Surface Geology of the Jeptha Knob Cryptoexplosion Structure, Shelby County, Kentucky

GEOLOGICAL SURVEY PROFESSIONAL PAPER 1151-B

Prepared in cooperation with the Kentucky Geological Survey

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By EARLE R. CRESSMAN

CONTRIBUTIONS TO THE GEOLOGY OF KENTUCKY

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New information on the character of an enigmatic structural feature

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CONVERSION FACTORS

Metric unit		Inch-Pound equivalent
Length		
millimeter (mm)	= 0.03937	inch (in)
meter (m)	= 3.28	feet (ft)
kilometer (km)	= .62	mile (mi)
Area		
square meter (m^2)	= 10.76	square feet (ft^2)
square kilometer (km^2)	= .386	square mile (mi^2)
hectare (ha)	= 2.47	acres
Volume		
cubic centimeter (cm^3)	= 0.061	cubic inch (in^3)
liter (L)	= 61.03	cubic inches
cubic meter (m^3)	= 35.31	cubic feet (ft^3)
cubic meter	= .00081	acre-foot (acre-ft)
cubic hectometer (hm^3)	=810.7	acre-feet
liter	= 2.113	pints (pt)
liter	= 1.06	quarts (qt)
liter	= .26	gallon (gal)
cubic meter	= .00026	million gallons (Mgal or 10^6 gal)
cubic meter	= 6.290	barrels (bbl) (1 bbl=42 gal)
Weight		
gram (g)	= 0.035	ounce, avoirdupois (oz avdp)
gram	= .0022	pound, avoirdupois (lb avdp)
metric tons (t)	= 1.102	tons, short (2,000 lb)
metric tons	= 0.9842	ton, long (2,240 lb)
Specific combinations		
kilogram per square centimeter (kg/cm^2)	= 0.96	atmosphere (atm)
kilogram per square centimeter	= .98	bar (0.9869 atm)
cubic meter per second (m^3/s)	= 35.3	cubic feet per second (ft^3/s)

Metric unit		Inch-Pound equivalent
Specific combinations—Continued		
liter per second (L/s)	= .0353	cubic foot per second
cubic meter per second per square kilometer [($m^3/s)/km^2$]	= 91.47	cubic feet per second per square mile [($ft^3/s)/mi^2$]
meter per day (m/d)	= 3.28	feet per day (hydraulic conductivity) (ft/d)
meter per kilometer (m/km)	= 5.28	feet per mile (ft/mi)
kilometer per hour (km/h)	= .9113	foot per second (ft/s)
meter per second (m/s)	= 3.28	feet per second
meter squared per day (m^2/d)	= 10.764	feet squared per day (ft^2/d) (transmissivity)
cubic meter per second (m^3/s)	= 22.826	million gallons per day (Mgal/d)
cubic meter per minute (m^3/min)	=264.2	gallons per minute (gal/min)
liter per second (L/s)	= 15.85	gallons per minute
liter per second per meter [(L/s)/m]	= 4.83	gallons per minute per foot [(gal/min)/ft]
kilometer per hour (km/h)	= .62	mile per hour (mi/h)
meter per second (m/s)	= 2.237	miles per hour
gram per cubic centimeter (g/cm^3)	= 62.43	pounds per cubic foot (lb/ft^3)
gram per square centimeter (g/cm^2)	= 2.048	pounds per square foot (lb/ft^2)
gram per square centimeter	= .0142	pound per square inch (lb/in^2)
Temperature		
degree Celsius (°C)	= 1.8	degrees Fahrenheit (°F)
degrees Celsius (temperature)	=[(1.8×°C)+32]	degrees Fahrenheit

SURFACE GEOLOGY OF THE JEPTHA KNOB CRYPTOEXPLOSION STRUCTURE, SHELBY COUNTY, KENTUCKY

By EARLE R. CRESSMAN

ABSTRACT

The Jeptha Knob crytoexplosion structure, described by Bucher in 1925, was remapped in 1973 as part of the U.S. Geological Survey and the Kentucky Geological Survey cooperative mapping program. The knob is in the western part of the Blue Grass region. Hilltops in the rolling farmland adjacent to the knob are underlain by the nearly flat-lying Grant Lake and Calloway Creek Limestones of middle Late Ordovician age, and the valleys are cut in interbedded limestone and shale of the Clays Ferry Formation of late Middle and early Late Ordovician age. Precambrian basement is estimated to be 4,000 ft below the surface. The mapped area is 50 miles west of the crest of the Cincinnati arch; the regional dip is westward 16 ft per mile. The 38th parallel lineament is 50 miles to the south.

The structure, about 14,000 ft in diameter, consists of a central area 6,300 ft in diameter of uplifted Clays Ferry Formation surrounded by a belt of annular faults that are divided into segments by radial faults.

The gross structure of the Clays Ferry Formation is that of a broad dome, but some evidence indicates that, in detail, the beds are complexly folded. The limestone of the Clays Ferry is brecciated and infiltrated by limonite. The brecciation is confined to single beds, and there is no mixing of fragments from different beds. A small plug of the Logana Member of the Lexington Limestone (Middle Ordovician) has been upfaulted at least 700 ft and emplaced within the Clays Ferry. The central uplift is separated by high-angle and, in places, reverse faults from the belt of annular faulting.

The concentric faults in the zone of annular faults are extensional, and the general aspect is of collapse and inward movement. Lenses of breccia are present along many of the concentric faults, but not along the radial faults. At least some of the breccia was injected from below. The youngest beds involved in the faulting are in the Bardstown Member of the Drakes Formation of late Late Ordovician age.

The faulted and brecciated beds are overlain by nearly horizontal dolomite and shale of Early and Middle Silurian age. The basal 5 ft of the oldest Silurian unit, the Brassfield Formation, contains calcarenite and calcirudite composed, in large part, of locally derived fragments from the Upper Ordovician formations.

The Jeptha Knob structure was formed in latest Late Ordovician or earliest Early Silurian time. At the time of formation, the area was either very slightly above or very slightly below sea level; the sediments were already largely indurated. At the onset of Silurian deposition, the area of the central uplift was probably a broad shallow depression not more than about 15 ft deep, possibly surrounded by a rim of Upper Ordovician rocks or rock fragments.

The origin of the Jeptha Knob structure cannot be determined from the available data. Shatter cones and coesite, considered by many to be definitive criteria for origin by impact, have not been found. On the other hand, geophysical studies indicate that there is no coincident uplift of the basement, and there is no certain relation of Jeptha Knob to any obvious structural trend.

INTRODUCTION

The peculiar circular structure of Jeptha Knob, Shelby County, Ky., was described in a paper by Walter H. Bucher in 1925. Bucher (1925, p. 227) interpreted the structure as being the result of the rise of a column of rock, driven by an unknown force of deep-seated volcanic origin, and applied the term "cryptovolcanic," originally coined by Branca and Frass (1905) for the Steinheim basin of southern Germany. Subsequently, Bucher (1933) applied the cryptovolcanic hypothesis to other similar features in the United States and proposed that the driving force was a sudden release of pent-up volcanic gases.

In 1936, Boon and Albritton suggested that some of the "cryptovolcanic" features described by Bucher might have resulted from meteorite impact, but at that time there were no known definitive criteria for impact origin. More than two decades later, Dietz (1959) suggested that shatter cones were diagnostic of impact. He based his opinion on the observation that shatter cones were known from "cryptovolcanic" structures, but were completely absent from rocks known to have been subjected to volcanic explosion. He also believed that phreatic explosions were of inadequate force to produce the cones. In the same paper, Dietz (1959) proposed that the term "cryptoexplosion" be used rather than "cryptovolcanic," because it was less specific genetically. Subsequent studies of cryptoexplosion structures by different workers showed that if the deformed beds are rotated to their prestructure configuration, the shatter cones commonly point upward and inward, an orientation consistent with an origin by impact from above but difficult to explain by an explosive force from below (Wilshire and others, 1972, p. H26). More recently, Roddy and Davis (1977) showed both by experiment and by theoretical considerations that pressures of 20–60 kbar are required for the formation of shatter cones; they noted that no known endogenic process can produce pressures of this magnitude in near-surface rocks, and nearly all workers now consider shatter cones as definitive evidence of impact (Milton, 1977, p. 703). Beginning in the late 1950's, studies of known and suspected impact structures have revealed that many contain fused glass, disordered minerals, coesite and stishovite (high-pressure polymorphs of silica), and basal deformation lamellae in quartz (Short and Bunch, 1968); all these features again indicate pressures that could be attained in near-surface rocks only by impact.

Thus, evidence accumulated that many "cryptovolcanic" structures were most probably of impact origin. Bucher, however, maintained to the end of his career that most of the structures were cryptovolcanic (Bucher, 1963), and his views were supported by others, including Amstutz (1964), Snyder and Gerdemann (1965), and Nicolaysen (1972). Their arguments were based mostly on evidence for structural control of the location of the features.

