

THE BARBER COAL FIELD, JOHNSON COUNTY, WYOMING.

By CARROLL H. WEGEMANN.

INTRODUCTION.

LOCATION OF THE AREA.

The Barber coal field, in Johnson County, Wyo., is a small and arbitrary division of the broad area of coal-bearing rocks in north-eastern Wyoming, eastern Montana, and portions of the Dakotas. Its extent depends in no way on geologic boundaries and is determined only by the amount of territory which could be mapped in the time allotted to the work. The field thus defined consists of seven townships (Tps. 50 and 51 N., Rs. 77, 78, and 79 W., and T. 49 N., R. 79 W.), which lie along Powder River and Crazy Woman Creek and occupy the divide between these streams a little south of their junction (Pl. XIX). The western border of the field is 12 miles east of the town of Buffalo, Wyo., which is situated near the base of the Bighorn Mountains.

ACCESSIBILITY.

The field is easily accessible. Buffalo, which has a population of about 1,500, is the principal town near the area and is reached by stages from Clearmont (35 miles) and from Sheridan (40 miles), both on the Chicago, Burlington & Quincy Railroad. From Buffalo a road leads down Dry Creek to Crazy Woman Creek, crossing the north-west corner of the field, and continues down Crazy Woman Creek to Powder River and thence down that stream to Arvada, on the Chicago, Burlington & Quincy Railroad. A road branches off from the Dry Creek road a little south of the old T. W. shearing pens, and after crossing the divide, reaches Crazy Woman Creek 2 miles above Hepp's ranch. From this point it continues eastward to Powder River across the divide between Crazy Woman Creek and Powder River. A road, poor in many places, follows Crazy Woman Creek throughout the length of that stream, and another road leads up Powder River from Arvada, but south of Barber post office it is often impracticable for heavy wagons. From Turner's ranch, in T. 51 N., R. 77 W., a good road, except for the first hard pull out of the Powder River valley, leads to Gillette, on the Chicago, Burlington & Quincy Railroad.

SETTLEMENT.

The country is but sparsely populated, settlement being confined to the flats along the two perennial streams, Powder River and Crazy Woman Creek. Back from these streams the land is uninhabited because of the lack of water. Along Crazy Woman Creek within the area under consideration there are perhaps half a dozen permanent ranches and along Powder River nine or ten. Mail is brought to Barber, the only post office in the field, once or twice a week from Arvada.

VEGETATION AND CLIMATE.

The country is for the most part a waste of treeless badlands whose surface is dotted with small clumps of sagebrush and is thorny with prickly pear. The slopes are covered with a scanty growth of wild grasses, which cure on the stem in early summer and furnish excellent feed for cattle, sheep, and horses the year round. Except along the river flats agriculture is impracticable both because of the roughness of the country and the aridity of the climate, for after the month of June little or no rain falls until October. The summer days are hot but not sultry and the air is clear and bracing. Comparatively little snow falls until Christmas and the winter is short. Storms, however, are sometimes severe.

WATER SUPPLY.

Water for irrigation, for stock, and even for domestic use, is often difficult to obtain during the dry summer months. At present the principal sources of supply are Powder River and Crazy Woman Creek. The water of these streams is slightly alkaline and is often charged with sediment, but when "settled" it is used for drinking. The supply for irrigation will be insufficient as soon as any considerable area of the river flats is placed under cultivation.

Back from the two principal streams the stock obtain a little water from pools or "water holes" along the dry beds of coulees, but this supply is generally exhausted by midsummer and the cattle are forced to go daily to the rivers, where they spend the heat of the day in the shade of the cottonwoods, returning to the hills (a distance of 4 or 5 miles) to graze at night.

It appears practicable to construct reservoirs by building dams across coulees at advantageous points, and as the country develops recourse will probably be had to this means of obtaining water both for stock and for irrigation.

Many of the springs of this general region are fit only for the use of stock. The water is commonly so charged with salts of magnesium, sodium, and other elements as to be not only unpalatable but poisonous. The white coating of "alkali" about the spring and the taste of the water are usually sufficient indications of its character.

FIELD WORK.

The field work for the following report was done in July and August, 1909, the writer being assisted by R. W. Howell, William Mulholland, and K. C. Haven. R. W. Stone spent several days in the field, and the author is indebted to him for numerous suggestions in regard to the field work. Publication of the report has been delayed for various reasons, but the author feels that the work has lost nothing thereby, as the delay has afforded opportunity to study other parts of the great coal area of northeast Wyoming and to gain data on the character and variability of the coal beds of the Fort Union formation that have materially affected the conclusions in regard to the Barber field.

