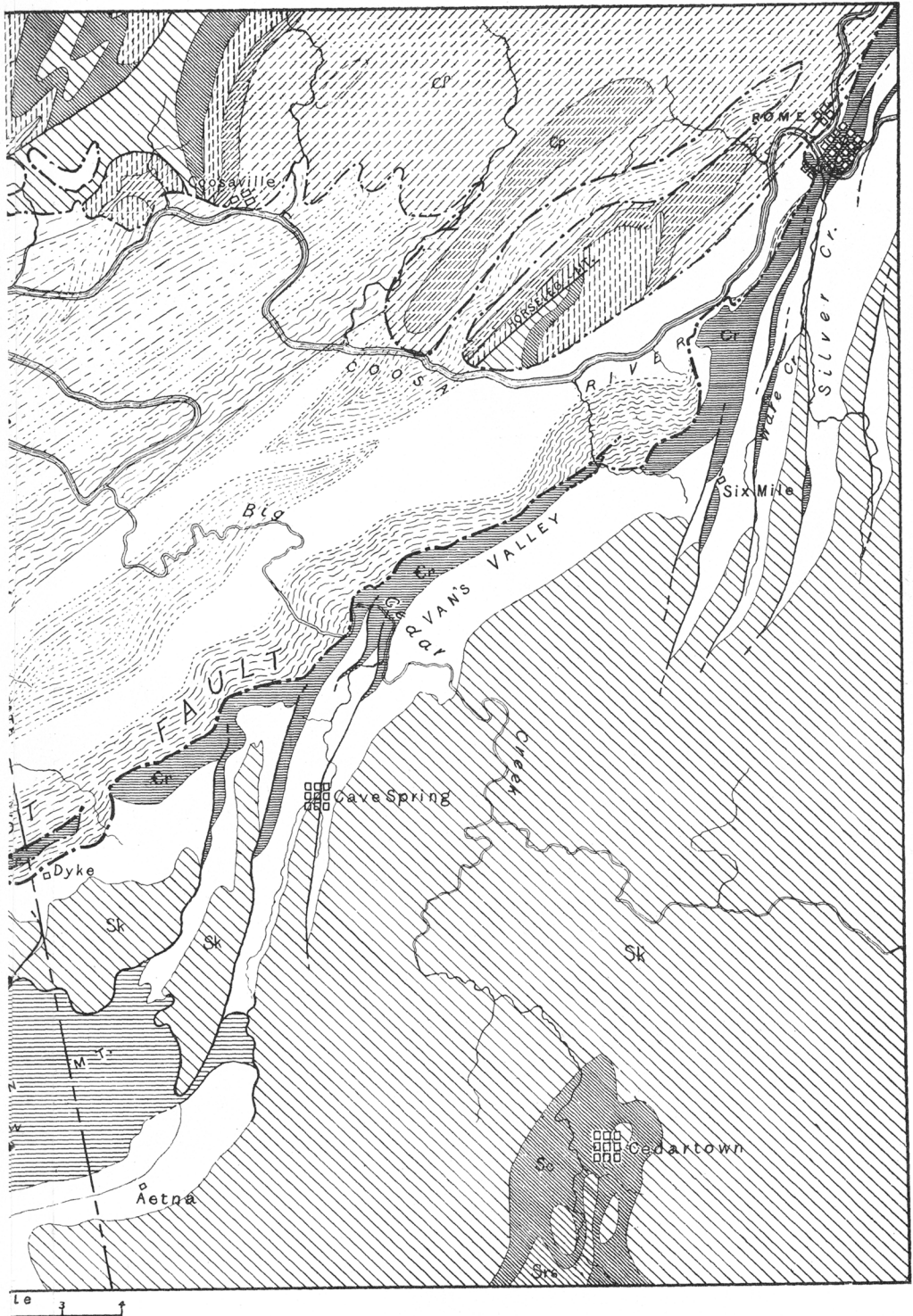


A PORTION OF THE COOSA VAL



GEOLOGY OF A PORTION OF THE COOSA VALLEY IN
GEORGIA AND ALABAMA *

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(Read before the Society December 28, 1893)

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INTRODUCTION.

The region discussed in the following paper embraces portions of the Rome and Fort Payne atlas sheets of the United States Geological Survey in Georgia and Alabama. The outlines of its geology have already been presented to this Society in a paper read at the Washington meeting in 1890. While the main features of its structure were known at that time the details had not yet been worked out. Further study of this region during the past summer has cleared up much of the obscurity heretofore surrounding its geologic history, and it is believed the results obtained are of sufficient importance to warrant bringing the subject

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before the Society again; also recent work by Mr Walcott on the paleontology of the region has made possible certain stratigraphic correlations of considerable interest.