Although many other cryptoexplosion structures have been investigated intensively in the last quarter of a century, little additional work has been published on Jeptha Knob, which had originally stimulated Bucher's interest. Jillson (1962) described some faults on the southern periphery of the structure that were newly exposed by roadcuts along Interstate Highway 64, and Seeger (1968) conducted a gravity and magnetic study, but until recently the only geologic map available has been the one originally published by Bucher.

In 1973, I mapped Jeptha Knob at a scale of 1:24,000 as part of the cooperative mapping program of the U.S. Geological Survey and the Kentucky Geological Survey; about two-thirds of the structure is in the Waddy 7½-min quadrangle and one-third in the Shelbyville 7½-min quadrangle. Geologic maps of both quadrangles are published as U.S. Geological Survey Geologic Quadrangle Maps (Cressman, 1975a, b). The purpose of this report is to offer observations on the surface geology that could not be presented in the format of the Geologic Quadrangle Map series and to discuss their implications concerning the origin of the structure. I have not made an exhaustive search of the literature, and the discussion of the origin is cursory. The paper is published chiefly with the hope that others involved more directly with the study of cryptoexplosion and impact structures will find the description useful.

REGIONAL SETTING

Jeptha Knob is in Shelby County, west-central Kentucky, about 5 miles east-southeast of Shelbyville, between U.S. Highway 60 on the north and Interstate Highway 64 on the south. Physiographically, the area is in the western part of the Blue Grass region, which is nearly coextensive with the area of outcrop of Ordovician rocks in central Kentucky. The surrounding country consists of gently rolling farmland where hilltops are at altitudes of 800 to 850 ft; the hilltops are underlain by limestone of Maysvillian (middle Late Ordovician) Age, and the valleys are eroded in interbedded limestone and shale of Edenian (early Late Ordovician) Age. Jeptha Knob is mostly wooded and rises well above the surrounding countryside to an altitude of 1,188 ft; it is a conspicuous topographic feature, particularly where viewed from the west.

In 1922, when Bucher mapped the knob, much of it was cleared and farmed. Since then, most of the farms have been abandoned, and forests now cover the slopes. As a result, some of the features described and illustrated by Bucher in his report of 1925 can no longer be observed.

Jeptha Knob is on the west flank of the Cincinnati arch about 50 miles west of the crest; exclusive of the disturbed area, the beds across the Waddy and Shelbyville quadrangles dip westward an average of about 16 ft per mile. The 38th-parallel lineament of Heyl (1972) is nearly 50 miles to the south (fig. 1). Heyl described the 38th-parallel lineament as consisting of a zone of faults and intrusions that extends from northeast Virginia to south-central Missouri. In Missouri, Heyl defined the lineament in part by the westward alinement of the Crooked Creek, Decaturville, and Weaubleau Creek cryptoexplosion structures, but Jeptha Knob is too distant from the lineament to be considered part of it or to have any obvious genetic relation to it.

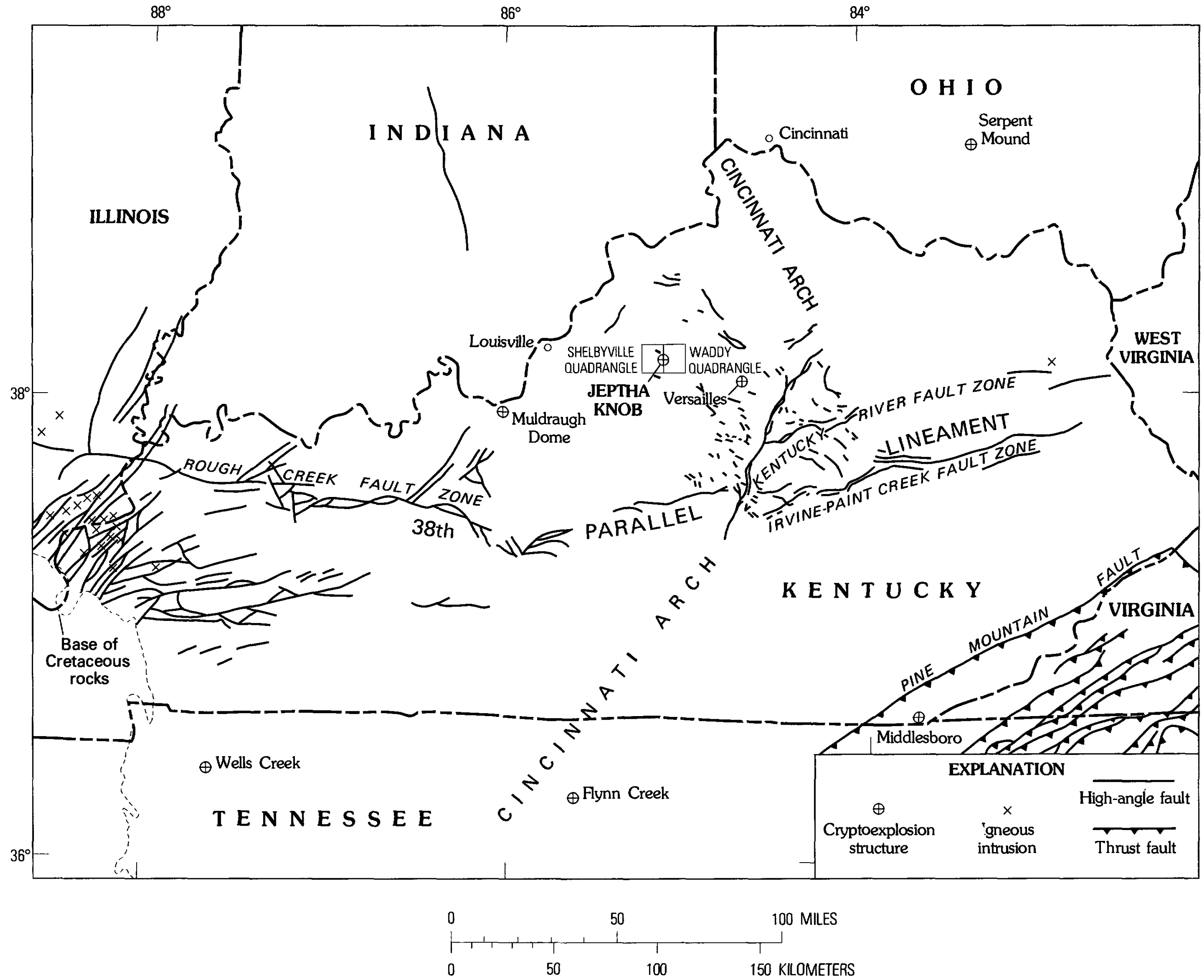

FIGURE 1.—Map showing structural features of Kentucky and parts of adjacent States. Structure in central Kentucky from unpublished compilation by D. F. B. Black; rest of map from Tectonic Map of the United States (U.S. Geological Survey and American Association of Petroleum Geologists, 1961).

Of the cryptoexplosion structures shown, Middlesboro (Dietz, 1966), Flynn Creek (Roddy, 1968), Wells Creek (Wilson and others, 1968), and Serpent Mound (Dietz, 1960) contain shatter cones and are probably of impact origin.

Jeptha Knob is approximately in line with, but 12 miles northwest of a zone of en echelon faults that extends north-northwest from the intersection of the Kentucky River and Irvine-Paint Creek fault zones (fig. 1; Black and others, 1976). Northwest of Jeptha Knob, D. F. B. Black (written commun., 1978) has found evidence of a lineament, defined by a monoclinal fold, a few short faults, and small structural basins, that has the same strike and is in line with the zone of en echelon faults. These features are depicted on an excellent structural map compiled by Black (1978). Black concluded that the lineament and the en echelon fault zone are the surface expression of a wrench fault in the basement that passes very near, if not beneath, Jeptha Knob. The evidence cited by Black for the existence of the lineament northwest of Jepth Knob is suggestive but not conclusive; the monoclinal fold is gentle and inconspicuous, the faults are short and widely spaced, and the structural basins are small.

Major faulting in central Kentucky took place in the Precambrian, in the Early and Middle Cambrian (Webb, 1969), between the Middle Silurian and

Middle Devonian (Simmons, 1966), and probably at the end of the Paleozoic. The two main periods of doming along the Cincinnati arch were in post-Middle Silurian and pre-Middle Devonian time and at the time of the Appalachian orogeny (McFarlan, 1943, p. 132).

Regional gravity and magnetic maps (Watkins, 1963; Zietz and others, 1968) show no unique features in the area of the knob. Similarly, more detailed gravity and aeromagnetic maps of central Kentucky (Black and others, 1976) show no peculiarities in the vicinity.