The great number and variability of the coal beds of this region made it impracticable to meander the outcrop of individual beds. An accurate topographic map was therefore made (see Pl. XIX), on which were indicated the locations of hand-level stratigraphic sections procured at numerous points and tied to altitudes which were calculated by vertical angle readings taken with a telescopic alidade. As the strata are horizontal, it is possible to arrange these sections according to altitudes and thus to correlate the coal beds represented and note their individual variations. From the topographic map the outcrop of a coal bed at a given altitude may be traced over any part of the area by interpolation between the contours. In the construction of the topographic map, locations were obtained by a system of triangulation expanded from a measured base line, the instruments used being a 15-inch plane-table and telescopic alidade. Stadia traverse was not employed. The working scale was 2 inches to 1 mile, and the mapping was done township by township, the various township maps being afterwards combined by means of common points along their margins.¹

Altitudes were carried to the Barber field from a bench mark established by the United States Geological Survey on a slag-capped mesa south of Dry Creek, in sec. 4, T. 50 N., R. 81 W. The elevation of this bench mark above sea level is 4,830 feet. From this point a flying level line was carried in the present work down Dry Creek to Crazy Woman Creek, a bench mark being established in the SW. $\frac{1}{4}$ NE. $\frac{1}{4}$ sec. 20, T. 51 N., R. 79 W. This bench mark is a spike driven into a large cottonwood tree on the north side of the creek, southeast of the first ford of the creek on the road above Allemand's ranch. The tree is blazed and the figures denoting the altitude (4009) are cut in the wood. From this point a level line was carried southeast over the divide toward Powder River. At the northwest end of the prominent hogback in the SW. $\frac{1}{4}$ SE. $\frac{1}{4}$ sec. 35, T. 51 N., R. 78 W.,

¹ For a detailed account of field methods see Wegemann, C. H., Plane-table methods as adapted to geologic mapping: Econ. Geology, vol. 7, 1912, pp. 621-637.

a bench mark was established on a piece of petrified wood almost buried in the earth at the base of the thick coal bed which outcrops around the hogback. The altitude is 4,594 feet. The level line was continued to the base of the wooden cross on the white cone in the SW. $\frac{1}{4}$ SW. $\frac{1}{4}$ sec. 5, T. 50 N., R. 78 W., the altitude of which is 4,626 feet. From these points altitudes were carried over the field by means of vertical angle readings taken with the telescopic alidade, the distances used in computing difference of elevation between points being scaled from the map. Elevations determined in this manner are in general accurate within 5 feet.

LAND SURVEYS.

The land survey of this area was made in 1880 and 1883 by E. F. Stahle. In the present work seven original corners were found along the west lines of Tps. 50 and 51 N., R. 79 W., and one corner on the north line of T. 51 N., R. 79 W. The validity of this corner has been questioned. No other original corners could be found within the area. Several township lines seem to have been surveyed, as the stream crossings are located correctly, but either the corners were never set or the work was so poorly done that no trace of them remains. Several corners are said to have been found along Powder River within the area, but they have been destroyed and their locations are in dispute. In the preparation of the map (Pl. XIX) the land lines were projected regularly over the area from the corners located along the west border. The location of the sections as shown is therefore to be considered only approximate.

GEOLOGIC WORK IN ADJOINING FIELDS.

As already stated, the Barber coal field is a small division of the great coal basin which lies in northeastern Wyoming and parts of adjoining States. Comparatively little geologic work has been done in this region aside from that carried on in the past few years by the United States Geological Survey. In 1907 J. A. Taff¹ examined a considerable territory in the vicinity of Sheridan, 40 miles north of Buffalo. In 1908 H. S. Gale, assisted by the writer,² examined the Buffalo coal field, and in the same year R. W. Stone and C. T. Lupton³ examined lands in the vicinity of Arvada and southeastward along the Chicago, Burlington & Quincy Railroad. The area considered in the present report is thus bounded on the north and west by lands previously examined and classified with respect to coal.

¹ Taff, J. A., The Sheridan coal field, Wyo.: Bull. U. S. Geol. Survey No. 341, 1909.

² Gale, H. S., and Wegemann, C. H., The Buffalo coal field, Wyo.: Bull. U. S. Geol. Survey No. 381, 1910.

³ Stone, R. W., and Lupton, C. T., The Powder River coal field, Wyo.: Bull. U. S. Geol. Survey No. 381, 1910.

No work has been done in the townships immediately adjacent to this area on the south and east, though the writer has mapped the coal lands in the vicinity of Sussex post office, 50 miles south of Barber.¹

TOPOGRAPHY.

RELIEF.

As already stated, badlands cover most of the region. The relief is not great, in amount the absolute difference in altitude over the entire field not exceeding 1,000 feet, but the dissection of the country by stream courses is so minute and the slopes of the hills so steep that travel across the area is exceedingly difficult to one unaccustomed to the region. The only really level land is that in the flood plains and terraces of the larger streams. Over a small area, however, along the crest of the divide between Powder River and Crazy Woman Creek the slopes are comparatively gentle and the land is rolling and grass covered. This condition exists only in areas as yet untouched by the rapid erosion of the present streams.

PHYSIOGRAPHIC HISTORY.

It seems probable that the comparatively level, gently rolling country along the crest of the divide between Powder River and Crazy Woman Creek is the remnant of a type of topography widely developed over this general region at a time when erosion was less active than at present. Whether the increase in erosional activity which began the present cycle was due to climatic changes or to uplifts of the region as a whole, or to a variety of causes, the writer would not attempt to say, but it is certain that in the small area described in this report and over a broad area east of Powder River extending as far south as Pumpkin Buttes, the gently undulating type of topography along the main divides represents an advanced stage of erosion, approaching that of a peneplain in certain areas. Above this general level the Pumpkin Buttes rise as monadnocks and represent strata which may have extended at one time over the whole general region, including the Powder River field.

