Geology and Mineral Deposits of the Powell River Area Claiborne and Union Counties Tennessee

By ARNOLD L. BROKAW, JOHN RODGERS, DEANE F. KENT, ROBERT A. LAURENCE, *and* CHARLES H. BEHRE, JR.

CONTRIBUTIONS TO ECONOMIC GEOLOGY

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By ARNOLD L. BROKAW, JOHN RODGERS, DEANE F. KENT, ROBERT A. LAURENCE, and CHARLES H. BEHRE, JR.

ABSTRACT

The Powell River area is in northeastern Tennessee in the Valley and Ridge province. The occurrence of zinc and lead minerals in the area has been known for more than a century, but commercial production has come from only three small mines.

The mines and prospects are in gently folded Cambrian and Ordovician sedimentary rocks exposed in the upper plate of the Pine Mountain (Cumberland) thrust block. The main part of the district, 6–7 miles wide, extends northeast along the crest of the Powell River anticline. This anticline is a compound fold at the surface and involves formations chiefly of the Knox Group, of Cambrian and Ordovician age. The area is within a trapezoidal block whose boundaries are tectonic features related to movement on the Pine Mountain thrust fault. The southeast edge of the trapezoid is a northeast-trending belt of tight folds and minor thrust faults; the southwest side is the northwest-trending Speedwell flexure; the northwest side is the sharply upturned flank of the Middlesboro syncline; and the northeast edge is the north-trending Rocky Gap flexure. The part of the Powell River anticline within the trapezoid is about 2 miles narrower than the part outside the block. Superimposed on the primary folds are secondary folds that trend northeast or northwest, and strike-slip faults that trend northwest. These secondary features apparently are related to rotational stresses that were activated when the forward motion of the Pine Mountain thrust was retarded between the Speedwell and Rocky Gap flexures.

The larger ore bodies are localized in openings along steeply dipping strike-slip faults which terminate at depth against bedding planes or bedding-plane faults. The most productive deposits are in the Maynardville Limestone Member of the Nolichucky Shale where it has been cut by the northwest-trending strike-slip faults. Deposits of lesser economic importance, which may represent chimneys from richer deposits below, are along faults and fractures that cut the younger rocks, mostly the Copper Ridge Dolomite.

The localization of these deposits is clearly related to tectonic features formed during the Appalachian orogeny. Therefore, the deposits are probably post-Pennsylvanian in age.

INTRODUCTION

The Powell River area, in western Claiborne County and northeastern Union County, is one of the most pervasively mineralized areas in eastern Tennessee. A northwest-trending belt of zinc and lead mines and prospects extends along the Powell River for about 15 miles from Kings Bend to Leadmine Bend. Within this belt more zinc and lead occurrences are known than in any other area of comparable size in east Tennessee.

The presence of lead and zinc in this area has been known for more than a century, but until 1935 the only significant production came from the New Prospect mine. It was operated almost continuously from 1883 to 1901, yielding a large but undetermined tonnage of zinc ore, probably on the order of 100,000 tons. Since 1901 the mine has been worked only sporadically on a small scale. Two new mines—the Bunch Hollow and the Kings Bend—were opened in the area in 1935 by the Imperial Mining Co. Approximately 800 tons of zinc and lead concentrates was produced before these two mines were shut down in 1945. No mining has been done in the district since that time.

Small exploration projects have been undertaken from time to time in the area by various mining companies and by agencies of the Federal government. The exploration has consisted mainly of drilling a few holes in the vicinity of the prospects near Leadmine Bend. The available information indicates that no significant ore discoveries have been made. Nevertheless, the potential economic importance of the area is considered to be fairly good, mainly because the most favorable beds are buried beneath younger strata in most of the area, and because the many occurrences of ore minerals in these younger rocks may indicate leakage from ore bodies of appreciable size at depth.

The shipping point nearest to the Powell River area is New Tazewell, which is just beyond the southeast edge of the mapped area. The district can be reached by a network of unimproved roads that connect with Tennessee State Highway 33, which passes through the southeastern part of the area, and with U.S. Highway 25E, which is a few miles northeast of the mapped area.

GEOLOGIC INVESTIGATIONS IN THE AREA

The zinc and lead deposits of the Powell River area attracted attention in the early years as a possible source of lead for bullets. The first published mention of these deposits was by Troost (1848), who gave a brief description of a few zinc occurrences in his report to the Tennessee General Assembly. Later, Safford (1869) described the occurrence of galena at the Caldwell mine in Union County and also the zinc carbonate deposits at the locality in Claiborne County that later came to be known as Leadmine Bend.

A few of these mines and prospects were described in reports by Purdue (1912) and Secrist (1924). Secrist's report contains the most complete description of the deposits that has previously been published.

The geologic field investigations for this report were started in 1942 and completed in 1945. Several geologists of the U.S. Geological Survey participated in various phases of the work. The geologic map of the Powell River area was prepared under the direction of John Rodgers. He was assisted for short periods by R. A. Laurence, D. F. Kent, C. H. Behre, Jr., Vincent Nelson, and the late Irvin Gladstone. Investigations relative to the economic geology of the deposits were the responsibility of Mr. Kent. In this work he was assisted by all other project personnel. The report in its present form was assembled from their unpublished maps and notes by Mr. Brokaw, who assumes responsibility for any errors or omissions.

ACKNOWLEDGMENTS

Many courtesies were extended to U.S. Geological Survey personnel by the residents of the area. Access to all parts of the area and information on the history and location of the mineralized areas, freely given, greatly facilitated the work. Special acknowledgment is given to Berlen C. Moneymaker, chief geologist,Tennessee Valley Authority, for making available unpublished maps and economic studies of the Norris Reservoir area. Mr. C. A. Harris granted permission to study and publish the geology of Bunch Hollow mine area. Mr. Johnson Crawford, formerly geologist for Universal Exploration Co., and Richard Sayrs, of the U.S. Bureau of Mines, effectively expedited the exploration projects at the Stiner and Bunch Hollow areas.

GENERAL GEOLOGY

Bedrock in the Powell River area consists of Cambrian and Ordovician carbonate rocks and minor shale. These rocks have been folded into the broad flat Powell River anticline and into other subsidiary folds that are either parallel and normal to the major fold. The Powell River anticline and the complementary Middlesboro syncline to the northwest are structural features of regional extent that are confined to the upper plate of the Pine Mountain thrust fault.

The oldest rock exposed is the Upper Cambrian Nolichucky Shale, which consists of a shale member and the Maynardville Limestone Member. These beds are overlain by the dolomites and limestones of the Knox Group. In this area the Knox is 2,500 feet thick and consists of, in ascending order, the Upper Cambrian Copper Ridge Dolomite and the Lower Ordovician Chepultepec Dolomite, Longview Dolomite, Kingsport Limestone, and Mascot Dolomite. The four Lower Ordovician formations correspond in general to the Beekmantown Dolomite of the northern Appalachians. All the formations of

the Knox Group are mainly light gray crystalline to compact cherty dolomite and minor limestone. The youngest formation exposed in the mapped area is the thin-bedded Chickamauga Limestone, of Middle and Late Ordovician age, which overlies the Mascot Dolomite.

STRATIGRAPHY

CAMBRIAN ROCKS

NOLICHUCKY SHALE

The Nolichucky Shale is exposed near the core of the Leadmine Bend anticline, near the Leadmine Bend of the Powell River, and in the core of the Sandlick anticline, near Sandlick. The bulk of the formation is yellow to green limy shale containing thin interbeds of fine- to medium-grained limestone. Locally some of the shale is red to maroon. The ratio of limestone to shale increases upward; the upper sequence, in which carbonate rocks predominate, has been separately mapped as the Maynardville Limestone Member.

As the base of the Nolichucky is not exposed in the area, the original thickness is not known. At the well-exposed section near Thorn Hill, 15 miles east of the Powell River area, the Nolichucky is about 1,000 feet thick. It is inferred to be this thick in the Powell River area, but it could be thicker because of repetition of beds along the flat-lying Pine Mountain thrust fault. Conversely, it could be thinner in the Powell River area owing to elimination of beds by movement along the fault.

MAYNARDVILLE LIMESTONE MEMBER

The Maynardville Limestone Member is at least 350 feet thick in this area. The lower unit, 215 feet or more thick, is blue or brown rather massive limestone, in part crystalline or oolitic, but mostly aphanitic and locally ribboned with dolomite. The upper unit, 135 feet thick, is light-gray well-bedded and well-laminated magnesian limestone and dolomite. The upper unit includes near its base several beds of blue limestone like that in the lower unit; in mineralized areas the limestone is commonly altered to secondary dolomite. At the New Prospect mine a conspicuous bed of gray dolomite, consisting in part of edgewise conglomerate, marks the contact between the limestone and dolomite units of the Maynardville Member. In unaltered sections this bed is the lowest dolomite bed in the Maynardville, but in dolomitized areas it loses its distinctiveness because its textures and color are similar to those of the secondary dolomite.

COPPER RIDGE DOLOMITE

Characteristically the Copper Ridge Dolomite is a dark-gray crystalline massive knotty dolomite. In the mapped area it is 900–1,000 feet thick. It contains disseminated asphaltic material, which gives it a

brownish or nearly black color and causes it to emit the odor of asphalt when broken. In most places the asphaltic dolomite makes up no more than half of the formation, and in the upper quarter it is rare. Interbedded with the dark dolomite are layers of light-gray well-bedded aphanitic to subaphanitic dolomite. Every gradation between the light and dark dolomite can be found, but the intermediate types are not common. Nodules and layers of chert occur throughout the Copper Ridge; they are normally dark gray in the lower beds and lighter in color in the higher beds.

The upper quarter of the Copper Ridge is chiefly light-gray well-bedded slightly silty dolomite. Interbedded with this dolomite are light-gray oolitic chert layers, some more than a foot thick. The oolites in the chert are mostly about a millimeter or slightly larger in diameter and exhibit tints of blue or gray that accentuate their concentric structure. One or two sandstone beds are present near the top of the Copper Ridge. A few beds of massive crystalline light-gray dolomite in beds 3–4 feet thick are present in the upper quarter of the formation. In many places in the district, galena is disseminated in these dolomites, and it is possible that most occurrences are in a single bed. The chert residuum from the upper quarter of the Copper Ridge is notably light in color and is mostly oolitic; much is jagged, but it is rarely porous. Near the top of the formation in some parts of the district is a massive ledge-forming layer of white chert.

Fossils are rare in the Copper Ridge, but *Scaevogyra* has been found in several places at a rather definite stratigraphic horizon about 300 feet below the top of the formation.

ORDOVICIAN ROCKS

CHEPULTEPEC DOLOMITE

The Chepultepec Dolomite is probably about 700 feet thick, but there are no complete sections in the district. The Chepultepec consists chiefly of alternate aphanitic and crystalline layers of fairly light-gray well-bedded dolomite, but it contains some sandstone in its basal, sandy member, and some dark-gray dolomite in its upper part. Much of the formation is silty, and the silt on weathered surfaces defines thin laminae. The upper part of the Chepultepec is thicker bedded than the lower part.

Several layers of sandstone 1–10 feet thick occur at or near the base of the Chepultepec—in the basal, sandy member, which is about 200 feet thick. The cement of the sandstone layers is dolomite in some places, quartz in other places, and chert in a few places. The base of the first sandstone above the oolitic chert zone in the Copper Ridge Dolomite marks the contact between the Copper Ridge and the Chepultepec. In some parts of the district, this sandstone is the most

prominent sandstone bed in the Chepultepec, or even the only one; but in other areas a bed 80 feet stratigraphically higher is more conspicuous. Other sandstone beds are present still higher in the formation, above the basal, sandy member; a prominent sandstone layer near Cupp Mill is about 300 feet above the base of the Chepultepec.

Flattened chert nodules are common in the Chepultepec and are abundant in certain layers; cavernous ropy chert is, however, the characteristic type of chert in the formation. Molds of small dolomite rhombs are abundant in much of the chert and make it porous and mealy. All the chert in the formation is normally light gray. Oolitic chert is common, but the ooids are generally smaller and less conspicuous than those in the chert from the Copper Ridge. In a few places the chert forms massive traceable ledges.

The top of the Chepultepec Dolomite is difficult to define because the Chepultepec grades into the overlying Longview Dolomite. The contact is generally placed just above the highest occurrence of dark-gray crystalline dolomite. In places a thin sandstone bed occurs in this interval; and where this bed is present, the contact is drawn at its base.

The residuum of the Chepultepec consists of fairly small pieces of light-gray chert, some of it oolitic, in orange clay. Where sandstone beds are present, fragments from them predominate in the residuum and also form float that extends far down the slope, over the underlying Copper Ridge.

LONGVIEW DOLOMITE

The Longview Dolomite, which is about 250 feet thick, consists of light-gray aphanitic to finely crystalline thick- to thin-bedded dolomite. In some places light-gray, blue, or brown aphanitic limestone is interbedded in the upper part of the formation. Chert nodules are not common. Some oolitic chert, similar to that in the underlying Chepultepec, is present. Sand grains are scattered through some beds, but they are rarely in sufficient quantity to constitute a bed of sandstone.

Upon weathering the Longview yields large quantities of light-colored porcelaneous brittle massive chert in blocks as much as 3 feet in diameter. Few blocks are cavernous, none are porous, and most are smooth surfaced. Much of the chert is faintly tinted blue, pink, or yellow. *Lecanospira* has been found in the massive chert. In a few places where the formation is known to be present, the typical chert is missing.

KINGSPORT LIMESTONE

In the Powell River area the Kingsport Limestone is about 200 feet thick; it is largely light-gray aphanitic thick-bedded dolomite in the upper part and light-blue or brown aphanitic limestone in the lower 60 feet. Sand grains are scattered through many beds, but sandstone beds are not common. Nodules of white chert are abundant in both the

dolomite and the limestone. The base of the formation is placed at the bottom of the lowest massive limestone bed.

On weathering the Kingsport yields compact, chalky, rather massive chert, commonly deeply stained with iron oxide. Fossils, though not abundant, have been found both in the chert and in the blue limestone.

MASCOT DOLOMITE

The Mascot Dolomite consists of light- to medium-gray well-bedded dolomite which is generally crystalline in its lower part and aphanitic and silty in its upper part. A zone of limestone occurs in the lower part in several places in the area and also on the south slope of Wallen Ridge, southeast of the district. In the southwestern part of the district, the base of the formation is marked by a conspicuous layer of sandstone cemented by chert, but this layer has not been recognized near the Straight Creek mine nor in the area to the north of it. The formation is slightly more than 500 feet thick, except where the upper beds have been removed by erosion at the unconformity at the top of the Knox Group.

In the Powell River area the Mascot is characterized by large quantities of white to gray dense chert. Among the Knox units, the Mascot ranks second only to the Longview in abundance of chert. The Mascot chert can be distinguished from the Longview chert by its lack of the pale blue, pink, and yellow tints and by its more irregular surfaces. In many places in the zone of weathering, the Mascot chert forms massive ledges that retain the strike and dip of the dolomite; such ledges are rare in the Longview. Only the uppermost beds of the formation lack chert in this area. Mixed with the massive white chert is other chert which is similar to that of the Kingsport.