SYSTEM	SERIES	GROUP, FORMATION, MEMBER Heavy line to left of column marks units that crop out in structure	THICKNESS, IN FEET	DESCRIPTION
SILURIAN	Middle	Louisville Limestone Waldron Shale Laurel Dolomite Osgood Formation	75	Concealed by soil and chert residuum. Presence inferred from fossils identified in residuum (Foerste, 1931, p. 182) and from thickness of interval
SILURIAN	Lower	Brassfield Formation	18	Finely crystalline calcareous dolomite; contains abundant small vugs; angular fragments of very finely crystalline dolomite present in some beds; basal 3 to 6 ft. in several localities is calcarenite and calcirudite consisting largely of fragments reworked from Upper Ordovician formations
		UNCONFORMITY		
ORDOVICIAN	Upper	Drakes Formation: Bardstown Member Drakes Formation: Rowland Member	25–50 50	Nodular-bedded fossiliferous limestone and shale Argillaceous, dolomitic limestone
ORDOVICIAN	Upper	Grant Lake Limestone	140	Nodular-bedded fossiliferous limestone and shale
ORDOVICIAN	Upper	Calloway Creek Limestone	60	Fossiliferous limestone and minor interbedded shale; 6–8 ft. thick calcarenite at top
ORDOVICIAN	Upper	Clays Ferry Formation	300	Interbedded limestone and shale
	?			
ORDOVICIAN	Middle	Lexington Limestone[1]: Sulphur Well Member Perryville Limestone Member Tanglewood Limestone Member Grier Limestone Member Logana Member Curdsville Limestone Member	200	Fossiliferous limestone Calcilutite Calcarenite Fossiliferous limestone Brachiopod coquina, calcisiltite, and shale; 24–56 ft. above base of formation. Calcarenite
ORDOVICIAN	Middle	High Bridge Group[2]: Tyrone Limestone Oregon Formation Camp Nelson Limestone "Wells Creek Dolomite"[2]	92 24 385 90	Calcilutite Finely crystalline dolomite Calcilutite and dolomite Argillaceous dolomite
		UNCONFORMITY		
ORDOVICIAN	Lower	Knox Group[3]	2000	Finely to coarsely crystalline vuggy dolomite
CAMBRIAN		Conasauga Formation[4] Rome Formation[4] Basal sand	[5]1200	Limestone and shale Shale and siltstone Sandstone
		UNCONFORMITY		
PRECAMBRIAN				

[1]Thickness and presence of members based on regional thickness and facies trends
[2]"Wells Creek Dolomite" is a driller's term. Thicknesses from Stoll Oil Refining Company No. 1 Whittaker well (Freeman, 1953, p. 280)
[3]Thickness from isopach map of Knox Group, McGuire and Howell, 1963, p. 4–17
[4]As used by McGuire and Howell, 1963, p. 2–2
[5]Thickness of pre-Knox Cambrian inferred from depth to basement—as shown by Bayley and Muehlberger, 1968

FIGURE 2.—Stratigraphic section at Jeptha Knob.

STRATIGRAPHY

The stratigraphic section of Jeptha Knob is summarized in figure 2. Thicknesses given for units above the Knox Group are reliable, but the thicknesses of the units from the top of the Knox to the Precambrian are based on regional thickness trends determined from sparse data and are approximate. More detailed descriptions of the exposed formations are given in the geologic maps of the Shelbyville and Waddy quadrangles (Cressman, 1975a, b).

The stratigraphic units that I have mapped differ somewhat from those mapped by Bucher (1925, p. 195), who distinguished his units largely on the basis of their faunas. As part of the mapping program in Kentucky, the Upper Ordovician rocks have been divided into lithologically defined formations and members (Weir and Greene, 1965; Weir and others, 1965; Peterson, 1970). These units, which have been mapped throughout many quadrangles, proved satisfactory for mapping in the faulted area of the knob. In figure 3, the units mapped by Bucher are compared with those used in the recent mapping.

STRUCTURE

The geologic map (pl. 1) involves much interpretation. Much of the knob is heavily forested, and chert float derived from the Silurian rocks that cap the heights covers large areas of the hillsides and interfluves. Most exposures are in stream valleys and gullies, and the structure must commonly be interpolated for considerable distances between drainages. In areas of excellent exposure, as in the roadcuts along Interstate Highway 64, the structure is invariably more complex than that which could be inferred in areas of sparse exposure.

The Jeptha Knob cryptoexplosion structure is about 14,000 ft in diameter, measured from outermost fault to outermost fault. It consists of a nearly circular domal uplift of brecciated rocks of the Clays Ferry Formation (upper Middle and lower Upper Ordovician) separated by faults from an annular belt in which Maysvillian (middle Upper Ordovician) and Richmondian (upper Upper Ordovician) formations have generally been dropped downward by concentric faults, which are in turn offset by radial faults. The knob is capped by nearly flat-lying Lower and Middle Silurian rocks that truncate the deformed rocks of the structure. My mapping has shown that the concentric faults of the annular belt are more common and more continuous than shown by Bucher and that radial faults are present, none of which were mapped by Bucher.

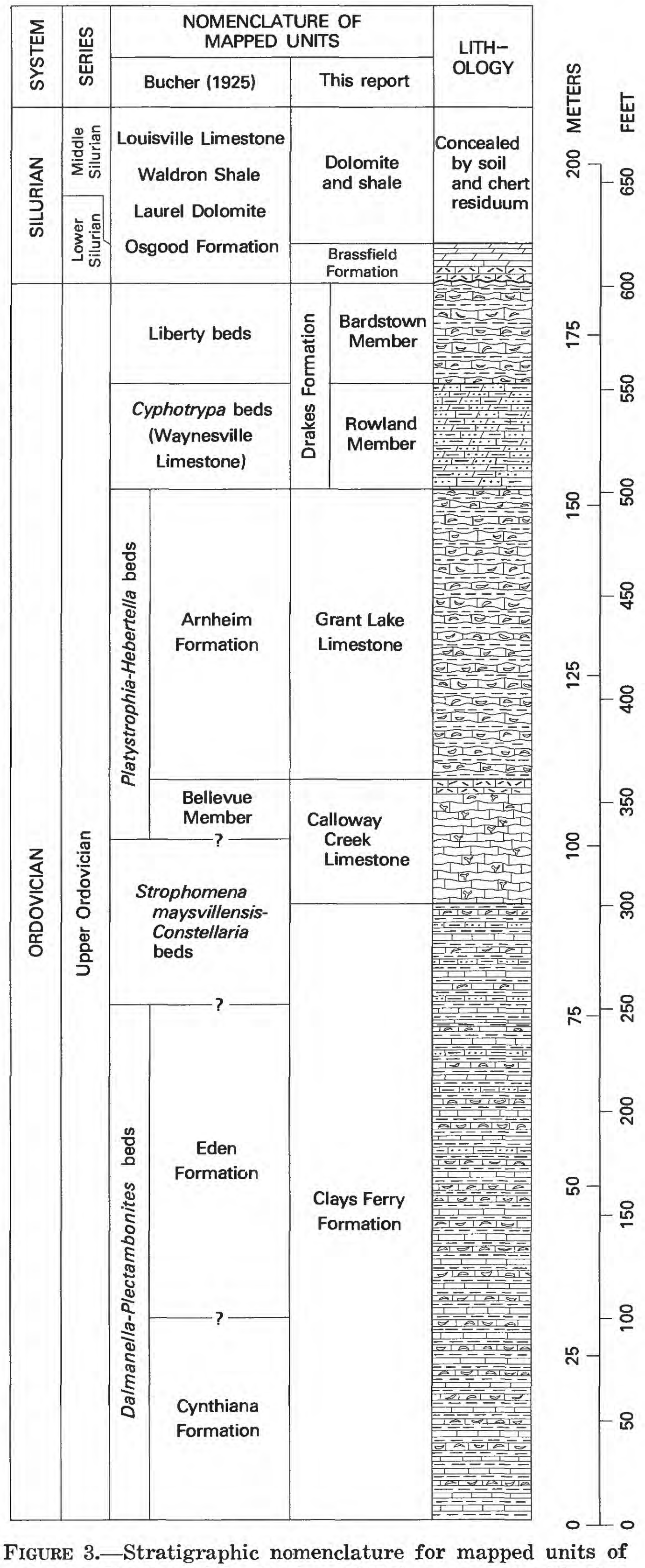

FIGURE 3.—Stratigraphic nomenclature for mapped units of Jeptha Knob used by Bucher (1925) compared with that used in this report.

CENTRAL UPLIFT

The central uplift, from fault boundary to fault boundary, is about 6,300 ft in diameter north-south and 7,000 ft east-west. The periphery of the uplift is apparently everywhere marked by a fault; at several localities on the north and west margins, the fault is high-angle reverse, but elsewhere the dip cannot be determined. The peripheral fault is locally offset and divided into several segments by radial strike-slip or oblique-slip faults.

