FIELD TRIP NO. 3 The Mascot-Jefferson City Zinc District

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The field trip to the American Zinc Company's Young Mine, in the Mascot-Jefferson City zinc district will follow U.S. 441 from Gatlinburg to Sevierville, U.S. 411 from Sevierville to Chestnut Hill, and Tenn. Rt. 92 from Chestnut Hill, through Dandridge to Jefferson City. Jefferson City is situated near the eastern end of the zinc district. The Young Mine, located near the center of the district, will be approached via U.S. 11. See Figure 1.

The general geology of the area is well shown by Rodgers (1953). The Gatlinburg-Sevierville leg of the trip follows the West Fork of the Little Pigeon River. About half way to Sevierville the route passes out of the Precambrian Ocoee Series of the Blue Ridge province, and into the area underlain by middle Ordovician shale and siltstone of the Valley and Ridge province. From Sevierville to Chestnut Hill the route essentially follows the regional strike and lies generally along the unconformable contact between middle Ordovician clastic rocks and the lower Ordovician carbonate sequence (upper part of the Knox Dolomite group). From Chestnut Hill the route turns northward across the strike of a broad syncline developed in middle Ordovician shale and siltstone. Douglas Reservoir, a part of the water control system of the Tennessee Valley Authority, located

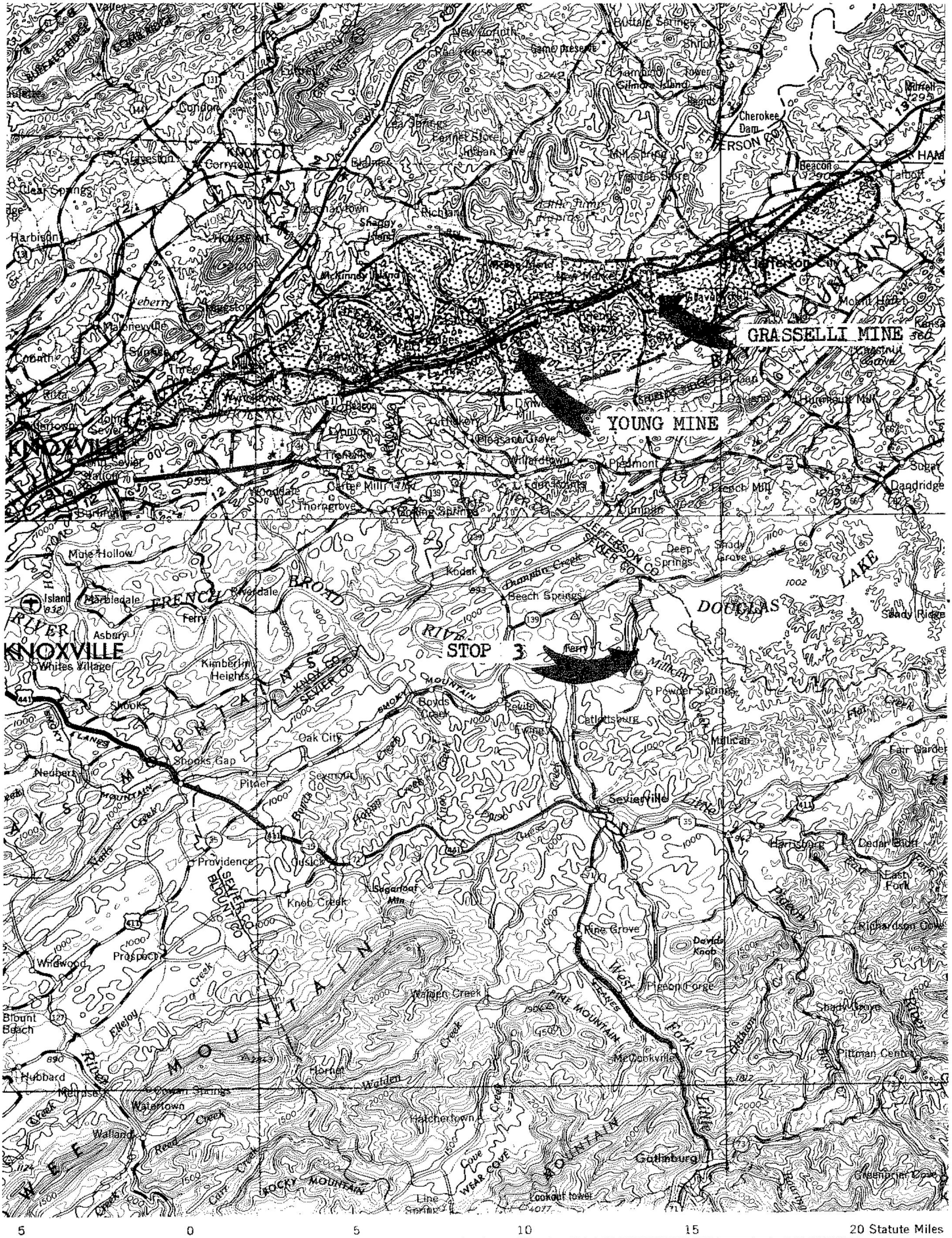

Fig. 2 The Mascot - Jefferson City zinc district of East Tennessee.

on the French Broad River, can be seen from several vantage points along this part of the trip. The French Broad River is crossed just before entering Dandridge.

From Dandridge to Jefferson City the route continues across the regional strike, and various road cuts show typical exposures of bedrock and residual weathering products of formations ranging in age from early Cambrian through early middle Ordovician. This leg of the trip crosses two of the major thrust faults of the region. The first of these, the Dumplin Valley fault, is encountered in the gap in Bays Mountain, about four miles northwest of Dandridge; early Cambrian Rome shale is thrust onto middle Ordovician Lenoir limestone. A second major thrust is encountered about a mile south of Jefferson City--the Rocky Valley fault. At this locality, the fault places late Cambrian Copper Ridge dolomite on early Ordovician Mascot dolomite. The actual fault trace cannot be seen, but its position has been approximately determined by distinctive features of the residuum of the two formations. The Mascot-Jefferson City zinc district lies in the footwall block of the Rocky Valley fault, and two of the principal mines in the district penetrate the fault in their shafts. One of these, the Jefferson City mine of the New Jersey Zinc Company can be seen just northeast of the road, about two miles south of Jefferson City.