PHYSIOGRAPHY OF THE REGION.

The accompanying map shows the areal distribution of the formations within the region, and the form of the surface is in large measure dependent on the character of the underlying rocks. From Rome, shown on the northeastern corner of the map, a line of hills extends diagonally across toward the southwestern corner, culminating in Weisner mountain. This line of hills separates the region into distinct physiographic divisions. On the northwest is the Coosa valley, underlain for the most part by soft shales and limestones which have been eroded down to a nearly perfect plain. The level surface is interrupted by a few slight elevations composed of harder shales or protected by a cap of coarse gravel. The Coosa river has an extremely sinuous course, evidently inherited from conditions differing slightly from those which prevail at present. Its channel is sunk 40 to 60 feet below the general level of the valley, and its flood-plain has only a very moderate width.

The southeastern portion of the area represented by the map is underlain by rocks of diverse character, and hence it has a more diversified topography. Adjacent to the dividing line of hills above mentioned is a narrow valley underlain by shales. South of Rome several other narrow valleys diverge from this one and penetrate a few miles within the border of the high rolling land to the eastward. Between Cave spring and Weisner mountain numerous narrow valleys alternate with irregular ridges and hills. The dominant topographic feature of this region is Indian mountain. It consists of several irregular ridges which coalesce to form its highest point and taper off rapidly toward the northeast and southwest.

STRATIGRAPHY OF THE REGION.

A detailed account of the lithologic character and distribution of the formations of this region will shortly be published with the Rome and Fort Payne atlas sheets, and only such details are included in the present paper as are essential for an understanding of the stratigraphic and structural problems.

Cambrian Rocks.—Passing diagonally across the mapped area, from Rome to Weisner mountain, along the northern base of the hills above mentioned, is the intersection of a major thrust-fault plane with the land surface. This has been named the Coosa fault on account of its relation

to the southern border of the Coosa valley. It will be fully described in a subsequent part of this paper, and is mentioned here only because it forms the boundary between two widely different phases of the Cambrian rocks. The formations south of the fault will be first described, then those of the Coosa valley, and finally probable correlations between the two regions will be pointed out.

Three typical sections of the Cambrian rocks south of the Coosa fault will be described briefly:

The first, measured in the vicinity of Rome, shows a gray silicious limestone at the base. This has as yet yielded no fossils, but has been provisionally correlated with the Beaver limestone, which occupies a similar position in the stratigraphic section of east Tennessee, and has been there determined as Lower Cambrian. Above this limestone are from 700 to 1,000 feet of thin-bedded sandstone and sandy shales, with a characteristic bed of white sandstone at the top. These beds constitute the Rome sandstone. Above the sandstone are several hundred feet of olive shales, then beds of oolitic limestone, and finally 1,000 or more feet of calcareous shales, interbedded toward the top with blue limestones.

The second section, measured on Big Cedar creek, shows the Beaver limestone and the Rome sandstone, similar in character and thickness to the same formations in the section at Rome. Here also the lower portion of the Connasauga is composed of fine olive shales, above which are a few beds of oolitic limestone. The upper portion of this formation, however, differs widely in the two sections. The fine calcareous shales of the Rome section are replaced on the Big Cedar by heavy beds of limestone. Some of these beds are gray and crystalline, closely resembling the Knox dolomite, but free from the compact nodular chert of the latter formation. Other beds contain considerable earthy matter which often retains the form of the rock after the calcareous matter has been removed, and also some chert having a characteristic porous structure.

The third section, constructed from numerous measurements in the vicinity of Indian mountain, shows wide differences from the two preceding, especially in its lower portion. The Beaver limestone has not been found here and the Rome sandstone is replaced by a formation of much greater thickness and wholly different in character, the Weisner quartzite. This consists at the base of a heavy bed of quartzitic conglomerate (700 feet), then a great thickness of micaceous shales (1,800 feet), and finally a series of interbedded quartzites, shales and coarse conglomerates (3,000 feet \pm). In the upper part of this variable series the shale predominates and the conglomerate occurs as thin lenses. Above this series are greenish silicious shales, having a very considerable though

undetermined thickness. The upper portion of the Indian mountain section closely resembles that on Big Cedar creek. No fossils have yet been found in any member of the Weisner formation, and hence its exact position is not determined, but it probably corresponds to the whole or at least the greater part of the Rome sandstone.