The lower part of the Clays Ferry Formation in the uplift is as much as 460 ft above its altitude in the undisturbed rocks adjacent to the structure. The Clays Ferry crops out in only a few localities, all near the periphery, but its presence throughout much of the area is indicated by float of limestone types characteristic of the formation. As indicated on the geologic map (pl. 1), no float from the Clays Ferry was found in the innermost part of the uplift; that part of the Jeptha Knob is thickly forested, and the only float found was from the overlying Silurian formations. Because of the paucity of exposures, the structure within the central uplift cannot be determined by surface mapping. However, float nearest the center commonly consists of coarse crinoidal limestone and of limestone containing abundant brachiopods of the genus *Sowerbyella,* both rock types common in the lower part of the formation but absent in the upper part, whereas float and outcrops near the periphery contain abundant brachiopods of the genera *Dalmanella* and *Rafinesquina* and resemble rocks that elsewhere are typical of the upper part of the formation. Accordingly, the gross structure of the Clays Ferry in the uplift is probably that of a broad dome. Attitudes in the Clays Ferry measured by Bucher (1925, p. 218) along the Knob Road on the south side of the knob indicate that the structure is complex in detail. This part of the Knob Road is no longer in use, and the exposures are too fragmentary to repeat Bucher's observations.

Much of the limestone float in the central uplift is brecciated and is stained various shades of yellow and brown by limonite. The brecciation seems confined to individual limestone beds, and no obvious disruption of the bedding or mixing of rock fragments from different beds has taken place. The breccia ranges from rocks that have fractures containing microbreccia infiltrated by limonite but that show only minor displacement and rotation of the larger fragments (figs. 4*A* and 5*A*) to rocks that have been thoroughly broken, disaggregated, and recemented and that retain no trace of the original sedimentary structure (figs. 4*B* and *C*, 5*B* and *C*). Fragments within the breccia differ from limestone

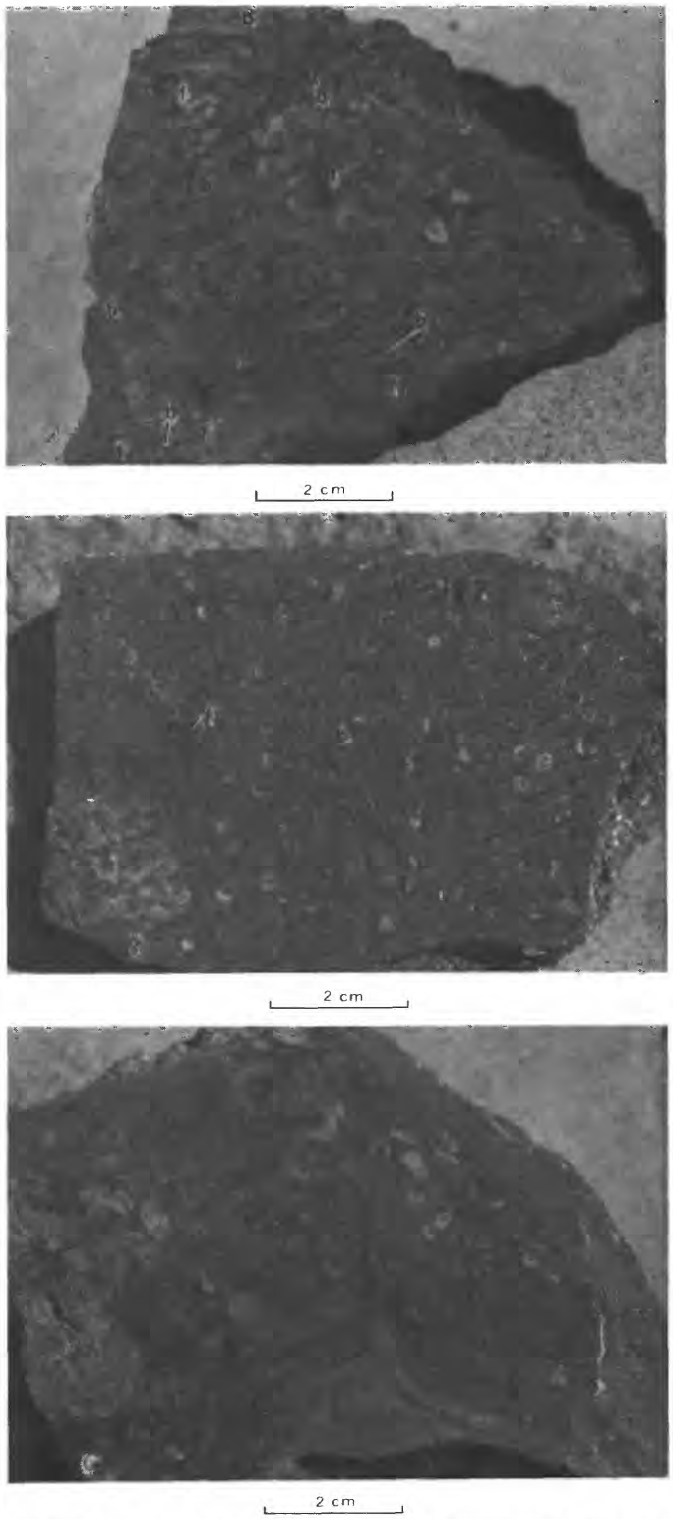

FIGURE 4.—Cut and polished hand specimens of brecciated limestone of the Clays Ferry Formation from the central uplift. *A*. Large fragments of medium-gray brachiopodal and crinoidal limestone (f) separated by fractures filled with moderate- to yellowish-orange microbreccia (b). *B*. Breccia consisting of fragments of light-gray limestone (l), crinoid columnals (c) and brachiopod fragments (f) in a light-brown microbreccia matrix (b). *C*. Light-brown to grayish-orange "flow breccia." See text for discussion.

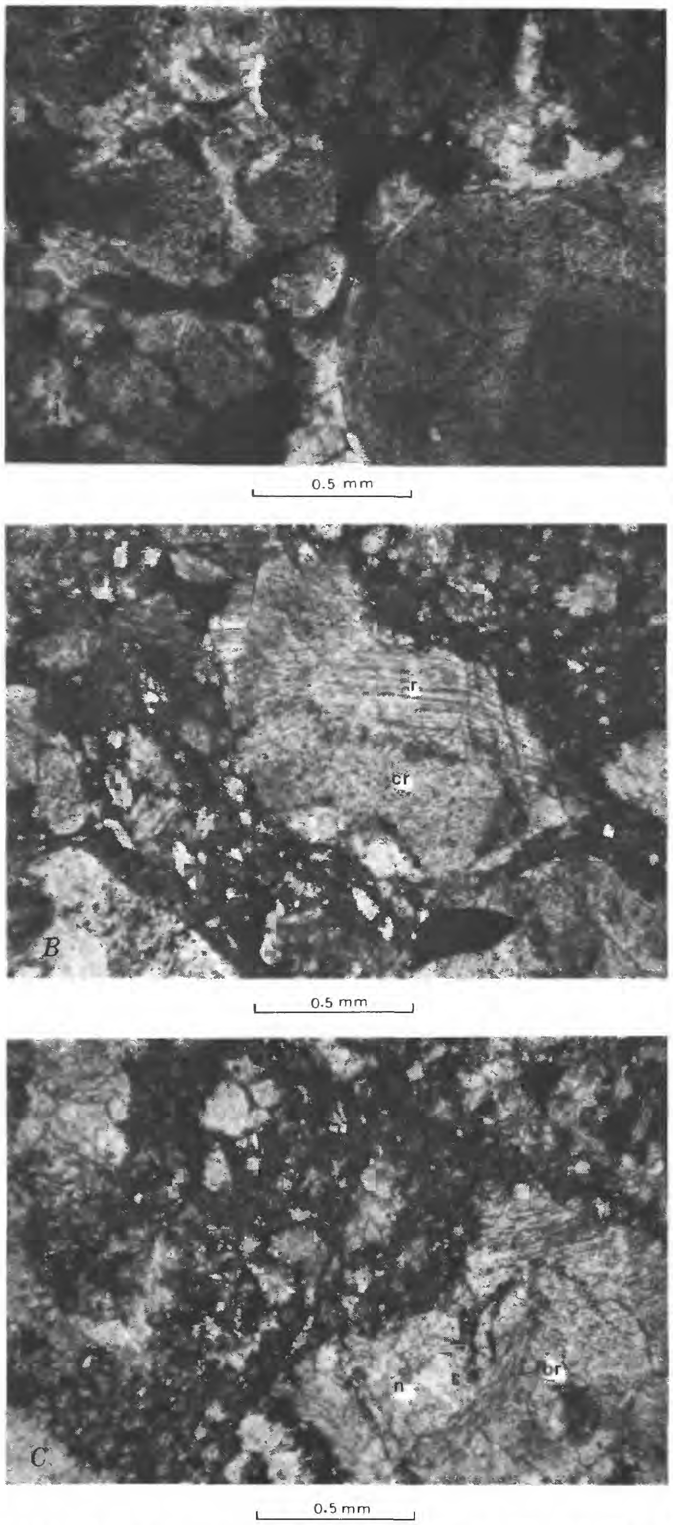

FIGURE 5.—Photomicrographs of brecciated limestone of the Clays Ferry Formation from the central uplift. *A*. Brecciated crinoidal biosparite. *B*. Brecciated crinoidal biosparite. Note crinoid plate (cr) with twinned and cleaved syntaxial rim (r). Dark matrix is limonite-stained microcrystalline calcite. *C*. Brecciated brachiopodal limestone. Note brachiopod (br) and neomorphic spar (n). The rock was originally a biomicrudite.

of the Clays Ferry Formation outside the disturbed area in that microspar, common in packstone and wackestone of the Clays Ferry elsewhere, has mostly been converted to neomorphic spar, some calcite crystals have been broken along cleavage planes, and twinned calcite is much more common in the breccia fragments than in the undeformed rock. Roddy (1968, p. 300) described similar twinning in calcite from breccias at the Flynn Creek structure of Tennessee (fig. 1), but his photographs indicate that the twinning is more intense there than it is at Jeptha Knob.