CHICKAMAUGA LIMESTONE

Unconformably overlying the Knox Group is a limestone sequence considerably more than 1,000 feet thick. It includes several varieties of limestone that succeed each other by abrupt changes in lithology. This sequence, which was not divided for mapping in this area, is called the Chickamauga Limestone, and it crops out in belts on the northwest and south sides of the Powell River anticline. The belt on the south side is interrupted by the structural features around the Straight Creek fold belt.

The lower part of the Chickamauga in this area consists of massive light-gray to buff fine-grained limestone, dark-gray fine-grained cherty limestone, coarse-grained nodular limestone, and pink silty limestone. In places red and yellow silty shale is also present. The basal beds commonly contain chert fragments derived from the underlying Mascot Dolomite. The upper beds are similar to the lower beds but contain more nodular, flaggy, and silty limestone.

STRUCTURE

The Powell River zinc area is in the zone of faulted Appalachian folds that trends northeastward across eastern Tennessee (fig. 1). It lies within the northwesternmost fault block that is bounded on the northwest, about 20 miles northwest of the Powell River area, by the Pine Mountain (Cumberland) thrust fault. This block differs markedly from most of the fault blocks farther southeast by being much broader and less deformed; that is, it contains large areas of nearly horizontal rocks. Thus, the attitude of the rocks in the block is similar to that of rocks in the Cumberland Plateau province to the northwest.

The dominant structural feature in the Powell River area is the Powell River anticline, a broad flat-topped fold 6–8 miles wide that extends northeast and southwest beyond the report area for several tens of miles. Superimposed on the major fold are smaller folds. The gentle undulations on the broad crestal area form a series of low-amplitude folds whose axes are parallel to that of the dominant anticline. Among these smaller folds are the Combs and Clouds anticlines and the intervening Greaver Hollow syncline. Other, more local, folds on the Powell River anticline are the Leadmine Bend dome and the Straight Creek fold belt, both geologically important because they expose the oldest rocks in the area and thus contain the more favorable ore-bearing beds. Flanking the Powell River anticline on the northwest are the more tightly folded Powell Valley syncline and Davis Creek anticline. The beds near the crestal area of the Powell River anticline have been broken by several strike-slip faults of small displacement.

The Clouds and Combs anticlines, named for stations along the Southern Railway, are clearly exposed along the railway's Cumberland Gap Branch in the eastern part of the area. The Combs anticline and the Greaver Hollow syncline continue southwest across the area; but the Clouds anticline dies out near Goin, and the parallel Johnson Hollow anticline rises to the south (fig. 1). The offset between these two anticlines is opposite the southwest end of the Straight Creek fold belt and probably reflects the southwest end of the constriction caused by that fold belt.

The Leadmine Bend dome is a doubly plunging anticline that trends northwest approximately at right angles to the Powell River anticline and most other folds in the area. Its axis can be traced for about 4 miles. Its flanks only locally dip more than 10°. The Leadmine Bend dome is probably related to the Speedwell flexure, a northeast-dipping monocline of regional extent that seems to begin near the center of the Powell River anticline and to extend northwest about 23 miles to the trace of the Pine Mountain fault. The synclinal bend of the Speedwell flexure (fig. 1; not shown on pl. 1) is about 1 mile north-

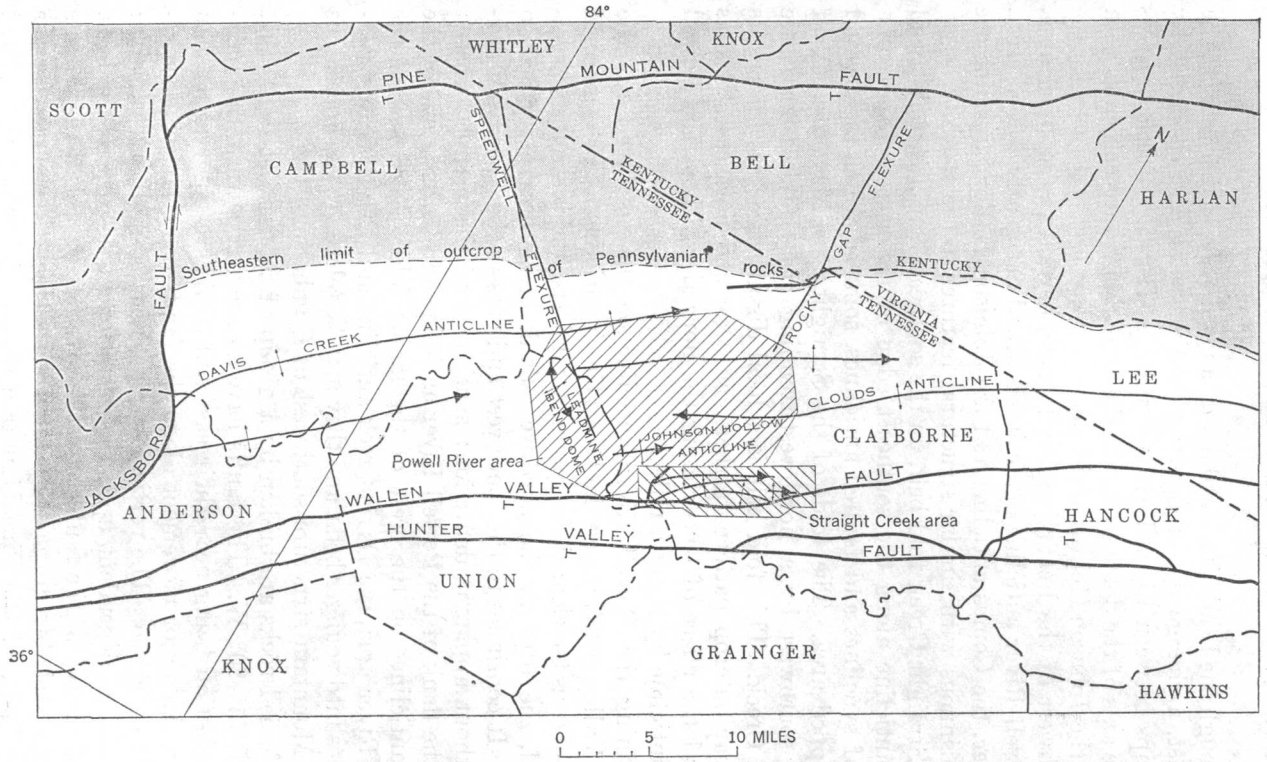

FIGURE 1.—Part of the Cumberland thrust block, showing the relationship of the Powell River area to the main structural features.

east of the crest of the Leadmine Bend dome. The flexure exposes rocks as young as Pennsylvanian in its northwestern part and causes a prominent offset in the Cumberland front northwest of Speedwell (fig. 1).

Although the Leadmine Bend dome cannot be traced definitely to the southeast, a change in the direction of the strikes and the typically steep dips between Little Barren Creek and Hunting Creek suggests that the axis of the dome swings to the east and perhaps coincides with that of the Johnson Hollow anticline.

Southwest of the Leadmine Bend dome, beyond the mapped area, the Powell River anticline again has a broad flat gently folded crest. However, the Combs anticline and the Johnson Hollow anticline are not continuous with similar structural features to the south.

The Straight Creek fold belt, on the southeast flank of the Powell River anticline along the southeast edge of the area, consists of a series of synclines and faulted anticlines, some of which are beyond the mapped area. The folds of the Straight Creek belt are cut off on the southwest by a northwest-trending cross fault near Little Barren Creek. This fold belt is a local disturbance that interrupts the linear outcrop pattern farther southwest and northeast. It has thus had the effect of constricting the normal width of the Powell River anticline by about 2 miles.

Adjoining the Powell River anticline on the northwest are the Powell Valley syncline and the Davis Creek anticline. In the mapped area the Davis Creek anticline plunges northeast and is strongly asymmetrical, the dips in the northwest flank being nearly vertical in places. It continues to the southwest and crosses the Speedwell flexure without apparent deflection; southwest of the mapped area it leaves the flank of the Powell River anticline and becomes one of the gentle anticlines on the crest of the major fold. Northeast of the Powell River area, the Davis Creek anticline and Powell Valley syncline pass into younger beds, and they may be related to the anomalous Powell Mountain structure southwest of Cumberland Gap.

The folded rocks are broken by a group of subparallel faults that strike N. 75°–80° W. The faults have an arcuate pattern, the maximum inflection being near their east ends. Where observations can be made, the major movement along the faults has clearly been horizontal or nearly so. The vertical displacement is small and variable; the amount is dependent upon the variation in the dip of the beds.

Significantly, all the faults mapped have left-lateral displacements and were probably formed by rotational stresses developed in the retarded block of the Pine Mountain thrust. They are not related to the direct northwest-southeast compressive forces generally associated with faulting in the Tennessee Valley.

The regional structure of the Pine Mountain thrust block, on which lie both the Powell River and the Straight Creek zinc districts, is discussed in several publications (Rich, 1934; Miller and Fuller, 1947; and Miller, 1954). Exposures of the fault in fensters at several high points along the Powell River anticline 15–20 miles northeast of the Powell River zinc district suggest that the sole of the thrust lies at fairly shallow depth beneath the mapped area. At the fensters the fault is in the Nolichucky Shale not far below the Maynardville Limestone Member, and there seems little reason to doubt that the fault is at about the same stratigraphic position under the Powell River and Straight Creek zinc districts. However, the fault is not exposed on the Leadmine Bend dome or at any of the other places along the Powell River anticline west and southwest of the district where the Nolichucky is at the surface.

The Speedwell flexure can apparently be traced from Speedwell northwest across the Pine Mountain block to Jellico Gap in Pine Mountain. The flexure was considered by Rich (1934) to be one of the two structural features that outline a trapezoidal fragment of the block that did not move as far to the northwest as did the adjoining parts of the block. The opposite leg of the trapezoid is formed by the north-trending Rocky Gap–Cumberland Gap lineament (Ashley and Glenn, 1906), which can be recognized as far south as Arthur, just north of the northeast corner of the Powell River district. If continued, this lineament would cross the district near its east edge. The southeast base of the trapezoid lies along the fault that crops out a short distance southeast of the Powell River anticline near the Straight Creek uplift. It is noteworthy that the two zinc districts on the Pine Mountain thrust block are both on or near this trapezoidal fragment.

Within this trapezoidal block are secondary features that are superimposed on the primary folds. These secondary features are apparently related to rotational stresses that became active when the uniform forward motion of the Pine Mountain block was retarded in the area between Speedwell and Arthur. A simple couple—having stresses developed in a north-northwest direction in the normal block and in a south-southeast direction in the retarded block—would be sufficient to form the transverse folds and strike-slip faults that are present in the area. Leadmine Bend dome, which is elongated in a northwest direction, is parallel to the Speedwell flexure. Apparently it is a simple buckle in the beds along the line of differential movement between an active and a passive block in the upper plate of the Pine Mountain thrust. Similarly, the small northwest-trending faults, along which the movement was essentially strike slip, were probably formed at the same time. These folds and faults have a significant

relationship to the base-metal deposits in the area. The largest ore body in the Powell River district—at the New Prospect mine—is in the Maynardville Limestone Member and is localized along a pair of northwest-trending strike-slip faults.

MINERAL DEPOSITS

CLASSIFICATION

The mineral deposits in the Powell River area are of three types: (1) replacement deposits along faults, with some open space filling in the breccia, (2) fracture fillings, and (3) bedded replacement deposits apparently unrelated to faults or fractures.

REPLACEMENT DEPOSITS ALONG FAULTS

The largest ore body closely associated with faulting is at the New Prospect (Leadmine Bend) mine, in the limestone unit of the Maynardville Limestone Member. At this deposit a high-angle fault that strikes N. 80° W. cuts nearly horizontal beds and has a vertical displacement of about 15 feet. However, as shown by a slight drag of the bedding, the movement was largely horizontal approximately parallel to the strike of the fault plane. The main mineralized zone is in the upper part of the limestone unit, which is predominantly a brown fine-grained limestone elsewhere but which has been dolomitized in the vicinity of the mine. The ores are massive and occur mainly as replacements in this zone; but in the overlying dolomitic unit, sphalerite and galena in bands as much as 8 inches thick fill the fractures and breccia interstices. Some sulfides occur along openings on the bedding planes. About 2 feet of gouge lies along the main fault on the north side of the ore body; part of the gouge has been replaced by finely disseminated galena and spahalerite. This is the only place where an exposure of the Maynardville Member coincides with that of the faults.

Most other fault-associated deposits are in the Knox Group. These ore bodies account for the largest number of small mines and prospects in the area. Sulfide minerals are most abundant along faults that cut a 150-foot-thick stratigraphic zone about 300 feet below the top of the Copper Ridge Dolomite. The beds in this zone are light-gray fine to coarsely granular dolomite with some dark chert bands and a few dark dolomite beds. Ore minerals are dark-brown sphalerite and galena. Pyrite also is abundant in deposits of this group. The individual ore bodies are vertically extensive and average 20 feet in width and 3 feet in thickness; almost without exception they are on the south side of the fault planes. The faults have an arcuate en echelon pattern; those at the east end of each fault group have strikes that average N. 65° W., whereas those at the west end of each group strike almost

due east. All the faults dip nearly vertically. The displacement on the faults is generally not great. Mining and diamond drilling have revealed that the vertical fault planes commonly terminate at depth against other planes of movement, some of which are bedding-plane faults. In the Bunch Hollow mine one fault plane flattens and then steepens within a single stoped area. The gouge zone along the faults is notably thin. Noteworthy sulfide replacements in the gouge were observed only at the New Prospect and Bunch Hollow mines, but others would probably be found if fresh exposures were available for examination. Silicified material along the fault is common but does not extend far into the walls.

FRACTURE FILLINGS

Many prospects have been opened on veinlets of sulfides in small fractures or joints. Most of these fractures trend N. 75° E. and are structurally important only in that they are locally associated with nearby fault zones. This association is recognizable at the Bunch Hollow and Sugar Creek Hollow zones; the fractures at the New Prospect mine, already described, belong to this system. Another widespread system of fractures striking N. 45° W. is not mineralized.

BEDDED REPLACEMENT DEPOSITS

The bedded deposits are of two types. The first type consists of disseminated sphalerite and galena in favorable carbonate beds. Deposits of this type can be seen especially well at the Day, Fortner, and Lynch prospects in Sugar Creek Hollow. Here a light-gray fine-grained dolomite bed 250 feet below the top of the Copper Ridge Dolomite has small quantities of sphalerite. The second type consists of thick beds of chert that have been shattered and mineralized as at the Ford prospect in Lonesome Valley.

MINERALOGY

The mineral deposits of eastern Tennessee are widely known for the simplicity of their mineral suites. The total mineral assemblage is composed of only about seven minerals. The ore minerals are sphalerite, galena, and their oxidation products, chiefly smithsonite and cerussite; the gangue minerals are pyrite, dolomite, and calcite.