In the present cycle of erosion the stage of development varies from place to place, depending on the distance of the area from the principal drainage lines. Near the heads of streams the ancient level is somewhat broken by broad shallow valleys. In a short distance these valleys increase in depth, developing into canyonlike forms whose walls of soft shale and sandstone are in many places difficult to climb. The divides between these valleys are generally

¹ Wegemann, C. H., The Sussex coal field, Johnson, Natrona, and Converse counties, Wyo.: Bull. U. S. Geol. Survey No. 471, 1912.

very narrow, the crests of some forming a sharp hogback^{only} a few feet in width. Here and there a hard ledge of calcareous sandstone resists erosion, forming a little terrace or plateau, and along the courses of the intermittent streams miniature flood plains are developed, but aside from these terraces and flood plains there is no level ground. Such are the badlands, which represent the mature stage of erosion in this region, the point in development at which relief is greatest. Beyond this stage the flood plains widen, the hills decrease in height with reference to the valley floors, and the land is reduced more and more to a general level, this stage being represented by the broad flats along the larger streams. Gravel-bearing terraces of small extent are found along Powder River, but they are not so well developed here as at other points along this stream both above and below this field.

Most badland streams are intermittent; that is, they flow only during rainy weather. Erosion during the summer months is thus practically at a standstill. In the spring heavy storms occur, and the dry stream valleys are filled with rushing torrents, sometimes 20 or 30 feet in depth. Erosion is then extremely rapid, great masses of shale caving from the steep banks into the water and being quickly removed.

A peculiar feature of the topography of this region is the marked parallelism in arrangement of the smaller streams. The larger streams—Powder River, Crazy Woman Creek, Dry Creek, or even Flying E and Coal creeks—show no indication of such arrangement, but the small side streams—those 6 or 7 miles in length and less—lie regularly in the direction N. 34° W. No matter from what side or at what angle they enter the larger streams, they hold the same direction as if by compass. This is especially peculiar, as the strata of the region are practically horizontal. Minor folds, did they exist, might direct the courses of the small streams, even though the folds were so slight as to be easily overlooked in the field, but it is difficult to imagine undulations numerous enough and regular enough to control the directions of all the small drainage lines over so wide an area, for this parallelism of streams may be observed in the Sheridan, Buffalo, and Arvada fields, as well as in the Barber. Joint planes in hard rocks control the direction of streams in some localities, but the Fort Union strata are comparatively soft, and it is doubtful whether jointing would here be effective. In fact, no adequate explanation can at present be given for the phenomenon.

GEOLOGY.

STRATIGRAPHY.

FORT UNION FORMATION.

Character and thickness.—The rocks exposed within the area, with the exception of the flood-plain and terrace deposits, are of one formation only—the Fort Union—which overlies the Lance formation and belongs to the Eocene, the earliest series of the Tertiary. The Fort Union formation is several thousand feet in thickness, but the middle part only is exposed in this field. On the basis of the coal beds of the Sheridan field, Taff¹ divided the Fort Union formation into three parts, each characterized by a coal group. These coal groups are, in descending order, the Ulm, the Intermediate, and the Tongue River. In the Barber field the two lowest beds of the Ulm coal group and several beds of the Intermediate coal group are exposed, the total stratigraphic section represented being about 1,000 feet in thickness.

The rocks consist of alternating beds of sandstone and shale, brown carbonaceous shale, and coal. Thin limestone layers and beds of calcareous sandstone occur at intervals. The sandstones range from coarse cross-bedded material to fine-grained shaly sandstone which passes imperceptibly into shale. The colors are yellow, buff, and brown, some beds, especially in the fine-grained sandstone, being almost white. The shales are of various shades of gray, some of them almost black. Certain finely laminated brown beds contain much carbonaceous material, as if made up in part of the matted leaves and stalks of plants. The coal beds are fully discussed in a later part of this report.

The variation and irregularity of all the strata of this formation are very pronounced. Sandstone beds give place to shale, and shale to sandstone along the strike, and beds thicken and thin from place to place. Many local unconformities occur, a coarse sandstone filling channels in coal or shale which are evidently the result of subaerial erosion. In a cut bank on the north side of Dry Creek, in sec. 2, T. 49 N., R. 78 W., just south of the field, a thin coal bed dips at an angle of 3° or 4°, being unconformable to the underlying strata, which are horizontal. Higher coal beds which appear at the top of the same bank are also horizontal, and it seems that the dipping coal bed must have been originally put down on a slope.

The intimate association of cross-bedded sandstone, evidently deposited by strong currents in shallow water, with fine-grained shale, which is indicative of still-water deposition, the presence of numerous coal beds, the repeated evidences of subaerial erosion, and the great

¹ Taff, J. A., The Sheridan coal field, Wyo.: Bull. U. S. Geol. Survey No. 341, 1909, pp. 129-130.

variability in character and thickness of all strata seem to indicate conditions of deposition other than those of a great inland lake. A large river or a group of rivers meandering over broad flats of their own making seems to offer conditions more favorable to the formation of such deposits. The coarse sandstone would represent ancient sand bars, the fine-grained shale the mud settling in quiet lagoons, and the coal beds the deposits in the low swamp lands between the river courses. As the rivers changed the deposits would change, sand being washed into what was once coal swamp and fine mud settling where formerly was the main river channel. In certain parts of the world to-day there are deltas hundreds of square miles in extent, as, for example, that of Yellow River in China. Such deposits are probably not the counterpart of those of Fort Union time, yet they may aid in the understanding of them.