The matrix material in most of the breccia specimens I have examined consists of microbreccia infiltrated by limonite, in which there is no obvious orientation of the constituent fragments (figs. 5*B*, *C*). Flowlike structure similar to that of the mylonite described by Wilshire and others (1971, p. 1011) in monolithologic breccia of the central uplift at Sierra Madera is present in rocks described by Seeger (1968, p. 650) as flow breccia, but examples are uncommon. Figure 4*C* shows that the matrix throughout most of the specimen is unoriented, but in the lower part of the specimen the fragments are arranged as if they had been oriented by flow toward and through the fracture that extends vertically through the center of the specimen. The relative scarcity of the flow structure such as that shown in figure 4*C* is probably a result of the abundant shale interbeds in the Clays Ferry Formation, which may have inhibited through-going fracturing and the consequent release of pressure and movement of fluids.

Table 1 compares the composition of five samples of brecciated limestone with the composition of five samples of unbrecciated limestone from the same formation collected from undisturbed beds along Interstate Highway 64 in the Waddy quadrangle. Differences in concentration of the elements and oxides between the brecciated and unbrecciated samples were evaluated by Student's test. The Fe_2O_3 concentration is significantly higher $(0.05 > P > 0.02)$ in the brecciated samples. The average contents of Co, Ni, Yb, and La are not significantly greater in the brecciated samples. The differences in composition are most simply explained by deposition of ferric hydroxide from circulating ground water. In the Rochechourt impact structure of France, Lambert (1977, p. 449–451) found Ni to be enriched in impact melts and fall-back breccias but not in monobreccias below the crater floor.

The brecciation is not uniform throughout the central uplift; it is intense near the center, whereas

TABLE 1.—*Chemical analyses of unbrecciated and brecciated limestone from the Clays Ferry Formation*

[Major elements determined by rapid rock analysis; Samuel Botts, analyst. Minor elements determined by emission spectrographic analysis; Norma Rait, analyst]

	Unbrecciated					Brecciated					Average	
	A	A	A	A	A	B	B	B	B	B	A	B
Major elements; in percent												
SiO_2	6.4	3.7	2.9	4.2	0.80	8.0	1.1	2.8	4.5	7.8	3.6	4.8
Al_2O_3	.70	1.5	.10	1.6	.16	2.4	1.2	1.7	.30	1.4	.8	1.4
Fe_2O_3	.32	.39	.42	.48	.19	4.0	.55	1.6	2.6	1.4	.36	2.0
FeO	.80	.56	.53	.48	.28	.08	.32	.44	.56	1.2	.53	.5
MgO	1.2	1.1	.78	.98	.82	.89	1.1	.67	1.3	2.2	1.0	1.2
CaO	48.8	49.8	51.4	50.2	54.4	48.0	53.5	51.3	48.0	45.0	50.9	49.2
Na_2O	.12	.24	.08	.09	.10	.08	.28	.14	.04	.14	.13	.14
K_2O	.44	.27	.28	.40	.11	.58	.12	.26	1.0	.60	.30	.5
H_2O^+	.39	.41	.33	.48	.31	1.0	.32	.53	.70	.72	.38	.6
H_2O	.08	.10	.07	.12	.04	.28	.04	.10	.13	.12	.08	.13
TiO_2	.05	.14	.03	.08	.00	.16	.01	.13	.15	.17	.06	.12
P_2O_5	.26	.25	.42	.13	.03	.17	.02	.07	.18	.17	.22	.12
MnO	.14	.14	.14	.08	.06	.10	.06	.07	.11	.08	.11	.08
CO_2	39.6	41.0	41.8	39.8	43.7	35.0	42.6	40.5	39.6	38.1	41.2	39.2
Minor elements; parts per million [1,2,3]												
Ba	120	1300	110	130	130	150	150	160	130	120	660	140
Ce	46	49	76	56	39	66	38	65	73	65	53	61
Co	2.7	2.4	1.8	2.2	<1.0	8.5	2.2	3.4	4.2	4.0	<2.0	4.5
Cr	<4.6	5.4	4.5	7.5	1.6	6.8	2.0	4.8	7.3	9.2	<4.7	6.0
Cu	4.7	6.5	7.4	14	5.0	13	10	1.8	12	7.0	8	9
Gd	12	13	16	8.4	15	3.7	12	9.9	9.7	9.6	13	9
Ho	4.1	3.7	<1.0	4.1	3.5	<1.0	3.5	3.4	4.9	3.4	-----	-----
La	29	25	40	28	24	34	31	33	32	37	29	33
Mo	<2.2	<2.2	2.8	2.8	2.9	2.7	2.4	3.0	2.4	2.4	-----	2.6
Nb	2.5	<2.2	<2.2	<2.2	3.9	<2.2	2.8	<2.2	5.6	<2.2	-----	-----
Ni	4.6	4.8	6.0	5.4	2.1	21	4.0	7.9	7.9	8.9	4.6	9.9
Pb	<1.0	<1.0	2.3	<1.0	<1.0	1.2	<1.0	<1.0	<1.0	<1.0	-----	-----
Sc	7.6	9.8	4.1	7.0	5.5	10	4.0	4.7	9.3	9.8	6.8	8
V	13	9.1	10	11	4.4	13	4.7	8.9	6.8	10	10	9
Y	8.9	10	14	8.6	7.5	14	6.8	11	8.2	10	10	10
Yb	.68	.64	.42	.66	.28	1.0	.40	.86	.70	.91	.54	.8
Zr	87	39	25	37	12	67	9.4	25	17	43	40	32

[1] The standard deviation of any single answer should be taken as plus 50 percent and minus 33 percent.

[2] The following elements were looked for but not detected; the figure in parentheses following each element is the detection limit in ppm Ag (0.10), As (100), Au (6.8), B (10), Be (1.01), Bi (1.0), Cd (15), Cs (3,200), Dy (3.2), Er (4.6), Eu (1.01), Ga (2.2), Ge (1.0), Hf (10), Hg (150), In (4.6), Ir (6.8), Li (3.2), Lu (3.2), Os (1.0), P (460), Pd (0.68), Pt (6.8), Rb (15,000), Re (10), Rh (1.0), Ru (1.0), Sb (68), Sm (4.6), Sn (3.2), Ta (150), Tb (6.8), Te (320), Th (22), Tl (3.2), Tm (2.2), U (220), W (22), Zn (320).

[3] Sr present in all samples in amounts >460 ppm.

beds near the north and west periphery show little or no brecciation. The zone of intense brecciation seems eccentric with respect to the area of the central uplift; the center of the zone of brecciation is about 1,000 ft southeast of the center of the uplift.

The breccias of the central uplift closely resemble the monolithologic breccias of the Sierra Madera structure of Texas as described by Wilshire and others (1972, p. 17–19); Sierra Madera is almost certainly of impact origin. According to D. J. Roddy (written commun., 1978), the breccias are also very similar to the authigenic breccias in the Flynn Creek impact structure (Roddy, 1968, p. 299). Monolithologic breccia as described by Offield and Pohn (1977, p. 330–331) at the Decaturville impact structure of Missouri is also similar to the breccia of Jeptha Knob.

A remarkable feature of the central uplift is an exposure of calcareous dolomite containing a multitude of silicified brachiopods at an altitude of 1,015 ft at the head of Wolf Run. The brachiopods were identified by R. B. Neuman (written commun., 1973) and L. G. Walker (written commun., 1974) as *Dalmanella sulcata* Cooper. In central Kentucky, this species is restricted to the Logana Member of the Lexington Limestone or its lateral equivalents; that is, to an interval about 25 to 60 ft above the base of the Lexington. The exposure at Jeptha Knob closely resembles a brachiopod coquina that is present 50 ft above the base of the Logana in its nearest outcrops, which are about 10 miles east of the exposure at the knob. The exposure at the knob may be slumped, but its position high on the hillside and less than 100 ft below the flat-lying Silurian that caps the structure indicates that it cannot be far from in place. The outcrop is at least 700 ft above the altitude of equivalent rocks or strata in undisturbed rocks adjacent to the knob.