Sphalerite (*blende*, *blackjack*) (ZnS).—Sphalerite is by far the most abundant sulfide mineral in these deposits. The fault-associated deposits contain sphalerite that is characteristically medium brown to black and is generally associated with significant quantities of pyrite and galena. The presence or absence of galena has no apparent effect on the coloration of the sphalerite, but a relationship between the quantity of pyrite and the color of the zinc is suspected. In

deposits where the pyrite content is greatest, the sphalerite is brown, probably because of a significantly greater iron content.

In the bedded replacement deposits the sphalerite is commonly honey-yellow or rosin colored. Pyrite is generally absent or occurs only in small amounts. Most of the sphalerite is fine grained. Crystals are rare; but where they are present, they are in small clusters of tiny dodecahedrons. Some of the light-colored sphalerite is banded, which suggests colloidal deposition.

Galena (PbS).—Galena is the common source of lead in the district. It is not as widespread as sphalerite, but, where present it is generally intermixed with sphalerite. Galena generally occurs in dendritic masses that lack crystal form or in discrete kernels. A common characteristic of the galena is the curved cleavage faces. This distortion presumably resulted from postdepositional stresses, probably during late-stage movement along some of the faults.

Pyrite (FeS_2).—Pyrite is widely distributed and is most abundant in the mines and prospects associated with faults. Commonly it is massive and fine grained, but locally it is present as minute cubic crystals disseminated in thin bands between sphalerite and the host rock or between sphalerite and galena. Some pyrite occurs as thin films along the bedding planes, particularly in thin-bedded carbonaceous zones, and some occurs as finely disseminated grains in the rock. Pyrite of this type is not believed to have been introduced at the time of ore deposition, but rather at the time the host rocks were deposited.

Smithsonite ($ZnCO_3$).—Smithsonite is the common oxidation product of zinc sulfide. It is generally referred to in this district as "carbonate," "drybone," or "bone." Pure smithsonite is rarely present. The common occurrence is as an admixture of clay and ferric hydroxide. Because of its earthy texture and yellow color, it often escapes attention as a zinc ore. Locally, the mineral occurs in botryoidal masses at the base of the weathered zone. These masses are generally faintly banded and waxlike in appearance.

In this area smithsonite is found above the water table in the upper part of the deposits and is therefore useful as a guide to sulfide ores at depth.

Cerussite ($PbCO_3$).—Cerussite is the only oxidation product of lead found in these deposits. The material is earthy, white, or yellowish and often has a sandy texture. It is commonly called "sand carbonate" locally, although most of the material so designated is probably smithsonite.

The cerussite occurs in small masses generally having cores of galena. Only rarely is cerussite found apart from galena. Crystalline forms are rare.

Dolomite ($CaMgCO_3$).—The most abundant gangue mineral is hydrothermal dolomite, which occurs as fracture fillings in brecciated rock and as a replacement of limestone. The dolomite that fills fractures is commonly coarsely crystalline, the grain size ranging from 1 to 3 mm and averaging about 2.5 mm. The mineral is uniformly white. In contrast, the dolomitized limestone can be texturally described as a fine- to coarse-grained marble. The grains are 0.2–1.5 mm in diameter, averaging about 1.9 mm. This dolomite is light to dark gray. The shade of color depends on the amount of dark-colored interstitial residue that was concentrated along grain boundaries during the dolomitization of the limestone.

Calcite ($CaCO_3$).—Calcite, a common constituent of lead-zinc ores throughout the world, is conspicuously rare in these deposits. Most of the calcite observed was in fracture fillings in the fault-associated deposits and in small vugs in the replacement deposits. In almost all occurrences the calcite was the latest mineral to form. The mineral is uniformly white and exhibits well-formed crystals. In some vugs, small "dogtooth" crystals (scalenohedrons) have formed, but small rhombohedral crystals are the common form.

MINERAL POTENTIAL OF THE DISTRICT

The mineral potential of the Powell River area probably is almost wholly in undiscovered ore bodies in the Maynardville Limestone Member of the Nolichucky Shale. The ore bodies in the Copper Ridge Dolomite are small but may be important, as they could represent "chimneys" extending upward from larger deposits in the Maynardville. The upward course of such chimneys is along steeply dipping faults and fractures which also cut the more favorable Maynardville at depth. Exploratory drilling has proven the existence of strongly mineralized areas in the Maynardville below at least one such chimney and along steeply dipping fractures or other favorable structural features. The Straight Creek mine, which is just outside the southeast edge of the mapped area, is also in the Maynardville Member. This fact lends support to the hope of finding ore at depth along favorable structural features in localities where beds stratigraphically higher than the Maynardville are the surface rocks.

MINES, PROSPECTS, AND MINERAL OCCURRENCES

The mineralized areas comprise mines, prospects, and occurrences. As here used, the term "mines" is applied to those workings from which ore has been shipped, "prospects" are those where development work has been done but from which no ore has been shipped, and "occurrences" are mineralized areas at which no development has been undertaken.

In the following descriptions all properties are listed in alphabetical order. Ownership information is as of 1943. Each property name is followed by a number in parentheses by which the property can be identified on the geologic map (pl. 1). A numerical list of the properties is shown on plate 1. A summary of the general geology of the mineralized areas, including the name of the quadrangle in which the area is located, is given in table 1, in which the properties are listed in alphabetical order.

Four properties regarded as typical of the three types of deposits present in the area are described in considerable detail. These are the Bunch Hollow and New Prospect mines and the Ritchie and Stiner prospects.

Beeler prospect (78)

The prospect is near the house belonging to Mr. Beeler, near the road from Meyers Ridge. It consists of an opening 20 feet long and about 5 feet wide cut into dark irregularly bedded fetid dolomite of the Copper Ridge Dolomite. The north wall of the cut follows a major east-trending fracture; other parallel fractures are present in the face of the cut. No sulfides were seen, but zinc carbonate is present as veinlets in weathered powdery dolomite close to the main fracture.

Bowen occurrence (80)

The mineralized area is near the mouth of the western of the two tributaries in Calloway Hollow, on land formerly belonging to Mr. Bowen but now owned by the Tennessee Valley Authority. A small amount of sphalerite is disseminated in a ledge of Copper Ridge Dolomite.

Charles Braden (western) prospect (31)

The Charles Braden (western) prospect is a shallow cut in the bed of an intermittent stream, 100 yards southwest of the Braden house on Whiteoak Ridge. It is on the north side of the principal tributary entering Big Branch Hollow from the west. A "dry-weather road" reaches the Braden house, but the nearest good road is half a mile to the west. The cut was made by Levi Ausmus and David Leach in about 1925.

The cut is in the Copper Ridge Dolomite not more than 75 feet below the basal, sandy member of the Chepultepec, which is exposed in the streambed. The rocks are nearly horizontal and are broken by east-trending joints. Galena and a trace of sphalerite occur in small veinlets in a 4-foot-thick bed of light-gray fine-grained dolomite that forms a fairly prominent ledge.

TABLE 1.—*Location and description of the mineral deposits*

[Minerals present are listed in order of decreasing abundance: Zn, sphalerite; Pb, galena; Fe, pyrite; L, limonite; ZnC, zinc carbonate or smithsonite; PbC, cerussite]

Name	Number on geologic map	Quadrangle	County	Type	Mineral	Structural control of deposits	Strike of fault or fracture	Stratigraphic position	
								Formation	Above (+) or below (−) base of Chepultepec Dolomite (feet)
Beeler	78	Ausmus	Union	Prospect	ZnC	Fracture	E	Copper Ridge Dolomite	−475
Bowen	80	do	do	Occurrence	Zn			do	−270
Braden, Charles (western)	31	do	Claiborne	Prospect	Pb, Zn(?)	Bedding	E	do	−75
(eastern)	32	do	do	Occurrence	Zn	do	N. 75° W	do	−100
Braden, J. D	34	do	do	Prospect	Fe, Pb, Zn	do	N. 15° W	Longview Dolomite	+515
Braden (western)	76	do	Union	do	Zn, Pb, Fe	Tear fault	N. 75° W	Copper Ridge Dolomite	−475
(eastern)	77	do	do	do	Zn	Fracture	N. 75° W	do	−475
Bruce, Robert	7	Cumberland Gap.	Claiborne	do	Zn, Pb, Fe	No bedrock exposed.		do	−250
Bunch Hollow	53	Clouds	do	Mine	Zn, ZnC, PbC, Pb, Fe.	Tear fault	N. 66° W	do	−300±
Caldwell mine	40	Ausmus	Union	do	Pb, Zn	do	N. 75° W	do	−325
Carey, F	46	Clouds	Claiborne	Prospect	Pb	Bedding		do	−180
Carey, Floyd	58	do	do	do	L	No bedrock exposed.		do	−320
Cawood	42	Ausmus	do	Occurrence	L			do	−225
Cline	23	Clouds	do	Prospect	Zn			do	−170
Combs Station	5	Cumberland Gap.	do	do	Fe	Fracture	N. 75° E	do	−320±
Cox (3 cuts)	75	Ausmus	Union	do	Pb, Zn [1]	Tear fault	N. 85° W	do	−700±
Crutchfield	29	Tazewell	Claiborne	do	Zn [1], L	No bedrock exposed.		do	−10
Day, F. M	64	Clouds	do	do	Pb, Zn	Bedding	N. 85° E	do	−180
Day, W. P	63	do	do	do	Zn, Pb	do	N. 70° E	do	−180
Deane	41	Ausmus	do	do	Pb, Zn	Tear fault	N. 75° W	do	−335
Dees	82	do	Union	do	Zn	Fracture	N. 70° E	do	−320
Due	27	Clouds	Claiborne	do	ZnC			do	−25
Duncan W. M. (southern)	68	do	do	do	Zn	Bedding		do	−75±
(northern)	21	do	do	do	Zn	do		do	−300
Evans	81	Ausmus	Union	do	Pb	do	N. 60° E	do	−320
Evans, Matt	15	Clouds	Claiborne	do	Zn, Pb	do	N. 75° W	do	−100
Farris		White Hollow	Union	do		do		Chepultepec Dolomite [2]	

Footnotes at end of table.

TABLE 1.—*Location and description of the mineral deposits*—Continued

Name	Number on geologic map	Quadrangle	County	Type	Mineral	Structural control of deposits	Strike of fault or fracture	Stratigraphic position	
								Formation	Above (+) or below (−) base of Chepultepec Dolomite (feet)
Ford	25	Clouds	Claiborne	Prospect	Zn, Fe	Bedding		Chepultepec Dolomite	+70
Ford—east	26	do	do	Occurrence	Zn	Fracture	N. 70° E.	Copper Ridge Dolomite	−15
Ford (Big Branch Hollow)	33	Ausmus	do	Prospect	Pb, Zn	Bedding	N. 75° W.	do	−315
Ford, J. B. (3 cuts)	70	Clouds	do	do	Zn, Fe			Chepultepec Dolomite	+50
Fortner (northern)	65	do	do	do	Pb	Bedding		Copper Ridge Dolomite	−180
(southern)	67	do	do	do	Zn, Pb, Fe	Tear fault	N. 60° W.	do	−190
Fortner Branch (old)	55	do	do	do	Pb, Fe	Fracture	N. 45° E.	do	−190
(new)	56	do	do	do	Fe, L	do	N. 65° E.	do	−190
Gap Creek	1	Cumberland Gap.	do	do	Zn, Pb, Fe	Tear fault	N. 81° W.	Longview Dolomite	+500
Gardner	2	do	do	do	ZnC	No bedrock exposed.		Chepultepec Dolomite	+435
Gardner (on Powell River)	4	do	do	do	Zn, Pb, Fe	Tear fault	N. 88° W.	Copper Ridge Dolomite	−125
Gardner=TVA	6	do	do	do	Zn, Pb, Fe	do	N. 84° W.	do	−260±
Goin, B. G. (Eli Goin)	59	Clouds	do	do	Fe, Zn, Pb	do	N. 70° W.	do	−75
Graves, H. M	92	Maynardville	Union	do	Zn, Pb, Fe	Bedding		Mascot Dolomite	
Honeysuck or Hunsucker	54	Clouds	Claiborne	do	Pb, ZnC	do		Copper Ridge Dolomite	−250
Hopper, J. M	52	do	do	Occurrence	Fe			do	−240
Hopper, Rupert	87	Ausmus	do	Prospect	Zn, L, Fe			do	−250
Johnson	89	Clouds	do	do	Zn	Bedding		Chepultepec Dolomite	+40
Johnson, H. B	47	Ausmus	do	do	Pb, Zn	do		Copper Ridge Dolomite	−170
Johnson, R. E	57	Clouds	do	do	Pb, Zn	do		do	−180
Jones, S	39	Ausmus	do	do	Zn	Fracture	E.-W.	do	−105
Jones, W. P	72	Clouds	do	do	Zn, Fe	Bedding		Chepultepec Dolomite	+125
Keck, J. D	85	Ausmus	do	do	Pb, Zn	Fracture	N. 75° E.	Copper Ridge Dolomite	−240
Keck, Robert	66	Clouds	do	do	Pb, Zn	Bedding		do	−180
Kings Bend mine	10	Cumberland Gap.	do	Mine	Zn, Pb, Fe	Tear fault	N. 76° W.	do	−285
Kings Bend (inside)	9	do	do	Prospect	ZnC			do	−270±
(northern)	11	do	do	do	L			do	−250±
(western)	8	do	do	do	ZnC	Tear fault	N. 78° W.	do	−250
Langford	71	Clouds	do	do	Zn			Chepultepec Dolomite	+40
Leadmine Bend (see New Prospect mine).									
Lindsay	28	do	do	Prospect	Fe, Zn	Bedding		Copper Ridge Dolomite	−150
Logan	24	do	do	do	Zn, Pb, Fe	do	N. 70° E.	do	−130