In the early geological study of this region the rocks underlying the Coosa valley were believed to be older than the Rome sandstone and to rest conformably beneath that formation. A study of their fossils, however, has shown them to be of the same age as the Connasauga shale, and hence younger than the Rome; also more careful examination has revealed the presence of the Coosa fault, separating the rocks of the Coosa valley from the Rome sandstone and other formations to the south.

Owing to the extensive deposits of silt and gravel which occur in the Coosa valley, and also to the extremely complicated structure, all attempts at subdivision of these rocks and mapping their distribution must be in a large measure unsatisfactory. In a very general way they may be divided into three groups, although they present so wide variations in lithologic character on opposite sides of the valley that the subdivision is of doubtful value.

The upper division, which generally comes in contact with the Rome sandstone along the Coosa fault, there consists of characteristic greenish silicious shales. In some cases the shale is replaced by greenish micaceous sandstone, which is always highly contorted and crushed into a series of lenticular masses from a fraction of an inch to four or five inches thick. The sandstone is always filled with cracks or fissures which have the appearance of having been produced by contraction of the strata. At the surface these cracks are partially filled with quartz and where they are unweathered the remaining space is occupied by calcite. The sandstone is confined to the southern border of the valley. Passing northward the silicious beds become fewer, being replaced by fine olive-green shales, and throughout the central portion of the valley this division is represented by shales in which occur numerous flat concretions composed of gray silicious material intermediate in character between fine-grained quartzite and chert. As the shale weathers, these concretions accumulate upon the surface, and closely resemble well worn river gravel. Along the northern border of the valley this division becomes very much more calcareous. The concretions are similar in appearance to those above described, but are composed of very silicious limestone.

The intermediate division of the rocks of the Coosa valley is composed of clay shales, but contains in addition varying quantities of limestone. The latter appears in some places as a few thin beds scattered

through the shales and in others as very massive beds, frequently several hundred feet in thickness.

The lowest division consists wholly of fine clay shales, which appear yellow at the surface and dark bluish gray below drainage.

Throughout Coosa valley there is no single stratum sufficiently characteristic as to be recognizable in different exposures and thus used as a datum for correlating other beds. For this reason and for others already mentioned the above classification is simply tentative. It cannot be asserted with any confidence that the divisions represented on the map are made at the same stratigraphic point for any considerable distance, either along the strike or across the outcrops.

When the rocks of the Coosa valley are compared with the Cambrian rocks south of the Coosa fault but little similarity is found. Nothing resembling the upper silicious division occurs in the Rome and Cedar creek sections, and, on the other hand, the characteristic oolitic limestone of these sections is wholly wanting north of the fault. On lithologic grounds alone these rocks would never be correlated. The presence of identical faunas, however, in the two regions affords unmistakable evidence of their contemporaneous deposition. These facts have an important bearing upon the structure of the region, and will be again referred to in connection with the Coosa thrust-fault.

Silurian Rocks.—The Knox dolomite probably represents a deposition period covering the upper Cambrian and extending well into the Silurian. The almost complete absence of fossils makes it impossible to fix the limit between the Cambrian and Silurian, and apparently there is no break in the continuity of deposition from bottom to top of the formation. The Knox dolomite has been described by various writers and needs only brief mention in this place. It is probably between three and four thousand feet in thickness, although the nature of its exposures and the fact that it is usually covered with a heavy mantle of residual material render measures of its thickness uncertain.

North of the Coosa valley the Knox dolomite is followed by the Chickamauga, a series of blue, dove-colored and purple limestones; also at a few points south of the Coosa fault the dolomite is overlain by blue limestone, although in the greater part of this region a stratigraphic break, which will be described more fully later, occurs at this point; also south of the fault the purple earthy limestones are replaced by a great thickness of black slates. They have been placed in a separate formation, the Rockmart slate, although they probably represent the same period of deposition as the earthy limestones further north, but it is impracticable to separate the latter from the purer limestones beneath.

North of the valley the Chickamauga limestone is followed without

apparent break by the Rockwood formation, and that by the Carboniferous, Fort Payne chert and Floyd shale. South of the Coosa fault the succession above the Chickamauga is quite different.

Devonian Rocks.—A few miles southeast of the region mapped the Rockmart slate is overlain by a thin bed of white quartzose sandstone, and this by fossiliferous chert supposed to correspond to the Fort Payne. In the area mapped no rocks are found which can be shown to rest conformably on the Rockmart slate. As shown upon the map, there are between Indian and Weisner mountains several small areas occupied by a formation which comes in contact with all the older rocks thus far described. It consists of coarse ferruginous sandstone, in some places white, resembling quartzite, and in others yellow or gray and weathering to incoherent beds of sand. Beneath this sandstone and usually deeply covered by its débris are shales, also variable in composition and appearance. No satisfactory measurement has been made of their thickness, but this is probably as variable as their physical appearance.