The extent of the Logana Member and its structural relation to the surrounding rocks cannot be determined because the steep slope is heavily forested and mantled with soil and with float from the overlying Silurian. Most of the Lexington Limestone consists of resistant beds that might be expected to crop out if they were present, and the topography is similar to that on the Clays Ferry Formation elsewhere in the structure. Therefore, the Logana is interpreted as being in fault contact on all sides with the Clays Ferry. The amount of uncertainty concerning even major aspects of the structure of this part of the knob is apparent from the location of the innermost occurrences of float from the Clays Ferry Formation as shown on the geologic map (pl. 1).

The brachiopod coquina of the Logana Member as exposed on the knob does not appear brecciated, but it differs from the coquina in the undeformed rocks of the same unit elsewhere in central Kentucky in that microspar, common as matrix in the coquina elsewhere (Cressman, 1973, p. 16, fig. 11), has been partly dolomitized and partly converted to neomorphic spar.

The residual gravity map of Jeptha Knob by Seeger (1968) shows a positive anomaly of 1.2 milligals centered on the central uplift. By assuming a density of 2.8 gm/cm^2 for the Silurian rocks and density of 2.6 gm/cm^2 for the Silurian rocks and the uplift, Seeger calculated that the anomaly can be totally explained by the density of near-surface (above 800 ft above sea level) rocks. Seeger's conclusion is undoubtedly correct, but the character of the Clays Ferry Formation in the central uplift is so similar to that of the Clays Ferry elsewhere (table 1) that I would not expect its density to appreciably exceed the value of 2.4 g/cm^2 used by Seeger for undisturbed rocks beyond the structure. I suspect that the anomaly results in part from an uplifted core of dolomitized rocks of the Lexington Limestone and the High Bridge Group. Thus, the small exposure of dolomitized Logana Member may be merely the tip of a much larger body of uplifted older dolomitized rock.

BELT OF ANNULAR FAULTS

The belt of annular faults consists of circular faults divided into segments by strike-slip or oblique-slip faults that for the most part extend from the margin of the structure into the central uplift. The

FIGURE 6.—Outcrops of breccia in the belt of annular faults. *A*. Brecciated calcarenite at top of Calloway Creek Limestone. Beds dip toward fault less than 3 ft to right of photograph. *B*. Breccia in fault in Grant Lake Limestone. Calcarenite fragments (c) are from calcarenite unit at top of Calloway Creek Limestone. *C*. Breccia in fault in Rowland Member of Drakes Formation. Calcarenite fragments (c) are from calcarenite unit at top of Calloway Creek Limestone; horn coral (h) is from the Bardstown Member of the Drakes Formation.

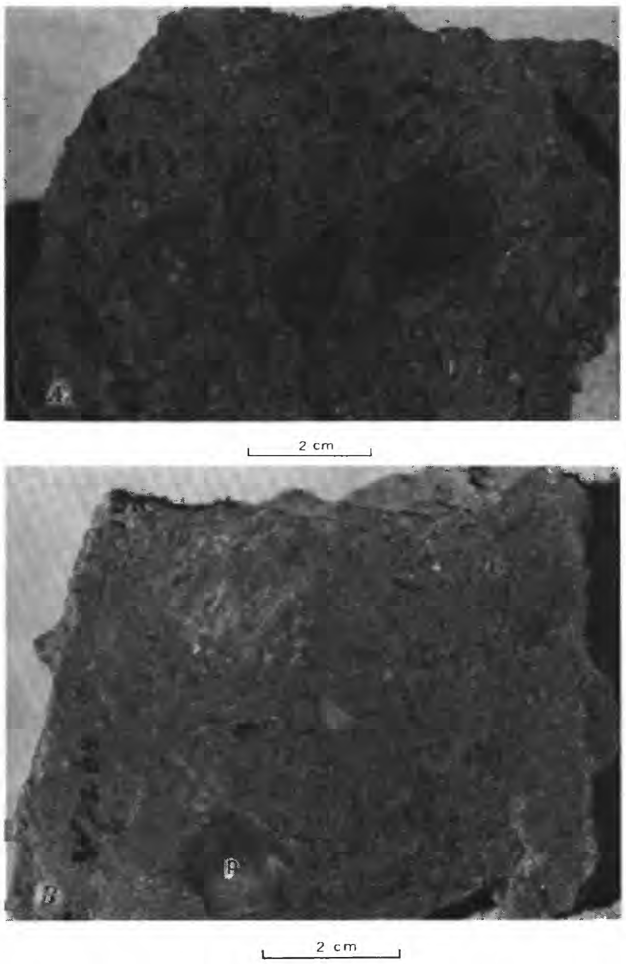

FIGURE 7.—Cut and polished hand specimens of breccia from margins of faults in the belt of annular faults. *A*. Large fragments are calcarenite from the top of the Calloway Creek Limestone. *B*. Large fragments (p) are of the brachiopod *Platystrophia*.

belt is 5,000 to 8,850 ft wide. The faults delineate both horsts and grabens, but there is no regular arrangement into outer and inner grabens separated by an intermediate horst, as described at the Wells Creek structure of Tennessee by Wilson and others (1968, p. 54–62). Although some fault blocks and parts of other fault blocks are above regional structure, most are below, and the general aspect of the belt is one of collapse and inward movement.

Many of the concentric faults can be located to within a few feet. The radial faults, on the other hand, are nowhere exposed, and their presence and positions are inferred from offsets in the concentric structural features. I have been unable to determine dips on either the concentric or the radial faults.

Many of the concentric faults contain zones of breccia, shown on plate 1 as mixed breccia, that are commonly about 3 ft across. The breccia zones are discontinuous along the faults, but their lengths cannot be determined because the exposures are too poor. The breccias consist of subangular to subrounded fragments of fossil-fragmental calcarenite, commonly 2 to 4 cm in diameter, and fossils of about the same size set in a matrix of unsorted fragments of fossils and calcite spar (fig. 6*A*, *B*; fig. 7). The calcarenite fragments, present in nearly all the breccia exposures, could have been derived only from the calcarenite in the uppermost part of the Calloway Creek Limestone. This calcarenite was particularly susceptible to fragmentation and is commonly brecciated for a distance of several feet from adjacent faults (fig. 6*A*). The calcarenite fragments are present in the breccia even where the calcarenite unit itself is well below the surface. For example, the breccia shown in figure 6*C* is along a fault in the Rowland Member of the Drakes Formation; although the calcarenite unit of the Calloway Creek is at least 150 ft below the surface, the breccia contains abundant calcarenite fragments. The same breccia pod also contains horn corals from the Bardstown Member of the Drakes, which was at least 33 ft above the breccia exposure before erosion. I have seen no fragments in any of the breccia that are diagnostic of units lower than the Calloway Creek Limestone.

Under the microscope, the breccia is seen to consist of unsorted fossils, fragments of crinoid biosparite, and fossil fragments (fig. 8). Patches of syntaxial calcite commonly adhere to crinoid fragments. Some twin lamellae are present in some of the unicrystalline fragments, but not obviously more than I have observed in undeformed Ordovician limestone. The finest matrix, probably originally

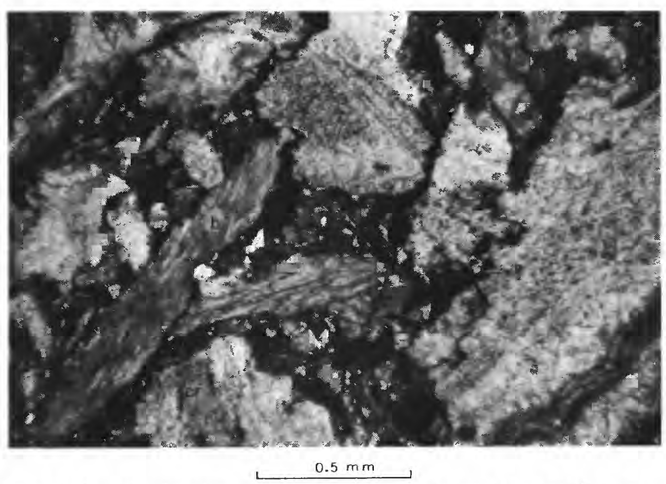

FIGURE 8.—Photomicrograph of breccia from the belt of annular faulting. Note brachiopod fragment (b), crinoid plate (cr) with syntaxial overgrowth (o), and stylolytic contact (s) between fragments.

rock flour, is stained by limonite, but not as heavily as is the breccia of the central uplift.

Some breccia lenses occur where there is no independent evidence of faulting, and two occurrences have been noted in the outer part of the central uplift.