Love Heirs		Wheeler	do	do	Pb, Fe, Zn	do		do	−175
Lundy, Charles	17	Clouds	do	do	Zn	No bedrock		do	−260±
Lynch (see Ritchie).									
Lynch, Howard (northern)	60	do	do	do	Zn, Pb, Fe	Bedding		Copper Ridge Dolomite	−180
(southern)	62	do	do	do	Pb, Zn, Fe	Tear fault	N. 70° W	do	−210
Lynch, J. F	61	do	do	do	Zn, Pb, L	Bedding	N. 70° W	do	−180
Lynch, W. J	22	do	do	do	Pb	do		do	−150
Medley, Wm., and C. Leach.	30	do	do	Prospect	Zn, Pb, Fe	Bedding		Kingsport Limestone	+825
Minton	3	Cumberland Gap.	do	do	ZnC	Fracture	N. 78° W	Chepultepec Dolomite	+250
New Prospect mine (Lead-mine Bend).	74	Ausmus	Union	Mine	Zn, Pb, Fe	Tear fault and bedding.	N. 80° W	Nolichucky Shale [3]	−1100±
Odell	88	Clouds	Claiborne	Prospect	Pb, Fe, ZnC, L.	Tear fault	N. 57° W	Copper Ridge Dolomite	−155
Proffitt, C	45	Ausmus	do	do	Pb	Fracture	N. 75° E	do	−240
Ritchie (Lynch)	69	Clouds	do	do	Zn, Pb, Fe	Tear fault	N. 62° W	do	−155
Robinson, S. J	14	do	do	do	Fe, Pb, L			Chepultepec Dolomite	+80
Rouse	90	Maynardville	Union	do	Zn, L	No bedrock exposed.		do	+150
Russell	73	Ausmus	do	do	Pb, ZnC, L	Fracture	N. 66° E	Nolichucky Shale [3]	−1200±
Russell, W. M	12	Clouds	Claiborne	do	L			Copper Ridge Dolomite	−300±
Shipley	13	do	do	Occurrence	Zn	Bedding		do	−320
Shofner (northeast)	35	Ausmus	Union	Prospect	Zn, Fe, Pb	Tear fault	N. 80° W	do	−315
(southwest)	36	do	do	do	Zn, Fe	Fracture	N. 85° W	do	−380
Shofner-Weaver	86	do	do	do	Pb	Bedding		do	−120±
Smith, Fred	19	Clouds	Claiborne	do	Zn	Fracture	N.-S	do	−160±
Smith, I. (eastern)	44	Ausmus	do	Occurrence	Zn			do	−450
(western)	43	do	do	do	Zn			do	−65
Snyder, L. F. (2 cuts)	18	Clouds	do	Prospect	Zn, Pb, Fe	Bedding and tear fault.	N. 75° W	do	−330
Stiner	79	Ausmus	Union	do	Zn, Fe	Tear fault and bedding.	N. 75° W	do	−800±
Taylor, J. W	83	do	do	do	Zn	Fracture	N. 65° E	do	−225
Tolliver, D. F., South	84	do	Union	Prospect	Zn, Pb, Fe	do		do	−240
Treece	16	Clouds	Claiborne	do	Zn, Pb	Tear fault	N. 65° W	do	−225
Tuttle	20	do	do	do	Zn, Pb, Fe	Fracture	N. 70° E	do	−250
Welch, J. P	50	do	do	do	Zn, Pb	Bedding	N. 70° E	do	−160
Welch, Robert	49	do	do	do	Pb, Zn, Fe, L	do		do	−160
Williams (eastern)	38	Ausmus	Union	do	L	Fracture	N. 75° E	do	−450±
(western)	37	do	do	do	L	do	N. 85° W	do	−450
Wilson, Chad	48	do	Claiborne	do	Pb, ZnC, L	do	N. 75° W	do	−320
Wilson, Shot	51	Clouds	do	do	Pb	Bedding	N. 65° E	do	−160
Wilson		White Hollow	Union	do	Fe, Zn	do		Chepultepec Dolomite	
Woods	91	Maynardville	do	do	Pb, Fe	do		Copper Ridge Dolomite	−50

[1] Oxidized.
[2] Basal sandy member.
[3] Lower, limestone unit of Maynardville Limestone Member.

Charles Braden (eastern) occurrence (32)

Near the top of the bluff on the western side of Big Branch Hollow, a bed of light-gray fine-grained dolomite is exposed. The bed is broken by a set of east-trending joints that contain veinlets of sphalerite and galena. The bed is in the upper part of the Copper Ridge Dolomite and is probably the same bed that is mineralized at the Charles Braden (western) prospect.

J. D. Braden prospect (34)

The prospect is on the west side of the upper end of Ausmus Hollow, on a north-sloping spur. A poor road leads up the hollow to Mr. Braden's house, but there is a good road on the spur west of the hollow. The prospect consists of two cuts made in bedrock. The larger opening is 50 feet long and is cut 20 feet into the hillside. The smaller cut is 400 feet north of the larger.

The cuts expose light-gray, fine-grained cherty dolomite belonging to the Longview Dolomite. The rocks dip 15° NW. and are slightly fractured. The mineralized rock contains pyrite and traces of galena and zinc carbonate.

Braden prospects (western (76) and eastern (77))

The Braden prospects are on the south side of the stream in Braden Hollow. They can be reached by a secondary road from Stiner's store to the top of Meyers Ridge and then by trail to the bottom of the hollow. The mineral rights are owned by the New Jersey Zinc Co.

The eastern prospect is a small caved pit showing an inconspicuous amount of disseminated sphalerite along a fault that strikes N. 75° W. light-gray crystalline Copper Ridge Dolomite about 475 feet below the top of the formation.

The western prospects are 1,200 feet N. 75° W. of the eastern prospect. One cut is 10 feet long, 2 feet wide, and 4 feet deep; no mineralized bedrock is visible. A larger opening 50 feet long, 15 feet wide, and 10 feet deep exposes two faults that strike N. 75° W. and N. 70° W., respectively. Veins and stringers of calcite branch from the south fault, and sphalerite, galena, and smithsonite occur along the fault. The rock is dark-gray Copper Ridge Dolomite about 475 feet below the base of the Chepultepec Dolomite.

Mr. G. S. Stiner (oral commun., 1942) stated that in about 1913 the New Jersey Zinc Co. drilled at least two diamond-drill holes on the eastward extension of the south fault at the western prospect. The results of this drilling are not available.

Robert Bruce prospect (7)

The Robert Bruce prospect is on the north bank of the Powell River about three-fourths of a mile southeast of the mouth of Gap Creek. A farm road leads from Gap Creek around the bends of the river to the prospect. The prospect is a long shallow cut that is generally

covered by water. When visited it was under water, but scattered pieces of rock that came from the opening were found on the river bank above; these contained sphalerite, galena, and pyrite. The pit is in Copper Ridge Dolomite about 250 feet below the Copper Ridge-Chepultepec contact. The cut is almost exactly on the strike of the pronounced fracture or fault at the Gardner-TVA prospect (6) half a mile to the west; this fracture may also be the one that passes through the Kings Bend mine (10) 1½ miles to the east.

Bunch Hollow mine (53)

The Bunch Hollow mine (pl. 2) is in Claiborne County, about 8 miles west of New Tazewell. It is reached by 4.9 miles of hard-surfaced road southwest from New Tazewell to Cupp Mill, and then by 5.7 miles of poor, secondary, gravel road to the mine. Concentrates from the mill near the mine were trucked over this route to New Tazewell and then shipped by rail over the Cumberland Gap Branch of the Southern Railway. A closer shipping point is at Clouds siding, but the 8 miles of secondary roads to this point is in poor condition. The mine is owned by the Imperial Mining Co. of Fountain City, Tenn., and is managed by C. A. Harris, Sr., who discovered an outcrop of oxidized ore in the summer of 1935. One carload of carbonate ore, mined from a series of shallow pits, was shipped in 1939. The main hoisting shaft was sunk in 1939, a crusher and one jig were installed during the winter of 1940, and one more jig was added in the winter of 1941. A flotation plant capable of processing 60 tons of ore per day was installed during 1943–44. The mine was operated until August 1944, and the mill was shut down soon afterward. The total production through 1944 was 840 tons of ore averaging 11.2 percent lead and 37.3 percent zinc, or 93.9 tons of lead concentrates and 317.5 tons of zinc concentrates.

The mine, which is on the crest of the Powell River anticline, is in the Copper Ridge Dolomite 300–400 feet below the basal, sandy member of the Chepultepec Dolomite. The Copper Ridge exposed in this area consists of light- to dark-gray fine-grained dolomite containing beds of dark oolitic chert or nodules of dark chert irregularly distributed throughout the exposed rocks.

The local structure is simple. The beds are almost horizontal, but very gentle northwest-trending flexures are indicated by changes in dips and strikes. A tear fault that passes through the area strikes N. 66° W. and has a probable length of 7 miles. The movement was nearly horizontal, but displacements of key horizons could not be determined. The fault is thought to be a minor structural feature having 20 feet or less of stratigraphic displacement. Only the conspicuous slickenside grooves on the fault surface can be cited as evidence that the north side moved west. A smaller normal fault, striking N. 40° W., was mapped

on the first and third mine levels. The ore body was widest between the two faults. In the mine the fractures are vertical and have an average strike of N. 45° W. They apparently had no effect on the localization of the core.

The ore minerals are galena and dark-brown sphalerite. Pyrite is abundant and intimately associated with the other sulfides. Smithsonite, calamine, and cerussite were mined from near-surface operations.

The minerals are concentrated along the south wall of the vertical fault. Most ore extends less than 3 feet from the fault. Although some sheared sphalerite has been found in the gouge, indicating postmineralization movement, the fault is considered to be premineralization and was probably the channel for the ore solutions. The two ore shoots are lenticular in cross section, and both have vertical dimensions greater than 100 feet (pl. 2). The ore shoots extend from the surface downward to the third level, where the main fault and the ore bodies terminate against the bedding or a bedding-plane fault. Diamond drilling by the U.S. Bureau of Mines (Sayrs, 1946) failed to find the extension of the fault or ore bodies below the third level.

Caldwell mine (40)

The Caldwell mine is on the east side of Norris Lake and on the west side of Bostic Bend. Except for an old caved shaft that is 300 feet from the lake, all the workings, including a long adit, were under water and could not be examined at the time of this investigation. The mine is in the Copper Ridge Dolomite 325 feet below the Chepultepec Dolomite. A vertical fault passing through the workings strikes N. 75° W. Pieces of ore found on the dumps showed some veinlets of sphalerite, galena, and associated oxidized minerals. Some ore reportedly was shipped to the old smelter at Clinton, Tenn.; the quantity is not known, but it probably was not very large.

F. Carey prospect (46)

The F. Carey prospect is in the largest reentrant on the west side of the Big Sink near Goin. Prospecting was begun here 30 or 40 years ago by a Mr. Underwood. At that time the property belonged to a Mr. Johnson; its owner in 1943 was Floyd Carey.

The prospect pit exposes a fairly prominent ledge of horizontal massive knotty light-gray dolomite 180 feet below the top of the Copper Ridge Dolomite. The rock contains sparsely disseminated blebs of galena. No sphalerite was seen. Rich lead ore is reported to have been struck in a shaft 10–15 feet deep.

Residents in the area also reported that lead ore was discovered in a shallow shaft about 300 feet farther west. This site is in an open field and is marked by barren dark-colored soil. It is stratigraphically higher than the outcrop of the mineralized bed just described.

Floyd Carey prospect (58)

This prospect is on the south side of the mouth of Leatherwood Hollow. It consists of a small cut which did not expose bedrock. The prospect is 320 feet below the base of the Chepultepec Dolomite. Only small amounts of limonitic material were found on the dump.

Cawood occurrence (42)

The Cawood locality is on the west side of Norris Lake 1,000 feet south of the mouth of Sharp Hollow. It is an occurrence of limonite in Copper Ridge Dolomite 225 feet beneath the Chepultepec.

Cline prospect (23)

This prospect is about 1,250 feet downstream from the Logan prospect on the north side of the hollow, on land belonging to James Cline. Disseminated sphalerite is present in a dolomite bed about 170 feet below the top of the Copper Ridge.

Combs Station prospect (5)

The Combs Station prospect is near the Southern Railway, 4,000 feet south of the bridge across the Powell River and 1,000 feet north of the abandoned Combs station. It can be reached by the Gap Creek prospect road. A little trenching was done here by Mr. Gardner of Rose Hill, Va., who hoped to find the extension of the fault which passes through the Gardner-TVA prospect. A conspicuous fracture zone striking N. 75° E. is exposed in the pit. Only disseminated pyrite was found in the bedded dolomite. The bedrock is Copper Ridge Dolomite approximately 320 feet below the Chepultepec Dolomite.

Cox prospects (3 cuts) (75)

The Cox prospects are near the road from Meyers Ridge to Stiner's dock. Vague outlines of an old pit can be seen close to the road. There the rocks are strongly jointed along a N. 85° W. trend. No mineralized material was seen. An old pit on the northwest side of the road is entirely in surface material.

Another prospect 1,000 feet farther northwest consisted, at the time of examination, of a cut 80 feet long, 15 feet wide, and 18 feet deep. G. S. Stiner (oral commun., 1942) reported shipment of four carloads of oxidized zinc ore from this prospect. Conspicuous fracture surfaces showing evidence of horizontal movement have a strike of N. 85° W. The cut is in dark-gray crystalline Copper Ridge Dolomite approximately 700 feet below the base of the Chepultepec Dolomite. A narrow pit 800 feet to the south exposes a fault striking N. 82° W. along which sphalerite and galena were deposited. The cut is now caved.

Crutchfield prospect (29)

The Crutchfield prospect is in Sherman Hollow southeast of Mayes Chapel. It consists of a small caved pit 10 feet below the base of the

Chepultepec Dolomite. A few pieces of oxidized zinc and limonite were found on the dump.

F. M. Day prospect (64)

The F. M. Day prospect is at an elevation of 1,285 feet in a ravine tributary to Sugar Creek. It is on the south side of Watson Ridge, 1,500 feet south of Watson Chapel. The nearest road is the one along the crest of the ridge. The ravine forms the boundary between two tracts of land. When the prospect was opened in about 1918, the tract on the east belonged to Francis M. Day, but it has since been sold to Clifford Watson. The surface rights to the tract on the west belong to Leonard Cupp, but the mineral rights belong to the W. P. Day heirs. The prospect consists of two cuts, one on each side of the ravine.

The cuts are in a 3-foot-thick bed of massive light-colored dolomite 180 feet below the top of the Copper Ridge Dolomite. The bed is nearly flat lying and is cut by fairly conspicuous joints that trend N. 85° E. and N. 60° W. The bed forms a prominent ledge and weathers to a knobby knotty surface on which scattered small lumps of galena can be found. The galena is disseminated in the bed without apparent relation to the joints. A small amount of golden-brown sphalerite is also present.

W. P. Day prospect (63)

The W. P. Day prospect is at an elevation of about 1,280 feet on the north side of Sugar Creek Hollow, a short distance below the forks and about 2,300 feet southwest of Watson Chapel. The nearest road runs along the crest of the ridge. The property is owned by George Widener. The mineral rights belong to the heirs of W. P. Day, who owned the property when the prospect was opened in about 1918.

The prospect, at the time of maximum development, consisted of an opencut 25 feet long and 20 feet deep at the face. The mineralized material is in a single horizontal bed 3 feet thick of massive knotty light-gray dolomite 180 feet below the top of the Copper Ridge Dolomite. The rocks are cut by a few joints trending N. 70° E. On the dump are pieces of rock that contain considerable amounts of golden-brown sphalerite and some galena. Some lumps might assay as much as 5 percent zinc. The mineralized walls of the opencut are lower grade, a fact suggesting that the richest pocket of ore has been mined out. This prospect is the richest concentration of disseminated lead and zinc minerals observed in the Powell River district. However, the overall grade within the 3-foot-thick bed is rather low—probably not more than 1 percent zinc.

The ore-bearing bed at this prospect forms a prominent ledge which can be traced along the side of the hollow for a considerable distance.

About 400 feet west of the W. P. Day prospect, a small cut in the ledge exposes shattered dolomite along joints trending N. 60° E. and N. 15° W. Galena and minute quantities of pyrite and sphalerite are found in these fractures. Galena can also be seen on the weathered surface of the ledge at other points.