Fossils.—The following fossils from the Barber field were identified by T. W. Stanton:

Bank of Crazy Woman Creek, 2 miles above mouth of Dry Creek:	SW. $\frac{1}{4}$ sec. 18, T. 50 N., R. 78 W.: Unio priscus M. and H. Sphaerium sp. Viviparus leai M. and H. Planorbis sp. Fort Union.
SW. $\frac{1}{4}$ NW. $\frac{1}{4}$ sec. 27, T. 50 N., R. 79 W.:	NE. $\frac{1}{4}$ sec. 35, T. 51 N., R. 78 W. In bottom of deep draw at elevation about 4,100 feet: Viviparus leai M. and H. Fort Union.
Unio priscus M. and H.? Viviparus leai M. and H. Physa sp. Goniobasis sp. related to G. tenera (Hall). Fort Union.	
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STRUCTURE.

The rocks of the Barber field are practically horizontal. Minor undulations of the strata occur along the divide between Powder River and Crazy Woman Creek, but they are so slight that they are apparent only from altitudes determined at short intervals on such beds as the Healy coal. The warping is but local, the strata soon regaining their normal position, and throughout the field the variation in altitude of the strata does not exceed 75 feet.

Sufficient data are not at hand to make it possible to outline the slight folds above mentioned. They are indicated at several points along the divide between Crazy Woman Creek and Powder River by variation in the altitude of certain coal beds. In the SE. $\frac{1}{4}$ sec. 35, T. 51 N., R. 79 W., the altitude of the Walters coal is 4,594 feet; 1½ miles farther east the altitude of the same bed is 4,635 feet. Here it is apparent that the strata dip very gently to the west. On the

head of Flying E Creek, in sec. 35, T. 50 N., R. 79 W., the coal beds of the Healy group dip northeast at about the grade of the stream, but in sec. 26 of the same township there is a slight dip to the southeast. In sec. 23, T. 49 N., R. 79 W., a dip to the north, amounting to 40 feet in less than half a mile, was observed. As above remarked, these dips are merely local. The altitude of numerous points on the outcrop of the Healy coal shows that outside the small area of the folds the coal remains at approximately the same altitude throughout the field.

THE COAL.

CHARACTER AND ORIGIN.

The coal of this general region is subbituminous in grade. No analyses from the Barber field are available, as there are no working mines and it is difficult to obtain unweathered material. Similar coals near Buffalo, however, 12 miles west of the western boundary of the field, range in calorific value, according to analyses made by the United States Geological Survey,¹ from 9,238 to 10,073 British thermal units. A sample taken by the writer of the coal mined west of Trabing, 25 miles southwest of Barber, gave 9,864 British thermal units, and a sample taken near Sussex, 50 miles south of Barber, gave 9,963 British thermal units. The coals of the Barber field may safely be estimated to average about 9,500 British thermal units.

The coal when fresh is dull black but contains thin streaks which are vitreous in luster. On exposure to the weather it slacks or breaks into small fragments, and it is noteworthy that it breaks down most rapidly when subjected to the direct rays of the sun. A supply of coal stored in a covered bin in the fall lasts all winter, whereas a chunk thrown out on the ground in the sun begins to check and crack almost immediately, probably because of the rapidity with which the surface loses its moisture. For this reason it is found advisable in shipping this grade of coal by rail to employ box cars rather than the ordinary open coal cars.

The coal is fairly brittle, having little of the tough woody character of the North Dakota lignite, and is thus easy to mine. Its woody origin is apparent, however, from the numerous fragments which show a distinct grain, much resembling that of cedar. Determinations of fossil leaves which occur in the rocks associated with the coal show that this "cedar" was closely allied to the sequoias or giant redwoods of California. Numerous deciduous trees, one of which was nearly allied to the cottonwood of the present day, also grew in the ancient forests.

¹ Gale, H. S., and Wegemann, C. H., The Buffalo coal field, Wyo.; Bull. U. S. Geol. Survey No. 381, 1910.

There is little doubt that the accumulations of tree trunks which formed the coal beds represent the deposits of a forest which stood where the coal now lies. It is not uncommon to find fossil stumps, or even the trunks of trees partly silicified, standing in an upright position embedded in the coal or projecting from the sandstone above the coal bed. Such a tree trunk, 3 or 4 feet in diameter and 10 or 12 feet in height, may be seen from the Dry Creek road in the NW. $\frac{1}{4}$ SW. $\frac{1}{4}$ sec. 5, T. 50 N., R. 80 W., east of Dry Creek and 1 $\frac{1}{2}$ miles below the old T. W. shearing pens, about 6 miles west of the Barber field.

The irregularity of bedding characteristic of the Fort Union strata has already been discussed. (See p. 269.) The coal beds are perhaps the most persistent strata of the formation, yet even they show considerable irregularity. The Healy coal, for example, has been traced in the Barber field and in the Buffalo field over an area of 600 square miles, and it probably extends over a still larger territory. It ranges, however, from a few inches to 18 feet in thickness and is represented in some places by one bed and in others by a group of two or three beds, which occur within a vertical distance of 50 feet. At the time of the deposition of the Healy coal a great swamp probably covered this territory. Over portions of this swamp the growth of the forest was uninterrupted for long periods of time and the fallen tree trunks were piled one upon another, forming a deposit many feet in depth. In other portions of the area quantities of sand or mud were washed in at intervals, separating the coal bed into two or more beds, the group being the equivalent of the single bed in the other places. As the preservation from decay of the wood which formed the coal was probably due to the fact that the tree trunks were in whole or in part covered by water when they fell in the swamp, the surface of the swamp must have been at water level over broad areas. In other words, the coal beds were laid down in horizontal strata and the distance between any two beds should remain fairly constant, providing the lower bed was not tilted by earth movement before the upper was laid down. This supposition appears to be supported by the facts in the field, the distance between the beds furnishing one of the best means of correlation of stratigraphic sections measured at different places.