A number of fossils have been found in these sandstones of Frog mountain. They include *Zaphrentis* sp. (?), *Chaetetes complanata* (?), *Spirifera arenosa* (?), *S. arrecta* (?), *Pterinea* sp. (?), *Platyceras* sp. (?), *Orthis musculosa* (?) and *Pentomerus*, cast like that of *P. oblongus conocardium*. Concerning these fossils Mr Walcott says* that "all the specific determinations are uncertain, as the material is not in a satisfactory condition, but the horizon of the Oriskany sandstone is strongly suggested by the general facies of the fauna."

The only formation in the Appalachians south of Tennessee which has hitherto been regarded as Devonian is the Chattanooga black shale, and this is wanting south of the Coosa river. If the Frog mountain sandstone proves to be Oriskany a part of the break between the Silurian and Carboniferous will be filled.

Unconsolidated Formations.—Reference has been made to beds of silt and gravel in the Coosa valley which are worthy of some further description. These deposits cover a considerable proportion of the valley, entirely concealing the underlying rocks over many square miles of its surface. They are found at two distinct levels, separated by a vertical interval of about 140 feet. At both levels they rest directly upon a smoothly cut surface of the highly contorted Cambrian shales.

The low-level deposits are most extensive and occur from 30 to 40 feet above the Coosa river. At their base, resting on the erosion surface, are from 1 to 5 feet of gravel and coarse sand showing some indications of bedding. The gravel is coarsest at the bottom, sometimes containing pebbles 6 to 8 inches in diameter. When fresh exposures are examined

* Am. Jour. Sci., vol. xlvii, 1894, p. 237.

the gravel is found to contain a large proportion of chert, in some cases as much as 50 per cent. Next to the chert, schistose quartzite is the most abundant constituent, and after that vein quartz, which makes about 10 per cent. The finer portions of the gravel contain many small fragments of shale and angular or partly rounded fragments of chert, showing clearly that the material has been subjected to only a moderate amount of stream or beach action. This gravel is overlain by from 5 to 15 feet of silt, colored deep red below and yellow or gray at the surface. The line between the gravel and silt is sometimes well defined, but more often the passage is gradual, and occasional pebbles occur several inches or even feet above the base of the silt; also lenses of coarse gravel are sometimes seen in the silt.

The high-level deposits form a cap upon certain isolated hills, which extend from Center, Alabama, northeastward near the middle of the Coosa valley. The composition and arrangement of their materials are almost precisely the same as in the low-level deposits. The gravel is perhaps a little coarser and the overlying silt more deeply colored, but otherwise the deposits are indistinguishable. The intermediate slopes between the upper and lower deposits are quite free from gravel, except the small quantity which has washed down from above, and, so far as can be determined, they are not portions of a single deposit originally spread mantlewise over the entire surface and subsequently removed from the slopes. On the contrary, the high-level deposit appears to be the older, consisting of the remnants of a sheet once continuous over the whole valley and almost entirely removed, together with 140 feet of the underlying shales before the deposition of the low-level deposits.

No opportunity has yet been afforded of tracing these unconsolidated formations to regions in which their age might be determined, and no attempt is here made at their correlation, but it seems probable that further study will show them to be the inland representatives of either the Columbia or Lafayette formations or both.

Overlaps.—In studying a region so extensively faulted as that between Indian and Weisner mountains, there is a strong tendency to attribute all unconformities to faulting, and especially is it difficult to discriminate between the broad horizontal thrusts and deposition overlaps. Sufficiently careful mapping, however, renders it possible to determine in most cases to which class an unconformity belongs, even in presence of a heavy residual mantle and deep decay of the rocks.

At least two well-marked erosion overlaps occur in this region. The first is at the top of the Knox dolomite. In the vicinity of Cedartown and immediately southeast of the area covered by the map the contact of the Knox dolomite and Chickamauga limestone is everywhere obscured

by a belt of deep red soil, with which beds of limonite are usually associated. It seems probable that this ferruginous clay represents the deep residual mantle of an old land surface. This is at present, however, only a working hypothesis and requires further field-work to determine its value.

West of the region mapped the evidence of this overlap is more conclusive. It consists in a heavy bed of conglomerate or breccia which occurs at the base of the Chickamauga limestone, and is composed of more or less angular pebbles of Knox dolomite chert imbedded in a calcareous matrix.