Deane prospect (41)

The Deane prospect is 2,000 feet S. 75° E. of the Caldwell mine and on the same fault. A long adit was driven along the fault but penetrated little mineralized material. Sphalerite and galena are disseminated throughout small areas of the shattered light-gray fine-grained Copper Ridge Dolomite, 335 feet below the base of the Chepultepec. This prospect is flooded when Norris Lake is at pool level.

Dees prospect (82)

The Dees prospect is 450 feet south of the mouth of the ravine in Capps Creek, on land formerly owned by a Mr. Dees. The bedrock is broken by strong joints trending N. 70° E. There are several depressions which might have been old pits. Some disseminated sphalerite was observed in bedrock directly above the pits.

Due prospect (27)

The Due prospect is in Lonesome Valley 1,500 feet southeast of the Ford prospect. It consists of a small cut, now caved, in the Copper Ridge Dolomite 25 feet below the base of the Chepultepec. A small amount of smithsonite was seen on the dump.

W. M. Duncan prospects (northern (21) and southern (68))

These two cuts are 3,000 feet apart. The northern prospect is in Mathis Hollow, 2,000 feet south of its mouth; the southern is in Sugar Creek Hollow. Both prospects are in the Copper Ridge Dolomite; the prospect in Mathis Hollow is 300 feet below the base of the Chepultepec Dolomite, and the southern prospect is 75 feet lower. Bedrock at both cuts shows small amounts of disseminated sphalerite in light-gray crystalline dolomite. The rocks are slightly fractured.

Evans prospect (81)

The Evans prospect is in the eastern of the two tributary ravines entering Calloway Hollow from the south. It is on the west side of the ravine about 700 feet above its mouth, on land owned by the Tennessee Valley Authority. The nearest road is along the Devils Backbone to the south.

A horizontal bed of massive light-gray dolomite about 320 feet below the top of the Copper Ridge Dolomite crops out as a knotty ledge on both sides of the stream. A little galena is disseminated in dolomite exposed in a small cut on the west bank. A short distance upstream the bedrock is cut by several conspicuous joints that trend N. 60° E.

Matt Evans prospect (15)

The prospect is at the fork of the stream at the head of Hen Hollow, 1,300 feet northwest of Locust Grove School, on the Killion Ridge road. It is reached by a trail starting at the schoolhouse.

Two cuts—one 15 feet long, 18 feet wide, and 8 feet deep, and the other 10 feet long, 10 feet wide, and 3 feet deep—were dug at the edge of the creek bed near the fork of the stream. The beds strike N. 60° E. and dip 8° NW. The bedrock is light-gray fine-grained Copper Ridge Dolomite 100 feet below the base of the Chepultepec. Two sets of joints striking N. 20° E. and N. 75° W. have shattered the bedrock. Some horizontal movement has taken place on the N. 75° W. joints. This prospect may be near the extension of the fault zone that passes through the Ritchie, Fortner, and Lynch prospects.

The minerals consist of galena in vugs scattered throughout the dolomite and of sphalerite in veinlets and masses. Calamine, cerussite, and smithsonite are present on the weathered surfaces. There is very little pyrite.

Farris prospect (not on pl. 1)

The Farris prospect is 7,000 feet due south of Mt. Olive School (White Hollow quad. west of Maynardville quad.) and is reached by good gravel roads from the post office at Sharps Chapel (in the northeast corner of the Maynardville quad.).

A cut 30 feet long, 50 feet wide, and 20 feet deep was made in the basal, sandy member of the Chepultepec Dolomite. No ore minerals were found in the bedrock. The dumps contain numerous specimens of the sandstone in which light-yellow sphalerite and galena are disseminated between the grains of sand. Apparently the minerals replace the carbonate cement and not the quartz grains. The sandstone is 6–8 feet thick, strikes N. 35° E., and dips 10° S. No jointing or faulting was observed.

Ford prospect (25)

The Ford prospect is in a hollow tributary to Lonesome Valley 2,100 feet north of Mayes Chapel. A short side road leads from Duo to the prospect. The prospects are in the Chepultepec Dolomite about 70 feet above the base. Amber sphalerite, small masses of galena, and a large amount of disseminated pyrite occur in two flat-lying dolomite beds. The lower bed is 2 feet thick and contains white massive chert which has been brecciated and mineralized. The upper bed is 2 feet thick and contains round patches of breccia; sphalerite and coarsely crystalline dolomite fill the spaces between the fragments.

At the time of examination (1942), approximately 30 tons of hand-cobbed ore was stockpiled near the prospect. The grade was estimated to be about 4 percent zinc and less than 1 percent lead.

Ford—east occurrence (26)

This occurrence is 1,100 feet east of the Ford prospect. It is in the Copper Ridge Dolomite 15 feet below the basal, sandy member of the Chepultepec. Finely disseminated light-brown sphalerite occurs in small vertical fractures that strike N. 70° E.

Ford prospect (Big Branch Hollow) (33)

This prospect is on the east side of the stream in Big Branch Hollow. A trail leads to the cut from the house on the Braden property. Traces of disseminated galena and sphalerite occur in light- to dark-gray crystalline dolomite. The mineralized zone probably is an extension of that at the Charles Braden property. This prospect is 315 feet below the top of the Copper Ridge Dolomite. Nearby ledges are cut by a set of strong fractures trending N. 75° W.

J. B. Ford prospect (3 cuts) (70)

The J. B. Ford prospect is about 4,000 feet east of Miracle Pond on the point of a spur projecting toward a large sinkhole. The nearest road is 1,500 feet away on the opposite side of the sinkhole. Two pits were dug here in about 1918 by Wesley Ford. The north pit is filled with rubbish. The south pit is open and exposes a rather massive bed of fairly coarsely crystalline light-gray dolomite that weathers to a knotty ledge. The bed dips about 5° SE. and appears to be about 50 feet above the base of the Chepultepec Dolomite. No fractures are visible, but the pit is alined N. 55° W. as though it had followed a fracture. The rock contains small bodies of coarsely crystalline white dolomite, a little pyrite, and sphalerite. The sphalerite was seen only in specimens from the dump.

Across the small ravine to the east, on property belonging to Silas Neely, is another small pit apparently in the same bed. Pyrite was the only mineral seen.

Fortner prospects (northern (65) and southern (67))

The Fortner prospect (65) is on the west side of the west fork of Sugar Creek Hollow, 3,200 feet northeast of Lily Grove school, on the property of James Fortner. The nearest road is on the ridge south of the prospect. The prospect, opened in 1940 by a Mr. Erwin of New Tazewell, Tenn., is an opencut 30 feet long that continues as a drift 10 feet long.

The prospect is in blue-gray fine-grained dolomite about 190 feet below the top of the Copper Ridge. The beds are nearly horizontal and are cut by two fractures, 5 feet apart, that trend N. 60° W. The northern fracture is the more conspicuous and forms a pronounced wall having slickensides plunging about 20° NW. Crosscutting fractures trending N. 20° E. are also present. The drift and opencut have been excavated in the shattered rock between the two fissures.

The ore minerals are galena, sphalerite, and pyrite; and they occur along the main fractures and parallel joints. Some ore occurs in vugs and disseminated in the country rock. The ore is spotty and low grade, probably not assaying more than 3 percent zinc. South of the main workings are several small pits along barren vertical fractures about parallel to those in the main cut.

On the same property 1,400 feet northwest of the main pit, on the bluff just west of the forks of Sugar Creek Hollow, a small amount of exploration was done in about 1918 by the American Zinc Co. An adit (67) was driven 10 feet into the ledge of massive knotty light-gray dolomite. This is probably the same bed that is mineralized at the F. M. Day and W. P. Day prospects. The rock is considerably shattered but shows no systematic jointing. Galena is sparse in the exposed rock; it is much more evident in the weathered rock on either side of the tunnel than in the fresh rock exposed in the walls. No sphalerite was observed.

Fortner Branch prospects (old (55) and new (56))

Fortner Branch prospects are in a tributary to Bunch Hollow Creek 1,500 feet north of the Bunch Hollow mine. Ore was discovered during the construction of two dams 200 and 600 feet, respectively, below the mouth of the largest tributary entering Bunch Hollow from the south. The owners of these properties are not known. The nearest road is in Bunch Hollow.

The dolomite beds in this vicinity dip gently downstream, so that for about 1,000 feet the stream cuts through only a very small thickness of beds. The beds are about 190 feet below the top of the Copper Ridge Dolomite. Strong joints cut the dolomite: at the upper, or New Dam, prospect they strike N. 65° E., at the lower, or Old Dam prospect they strike N. 45° E. At the lower prospect the dolomite is brecciated. Considerable pyrite and a trace of galena are present.

Gap Creek prospect (1)

The prospect is on Gap Creek 11,500 feet southwest of Arthur station of the Cumberland Gap Branch of the Southern Railway and 1 mile by secondary road from U.S. Route 25W. The owner is Charles H. Turner.

The prospect is in beds just above the base of the Longview Dolomite. The mineralized area is localized along a fault of small displacement that strikes N. 81° W. and dips 85° S. The workings consist of an inclined shaft, a vertical shaft, and several pits. The inclined shaft is reported to be 120 feet long and driven along the north side of the fault; it is now partly filled with water. One prospect pit is 150 feet above the incline, and 100 feet above this pit is the vertical shaft, which is 40 feet deep. Two vertical fractures 4 feet apart and striking N. 80° W. are exposed in the shaft. There are sev-

eral small caved pits, both east and west of the main workings. Mr. Gardner reported that a diamond-drill hole just south of the collar of the incline cut 47 feet of yellow sphalerite at a depth of 653 feet. The vein is traceable along strike for 600 feet farther up the hill owing to limonite and smithsonite float. The fault, where exposed, contains about an inch of unmineralized but heavily silicified gouge.

The ore exposed is a mixture of galena, smithsonite, and pyrite in veins ½–6 inches wide. The absence of sphalerite is probably due to the deep oxidation along the fault zone. Many unmineralized small faults and fractures intersect the main fault.

Gardner (2) and Minton (3) prospects

These prospects, on the south side of a small ravine 2,000 feet southeast of the Gap Creek prospect, consist of two pits not more than 20 feet apart. The eastern pit (Minton) was first worked prior to 1913 and was reopened by Mr. Gardner; no bedrock is visible in the pit. The western pit (Gardner) is along a conspicuous joint trending N. 78° W. that exposes a dolomite bed near the middle of the Chepultepec Dolomite. No ore minerals were found in the pits, but some smithsonite was seen on the dumps.

Gardner prospect (on Powell River) (4)

The prospect is on the west bank of the Powell River 10,000 feet due south of the Arthur station on the Southern Railway. The prospecting was done by Mr. Gardner of Rose Hill, Va.

A single pit about 100 feet from the river's edge shows light-gray fine-grained Copper Ridge Dolomite, 125 feet below the Chepultepec. The rock is fractured and is cut by a vertical fault that strikes N. 88° W. Sphalerite, galena, and pyrite are disseminated along the fault in a zone 18 inches wide. The gouge along the fault is unmineralized. In places the fine-grained dolomite appears to have been altered to coarsely crystalline dolomite. The overall grade is estimated at 4 percent Zn and 3 percent Pb.

Gardner-TVA prospect (6)

The Gardner-TVA prospect is on the west bank of the Powell River 3,000 feet due south of the Southern Railway bridge. It is reached by traveling the road leading to the Robert Bruce prospect and then crossing the river by boat. The property is owned by Mr. Gardner of Rose Hill, Va.

The prospect has several shallow shafts and trenches developed along a fault from river level to the top of the bluff 300 feet higher.

The ore occurs in light-gray crystalline Copper Ridge Dolomite about 260 feet below the Chepultepec. The mineralized zone is on the south side of a fault which strikes N. 84° W. and dips 80° S. The movement, as indicated by the slickensides on the fault surface, was

nearly horizontal, the north side moving to the west. The gouge zone is about half an inch thick. The rock on the south side of the fault is fractured and brecciated, and the ore is in the interstices of the breccia (a zone 3 ft. wide). The minerals are galena, sphalerite, and pyrite. The estimated grade of ore is 3 percent sphalerite, 7 percent pyrite, and less than 1 percent galena. There is very little crystalline dolomite in the breccia. On a dump near the base of the hill are several tons of partly oxidized sulfide ore which has been hand cobbed from the various cuts.

B. G. Goin (Ell Goin) prospect (59)

The Goin prospect is 1.2 miles by secondary road northeast of the Goin post office. It is on the north side of a small ravine leading to Miracle Pond, at an elevation of 1,460 feet. The property is owned by Peter Markel, of Goin.

The workings consist of one large pit 20 feet long, 50 feet wide, and 3 feet deep, and three smaller trenches. The north side of the main pit may be a vertical fault or fracture surface striking N. 70° W. The bedrock is light-gray fine-grained Copper Ridge Dolomite 75 feet below the base of the Chepultepec. No ore was seen in the bedrock. Zinc carbonate ore was seen on the dump, and pieces of dolomite containing galena and pyrite were found in the trenches. Mr. Markel (oral commun., 1943) stated that the New Jersey Zinc Co. diamond drilled one hole on the north side of the main pit and found some zinc ore. A 6-inch section of drill core found at this location contained veinlets of light-brown sphalerite and considerable disseminated pyrite.

H. M. Graves prospects (two cuts) (92)

The Graves prospects are near the secondary road that branches from Tennessee Highway 33, 1.3 miles east of Sharps Chapel. They are owned by Mr. H. M. Graves of Sharps Chapel.

The eastern prospect is 200 feet north of the road and just south of the house. The bedrock strikes N. 70° E., dips 31° S., and consists of light-gray fine-grained dolomite near the base of the Mascot Dolomite. Small quantities of sphalerite, galena, and pyrite occur in small masses scattered throughout the rock in an area more than 100 feet square.

The second prospect is a small pit 100 feet east of Union School. It is in the same stratigraphic position as the eastern prospect but does not expose any mineralized material. Mr. Graves (oral commun., 1943) reported that lead had been found here several years before.

Honeysuck or Hunsucker prospect (54)

The Honeysuck prospect is in a ravine entering Bunch Hollow from the south, 750 feet east of the Bunch Hollow mine and about 800 feet south of the Bunch Hollow road. An opencut was made at the foot of the hill on the west side of the ravine.

The exposed rock is a flat-lying bed of massive knotty light-gray dolomite about 250 feet below the top of the Copper Ridge Dolomite. The bed contains disseminated galena, both in and near the opencut and also in a ledge on the opposite side of the ravine. No sphalerite was seen, but its presence was suggested by a small amount of zinc carbonate found in the dump material. The mineralized dolomite is clearly restricted to a single bed and does not seem extensive.

J. M. Hopper occurrence (52)

This occurrence is about 700 feet south of the ruins of J. M. Hopper's house in Caney Hollow, on land once belonging to Mr. Hopper. A little pyrite was seen in a dolomite ledge at this locality, but no ore minerals were found.

Rupert Hopper prospect (87)

The Rupert Hopper prospect is in Odom Hollow on the farm of Rupert Hopper. At a spring west of the lowest house (now abandoned) in the hollow, a large loose block of nearly solid pyrite, containing an appreciable percentage of sphalerite, was found. No sulfide minerals were seen in the bedrock. The exposures around the spring are about 250 feet below the top of the Copper Ridge Dolomite and show joints trending N. 75° E.