The mixed breccias at Sierra Madera (Wilshire and others, 1972, p. 19–21) resemble the mixed breccias at Jeptha Knob in that they are found, in part, along faults and consist of fragments that have moved both upward and downward. However, most of the mixed breccia at Sierra Madera is not along faults but forms tabular sheets and irregular masses that cut the country rock at steep angles, and most of the breccia is in or near the central uplift.

POST-STRUCTURE CAP

Jeptha Knob is capped by nearly horizontal beds of Silurian age that rest unconformably on the structurally deformed rocks. The Silurian units dip west about 35 ft per mile, which is about twice as much as the regional dip but about the same as the local dip adjacent to the structure. The Silurian was mapped as two units—a basal ledge-forming dolomite 16 to 20 ft thick, which is identified as the Brassfield Formation[1], and an upper unit, 75 ft thick, which is completely concealed by soil and chert residuum but is inferred, on the basis of fossils in the chert (Bucher, 1925, p. 216; Foerste, 1931, p. 182) and on exposures observed by Bucher (1925, p. 212) but no longer extant, to consist of dolomite and shale of Middle Silurian age.

The Brassfield Formation consists largely of grayish-orange fine- to medium-crystalline slightly glauconitic calcareous dolomite. The rock commonly contains abundant vugs that are mostly less than 1 mm in diameter and make up 10 to 20 percent of the volume. Bedding is obscure, and the dolomite commonly crops out as thick rounded ledges. Microscopically, the dolomite consists of subhedral and euhedral dolomite rhombs averaging 0.1 mm in diameter and a few anhedral calcite crystals, some of which are corroded pelmatozoan plates. Some exposures contain breccia consisting of fragments as much as 4 cm in diameter of nonvuggy fine- to medium-crystalline dolomite in a matrix of vuggy calcareous dolomite. The breccia is probably intraformational and unrelated to the Jeptha Knob structure. I have seen similar breccia in exposures of the Brassfield 20 miles from the knob, and breccia in the Brassfield near Louisville has been described by Gauri and others (1969, p. 1882).

In several localities, the basal 5 ft of the Brassfield consists of calcarenite and calcirudite that contain fragments of rocks and fossils from the Upper Ordovician formations. The calcarenite is typically a crinoidal, brachiopodal biosparite that contains some grains of gray and green micrite and argillaceous micrite derived from the Rowland Member of the Drakes Formation (fig. 9*C*). The crinoid plates and brachiopod valves show little evidence of wear and are probably nearly autochthonous. The calcirudite consists of fragments of Upper Ordovician rocks and fossils, oriented and somewhat sorted, in a matrix of limonite-stained silt-size calcite (fig. 9*A*, *B*). Bucher (1925, p. 210) found both Late Ordovician and Early Silurian fossils in the calcirudite, and Charles Helfrich (written commun., 1974) found Late Ordovician conodonts in the calcarenite.

The identification of the Silurian rocks above the Brassfield Formation is discussed on the geologic map of the Waddy Quadrangle (Cressman, 1975b).

DISCUSSION

The time of formation of the Jeptha Knob structure can be dated closely. The youngest deformed unit is the Bardstown Member of the Drakes Formation; the Bardstown is of middle Richmondian (late Late Ordovician) Age. The oldest unit that caps the structure is the Brassfield Formation of late Early Silurian age; in terms of the British standard section, the Brassfield is probably of late early and middle Llandoverian Age (Rexroad, 1967, p. 11–15). The Jeptha Knob structure, therefore, was formed in latest Late Ordovician or Early Silurian time.

In most of west-central Kentucky, the Bardstown Member of the Drakes is overlain by the Saluda Dolomite Member, also of the Drakes Formation, and the Brassfield rests disconformably on the Saluda. The Saluda, which consists of greenish-gray to dusky-yellow laminated micrograined dolomite, is not present at Jeptha Knob; its nearest exposures are in the Fisherville Quadrangle 32 miles to the west, where the unit is 36 to 45 ft thick (Kepferle, 1976). If the structure contours on the top of the Clays Ferry Formation are projected through Jeptha Knob, the 820-ft contour is nearly coincident with

[1] Bucher (1925, p. 213) considered the basal ledge to be of post-Brassfield and of Middle Silurian age because fossils typical of the Brassfield were found only in calcirudite at the base of the unit; the dolomite itself, which is unfossiliferous, was thought to be part of the Osgood Formation. Although the dolomite lacks the chert nodules and large calcite-lined, oil-stained vugs common in the dolomite facies of the Brassfield southeast of Louisville, it does resemble the Brassfield in color and texture; it does not resemble dolomite of the Osgood Formation or that of the Laurel Dolomite. Furthermore, some of the calcarenites in the lower part of the unit on the knob closely resemble limestone in the Brassfield to the west. I am confident, therefore, that the entire ledge is properly assigned to the Brassfield Formation and is thus of Early Silurian age.

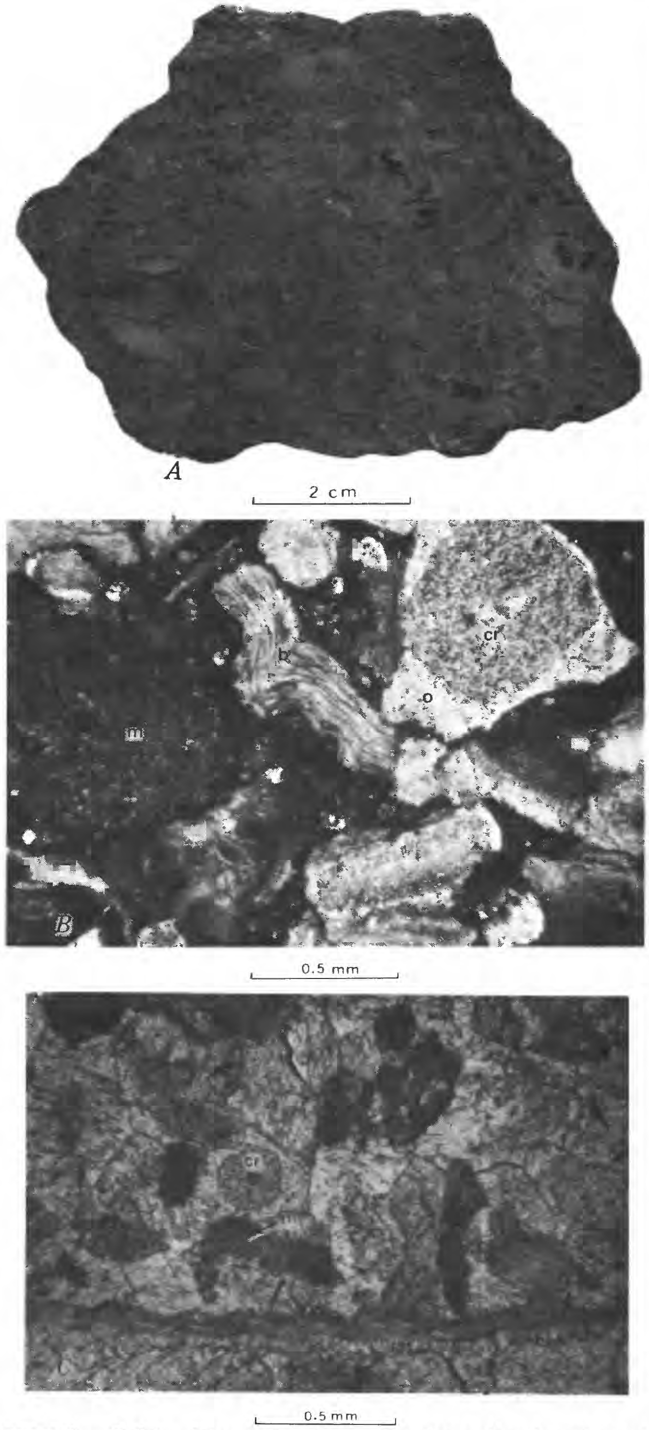

FIGURE 9.—Calcirudite and calcarenite from the basal part of the Brassfield Formation. *A*. Cut and polished hand specimen of calcirudite. *B*. Photomicrograph of calcirudite. Note micrite grain (m) derived from Rowland Member of Drakes Formation, brachiopod fragment (b) probably derived from the Grant Lake Limestone, and the crinoid plate (cr) with a syntaxial overgrowth (o). *C*. Photomicrograph of calcarenite (crinoidal brachiopodal biosparite). Note grains of argillaceous micrite (m) derived from Rowland Member and the crinoid columnals (cr) with syntaxial cement.

the 1,120-ft structure contour on the base of the Brassfield Formation. The difference, 300 ft, is the same as the total thickness of the section between the top of the Clays Ferry and the top of the Bardstown Member of the Drakes. Apparently, little or no Saluda was present in the immediate area when the structure was formed. The Saluda is a regionally extensive unit, which shows no known facies change near Jeptha Knob; therefore, its absence at Jeptha Knob probably resulted from pre-Brassfield erosion rather than from nondeposition. If this is true, the period in which the structure was formed is further restricted. Unfortunately, in view of its obvious significance to the origin of Jeptha Knob, I cannot determine whether the inferred erosion and removal of the Saluda was due to regional uplift or to local uplift premonitory to formation of the structure.

