoma.

DALLAS PETROLEUM GEOLOGISTS, 1951, Geology of Dallas County, Texas, 134 pp.

GIGNOUX, MAURICE, 1955, Stratigraphic geology: English translation of fourth edition; 1950, by G. G. Woodford, San Francisco, W. H. Freeman and Co., 682 pp.

INGELS, J. J. C., 1957, Geology of the Lancaster quadrangle, Dallas and Ellis Counties, Texas, Unpublished Master's Thesis, Southern Methodist University.

NATIONAL RESEARCH COUNCIL, 1948, Rock-color Chart: Washington, D. C.

PETTIJOHN, F. J., 1957, Sedimentary rocks: 2nd ed., N. Y., Harper and Brothers, 718 pp.

OVERMYER, D. O., 1953, Geology of the Pleasant Grove area, Dallas County, Texas, Field and Laboratory, v. 21, pp. 112-119.

REASER, D. F., 1957, Geology of the Ferris quadrangle, Dallas and Ellis Counties, Texas, Unpublished Master's Thesis, Southern Methodist University.

RODGERS, JOHN, 1954, Terminology of limestone and related rocks: an interim report, J. Sediment. Petrol., v. 24, pp. 225-234.

STEPHENSON, L. W., 1937, Stratigraphic relations of the Austin, Taylor, and equivalent formations in Texas, U. S. Geol. Survey, Prof. Paper 186-G, pp. 133-146.

SMITH, C. I., 1955, Stratigraphy of the upper Austin in the vicinity of Dallas, Texas, Unpublished Master's Thesis, Louisiana State University and Agricultural and Mechanical College.
WATKINS, J. L., 1954, Geology of the Cedar Hill quadrangle, Dallas and Ellis Counties, Texas, Field and Laboratory, v. 22, pp. 70-78.

A Note on "Vinzent's Texanische Pflanzen, 1847"

S. W. Geiser

I

The *Botanische Zeitung, 5,* 447-48, May, 1847, printed the following note by Otto Boeckeler of Varel a/Jahde, Grand-duchy of Oldenburg. As no further notice appeared in subsequent volumes of the journal, and as it poses a problem that has concerned students regarding the identity of the collector "Vinzent" in Texas, I translate the note freely:

Herr Vinzent some years ago settled in Rusk County, northeastern Texas, not far from Crockett. At my suggestion he has devoted himself to collecting plants from that region in considerable numbers; and some time ago his first shipment of dried plants arrived for me to dispose of. After the names of the plants have been determined (which Professor [Moritz] Seubert has kindly undertaken), I shall offer them to botanical students. The lots for sale include 100 species, and will be disposed of at the extremely moderate price of 1 louis d'or, or 5⅔ thalers per century [about $4.00]. They are in excellent condition. This first century contains only phanerogamous plants (among them, two new Compositae, named by Dr. C. H. Schultz, and several new grasses, which I—except for an *Agrostis*—will be able to distribute generally through the collections).