Near the Hopper house, 450 feet south of the spring, a small pit in a gully exposed a large amount of limonite. Similar limonite has been plowed up on the opposite side of the hollow, about S. 75° E. from this pit. At neither place was zinc carbonate seen. Outcrops near these localities are sparse and show no pronounced jointing.

Johnson prospect (89)

The prospect is 2,200 feet south of Cupp Mill in a small valley tributary to Little Barren Creek. The rock exposed in a small cut at the north side of an old road shows small veinlets of sphalerite. The cut was made originally for road metal, and little additional work has been done. The prospect is 40 feet above the base of the Chepultepec Dolomite.

H. B. Johnson prospect (47)

The H. B. Johnson prospect is on the hillside south of Camp Creek just west of the junction of Leatherwood Hollow and Camp Creek. There are good roads in both valleys. The property belongs to H. B. Johnson, who found a float block of dolomite containing fairly rich sphalerite and galena ore. A cut was made in the hillside at the point where the block was found, but the bedrock penetrated contained no sulfides. Later, an outcrop of dolomite (about 170 feet below the top of the Copper Ridge Dolomite) containing disseminated galena and a trace of sphalerite was found higher on the hill. This occurrence in the outcrop is typical of the disseminated galena deposits of the Powell

River district; the float block, however, resembled ore associated with major fractures, as in the Bunch Hollow mine and the Ritche prospect. If the piece of ore-bearing dolomite was derived from a deposit on the hillside, the main deposit has probably not been located.

R. E. Johnson prospect (57)

The R. E. Johnson prospect is on the east side of the road in Johnson Hollow, a tributary to Camp Creek just west of the Big Sink, near Goin. It is just south of Mr. Johnson's house, which is above the mouth of the hollow. The prospect is an opencut of fair size, but now largely filled, in a flat-lying bed of massive light-gray dolomite about 180 feet below the top of the Copper Ridge. The rock contains both galena and sphalerite in small quantities. It may be the same bed that is mineralized at the Floyd Carey prospect.

S. Jones prospect (89)

The Jones prospect is directly across the Powell River from the Caldwell mine and 300 feet from the riverbank. Two trenches expose minor amounts of disseminated sphalerite in light-gray crystalline dolomite 105 feet below the top of the Copper Ridge Dolomite. A conspicuous set of east-trending fractures cuts beds uncovered in the pits.

W. P. Jones prospect (72)

The W. P. Jones prospect is near a spring half a mile southeast of Ford Chapel on the north side of the road in Oxford Hollow. A prospect (called the Goin Brothers prospect) was reported in this vicinity in 1913; but as it supposedly was on the south side of the hollow, it may not be the same as the Jones prospect. The oldest work at the Jones prospect was done in about 1933 by the late T. J. Ford. Additional showings were opened when the road was widened by blasting away the rock on its north side.

The rather fresh cuts along the road were made in a bed of light-gray medium-crystalline cherty dolomite, which dips gently southeast and appears to be about 125 feet above the base of the Chepultepec Dolomite. A few fairly large patches of dark sphalerite associated with coarse white crystalline dolomite and a few minute crystals of pyrite were observed. The minerals appear to be confined to the one bed.

The ore at this prospect is not obviously related to fractures, but Oxford Hollow as a whole is alined N. 65° W. along the continuation of the major fracture passing through the Bunch Hollow mine and the Eli Goin prospect. Near the head of Oxford Hollow, outcrops at the lip of and in the uppermost sinkhole show pronounced shattering along closely spaced N. 65° W. joints.

J. D. Keck prospect (85)

The prospect is near the head of Capps Creek. Disseminated masses of sphalerite and galena were found here by Mr. Keck in 1916. A small caved cut shows a conspicuous set of fractures trending N. 75° E. in the mineralized zone. The top of the Copper Ridge is 240 feet above the cut.

Robert Keck prospect (66)

The Robert Keck prospect is at an elevation of 1,295 feet on the point of the spur between the forks of Sugar Creek Hollow. The nearest road is on the west side of Watson Ridge half a mile to the south. In 1918, when the prospect was opened, it belonged to George Cupp; in 1943 it belonged to Robert Keck.

The prominent ledge of massive knotty light-gray dolomite like that which is mineralized at the F. M. Day and W. P. Day prospects. crops out around the spur, and conspicuous knots of galena are present in it at several points. The prospect is a shallow cut in the face of this ledge. In addition to galena, a small amount of disseminated sphalerite was observed in the dolomite. The mineralized material is rather low grade and is restricted to the ledge-forming bed.

Kings Bend mine (10)

The mine can be reached by following the road from U.S. Highway 25E down Blair Hollow and then the access road to the mine. The property is owned by Fanny Goin, and the mineral rights, by the Swab heirs. Messrs. Johnson and Brown of Hancock County, Tenn., leased these rights to C. H. Harris, Sr., of the Imperial Mining Co. of Fountain City, Tenn.

The workings consist of several adits and a vertical shaft. The shaft connects with a stope 120 feet long and 25 feet wide developed along the south side of a vertical fault that trends N. 76° W. The bedrock is Copper Ridge Dolomite—mainly light-gray crystalline fractured dolomite containing some beds and nodules of dark chert—about 285 feet below the basal, sandy member of the Chepultepec Dolomite. The ore appears to be localized by a nearly horizontal bedding-plane fault and by fractures associated with this fault. The fractures strike N. 55° W., N. 35° E., N. 70° E., and N. 78° E. A little ore was found at one place on the north side of the main fault.

The ore has an estimated grade of 15 percent sphalerite, 10 percent galena, and 14 percent pyrite. Some narrow faces contain more than 50 percent sulfides.

Kings Bend prospect (inside) (9)

This prospect consists of a series of six small pits which can be reached by boat from the Kings Bend mine or by poor roads and a trail 3.6 miles southeast from Arthur. No bedrock is exposed, but the stratigraphic position is in the Copper Ridge Dolomite approximately

270 feet below the base of the Chepultepec Dolomite. Small fragments of smithsonite were found on the dumps.

Kings Bend prospect (northern) (11)

A small cut was made at this location by the prospectors working around the Kings Bend mine. Apparently the prospectors thought that the ore found at Kings Bend mine was confined to a single stratum and that this pit would prospect that bed. Only pieces of limonite were found. The stratum prospected is in the Copper Ridge Dolomite approximately 250 feet below the Chepultepec Dolomite. Access to the area is by the road to Kings Bend mine, and then northwest to where Blair Creek enters the Powell River.

Kings Bend prospect (western) (8)

This prospect is developed by a small pit which can be reached by walking along the Powell River bank from the Kings Bend mine. The rocks exposed are cut by a vertical fault which strikes N. 78° W. This fault is probably on the extension of the Kings Bend fault zone. No mineralized material was seen in the bedrock, but some smithsonite was found on the dump.

Langford prospect (71)

A prospect had been reported on the Langford property, but careful search revealed only flakes of disseminated sphalerite in the bedrock. The local residents have no recollection of any work having been done in that vicinity.

Lindsay prospect (28)

The Lindsay prospect is in Lonesome Valley on the north side of the road and 800 feet southeast of Mayes Chapel. A small amount of sparsely disseminated sphalerite and pyrite was found in light-gray fine-grained Copper Ridge Dolomite 150 feet below the Chepultepec Dolomite. No fractures cut the mineralized zone. The beds strike N. 65° W. and dip 20° NE.

Logan prospect (24)

The Logan prospect is on the south side of Greaver Hollow, just east of the Clarence Logan home. A fair road extends down the hollow past the prospect.

The prospect was opened before 1913, but since that time very little work has been done. The prospect is in shattered dolomite 130 feet below the top of the Copper Ridge Dolomite. The dolomite contains vugs and scattered masses of coarsely crystalline dolomite with some sphalerite, galena, and pyrite. The rocks are cut by joints trending N. 60° W. and N. 25° E. The mineralized area covers only a few square feet.

Love Heirs prospect (not on pl. 1)

The Love Heirs prospect is 7 miles northeast of the Kings Bend mine, in the Wheeler quadrangle (north of the Tazewell quadrangle) well outside the mapped area. It is on the south side of the Powell River, on a bluff overlooking Massengill Bend. It is half a mile by road from the bridge that crosses the river at Cosby Ford. The prospect is on a small tract reported to have last belonged to the Love heirs.

A small amount of excavation has been done at several places along a prominent ledge formed by a flat-lying bed of massive knotty light-gray dolomite 4 feet thick. This bed appears to be about 175 feet below the top of the Copper Ridge Dolomite. Galena and small quantities of pyrite and sphalerite occur disseminated in about 2 feet of the bed. Where galena is present, the dolomite is medium crystalline and almost white; elsewhere it is finely crystalline and gray. Galena was observed at four places along 100 feet of the ledge and is reported to occur at several more places, including some on the property of Columbus Whiteaker, to the east.

Charles Lundy prospect (17)

The Lundy prospect is 2,300 feet northeast of the Snyder prospect and is reached by the same access road. A small cut shows no bedrock, but disseminated light-brown sphalerite was seen in pieces of dolomite on the dump. It is in the Copper Ridge Dolomite approximately 260 feet below the top of the formation.

Howard Lynch prospects (northern (60) and southern (62))

The Howard Lynch prospects are about 4,600 feet northwest of Lily Grove School on the west side of a ravine tributary to Sugar Creek Hollow. A farm road extending to the head of the ravine connects with the road along the crest of Killion Ridge to the south. The property is owned by Howard Lynch and Alifaria Lynch Loveday.

The prospects consist of three pits at an elevation of 1,290 feet. The pits expose flat-lying light-gray dolomite about 180 feet below the top of the Copper Ridge Dolomite. The northern pit (60) exposes a conspicuous fracture trending N. 70° W.; the other two pits (62) expose dolomite that is jointed but exhibits no comparable break. Considerable limonite and zinc carbonate are present on the dumps, but only a little partly oxidized galena and pyrite were observed in the dolomite.

Across the ravine, on property owned by the Tennessee Valley Authority, some digging has been done at about the same elevation and on line with the fracture trending N. 70° W. The rock is considerably jointed, but no major fracture is exposed. A little galena is present.

J. F. Lynch prospect (61)

Near the top of the hill, on property belonging to J. F. Lynch, six pits have been dug apparently at random, although an attempt was

made to dig some of them on line with the fracture exposed at the Howard Lynch pit below. The blanket of residual material is very thick, and the pits were dug entirely in clay containing large blocks of ferruginous chert.

Some prospecting has also been done on the J. F. Lynch farm, at an elevation of 1,250 feet on the west side of the ravine. A cut has been made in the face of a ledge of massive knotty light-gray dolomite. The ledge is 180 feet below the top of the Copper Ridge and is apparently the same bed as that mineralized at the F. M. Day and W. P. Day prospects. The dolomite here contains considerable disseminated galena, but the amount decreases rapidly in both directions along the ledge. A trace of sphalerite was observed.

W. J. Lynch prospect (22)

The W. J. Lynch prospect is in Mathis Hollow 1,200 feet south of the W. M. Duncan prospect. The prospect is reached by a trail from the road along the crest of Watson Ridge. Small masses of galena were found in three cuts which exposed dark-gray crystalline Copper Ridge Dolomite 150 feet below the base of the Chepultepec Dolomite.

William Medley and C. Leach prospect (30)

This prospect is on the east side of the hollow west of Weaver Knob, about 3,500 feet southeast of the county road paralleling Davis Creek. The prospect was opened by Levi Ausmus of Speedwell on land owned by William Medley. It consists of several small pits on the face of the hill and one fairly large cut that is 30 feet long, 10 feet wide, and 10 feet deep.

The larger cut exposes light-gray rather coarsely crystalline dolomite, which probably represents a dolomitized limestone bed near the base of the Kingsport Limestone. The rocks dip 15° NW. Sphalerite, galena, and pyrite occur as a replacement of the dolomite and also as fracture filling accompanied by coarsely crystalline dolomite. The ore is very low grade.

New Prospect mine (Leadmine Bend) (74)

New Prospect mine is in Union County, Tenn., 13 miles southwest of New Tazewell and 15 miles west of Lone Mountain, which are the nearest railroad points. The area is on a short peninsula between two branches of the Powell River arm of Norris Lake. This area, long known as Leadmine Bend, is in the southwestern part of the Ausmus quadrangle. The portal of the mine is 25 feet above the normal pool level of Norris Lake.

Access to the mine is by 6.1 miles of improved gravel road and 1.3 miles of unmaintained dirt road that leaves Tennessee Highway 33 at a point 13.3 miles southwest of New Tazewell. The land is owned by the Tennessee Valley Authority, but mineral rights are owned by George Blow of New York City.

Development.—The date of the earliest operations at New Prospect is not definitely known. Safford (1869) referred briefly to the deposit in his report, but apparently there was little development at that time. Peter E. Blow is reported to have worked at the mine as early as 1869. The following account by Purdue (1912) is the most complete statement of the early history now available.

> According to Mr. T. J. Davis, of Sharp's Chapel, this mine was opened in 1883, by Squires and Manning, of New York. These men hauled the ore to Powell River, and shipped by water to Clinton, Tennessee, and from there by rail to New York. They worked the mine until 1888. About 1889, the property was taken over by Eades, Mixter, and Heald Zinc Company. This company built the first mill, which consisted of a crusher and hand jig, in 1890. The present mill was built in 1891. It has eight jigs with a capacity of 100 tons. The company operated the mine until 1897. In 1899, the property was leased to the American Metals Company, of New York City, who worked it until 1901. Since 1901, it has not been operated except for three weeks in 1903 by a man named Joseph D. Hardin, who shipped no ore.
>
> While the Eades, Mixter, and Heald Zinc Company was operating, the ore was shipped to Clinton, Tennessee, where it was smelted. The American Metals and Mining Company shipped the ore to Marion, Indiana. A part of it was shipped by water to Clinton, and from there by rail, and a part was hauled in wagons to Caswell Station on the Cumberland Gap and Louisville Railroad. Approximately 1,000 barge loads of concentrates are said to have been shipped by river, averaging 65 tons to the barge. The amount hauled by wagon to the railroad was not ascertained.

Mr. George Blow (written commun., 1942?) reported that the 65,000 tons shipped by barge contained 47 percent zinc. He also reported that 24,000 tons of crude ore (grade not known) was hauled to the railroad at Tazewell by the American Metals Co.

The mine has been idle since 1903 except during the two World Wars, when it was operated by the Union Zinc Co., of which George Blow was president. Mr. Blow reported shipments in 1916–18 of 634 tons of concentrates averaging about 50 percent zinc, and shipments in 1939–43 of 3,089 tons of hand-picked ore averaging 23.7 percent zinc and about 1 percent lead.

The foregoing account makes it apparent that it is impossible to give an accurate figure on total production for the New Prospect mine. W. C. Clarke estimated, in 1907, that 175,000 tons of crude ore and concentrates had been shipped; and this estimate is reasonable, on the basis of the size of the workings. How much of this was crude ore, how much was concentrates, how much was sulfide ore, and how much was oxidized ores cannot even be estimated closely.