The second erosion overlap occurs about the top of the Silurian. It is marked by much more pronounced folding than the earlier one, but is confined to a smaller area. It produces the greatest unconformity in the vicinity of Frog mountain. As shown upon the map, the Frog Mountain sandstone and shale come in contact at different points with the Connasauga shale, Knox dolomite, Chickamauga limestone and Rockmart slate. To bring about this relation by faulting would require a period of folding and erosion followed by the horizontal transfer of younger rocks across the eroded surface of the older. There is no reason why such a process might not take place under proper conditions, but the evidence is against the hypothesis of faulting in this particular case and in favor of the hypothesis of overlap. No rocks are found in this region belonging to the Rockwood (Upper Silurian), while toward the northeast and southwest this formation carries heavy conglomerates, which represent shore conditions of deposition adjacent to a Silurian land area.

The entire absence of the Chattanooga (Devonian) black shale south of the Coosa river indicates a third overlap. The corresponding period of erosion must have covered nearly the whole of the Devonian, but was probably marked by slight elevation, and consequently little degradation, so that the Carboniferous rocks appear to rest conformably upon the Frog Mountain (Lower Devonian) or Rockwood (Upper Silurian) sandstones.

GEOLOGIC STRUCTURE OF THE REGION.

The structure of the region between Rome and Weisner mountain is probably as complicated as that of any portion of the Appalachians. Three types of structure, more or less closely related genetically, are here found associated, and the complication is further increased by extensive deposition overlaps and by abrupt lithologic changes. Only the main features of this structure could be presented here, even if all the details had been or could be worked out. For reasons given above all attempts

to unravel the complicated structure of the Coosa valley rocks have proved unavailing, but more satisfactory results have been obtained in the region south of the Coosa fault.

Folds.—Probably in this region, as elsewhere in the Appalachians, the first structural forms developed by horizontal compression were the ordinary step-folds. These were doubtless modified by irregularities in the original synclines of deposition, which are indicated by the unconformities and great variations in formation thicknesses. In the less complicated portions of the region these folds remain more or less perfectly preserved, but generally they have been entirely obliterated by subsequent faulting.

Immediately south of Rome several short folds bring the Connasauga shale above baselevel, and consequently give rise to narrow valleys, penetrating southward a few miles within the dolomite area. Each of these folds, however, has been faulted along its western side. A similar faulted anticline extends southward from Cave Spring. The extensive area of dolomite, whose border is penetrated by these narrow anticlines, is a broad, gently undulating syncline pitching southward. Its axis at Cedartown is occupied by the overlying Chickamauga limestone and Rockmart slate. An explanation of this broad area of practically undisturbed rocks adjacent to the intensely faulted region on the west will be suggested below.

In the region west of Cave Spring the folds which probably once existed have been entirely obliterated, excepting a few very irregular synclines in the faulted blocks of dolomite and possibly an anticline in the Rome sandstone west of Exie. So far as their structure can be determined, the Frog Mountain sandstones form closed synclines, but these are secondary structures, developed after the subterranean had already been folded and eroded.

Minor Thrust-faults.—The second type of structure is the normal Appalachian thrust-fault, modified by the peculiar conditions prevailing in this region. A great majority of these faults extend nearly due north and south, and hence intersect the main structure axes of the region at angles of 30° or 40°. Immediately south of Rome at least seven of these minor thrusts occur within a belt three miles wide. They vary in length from 3 to 8 miles and overlap along the strike. The strata are thus cut into a number of narrow strips which form monoclinals dipping steeply toward the east. In the vicinity of Cave Spring is another series of faults similar in most respects to those south of Rome.

Between Indian and Weisner mountains there is less regularity in the arrangement of the minor thrusts, and their general trend is somewhat east of north. A strip of Knox dolomite from one to four miles in width

extends from near Cave Spring toward the southwest, lying north of Indian and south of Weisner mountains. This belt of dolomite is intersected by a series of nearly parallel thrust-faults which cut diagonally across, separating it into irregular monoclinal blocks. The faults disappear in the belt of Connasauga shale on the north, while their throw is greatest at the northern edge of the dolomite, decreasing southward, and in some cases disappearing within the dolomite area. These faults give rise to the narrow belts of shale which branch from the northern belt and extend varying distances toward the south, forming narrow valleys among the dolomite hills.

One of these faults, beginning on the state line, turns westward along the northern base of Indian mountain, passing through Rock Run. It is specially interesting on account of its connection with the Rock Run limonite and bauxite deposits.