It should not be inferred from the above statement that all or by any means the greater number of the coal beds of this region extend over broad areas. In fact, such beds as the Healy are the exception rather than the rule. It is not at all unusual to find that a coal bed at one point several feet in thickness dwindles to a few inches in half a mile or perhaps disappears altogether. In many places as one bed thins another bed comes in above or below it, the deposits being lenticular in form and the ends overlapping. Where the outcrops are partly

concealed for long distances, it is difficult to distinguish the two beds where the distance between them is not more than 50 or 60 feet. In these places two outcrops half a mile apart, and occurring, for example, at 4,100 and 4,150 feet above sea level, respectively, may be taken to represent the same bed, the difference in elevation being attributed to a slight warping of the strata, when in reality the exposures represent two distinct beds which are not continuous one with the other.

BURNING OF THE COAL BEDS.

The Healy and Walters coal beds have been burned along the outcrop over a large area in the Buffalo field.¹ The coal probably takes fire by spontaneous combustion and burns back from the outcrop until the fire is extinguished by the caving of the overlying strata, the rocks above the burning coal being reddened and baked and in many places melted to slag.

The burning of the coal beds is general over the territory lying west of Crazy Woman Creek, but east of that stream, although the same coal beds are represented, burning has not taken place except over very small areas. The explanation that the burning was interrupted by the stream valley seems inadequate, as it is very probable that the fire did not originate at one point only, and from it spread over the whole area, but rather that the coal when exposed to atmospheric agencies by erosion took fire through spontaneous combustion at many points. Both the Healy and Walters coals are thinner east of Crazy Woman Creek than they are west of that stream and it is not improbable that these beds vary somewhat in composition as well as in thickness, so that they may be more liable to spontaneous combustion in some areas than in others. Sufficient analyses may in time solve this problem.

NUMBER OF IMPORTANT COAL BEDS.

Although the total number of coal beds is large in this field, over 20 being exposed in T. 51 N., R. 79 W., the number of beds which are above 24 inches in thickness and of good quality over considerable areas is but four. Certain of these main beds are at places represented by groups of beds. In descending order, the Walters (altitude 4,600 feet), Healy (altitude 4,450 feet), and Dry Creek (altitude 4,200 feet) are the principal coal beds in the Buffalo field, and the names there given them¹ have been applied in the Barber field also. The fourth and lowest bed, at an altitude of 3,800 feet, is rather doubtfully correlated with the Felix coal of the Arvada field mapped by Stone and Lupton. All these beds are in general thinner in this area than

¹ Gale, H. S., and Wegemann, C. H., op. cit.

in the Buffalo and Arvada fields, where they were first mapped and named. Other beds develop locally in the intervals between those above named, and will be discussed in detail in the description of the coal by townships.

ESTIMATED TONNAGE OF THE BARBER FIELD.

Owing to the extreme variability in the thickness of the coal beds of this field, any estimates of tonnage must be regarded as merely approximate. The estimate given below is probably under rather than over the true amount, as in it no account was taken of the lower coal beds, which outcrop along Powder River north of the field and which in all probability underlie the area under discussion. Only coal beds more than 24 inches in thickness which outcrop within the limits of the field were considered, and the estimate was made on the basis of 1,800 tons per acre-foot of coal. The total tonnage thus figured for the seven townships included in the Barber field reaches the enormous figure of 1,021,795,200 tons.

DESCRIPTION BY TOWNSHIPS.

The townships in this description are taken up in order from left to right, beginning at the northwest corner of the field. Sections of the coal beds are shown in Plates XVII and XVIII, the locations being correspondingly numbered on the map, Plate XIX.

T. 51 N., R. 79 W.

The lowest coal bed exposed in T. 51 N., R. 79 W., outcrops at several places along Crazy Woman Creek, at an elevation of 4,000 feet above sea level. The northernmost of these outcrops is in the NE. $\frac{1}{4}$ sec. 3, where the bed measures 24 inches in thickness with a thinner bed $5\frac{1}{2}$ feet below (No. 1).¹ A mile southeast of this place, in the SE. $\frac{1}{4}$ sec. 2, two beds appear at this altitude, the upper measuring 16 inches and the lower 20 inches (No. 2). In the SE. $\frac{1}{4}$ sec. 16 a coal bed at an altitude of 4,005 feet, measures 30 inches (No. 3), and in the NW. $\frac{1}{4}$ sec. 20 a bed, probably at the same horizon, is 32 inches in thickness (No. 4). The same bed measures 26 inches in the NE. $\frac{1}{4}$ sec. 30 (No. 8). Whether this bed is more than 24 inches in thickness throughout the area on the northwest side of the creek it is impossible to say, as exposures are for the most part concealed in the grassy slopes along the creek bottoms. Its outcrop should follow the 4,000-foot contour, but the writer has hesitated to sketch it on the basis of the facts at hand. A bed at about the same horizon