The last part of the route to the Young Mine traverses most of the eastern part of the zinc district. Bedrock is very poorly exposed, and the extensive residuum provides excellent soil for farming in the area. On the south side of the highway just west of Jefferson City are the Zinc Mines Works of the United States Steel Company (also known as the Davis-Bible, or Universal mine), the third oldest operating mine in the district. About four miles west of Jefferson City, the headframes of the Grasselli Mine of the American Zinc Company, second oldest operating mine in the district, can be seen to the south of the highway.

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The geology of the Mascot-Jefferson City zinc district has been well summarized by Bridge (1956), and by Oder and Ricketts (1961). A general statement about the Young Mine is provided by Oder and Ricketts (1961, p. 26-28). The zinc ores of this district occur in the upper part of the Cambro-Ordovician Knox Dolomite group. The main ore-bearing zone is the lower 200 feet of the Kingsport formation and centers chiefly about the contact between the first major limestone beneath the top of the Knox dolomite and the overlying fine-grained dolomite. Some mineralization, however, occurs locally several hundred feet above and a few tens of feet below this zone. Thus, the total stratigraphic range of the mineralization can be as much as 700 feet, straddling the Kingsport formation from the Longview dolomite below to the Mascot dolomite above. The mineralization is comparatively simple, consisting primarily of yellow sphalerite with minor amounts of pyrite, distributed in a gangue that is chiefly breccia blocks of dolomitic and calcareous country rock, with white secondary dolomite. Minor amounts of chert and secondary calcite occur locally, as do traces of chalcopyrite, fluorite, and barite. Only two traces of galena, widely separated, have been reported from the district (Oder and Ricketts, 1961, p. 7-8).

Opinions about the controls of the zinc deposits have been highly divergent. Two basic schools of though exist, with perhaps as many variations in either theme as there have been geological investigators. The differences of opinion center chiefly about the origin of the breccias hosting the ore. One school of thought holds that the breccias are of tectonic origin, originating with warping during the late Paleozoic Appalachian orogeny. In this case, the sphalerite emplacement must have been contemporaneous with, or subsequent to the tectonic activity. Relatively recent selected articles favoring this hypothesis are those by Newman (1933), Currier (1935), Crawford (1945), Brokaw (1948), Behre (1950), and Oder and Hook (1950).