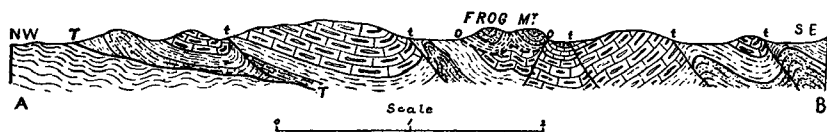


FIGURE 1.—Section through Frog Mountain, south of the Coosa Valley.

T T = Major thrust-fault; t t t = Minor thrust-faults; O O = Upper Silurian overlaps.

The fault which begins about two miles southwest of Forney is shown on the map as passing around the southwestern end of Frog mountain and turning back toward the northeast as far as Rock Run, the two portions of the fault being thus approximately parallel. To produce the observed distribution of the formations the two parallel limbs of this fault must have in opposite directions. The northern limb is precisely similar to the other thrust-faults of this series, the younger rocks are upon its northern side and the fault-plane dips toward the south. The relation of the formations along the southern limb is different. From Hurricane creek to the northeastern end of Frog mountain the rocks on the northern side of the fault are the younger, while from that point to Rock Run they are the older. The latter is the normal relation for a northward dipping fault-plane, as this is believed to be. The abnormal relation along the southern border of Frog mountain is brought about by the presence of the plane of overlap, indicated by O O in the structure section, figure 1. The fault branching from the one just described west of Rock Run and extending nearly to Forney is quite distinct and has the normal southeastern hade.

The very marked differences between these folds and faults and those further north in Tennessee and Virginia are due chiefly to the peculiar

stratigraphic conditions of the region. For a long distance north of Indian mountain the Cambrian rocks consist of soft shales and limestones which afford little resistance to folding, while toward the south they contain great masses of conglomerate and quartzite. These massive strata themselves resisted folding and acted as immovable buttresses, against which the less rigid rocks were thrust; hence the effect of great compression was concentrated within a narrow belt west of Indian mountain, while the broad Cedartown syncline lying to the eastward of this buttress was so protected from the compression that its strata remain nearly horizontal. The eastward flow of strata past the northern end of this buttress necessitated a certain amount of rotation in the strata of this region, and this rotation determined the position of the minor thrusts transverse to the main structure lines. The rotation is especially marked in the monoclinical blocks of Knox dolomite between Cave Spring and Weisner mountain, and this also accounts for the group of minor thrusts south of Rome.

Major Thrust-faults.—Two or three faults of this type occur within the region under consideration. The most remarkable of these, the Rome thrust-fault, has already been described.* Owing to peculiarly favorable conditions, certain portions of the overthrust rocks have been preserved from erosion and afford unmistakable evidence of horizontal displacement of the strata as well as a minimum measure of its amount.

The second example of this type, the Coosa fault, has been already referred to above. As shown on the accompanying map, it extends from Rome southwestward on the border of the Coosa valley along the northern base of Weisner mountain, turning south and then southeast around its western end. The diversity of formations adjacent to different portions of this fault is very much less than in the case of the Rome fault. Chiefly for this reason it was overlooked in the early study of the region, and until the entire belt was carefully mapped it was regarded as a normal contact between adjacent formations. Upon the northern side of the fault throughout its entire length, with the exception of a mile or two near Rome, occur the green silicious Cambrian sandstone and shale above described. On the southern side of the fault there is not quite so great uniformity. Throughout a little more than half its length the Rome sandstone lies immediately superjacent to the fault plane. Between Rome and Cedar creek a narrow strip of Beaver limestone occurs at intervals beneath the Rome sandstone and next to the fault. From Forney to the eastern end of Weisner mountain the Rome sandstone almost entirely disappears, or if present is not in contact with the fault, being replaced by the Connasauga.

* The Overthrust Faults of the Southern Appalachians: Bull. Geol. Soc. Am., vol. 2, 1891, pp. 141-154.

Although the residual surface material usually conceals the fault plane, artificial cuttings at some points reveal the exact contact between the overthrust and underthrust strata. As stated above, the green silicious shales of the Coosa valley are always highly contorted, but much more so near the fault than elsewhere. The original bedding is sometimes quite obliterated and the rock is in the form of small lenticular masses with slickensided surfaces. The rocks above the fault plane are usually much less disturbed than those below. In all cases where the exact contact could be seen the rocks above the fault plane were the Rome sandstones and their greater rigidity may in a measure account for their less disturbance.

Just south of the Etowah river in Rome the fault plane is well exposed. The rocks are crushed and deeply weathered, but the bedding, so far as it can be determined, is approximately parallel above and below the fault plane. A stratum of obscurely bedded red and yellow clay 8 or 10 feet in thickness marks the plane on which the maximum motion occurred. It contains fragments of the overthrust and underthrust rocks and is evidently a finely comminuted and deeply weathered fault breccia. A large amount of motion has evidently taken place within the strata on both sides of the main thrust plane, and every bedding plane for some distance above and a considerably greater distance below shows sickensiding.