¹ Numbers in parentheses refer to measured sections of coal beds shown graphically on Pls. XVII and XVIII and also to the locations of these sections on the map, Pl. XIX.

outcrops along Powder River, in Tps. 50 and 51 N., R. 77 W., yet this fact proves nothing as to the thickness or even the continuity of the bed across the divide. In the SE. $\frac{1}{4}$ sec. 16 a coal bed 46 inches in thickness was found at an altitude of 4,070 feet (No. 5), and in the SW. $\frac{1}{4}$ sec. 32 a bed at the same horizon outcrops in the creek bank, where it has been mined (No. 6). A bed at 4,100 feet, 32 inches thick, was noted in the NE. $\frac{1}{4}$ sec. 3 (No. 7). These exposures, Nos. 5, 6, 7, and 8, may be on one bed, but they are so widely separated that the outcrop is not drawn between them. At an altitude of 4,125 feet a coal bed 24 inches thick outcrops in the SE. $\frac{1}{4}$ sec. 15 (No. 9), and 22 feet above it is a coal bed in three benches which, however, vary greatly in thickness along the outcrop. In the SE. $\frac{1}{4}$ sec. 2 (No. 10) is a bed 30 inches thick, at an altitude of 4,140 feet. These beds are apparently local lenses of coal, and can not be definitely correlated one with another.

A more important bed is found in this township at an altitude of about 4,200 feet. In the NE. $\frac{1}{4}$ sec. 3 it measures 24 inches in thickness (lowest bed of No. 11), and in the south half of sec. 1 (No. 12) 36 inches of coal, which apparently represents the same bed, outcrops at an altitude of 4,220 feet and can be traced to the SE. $\frac{1}{4}$ sec. 2, where it measures 36 inches (No. 13). About 20 feet above this bed is another, from 13 to 16 inches in thickness. In the E. $\frac{1}{4}$ sec. 15 is a bed at 4,200 feet, measuring 38 inches (No. 14), and one 20 feet above it measures 24 inches, the two probably representing the two beds just described. The upper bed outcrops in the NW. $\frac{1}{4}$ sec. 22 (No. 15) at an altitude of 4,220 feet. South of this place no more coal was found at this horizon for 6 miles, but in the southwest corner of T. 50 N., R. 79 W., a thick bed (No. 66) appears at an altitude of 4,170 feet. Apparently the bed at location 66 is not continuous with that at location 15, and there are here two distinct coal basins, the coal being deposited in separate marshes, which, however, existed at the same time on a comparatively level surface, so that the elevations of both above the sea were the same.

A group of coal beds underlies a considerable area in T. 51 N., R. 79 W., at an elevation of 4,300 feet above sea level. On the northwest side of Crazy Woman Creek it outcrops around the three buttes in sec. 18 (No. 16), where it consists of two beds, each divided into two benches. To the east of the creek a bed 24 inches in thickness, at an altitude of 4,265 feet, appears in sec. 1 (No. 17) and probably represents the lower bed of location 16. In the SW. $\frac{1}{4}$ sec. 24 (No. 18) a bed 58 inches thick, but broken by a foot of shale into two benches, appears at an altitude of 4,280 feet. Forty-four feet above that bed is another 24 inches in thickness, and 25 feet still higher is a bed 28 inches in thickness. This group of coal beds is

represented in the NW. $\frac{1}{4}$ sec. 22 (No. 19) by a single bed 30 inches thick, at an altitude of 4,290 feet. In the NW. $\frac{1}{4}$ sec. 28 (No. 20) it appears as two beds, separated by 5 feet of shale, the lower occurring at an altitude of 4,300 feet. Apparently this coal bed thins to the south, for in the SW. $\frac{1}{4}$ sec. 32 (No. 21) a bed exposed at this horizon measures only 22 inches, although 60 feet above it at the same locality is a bed 30 inches thick.

The slag forming the crest of the buttes in sec. 18 is produced by a coal bed named in the report on the Buffalo coal field the Healy coal.¹ It is the most widely distributed coal in the Barber field, and is represented in some places by a single bed and in others by a group of beds. In the buttes mentioned in sec. 18 (No. 22) the lowest bed of the group occurs at an altitude of 4,400 feet and measures 36 inches, but the other beds are partly burned and form the slag caps of the buttes. In the NE. $\frac{1}{4}$ sec. 13 this coal is represented by a group of five beds (No. 23), the lowest of which measures 24 inches in thickness and lies at an altitude of 4,420 feet. Four other beds, 24 inches or more in thickness, appear above this bed, the whole group being distributed through a stratigraphic distance of 120 feet. The group appears again in the NW. $\frac{1}{4}$ sec. 24 (No. 24), where it consists of four beds—60, 54, 22, and 30 inches thick, respectively. There is, in addition, a thin bed 10 inches in thickness 4 feet above the lowest bed. In the NW. $\frac{1}{4}$ sec. 25 (No. 25) the same group is exposed, the beds measuring 72 (No. 10), 57—in two benches—22 and 24 inches, respectively. The top bed is at an altitude of 4,480 feet. In the NE. $\frac{1}{4}$ sec. 35 (No. 26) the group is represented by two beds measuring 68 and 36 inches in thickness, and in the NE. $\frac{1}{4}$ sec. 28 (No. 27) there are three beds 35, 77, and 15 inches thick, respectively. The lowest of these beds is exposed in the hill in the NE. $\frac{1}{4}$ sec. 21 (No. 29). The most southerly exposure in the township is found in the SW. $\frac{1}{4}$ sec. 33 (No. 28), where the group is represented by three beds—36, 38, and 38 inches in thickness—the top bed being separated into two benches by 12 inches of shale. The great range in thickness of this bed in comparatively short distances is apparent, as is the variation in thickness of all the coal beds of this field. The Healy coal group is, however, much more persistent than the beds previously described, for this group is everywhere marked by the occurrence of coal and carbonaceous shale, the bed or group of beds nowhere disappearing entirely. The Walters bed, so named in the report on the Buffalo coal field, outcrops in two high points in this township—one in sec. 35 (No. 30) and the other in sec. 36 (No. 31). In the exposure at location 30 the bed contains about 12 feet of coal.