The other school of thought supports the thesis that the sphalerite-bearing breccias were formed by collapse of open cavities. Whether the cavities, and collapse of the cavities, was generated by hydrothermal solution-stoping, as suggested by Odell (Oder and Hook, 1950, p. 78), or was related to the development of a deep karst (or paleo-karst) terrane at the top of the Knox dolomite group in early middle Ordovician time, as intimated by Ulrich (1931), Oder (1958, p. 53), Laurence (1960, p. 114), and Wedow (1961), is at this time open to discussion. The "karst-collapse" hypothesis has been developed more fully in recent papers by Callahan (1964), and Hoagland, Hill, and

Fulweiler (1965). It is perhaps instructive to point out that evidence in the mines indicates that the bulk of the sphalerite must have been emplaced while the enclosing strata were still in a more or less horizontal position (Kendall, 1960, p. 994); in this case, the zinc deposition pre-dates the late Paleozoic orogeny. Oder and Ricketts (1961, p. 15-18) also favor the early, collapse origin of the mineralized breccias, as do Wedow and Marie (1963 and 1965).

The source of the zinc is more problematical. Most students of the district favor some form of hydrothermal origin in the classic sense (ascending warm waters from an unknown igneous source). On the other hand, the environment in which the sphalerite was precipitated was essentially stagnant, as illustrated by the persistent occurrence of sulfides in the lower portions of former open spaces between breccia blocks or fragments, and by the occurrence of much sulphide as "caps" on breccia blocks (Behre, 1950, Fig. 2; Oder and Hook, 1950, Pl. 1). It was also in this environment that the varved, or thinly-laminated breccia matrix was deposited (Kendall, 1960, p. 993-994), further substantiating the near-stagnant condition of the water from which the spalerite was precipitated.

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The underground trip will take place in the Young Mine of the American Zinc Company. Note that this trip is being made on a working day, so please stay with your guides. At least three areas will be visited underground at which many of the typical features of mineralization in this district are well illustrated.

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After lunch, the return trip to Gatlinburg will be by way of Jefferson City and Dandridge. From Dandridge, the route will follow Tenn. Rt. 66 to Sevierville, and U.S. 441 from Sevierville to Gatlinburg. A stop will be made at the abandoned Grasselli open-cut mine. This pit was developed where the ore horizon intersects the surface on the west flank of the broad Cherokee anticline. The beds dip gently to the west-northwest. Smithsonite ($ZnCO_3$), and calamine [$Zn_4(OH)_2Si_2O_7 \cdot H_2O$], the "bone ore" of the miners, can be seen locally in typical development, and sphalerite is present in the exposed breccias at many places in the pit.

It is interesting to note that the sphalerite here occurs in ore grade--about three to four percent of the rock. A different impression is gained when observing this economic mineralization on the surface, in a large open pit, as contrasted with that apparent underground in the mine. This open pit intersects the underground workings of the Grasselli Mine at the lowest exposed point, and this opening is used for ventilation of the mine.

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West of Dandridge, the return route generally follows the north shore of Douglas Reservoir. Bedrock exposures in road cuts are mostly lower Ordovician formations of the Knox Dolomite

Group. The unconformity at the top of the Knox Group is particularly well exposed along the north shore of the Reservoir during periods of low water. Several paleo-karst features can be seen in great detail (Bridge, 1955). Unfortunately, one of the most interesting of the ancient sinkholes in this paleo-karst terrane was discovered, and immediately concealed, during construction of the left abutment of Douglas Dam. This sinkhole apparently extended several hundred feet down into the Mascot dolomite, and was filled with basal middle Ordovician sediments, including about 60 feet of white, orthoclase-bearing volcanic ash (Laurence, 1945).

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A short stop will be made at the visitors overlook above the north abutment of Douglas Dam.

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A stop will be made at a locality on Tenn. Rt. 66, about a mile south of the bridge below Douglas Dam. Many unusual, doubly-terminated quartz crystals have been collected from the road cuts, and after plowing, in the field to the east of the road. The crystals apparently develop in the residuum on the Lenoir limestone. A peculiar feature is the common occurrence of crystals with pyramidal faces much better developed than the prism faces, resulting in nearly tabular crystals, foreshortened along the <u>c</u> - axis.

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