In a roadcut about six miles southwest of Rome the fault plane is shown even more clearly than in the case above described. It dips southeastward about 12° , although in the 20 feet observed the angle varies from 10° to 15° . The thrust-plane is marked by a bed 2 or 3 feet in thickness of reddish clay containing many small angular fragments of the adjacent rocks. Above this fault breccia the sandstone is only slightly disturbed, while below the green silicious shale has almost entirely lost its bedding.

Relation of minor and major Thrusts.—It will be seen from the accompanying map that while the minor thrust-faults have a nearly north-and-south trend they do not cross the Coosa fault, but in most cases die out in the band of Cambrian shale and sandstone upon its southeastern side. At two points the Coosa fault appears to be intersected and offset, but in neither case does the intersecting fault belong clearly to the class of minor thrusts above described. It seems scarcely possible that if major and minor thrusts were developed at the same time the latter should not in some cases at least intersect the former; also if the minor thrusts had been developed subsequent to the major thrusts they would have intersected the latter even more frequently; hence it seems a fair inference that the two types of faulting belong to distinct periods of or-

ogenic activity. If these periods were separated by a long time-interval considerable erosion must have taken place. Thus some indication is afforded of the conditions which determined the character of the faulting, and the conclusion reached by other lines of evidence is strengthened, that folding and minor thrust-faulting result from the compression of a competent stratum under great load, while major thrusts result from compression after erosion has removed much of the load from the rigid beds and at the same time developed lines of weakness in them.

Amount of horizontal Displacement.—As described in the paper above cited, the thrust-plane of the Rome fault has itself been folded by subsequent compression. By reason of this folding certain portions of the overthrust rocks which rest in the synclines have been preserved from erosion and afford a minimum measure of horizontal displacement. If such subsequent folding has taken place in the case of the Coosa fault, the resulting folds have either not yet been revealed by erosion or they have been entirely removed. The latter is the more probable. Excepting the two small offsets, evidently produced by intersecting faults, the course of the Coosa fault is remarkably direct, considering the low inclination of the thrust-plane; but it is quite probable that if the surface of this region were degraded only a few hundred feet further the outcrop of the Rome fault-plane, now so remarkably sinuous, would be equally as direct as that of the Coosa fault, and the latter may have had at some earlier stage of erosion a course equally as sinuous as the former has at the present time.

The strongest evidence of great horizontal displacement on the Coosa thrust-plane is found in the widely diverse character of contemporaneous formations on its opposite sides. It will be recalled that the same faunas are found in the Connasauga shale and in the formations underlying the Coosa valley, but the rocks which contain these fossils differ widely in appearance and point to very different conditions of deposition. Two explanations of these facts are suggested: First, there may have been a barrier of land between the two areas of deposition, so that the rocks of the Coosa valley and those south of the Coosa fault were laid down in separate, though contiguous, basins. Deriving their sediments from different sources, they would differ in lithologic character, while the faunas would be essentially the same. No trace of such a land barrier, however, has yet been found, and the rocks in question contain none of the characteristic marks of littoral deposition.

The second explanation of the above facts is that the rocks now occupying adjacent areas at the surface were originally deposited in comparatively remote parts of the same sea, and that the observed lithologic differences are due to the gradual change which is always found to occur

when the same beds are traced for a considerable distance. The contrast in character is greatly heightened, since all the intermediate varieties are wanting and the most different types are brought into immediate contact, where comparison reveals differences which in their normal relation would entirely escape notice. The visible displacement on the Rome fault is about $4\frac{1}{2}$ miles. Upon a very moderate estimate of subsequent folding and erosion, the original displacement must have been at least twice, and was more probably three times, that amount. If an equal displacement has occurred on the Coosa fault-plane, the original 10 or 15 miles of interval between rocks now adjacent would easily account for these observed lithologic differences.

PALEOZOIC HISTORY OF THE REGION.