¹ Gale, H. S., and Wegemann, C. H., op. cit.

T. 51 N., R. 78 W.

The lowest coal bed exposed in T. 51 N., R. 78 W., outcrops in the SE. $\frac{1}{4}$ sec. 33 at an altitude of 4,061 feet (No. 32) and measures 84 inches in thickness, but the bed is apparently lenticular, for it decreases in a mile to the southeast to a thickness of 10 inches. A bed at a slightly higher altitude (4,120 feet) is exposed in the NE. $\frac{1}{4}$ sec. 35 (lowest bed of No. 34), where it measures 36 inches. Forty-two feet above this bed is another bed 34 inches in thickness. These beds do not seem to decrease in thickness to the south, but a mile north of this locality, in the NE. $\frac{1}{4}$ sec. 26, a bed which seems to represent the upper bed is only 22 inches thick. The lower bed is 34 inches thick in the NE. $\frac{1}{4}$ sec. 25 (No. 37) and 55 inches thick in the SE. $\frac{1}{4}$ sec. 36 (No. 33). A bed 24 inches thick outcrops in the NE. $\frac{1}{4}$ sec. 35 (top bed of No. 34) at an altitude of 4,225 feet. These beds seem to represent the group that occurs in T. 51 N., R. 79 W., at an altitude of 4,200 feet. A bed 58 inches in thickness, divided into two benches, occurs at an altitude of 4,325 feet in the NE. $\frac{1}{4}$ sec. 35 (No. 35). In the SW. $\frac{1}{4}$ sec. 15 (No. 36) two beds, 44 and 51 inches thick, separated by 17 feet of shale, were noted at the position of this group. No other exposures of this coal were found in the township, and it is impossible to say whether or not the bed is continuous between these two exposures.

The Healy coal underlies a considerable area in this township. Its most northern exposure is in the NW. $\frac{1}{4}$ sec. 7 (No. 38), where it is represented by three beds, the lowest 40 inches, the second (12 feet above it) 36 inches, and the third (32 feet above the second) 38 inches in thickness. In the SW. $\frac{1}{4}$ sec. 9 the Healy coal is represented by a group of four beds (No. 39), which are distributed through a stratigraphic distance of about 70 feet. In the NW. $\frac{1}{4}$ sec. 22 (No. 40) one bed of the group 32 inches in thickness is exposed at an altitude of 4,425 feet, and in sec. 23 the group was found in an isolated hill (No. 41). No exposures of this coal were found in the southwest part of the township, where the slopes are gentle and grass covered, but it doubtless extends across this area, as it is of considerable thickness only a short distance to the west beyond the Powder River divide. An isolated exposure of the Healy coal occurs in the NE. $\frac{1}{4}$ sec. 35 (No. 42), where it lies in three benches, the top one being of value. The Walters coal outcrops in two high buttes in sec. 21 (No. 43), but the area underlain by it is very small. In this section also a bed appears above the Walters coal (Nos. 45 and 46).

T. 51 N., R. 77 W.

The lowest coal exposed in T. 51 N., R. 77 W., outcrops in the NE. $\frac{1}{4}$ sec. 7, on the west side of Powder River Valley (No. 47), at an altitude, of 3,800 feet and measures 42 inches in thickness. This bed is rather doubtfully correlated with the Felix coal mapped by Stone and Lup-

ton along Powder River north of this field.¹ It is exposed again in the NE. $\frac{1}{4}$ sec. 17 (lower bed of No. 48), where it measures 47 inches, and again in the SE. $\frac{1}{4}$ sec. 19 (No. 49), where it measures 46 inches in thickness. No exposures of this bed were found in secs. 30 and 31, but a bed at about this horizon is exposed at several places on the east side of Powder River. In the NW. $\frac{1}{4}$ sec. 4 (No. 50) it measures 54 inches, and 50 feet above it occurs a second bed 36 inches in thickness. In the SE. $\frac{1}{4}$ sec. 9 only the lower bed is exposed, and here is 60 inches thick (No. 51). A higher bed, 75 feet above the one just described, outcrops in the SW. $\frac{1}{4}$ sec. 28, where it measures 35 inches (No. 52) in thickness. This may represent the bed noted above in sec. 4, yet the distance between the two exposures is so great that such a correlation is uncertain. The lower bed is exposed at two places in the NE. $\frac{1}{4}$ sec. 32 (Nos. 53 and 54), where it is 36 and 37 inches thick.