The main surface excavation at the New Prospect mine is an opencut 420 feet long and 100 feet wide extending eastward into the hillside—its floor following a gently dipping limestone bed—to a depth of 65 feet (pl. 3). From that point, underground workings averaging about 22 feet in height and 10–95 feet in width extend

eastward for 555 feet following the same bed as a floor. Thus, the east half of the underground workings is below the normal pool level of Norris Lake (1,020 ft) and is filled with water except when the lake is drawn down at least 30 feet. There is a shallow opencut on top of the hill above the underground part of the mine, and an air shaft extends from this cut to the mine, 450 feet west of the portal. A winze was sunk 16 feet on the north fault, about 150 feet west of the portal, but was filled by muck long ago.

In 1939 there were 12 large pillars left in the mine, but subsequent mining consisted chiefly of removing these pillars. By 1942 only one pillar remained.

The mill, which was just west of the opencut, has long been dismantled and the machinery removed. Only the foundation now remains.

Geology.—New Prospect mine is on the east side of the Leadmine Bend dome, a cross anticline which brings the Nolichucky Shale to the surface just west of the mine (pls. 1, 3). The ore body is in the upper part of the limestone unit of the Maynardville Limestone Member, and the bed which forms the floor of the mine is about 200 feet above the base of the Maynardville. Average strike of the beds is N. 10° W., and their dip is 5° E.

Faulting at New Prospect has been almost entirely limited to horizontal, or nearly-horizontal, movement. Slickensides are evident on many bedding and fracture surfaces in the mine, but the major movement has been on one steeply dipping east-trending tear fault; minor movement has occurred on two other steep faults that are nearly parallel to the major fault.

The major fault, usually referred to as the north fault, is plainly visible in several places: in the back, in parts of the north wall of the mine, in the rock face above the entrance to the mine, and in the opencut above the mine. The fault trends east at the mine mouth, but swings slightly to the southeast at the heading. A conspicuous gouge zone along the fault has been oxidized throughout the mine. Slickensides on the fault surface are nearly horizontal, having only a slight dip to the east; and the position of a conspicuous dark blocky dolomite bed on opposite sides of the fault indicates that the relative movement was westward on the north side of the fault and eastward on the south side. Dip of this fault ranges from vertical to 70° N.

A conspicuous fracture, usually called the south fault, is 65 feet south of the main (north) fault, at the mine entrance. It is visible in the roof of the mine as a tight fracture with a thin oxidized zone. If this fault continued to the east, it would intersect the main fault a short distance beyond the present heading; however, it apparently dies out in the present workings, as it cannot be traced through them.

A third fault was observed in the crosscut south of the south wall. The drag of the beds and the relative displacement of the dark blocky beds indicate slight upward and eastward movement on the south side of the fault. Westward, this fault apparently passes into a small anticline, which is exposed in the crosscut that extends south from the opencut.

Between the main fault and the south fault, and for a short distance beyond both faults, the rocks have been intensely fractured and shattered, but there is very little breccia. Although the beds between these faults have been rather thoroughly dolomitized, very little white crystalline dolomite is present.

The limestone and "ribbon" beds which underlie the mine are neither shattered nor brecciated, but they contain small folds, some of which are exposed in the floor of the opencut.

The ore body is roughly rectangular, in both cross section and plan, but the upper and southern limits are not as definite as the northern and lower ones. Mineralizing solutions apparently gained access by the north fault and spread out into the block of broken rock south of it, as is indicated by the fact that there is very little ore on the north side of that fault. At the mine mouth and in the opencut, the south fault appears to form the approximate southern limit of the ore body; but farther back in the mine, where this fracture is indistinct, the south boundary of the ore also is rather indefinite, and the ore body is narrower.

In vertical section the ore body may be considered as three separate blocks, whose boundaries are stratigraphic. The lowest of these blocks is the richest and includes the 22 feet of beds just above the mine floor. Above this is about 30 feet of lower grade ore, which in turn is overlain by beds of shattered dolomite that are almost unmineralized except at the north fault.

The ore.—Sphalerite, galena, and dolomite are the principal ore minerals. Pyrite and greenockite are present in minor quantities. The ore minerals were deposited both as replacements of dolomite and as fissure fillings along minor fractures, though the former type is apparently much more abundant than the latter. The most conspicuous occurrences of the ore minerals are almost solid masses as much as 3–4 inches thick along certain bedding planes or fractures. Fragments of one of the most widespread of these can still be seen adhering to the back of the mine.

Production and reserves.—In 1935 and 1938, during negotiations between the Tennessee Valley Authority and the Union Zinc Co., estimates of the tonnage and the grade of ore then remaining at the New Prospect mine were made by G. A. Muilenburg, a consultant for the Authority, and by J. S. Cullison and H. S. Rankin, geologist and mining engineer of the Authority's Geologic Division, on the basis

of two independent samplings by Muilenburg and Cullison. Also, in December 1938, 37 wagon-drill holes were drilled into the block of rock lying south of the south wall in the eastern part of the mine. Results of these estimates have been made available for use in this report by the courtesy of Mr. Gordon Clapp, former general manager, and Mr. B. C. Moneymaker, chief geologist of the Tennessee Valley Authority.

These results showed that as of January 1939 the mine and dumps contained a total of 162,000 tons of measured ore containing 9,100 tons of zinc and 1,900 tons of lead. Indicated ore east of the heading amounted to 30,000 tons containing 2,000 tons of zinc and 230 tons of lead. To show the character of the different parts of the ore body, the following breakdown of the measured ore totals, as of January 1939, is given:

	Ore (tons)	*Zinc (tons)*	*Lead (tons)*
Tailing piles	10,000	795	74
Dumps (derived almost entirely from roof block above opencut)	45,775	2,605	440
Pillars	6,600	820	78
South of south wall	2,000	50	1
Roof block, above mine	98,000	4,850	1,330

The drilling into the south wall proved that the block (40 ft. long, 200 ft. wide, and 20 ft. thick) had an average zinc content of only 0.85 percent, whereas the 5-foot-wide block at the mine wall had an average zinc content of 2.55 percent throughout its 200-foot length.

Production from 1940 through 1943, which was almost entirely from the pillars, reportedly was 3,089 tons of ore containing 742 tons of zinc and 31 tons of lead. Since removal of the pillars, consideration of future mining at New Prospect except as an opencut operation has become impracticable.

Odell prospect (88)

The Odell prospect is in a valley on the south side of Camp Creek Hollow. It is reached by a secondary road from Pleasant Point School. The property is leased by D. W. Harris of Goin, Tenn.

A shaft 60 feet deep was sunk on a fault which strikes N. 57° W. and dips 83° S. Subsidiary joints strikes N. 43° W. The bedrock is Copper Ridge Dolomite 155 feet below the top of the formation. The generally flat lying beds are heavily fractured and rotated adjacent to the fault. The fractures are filled with smithsonite, galena, limonite, and pyrite. The mineralized zone ranges from 18 inches to 4 feet in width and is confined to the hanging-wall side of the fault. A trench northwest of the shaft followed the same fault for more than 100 feet. The ore grade is estimated at less than 5 percent combined zinc and lead.

In 1944 an adit was driven into the hill below the shaft in an attempt to connect with the shaft below the oxidized zone. This work was abandoned after driving 60 feet, about half the distance to the bottom of the shaft.

C. Proffitt prospect (45)

The Proffitt prospect is on the south side of the Proffitt Hollow, 3,000 feet west of Chestnut Grove School. The nearest passable road is at the school. The prospect was opened some time before 1913 and apparently has not been worked since. The pit consists of a fairly shallow opencut 6 feet wide and about 15 feet long in fine-grained fairly well bedded Copper Ridge Dolomite 240 feet below the top of the formation. The rock is broken by two intersecting sets of joints that trend N. 75° E. and N. 20° W. The only mineralized material seen was in a single large block of rock found on the dump. It contained galena both disseminated in the dolomite and in discontinuous veinlets.

Ritchie (Lynch) prospect (69)

The Ritchie (formerly called Lynch) zinc prospect (pl. 4) is in Clairborne County approximately 10 miles by secondary gravel road northwest of the town of New Tazewell. The Ritchie prospect is on the middle branch of Sugar Creek approximately 2,000 feet below its head. The nearest rail point is about 4 miles northwest of Clouds, Tenn., on the Cumberland Gap Branch of the Southern Railway.

The prospect was briefly described by Secrist (1924), who reported that the first work was done in 1910 and that additional work was done in 1916. In 1940–41 the shaft on the property was deepened by the Imperial Mining Co.

The prospect is on the crest of the Powell River anticline. The detailed map (pl. 4) shows considerable local variation in the strike of the beds; however, because the dips are gentle and seem to be produced primarily by minor undulations on individual bedding-plane surfaces, the attitude of the beds can be termed horizontal.

Except at the southeast corner of the area (pl. 4), where the basal, sandy member of the Chepultepec crops out, the bedrock is Copper Ridge Dolomite. The upper part of the Copper Ridge contains several beds of oolitic chert that range in thickness from a few inches to 2 feet. In the southern part of the area, three such beds were traceable over considerable distances, and their outcrop pattern indicates that they are nearly horizontal. Unfortunately, outcrops are not continuous enough to permit definite correlations of the various chert beds on the two sides of a fault zone which passes through the area.

The prospect consists of an irregularly shaped opencut (No. 1 on pl. 4) about 50 feet long; a long tunnel (No. 2); and a second and smaller opencut (No. 3) approximately 6 feet deep, 20 feet long, and

less than 10 feet wide. The shaft (No. 4) is flooded. Two other small opencuts (Nos. 5 and 6) north of the tunnel are rather far from the mineralized area and, consequently, reveal nothing regarding the ore.

At the larger of the two opencuts, two faults are conspicuous. The southern fault trends N. 58° W. It is marked by a shattered zone about 2 feet wide and consists of closely spaced subparallel vertical shear planes. At the north edge of the opencut is a pit 2 feet deep. Near this small pit sphalerite and galena are scattered through the rock for about 5 feet south of the fault and 2 feet north of it. No mineralized rock was observed near this fault at the east edge of the opencut. A few feet from the east edge of this cut a small fault, striking S. 20° E. and dipping 62° NE., branches from the main shear zone. A light-gray dolomite bed on the southwest side of the fault has been displaced 2½ feet vertically.

The second, northern fault is exposed in the east face of the opencut about 9 feet northeast of the other fault. This fault consists of two nearly parallel breaks not more than 1 foot apart. Material dragged in the fault zone indicates predominantly vertical movement with the upthrow on the southwest side. The strike of the fault zone here appears to be about N. 55° W. Fairly rich zinc and lead ore occurs in the face of the cut for about 3 feet south of the fault, but the rock is barren on the north side except for small patches of zinc and lead sulfides in the creek bottom. The fault is exposed in the tunnel 25 feet from the portal. Here, however, it consists of a single fracture striking N. 65° W. and dipping 82° NE. It contains 1–2 inches of clay gouge marked with horizontal slickensides. No perceptible change in the character of rock could be observed on either side of the fault.

From the fault southward to the face of the tunnel, the beds become progressively more shattered, so that in the last 8 feet the bedding is almost completely obliterated; this condition suggests that the south fault lies only a few feet south of the tunnel face. Two minor fractures that dip 20° N. are visible in the walls of the tunnel. From their intersection with the fault, they extend southward about 10 feet, before dying out in shattered rock. Widely scattered sphalerite and galena blebs are present between the fault and the face of the tunnel. The dump material from the shaft contains pieces of rich sphalerite ore and some galena.

A smaller opencut is approximately 120 feet N. 60° W. from the larger one. The rock is shattered by subparallel shear planes that extend through a zone about 8 feet wide. Low-grade sulfide ore is scattered through this zone. The zone of shearing is almost certainly related to the two faults seen in the larger opencut.

Two shear zones about 20 feet apart occur in the bottom of the creek (shown in the steep valley in the western part of the area (pl. 4)). These zones are about on strike with the zone seen at the two opencuts. The southern shear zone is made up of several feet of closely spaced fractures, as is the southern fracture zone at the large opencut. The northern fracture is a single break. The similar alinements of the shear zones mapped at the available exposures make reasonable the assumption that a single zone of shearing or faulting traverses the entire area. On the projection of this fault zone, sulfide mineralization along faults has been observed in creek bottoms for several miles. In the Ritchie area it was not possible to correlate marker beds across the fault zone; however, vertical displacement cannot have been great, because the contact between the Copper Ridge and Chepultepec shows no evidence of such movement. As the beds are virtually flat lying, the horizontal component cannot be calculated, but it might be large.

S. J. Robinson prospect (14)

The Robinson prospect is on the crest of the northwest spur of Killion Ridge. It is reached by the poor secondary road that passes the Locust Grove School.

A pit 10 feet long, 5 feet wide, and 2 feet deep exposes large masses of brecciated dolomite that is heavily impregnated with limonitic material and contains small scattered masses of galena. The breccia fragments are very siliceous. No unbrecciated bedrock is exposed. Being about 80 feet above the base of the Chepultepec Dolomite, this prospect is at approximately the same stratigraphic position as the Ford prospect in Lonesome Valley.

Rouse prospect (90)

This prospect is on the west side of the east fork of Welch Hollow. The pit is in dark-gray fine-grained dolomite 150 feet above the base of the Chepultepec Dolomite. Only a small amount of sphalerite and limonite was found in loose blocks from this cut. No bedrock is exposed in the cut itself.

Russell prospect (73)

The Russell prospect is 900 feet southwest of the New Prospect mine (pl. 3) and is below full-pool level of Norris lake. It is in the lower, limestone unit of the Maynardville Limestone Member. The Limestone pinnacles show a conspicuous set of fractures trending N. 66° E. that contain smithsonite, galena, and limonite. The limestone is brecciated and moderately dolomitized. Reportedly 80 carloads of oxidized ore was mined.

W. M. Russell prospect (12)

The W. M. Russell prospect is on the east side of Long Hollow about 1½ miles south of Red Hill School. A road extends down the hollow

but not as far as the prospect. The prospect is a small pit, now overgrown with vegetation, which did not expose bedrock. The surrounding outcrops are of the Copper Ridge Dolomite. A few blocks of limonite are scattered around the pit, but no zinc, or lead minerals were seen.

Shipley occurrence (13)

This occurrence of sphalerite was found in the stream bed 1,500 feet south of the mouth of Hen Hollow. The sphalerite occurs disseminated in the light-gray fine-grained Copper Ridge Dolomite 320 feet below the base of the Chepultepec Dolomite.

Shofner prospects (northeast (35) and southwest (36))

The Shofner prospects are in Williams Hollow, 4.8 miles southeast of Speedwell, Tenn. They are reached by a secondary road which terminates on Copper Ridge, east of the prospects. The prospects are 1,300 feet apart. Both are in the Copper Ridge Dolomite; the northeast is 315 feet below the base of the Chepultepec Dolomite, and the southwest, 380 feet.