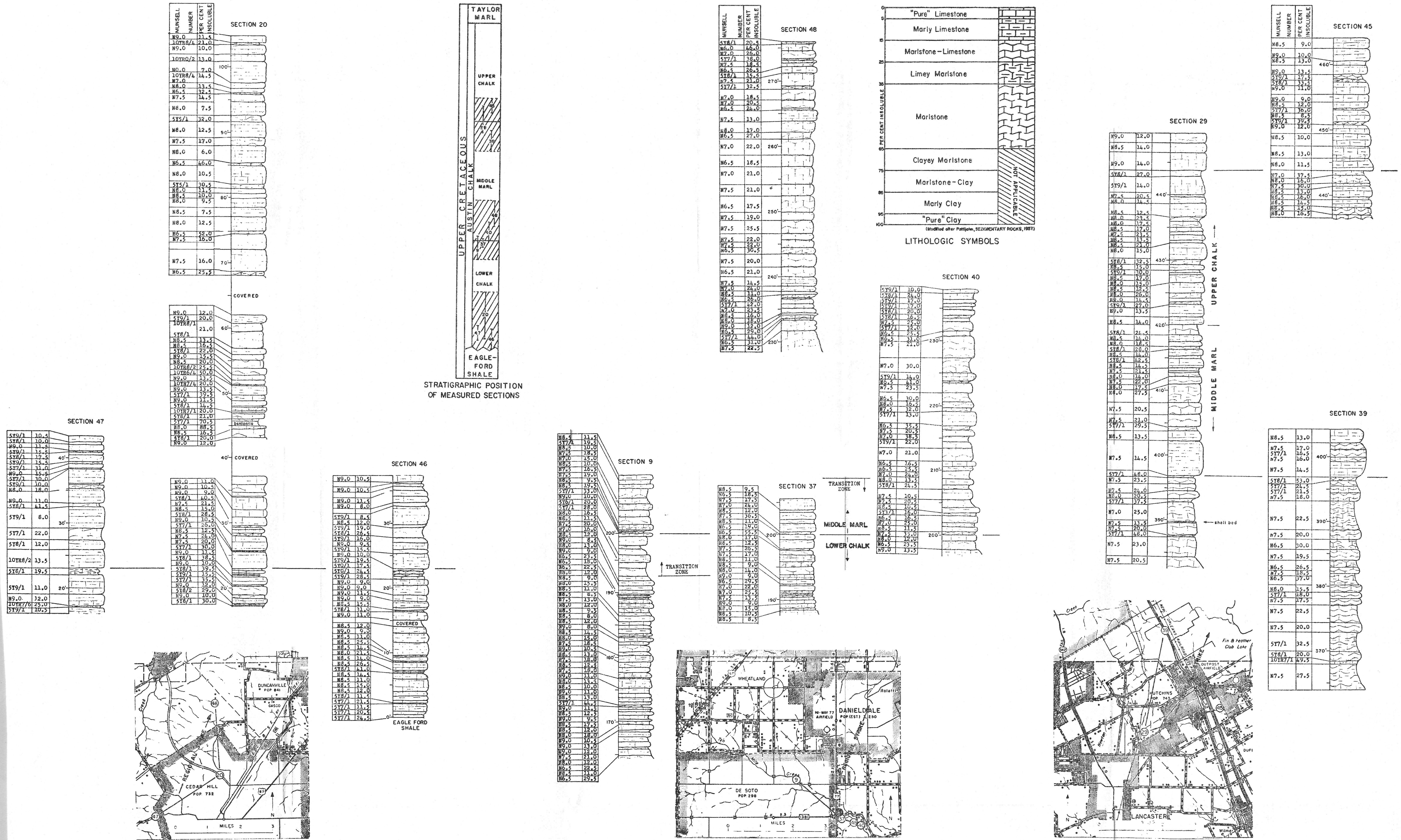
Professor Seubert in Carlsruhe has very kindly offered to take orders for Vinzent's plants and to ship them out; and those subscribers who would find it more convenient to order them from Carlsruhe than from Varel can do so. Also, Professor Buchinger of Strassburg, and *Apotheker* [Johann Nikolaus II] Buek in Frankfurt a/Oder have indicated a willingness to help in the distribution of the plants, in similar fashion.

If Mr. Vinzent is encouraged to continue in his collecting, through the disposal of his plants, without doubt we may soon be able to anticipate a second, larger shipment from this region, which may furnish much that is new and interesting.

The foregoing notice, when it came to my attention ten years ago, piqued my interest in a Texan collector who has long been lost sight of. Ignatius Urban, in his historical publications on the Berlin botanical museum (1881, 150, 162; and 1916, 407) mentions a collection of Texas plants received from Vinzent "about 1847"; but only a few references to Vinzent or his plants seem to have gotten into the literature. That the first century (of 1847) was disposed of, seems to be clear, but probably was not very prominently or widely distributed. There are Vinzent specimens in the British Museum (Natural History), the Jardin des Plantes

SOUTHERN METHODIST UNIVERSITY
DEPARTMENT OF GEOLOGY

PLATE I



BASE OF LOWER CHALK

LOWER CHALK – MIDDLE MARL CONTACT

MIDDLE MARL – UPPER CHALK CONTACT

CORRELATION OF AUSTIN CHALK IN SOUTHERN DALLAS COUNTY, TEXAS

T E WILLIAMS 1957