At the time the structure was formed, the area was either just above sea level or was covered by an extremely shallow sea (Gray and Boucot, 1972). The Upper Ordovician rocks were, in large part, indurated at the time of deformation. Limestone of the Clays Ferry Formation and calcarenite of the Calloway Creek Limestone were both cemented sufficiently to brecciate, and limestone of the Rowland Member of the Drakes Formation was sufficiently cemented to supply fragments to the calcirudite in the basal part of the Brassfield Formation.

According to Bucher (1925, p. 210–211, 224), calcirudite in the basal Silurian beds is present as lenses that are thicker and that contain larger fragments outward from the center of the structure. I have not been able to confirm Bucher's observation because many of the outcrops visited by him, including the one illustrated by photograph (Bucher, 1925, p. 211), are no longer exposed. However, he was an acute observer, and I have no reason to doubt his statement. Bucher (1925, p. 224–225) interpreted his observations as indicating that the fragments in the calcirudite had been transported inward from a raised rim around the periphery of the structure. He believed that the rim itself resulted from differential erosion of the central part of the structure after deformation. The rocks of the central uplift do not now seem more erodible than the surrounding rocks, and it seems more likely to me that the rim and basin inferred by Bucher were original features of the structure. Inasmuch as any such rim has been destroyed by erosion, I do not know whether it consisted of coherent rock in fault blocks or of fragmental material. Whatever the origin of the basin, it was very shallow. Float from the Clays Ferry Formation occurs less than 10 ft below the base of the

Brassfield Formation at several localities, and assuming that the calcirudite and calcarenite were basin fill, the topographic depression throughout the area of the central uplift was about 15 ft.

The gross structure of the central uplift is that of a broad dome, but the variable dips noted by Bucher (1925, p. 218) suggest that the structure is complex in detail, and I suspect that it is similar to the intricately folded and faulted but broadly domal core uplift of the Sierra Madera impact structure of Texas (Wilshire and others, 1972, pl. 4). The structure also seems similar to that of the central uplift of the Decaturville impact structure where the formations are intricately deformed in detail, but as whole units they have relatively gentle dips off the dome (Offield and Pohn, 1977, p. 328). The twinning and fracturing of calcite in the breccia might be an indication of shock metamorphism (Short, 1968, p. 238), but according to W. C. MacQuown (oral commun., 1974), of the Department of Geology, University of Kentucky, who has examined thin sections from both areas, twinning is considerably less common in the breccia of Jeptha Knob than in limestone adjacent to faults of the Kentucky River fault zone.

The annular faults are extensional, and the breccia pods along the faults were, to some extent, injected from below. Wilson and others (1968, p. 95) have shown, in an elegant analysis, that fault blocks in the annular ring at the Wells Creek structure have moved both downward and inward. The map pattern of Jeptha Knob is too irregular to allow the use of their procedure, but because it bears enough similarity to the pattern at Wells Creek, their conclusions probably apply.

Little can be said with confidence about the subsurface structure beyond Seeger's (1968) conclusion from his gravity and magnetic surveys that the basement is not uplifted. Even the shallow structure shown in the structure sections could be interpreted differently. The lack of fragments in the breccia pods from formations below the Calloway Creek Limestone might be taken as evidence that the annular faults do not extend deeper than the Clays Ferry Formation, and on that assumption, sections very different in appearance from those in figure 3 could be constructed. Only by drilling can the correct interpretation be determined.

Two exploration wells for oil and gas were drilled within the structure in 1924 and 1925, both to depths of about 950 ft (McGuire and Howell, 1963, p. A9); the wells were dry. One well was reportedly near the southwest margin of the structure where it is crossed by Interstate Highway 64; the other was in the central uplift in the valley of Britton Run. However, locations given for old wells are notoriously inaccurate. Drillers' logs, the only information available, were published by Seeger (1968) and are inadequate to determine what stratigraphic units are present. Seeger noted that red beds were described in both wells at about the same altitude—about 100 ft above sea level—and therefore concluded that deformation was limited to near-surface rocks. However, no red beds have been reported from the Cambrian and Lower and Middle Ordovician section in Kentucky, and the red units reported in the logs might be taken as evidence that alteration, and thus faulting, extends to 900 ft below the surface. A more probable conclusion is that the drillers' logs are inaccurate.

Most geologists on reviewing the evidence would probably conclude, as did Seeger (1968), that the Jeptha Knob structure was of impact origin. The impact hypothesis satisfactorily explains the intense localization of the deformation, the absence of basement uplift and of intrusive rocks, and the lack of any certain relation to well-defined structural trends in either the surface rocks or the basement. Furthermore, Jeptha Knob is similar in gross structure and in the nature of brecciation to other cryptoexplosion features that contain shatter cones, coesite, and other products of shock matamorphism indicative of impact. Jeptha Knob also shows many similarities to explosion craters produced experimentally to simulate the conditions of impact (Roddy, 1976, 1977). Nevertheless, for reasons discussed in the following paragraphs, I do not believe that an impact origin can be accepted without reservation.

No evidence at Jeptha Knob indicates whether the structure was formed by a single major nearly instantaneous event, as required by the impact hypothesis, or whether it resulted from a series of less severe events distributed through the several million years between latest Ordovician time and deposition of the Brassfield Formation. Furthermore, in the absence of shatter cones and of severe shock metamorphosis, there is no immediately apparent method for determining whether or not the near-surface pressures were too great to have resulted from endogenic processes.

Another factor that suggests caution is the presence elsewhere in the midcontinent of undoubted endogenic circular structures and clear evidence in a few localities of explosive volcanic activity. One such structure is Hicks Dome in southern Illinois. Hicks Dome is an oval uplift that has a diameter of about 9 miles and a structural relief of 4,000 ft and that is bounded in part by arcuate faults (Baxter and Desborough, 1965, pl. 1). The dome contains oval intrusions of kimberlite and pipes of explosion breccia that contain igneous rock fragments and are enriched in rare earths, thorium, beryllium, fluorite, and barite (Heyl, 1972, p. 887). The dome is clearly of endogenic origin, yet it is not reflected on the aeromagnetic map of the area (McGinnis and Bradbury, 1964, fig. 2); therefore, the lack of any expression of Jeptha Knob on the aeromagnetic map of the area (p. 4) cannot be taken as evidence that no intrusions are present at depth within the structure. Clearly, however, both in gross structure and in many of the detailed features, Jeptha Knob more closely resembles structures of nearly certain impact origin such as Wells Creek in Tennessee (Wilson and others, 1968) and Sierra Madera in Texas (Wilshire and others, 1972) than it does Hicks Dome.

The structure of Muldraugh Dome in Meade County, Ky., raises some interesting questions about whether the impact hypothesis is applicable to all cryptoexplosion structures. At the surface, limestone and shale of Osagean and Meramecian age (Early and Late Mississippian) form an unfaulted dome about 1.8 miles in diameter that has a structural relief of about 360 ft. Dips on the flanks are about 5° (Withington and Sable, 1969). Holes drilled for gas near the apex of the dome reached the base of the New Albany Shale of Devonian age at a depth of 450 ft (Withington and Sable, 1969), passed through about 15 ft of Silurian dolomite, and penetrated brecciated dolomite of the Knox Group of Cambrian and Ordovician age (Freeman, 1959, p. 38). In the normal stratigraphic section in that area, the top of the Knox Group is 1,560 ft below the base of the New Albany (McGuire and Howell, 1963, p. A7). These data indicate uplift (at least 1,560 ft) and brecciation of the Knox in Early or Middle Silurian time, deposition of the uppermost Silurian, Devonian, and Lower Mississippian rocks, and doming sometime after the Early Mississippian. Uplift may also have taken place in Middle Devonian time, inasmuch as the New Albany Shale is underlain by limestone of Early and Middle Devonian age in nearby sections. This series of events seems incompatible with an impact origin. However, the subsurface geology of this interesting feature is poorly known, and the extent to which the structure is analogous to that of Jeptha Knob and other cryptoexplosion structures is uncertain. Muldraugh Dome certainly deserves more study.

Finally, the evidence that Black (1978; and written commun., 1978) cited for structural control of the location of Jeptha Knob needs to be evaluated, probably by seismic methods, to determine whether or not a major basement fault passes beneath the structure, as suggested by Black.

In summary, the structure of Jeptha Knob is so similar in gross aspect and in many details to impact structures elsewhere that meteoroid impact seems the most likely origin. Nevertheless, enough unanswered questions remain so that Jeptha Knob cannot yet be classified with those cryptoexplosion structures whose origins by impact can be considered as demonstrated.

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