The northeast prospect consists of three openings. The first, and lowermost, is a cut 10 feet long and 5 feet wide which is caved and shows no bedrock. The second, just above the first, is a cut 40 feet long, 6 feet wide, and 12 feet deep at the face. A vertical fault striking N. 80° W. is exposed on the north side of the cut. A mineralized zone 6 inches wide on the south side of the cut contains sphalerite, pyrite, and a trace of galena in a fine dolomite breccia. Very little mineralized rock occurs outside this zone. The third cut, 100 feet farther up the hill, contains small amounts of oxidized zinc minerals.

The southwest prospect consists of two openings. The first is a pit at the head of the lake on the west side of the hollow. It is 30 feet long and 10 feet wide and follows a breccia zone which strikes N. 85° W. The breccia is heavily pyritized but contains only traces of sphalerite. The second pit, 100 feet north of the first, is caved, and no bedrock is showing.

Shofner-Weaver prospect (86)

The Shofner-Weaver prospect is south of the Powell River, on the south side of Leatherwood Hollow 1 mile southwest of Leatherwood Church. A good road runs the length of this hollow and passes within a few yards of the prospect. The prospect was opened before 1913, but apparently has not been further developed in recent years.

The prospect was an opencut of fair size but is now largely filled. The face of the cut is in a flat-lying bed of massive knotty light-gray dolomite about 120 feet below the top of the Copper Ridge Dolomite. A small amount of galena is disseminated in the dolomite at the cut; but elsewhere along the same bed, no mineralized rock was seen.

Fred Smith prospect (19)

The Smith prospect is east of the Snyder prospect and near the bottom of McNew Hollow. Access to the prospect is by the same road that is used to reach the Snyder prospect. A small cut on the west side of the stream bed exposes a small amount of sphalerite in a dolomite bed approximately 160 feet below the Chepultepec Dolomite. The fractures observed strike north.

I. Smith occurrences (western (43) and eastern (44))

These two occurrences, which are between Norris Lake and Greasy Hollow, show disseminated light-brown sphalerite in light-gray fine-grained Copper Ridge Dolomite. The eastern and western occurrences are 450 feet and 65 feet, respectively, below the top of the Copper Ridge.

L. F. Snyder prospects (2 cuts) (18)

The Snyder prospects are on both branches of Tuttle Hollow, on the south side of Slate Creek, and can be reached by a very poor road down the hollow from near Meyer Grove Church. The prospects are owned by Mr. Snyder, who lives just south of the Ritchie prospect.

The workings include a cut and a short drift (15 ft long) on the east branch of the stream. The bedrock is shattered gently dipping light-gray fine-grained Copper Ridge Dolomite 330 feet below the base of the Chepultepec. The mineralized zone is 4 feet thick and is confined to fractures in a brecciated white chert bed on the south side of a fault that trends N. 75° W. The ore consists of sparse amounts of sphalerite, galena, and pyrite. A second cut is 300 feet up the hill on the west branch of Tuttle Hollow; no bedrock or mineralized material is exposed.

Stiner prospects (79)

The Stiner prospects are in the northwest corner of Union County, Tenn., in the southwest quarter of the Ausmus quadrangle. Most of the prospects are approximately 3,000 feet S. 75° E. of the New Prospect mine. The small diggings at the prospects were briefly described by Secrist (1924). No ore has been produced from them. The land is owned by G. S. Stiner of New Tazewell.

Bedrock in most of the area (pl. 3) is Copper Ridge Dolomite of the Knox Group; but in the southwestern part of the area, the Maynardville Limestone Member of the Nolichucky crops out. The contact between the Copper Ridge and Maynardville is exposed for a very short distance near the Stiner prospects.

The prospects are on the northeast flank of the Leadmine Bend dome. The beds strike generally northwest and dip gently to the northeast. All the prospects are in Copper Ridge Dolomite except cut 5, which is in the upper, dolomite unit of the Maynardville Limestone Member.

The Stiner prospects consist of five small cuts. The northernmost of these (pl. 3, cut 1) was described by Secrist (1924, p. 41) and referred to as the Davis north cut. It is a shallow north-south trench 50 feet long. The west wall exposes a zone of fractured and sheared dolomite 15 feet thick. The strongest shear within this zone strikes N. 80° E. and dips 75°–85° S. Sphalerite in veinlets and in irregular masses, along with limonitic boxwork, occurs within the zone of brecciated dolomite. The mineralized zone and shearing can be traced southwestward for 40 feet, but beyond that the bedrock is covered. Several small outcrops contain as much as 5 percent zinc, but mineralized material in the face of the cut probably averages 15 percent zinc.

Cut 2 is a north-south trench 40 feet long 200 feet S. 30° E. of cut 1. The north end of the trench intersects a N. 76° E.-trending shear zone. The sphalerite exposed in the face of the cut is in veinlets and in open spaces between dolomite fragments. White crystalline dolomite is associated with the sulfide minerals. The grade is estimated at 8 percent zinc.

Cut 3 is 100 feet east of cut 2 and exposes the same shear zone in a 35-foot trench. Sphalerite is present in only minor quantities. The strongest shears in both cuts dip 80°85° S. Rocks cropping out between the two workings show evidence of shearing, but individual breaks cannot be traced from one pit to the other. The limonite stain on rocks in the intervening area suggests a zone of mineralization, though no sphalerite was observed.

The exposures in cuts 1, 2, and 3 indicate the presence of several fairly well defined shear zones within the prospected area. The strike of the shears is difficult to determine but apparently ranges from N. 80° W. to S. 75° W. These shear zones are significant in the light of the structure at the New Prospect mine to the west. At the New Prospect mine the ore is confined to a 22-foot-thick zone, 140–200 feet below the top of the Maynardville Limestone Member. The ore deposit is apparently controlled by two east-west vertical faults that intersect the Maynardville Member. The fractured zones mapped at the Stiner prospects may represent the eastward continuation of the fault zone that passes through the New Prospect mine.

In 1944 and 1945 the U.S. Geological Survey and the U.S. Bureau of Mines completed an exploration project that tested this hypothesis. Thirteen holes were drilled into and through the favorable zone in the Maynardville. Traces of zinc were found in most holes, but ore of commercial grade was not discovered.

Most drill holes cut highly fractured ground, which indicates that the area prospected is a shear zone of undetermined width. In contrast, the ore at the New Prospect mine is closely related to two distinct faults. It seems likely, therefore, that the main fault as exposed in the New Prospect mine is not continuous to the Stiner prospects but

probably has dissipated into many closely spaced fractures. It is also possible that the main fault at the New Prospect mine changes strike in the intervening distance between the mine and prospects; a northward change in strike of 5°–10° would place the fault outside the area prospected. In 1946 the New Jersey Zinc Co. drilled several closely spaced holes in the area immediately north of the area explored by the Government, but the results have not been made available.

Two other prospect pits have been opened on faults within the mapped area. Cut 4 (pl. 3) is 200 feet S. 50° W. of cut 1. It exposes a small fault for a distance of 50 feet. At its westernmost exposure the fault strikes N. 75° E., but within 25 feet it swings due east. Throughout its exposed length the fault maintains a 70° N. dip. The position and dip of the fault preclude its connecting with the shears exposed in cuts 1, 2, and 3.

A fault trending N. 68° E. cuts Maynardville Limestone Member exposed in the workings at cut 5. A distinctive limestone bed 1 foot thick is offset about 8 feet vertically, the north side being upthrown. The rocks adjacent to this fault are sheared and somewhat brecciated. A few discontinuous veinlets of zinc are on the north side of the fault. This fault is not on the strike projection of the main faults in the New Prospect mine. Exposures are sufficiently good to rule out the possibility of a continuous fault from cut 5 to the other prospects. It therefore seems probable that the mineralized fault in cut 5 is not an extension of the mineralized area at cuts 2 and 3, despite a similarity in structure.

J. W. Taylor prospect (83)

The Taylor prospect is near the Capps Creek road, 1,700 feet south of the mouth of the ravine in which the Tolliver prospect lies. It is on land owned by the Tennessee Valley Authority. Here, strongly brecciated gray dolomite that is cut by conspicuous joints trending N. 65° E. and contains disseminated sphalerite crops out in the road and in the streambed. The exact stratigraphic location of the prospect is uncertain, but it is probably near the top of the Copper Ridge Dolomite.

D. F. Tolliver prospect (southern) (84)

The D. F. Tolliver prospect is in a ravine on the east side of Capps Creek about 3,700 feet north-northeast of Capps Creek Church. A poor road branching from better roads on the ridges around the head of Capps Creek Valley extends as far as the mouth of the ravine. The land is owned by Daniel F. Tolliver.

A little prospecting was done here by Mr. Shofner, and this work exposed light-gray brecciated Copper Ridge Dolomite about 240 feet below the top of the formation. The dolomite contains considerable pyrite but only minute quantities of galena and sphalerite.

Treece prospect (16)

The Treece prospect is at the mouth of Greaver Hollow, 1,000 feet northeast of the Southern Railway trestle. The main prospecting was done in a cut 10 feet deep and 30 feet long. The cut follows a pronounced vertical fracture that strikes N. 65° W. The only minerals seen were sphalerite and galena in material from the dump. Two badly caved pits on either side of a millrace south of the stream show 10-foot faces of unmineralized light-gray dense Copper Ridge Dolomite. The bedding strikes N. 55° E. and dips 8° SE. The stratigraphic position is 225 feet below the base of the Chepultepec Dolomite.

Tuttle prospect (20)

The Tuttle prospect is a small cut 400 feet east of the Fred Smith prospect. Small amounts of sphalerite, galena, and pyrite were deposited along fractures trending N. 70° E. The prospect is 250 feet below the base of the Chepultepec in dark-gray coarse-grained fetid Copper Ridge Dolomite.

J. P. Welch prospect (50)

Three prospect pits are grouped around the head of the small ravine that opens into Caney Hollow from the east three-quarters of a mile above its mouth and half a mile northwest of the Bunch Hollow mine. A road leading to a house near the property follows the crest of the ridge between Caney Hollow and Bunch Hollow. Some of these pits are on land owned by J. P. Welch, but the mineral rights to other pits belong to Dan C. Swab. Some zinc carbonate reportedly was taken from these pits in about 1923.

Two pits are on the north flank of the ravine and one is on the south flank. At the northernmost pit, a tunnel was driven into the hill, but it is now inaccessible. The three pits are all in the same massive knotty light-gray dolomite about 160 feet below the top of the Copper Ridge Dolomite. The ravine is alined along the trend of the major fracture that was seen at the Bunch Hollow mine. This fracture probably trends N. 65° W. through the ravine to the Chad Wilson prospect in Caney Hollow. The rocks exposed in the bottom of the ravine are strongly sheared; but at the pits, joints are less conspicuous.

Disseminated sphalerite and galena occur in the bed at each pit; mineralized rocks are richest at the middle pit but even there do not exceed 2 percent total sulfides.

Robert Welch prospect (49)

The Robert Welch prospect is at an elevation of 1,290 feet on the steep side of Bunch Hollow opposite the mouth of the first tributary ravine above the mouth of Caney Hollow. The nearest road is in Bunch Hollow. The land is owned by Robert Welch. An opencut

into bedrock, 20 feet long and 12 feet deep at the face, was opened by Mr. Erwin of New Tazewell.

The cut exposes a massive bed of white crystalline dolomite 160 feet below the top of the Copper Ridge Dolomite. The bed lies flat, but in the cut it is considerably brecciated. The cracks of the breccia are incompletely filled with galena and coarsely crystalline white dolomite. No entirely fresh samples could be obtained, but the presence of limonite and probably zinc carbonate in the weathered material suggests the former presence of pyrite and sphalerite; the best samples obtained had perhaps 2 percent lead. The mineralized area probably was largely a single pocket.

Williams prospects (western (37) and eastern (38))

In 1913 two small areas were prospected on the north side of Powell River near Williams Hollow, on land subsequently acquired by the Tennessee Valley Authority. One prospect was close to the mouth of Williams Hollow, and the other was at the mouth of the next small hollow to the west. The area is submerged when Norris Lake is at pool level.

The localities were visited during a low-water stage; and, in each, limonite was found along the fractures of strongly jointed Copper Ridge Dolomite. The localities visited are shown on plate 1, but it is not certain that they represent the exact position of the original prospects.

Chad Wilson prospect (48)

The Chad Wilson prospect is on the west side of Caney Hollow 2,700 feet above its mouth. The nearest road is the Bunch Hollow road, which extends to the mouth of Caney Hollow. The land is owned by Chad Wilson, who also owns half interest in the mineral rights; the other half belongs to the heirs of Jim Keen. The prospect was opened in about 1920 by Ben England, who sank a shaft in bedrock and reportedly found both zinc and lead sulfides. In 1940 the prospect was leased to C. A. Harris; but no work was done, and the lease expired.

The shaft is filled. Strongly weathered dolomite about 320 feet below the top of the Copper Ridge is exposed near the site. Conspicuous jointing trends N. 75° W., and the shaft was apparently sunk on fractures having this trend. A slight southeastward shift in strike would connect these fractures with the fault at the Bunch Hollow mine.

Limonite and a little zinc carbonate can be seen on the dump. Small pieces of galena were found on the hillside nearby, but they could have been washed downhill from the outcrop of the fracture zone.

To the northwest across the hill, nearly on the projected strike of the fracture, limonite and zinc carbonate have been found.

Shot Wilson prospect (51).

The Shot Wilson prospect is on the east side of Caney Hollow about 2,500 feet west of the Bunch Hollow mine. It is reached by a farm road along the ridge to the east that connects with a graveled road along Chestnut Grove Ridge to the south. The land is owned by Shot Wilson.

The prospect is an opencut, once perhaps 20 feet wide and 15 feet deep at the face, but now overgrown with vegetation and partly filled. It exposes flat-lying blue-gray dolomite about 160 feet below the top of the Copper Ridge. It is cut by joints trending N. 65° E. and N. 10° W. The rock contains small vugs partly filled with dolomite and galena crystals, and also some blebs of galena. The galena seems to have no relation to the joints.

Wilson prospect (not on pl. 1)

The Wilson prospect is in White Hollow 2,000 feet downstream from the former settlement of White Hollow or Rhodelia, on land owned by the Tennessee Valley Authority. It is about 5 miles southwest of the New Prospect mine but is in the White Hollow quadrangle, outside the area shown on plate 1. The prospect consists of two pits 70 feet apart in bedrock on opposite sides of the stream. The east pit is 12 feet in diameter and is now filled with water; the west pit is smaller and is filled with debris.

The prospect is in the Chepultepec Dolomite, not far above the highest prominent sandstone bed of the basal, sandy member. The dolomite dips 15° SE. and is cut by a set of strong joints trending about N. 75° W. The ore does not follow the joints but is disseminated in a brecciated bed. The matrix of the breccia is largely coarsely crystalline dolomite containing some pyrite and a little sphalerite. Bedrock exposed between the two pits is jointed but not brecciated; it is not mineralized.

Woods prospect (91)

A little galena and pyrite disseminated in dolomite along bedding planes is exposed in a cut opened in the Copper Ridge Dolomite. The Chepultepec Dolomite is 50 feet above. Access is by good secondary road from Sharps Chapel, 1.8 miles to the southeast.

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