From the facts detailed above a tolerably definite idea may be obtained of the history through which this region has passed. It begins in Cambrian time, when the land lay to the southeast and a broad expanse of sea stretched far to the west and northwest. The rivers brought down sediments from the crystalline rocks on the east. At first, while the land was high, coarse sand was deposited in great lenses about the river mouths, and as the land was worn down the sediments became finer, till at the close of the Connasauga epoch only the finest mud was deposited. Then followed a long period of calcareous precipitation, with conditions, not clearly understood, favoring the deposition of amorphous silica as chert or flint. This was the Knox dolomite epoch, covering late Cambrian and early Silurian time. Following this was an uplift with gentle folding which brought portions of the region above sealevel. Probably most of the area covered by the map was dry land undergoing subaërial degradation, with the formation of a deep residual mantle and the deposition about its border of conglomerates composed of the indurated portions of the eroded rocks. Following this comparatively short period of uplift was a much longer one, during which the sea covered the region and the Chickamauga limestone was deposited. After a few hundred feet of blue limestone had formed changes occurred in the altitude of the land toward the southeast, so that fine mechanical sediments replaced pure limestone, and a great thickness of calcareous clay shales, now the Rockmart slate, was laid down. This long period of quiet deposition was terminated by a period of disturbance similar to the one which brought the Knox dolomite epoch to an end, but the folding was very much more profound in the second than in the first. Within the area mapped, and extending some distance toward the southeast, rather sharp folds were produced, trending nearly north and south.

The folding was accompanied and followed by erosion, which probably reduced the rising land nearly or quite to sealevel. This period of erosion extended over the latter part of the Silurian, but early in the Devonian the region was again invaded by the sea, and across the truncated edges of the folded strata coarse sands were deposited which now form the Frog Mountain sandstones. The region may have been above sealevel again during the latter part of the Devonian, but if elevation occurred at that time it was accompanied by so little folding that practically no erosion took place, and the overlap is indicated only by the absence of Upper Devonian formations and not by any appreciable unconformability of strata. During early Carboniferous time the region was again covered by the sea and a continuous layer of cherty limestone deposited over its entire extent.

The orogenic activity which had manifested itself at intervals during most of Paleozoic time culminated in the great Appalachian revolution probably near the close of the Carboniferous. Considering the entire Appalachian province as a unit, the activity may have been continuous, although in any particular region it apparently consisted of several periods of activity separated by intervals of comparative quiet. During the early part of this complex series of movements in the region under consideration the horizontal compression found relief in the formation, first, of simple folds, and then of the minor thrusts. Finally, after a comparatively long period of erosion, the strata thus folded and faulted were displaced upon nearly horizontal planes, producing the major thrust-faults above described.

POST-PALEOZOIC HISTORY OF THE REGION.

The history sketched above is recorded in the rocks of the region and their underground structure. The post-Paleozoic history, on the other hand, is recorded chiefly in its physiography; in the forms of surface relief and drainage. The accompanying map represents too small an area for the deciphering of this later history, which has been made out from a study of the entire Appalachian province.*

Evidence has elsewhere been found of two prolonged periods of base-leveling which resulted in the formation of extensive peneplains. The first or Cretaceous peneplain was most perfectly developed, but has been to a considerable extent destroyed by subsequent erosion. In the area mapped the few remnants of this plain have an altitude of 1,300 feet. They are found in the crests of the subordinate ridges forming Indian

* The Geomorphology of the Southern Appalachians, by C. Willard Hayes and Marius R. Campbell. *Nat. Geog. Mag.*, vol. vi, 1894.

and Weisner mountains, while the main summits of those mountains were not reduced quite to the level of the Cretaceous peneplain.

The second or Tertiary peneplain was developed only on areas of comparatively soft rocks, but has been more perfectly preserved, so that considerable remnants are found in the region mapped. This peneplain, like the preceding, was warped as it was elevated, and now slopes gently toward the northwest, decreasing in altitude from more than 900 feet in the vicinity of Cedartown to about 750 at the Coosa river. The broad dolomite area between Rome and Cedartown was nearly reduced to base-level, though the more silicious portions remained as low hills from 100 to 150 feet above the peneplain.

During the closing epoch of the Tertiary, erosion was active upon the surface of this peneplain, and the Coosa valley was lowered about 140 feet on the underlying soft shales, only a few low hills, as the one on which Center is located, escaping degradation. Following the formation both of the Tertiary peneplain and the subsequent baseleveled valley came a slight depression of the surface probably nearly or quite to sea-level. At the same time the carrying capacity of the upper portion of the streams was increased either by steeper slope or greater volume, so that they brought down vast quantities of gravel which they deposited along their slackened lower courses. These are the high and low-level deposits of silt and gravel already described.

Finally, the region has very recently been slightly elevated, and the Coosa river is at present lowering its channel in the last formed baselevel valley. Its sinuous course is inherited directly from the conditions which prevailed during the deposition of the low-level gravels when the stream was overloaded and wandered from side to side of a broad deposition plain.

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