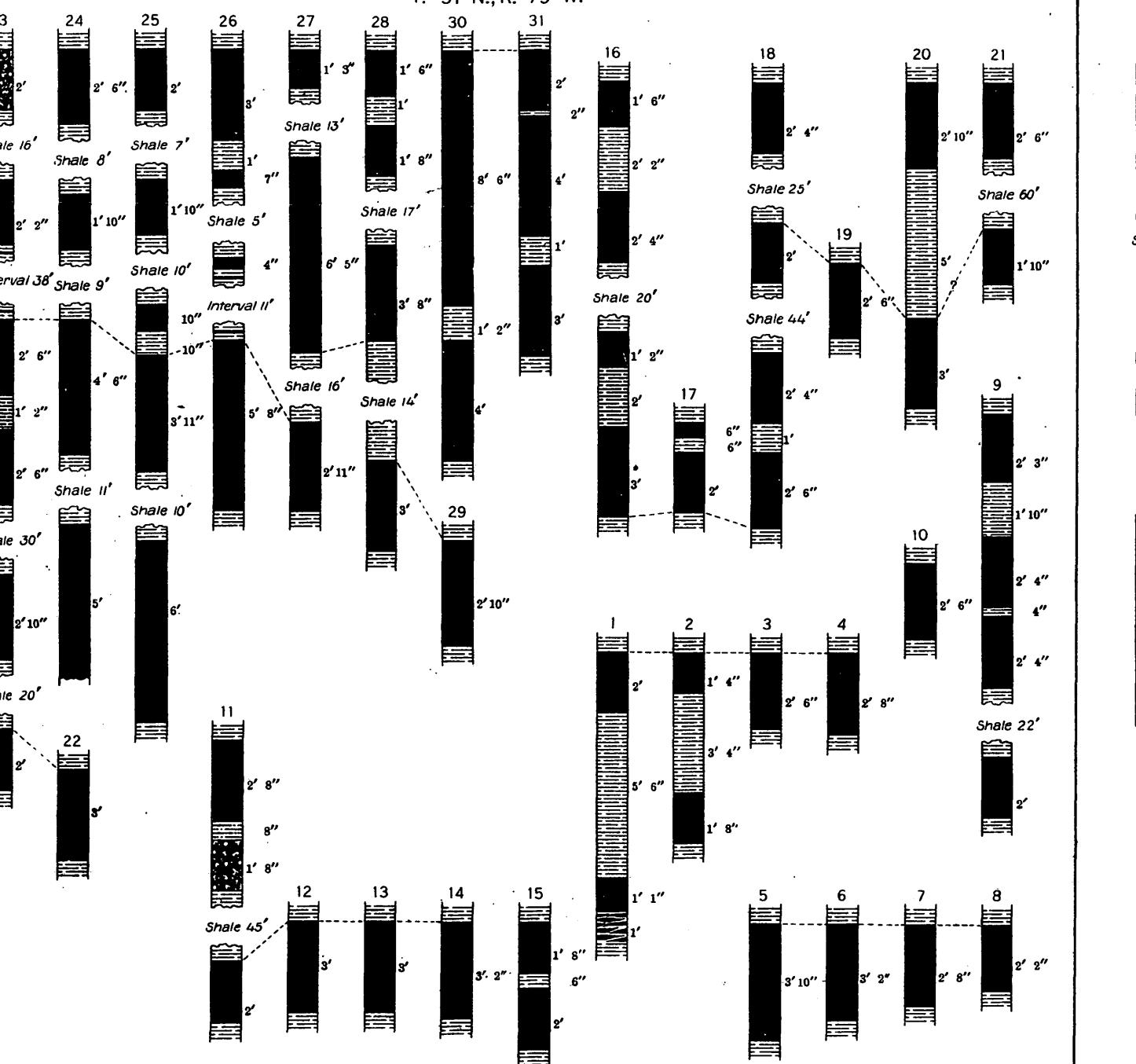
In the SE. $\frac{1}{4}$ sec. 22 (No. 55) a coal bed 43 inches in thickness outcrops at an altitude of 4,080 feet. In the SE. $\frac{1}{4}$ sec. 4 (No. 56) a coal bed 54 inches in thickness, divided into two benches, appears at an altitude of 4,100 feet. These two exposures are at about the same horizon, but they may not represent one continuous bed. A bed at 4,050 feet in sec. 35, T. 52 N., R. 77 W. (No. 57) is 30 inches thick and appears to be at the same horizon. Coal 28 inches in thickness outcrops at an altitude of 4,245 feet in the NW. $\frac{1}{4}$ sec. 19 (No. 58), but the area underlain by it is small. The same bed outcrops in a knoll one-half mile to the northwest (No. 59). A bed 30 inches in thickness outcrops at 4,210 feet in sec. 35, T. 52 N., R. 77 W. (No. 60), and 80 feet above it lies another bed of the same thickness (No. 61). In the SE. $\frac{1}{4}$ sec. 4 a bed 27 inches in thickness outcrops at an altitude of 4,340 feet (No. 62). In the SW. $\frac{1}{4}$ sec. 13 a bed 45 inches in thickness (No. 63) outcrops at an altitude of 4,390 feet. Whether or not these two exposures represent the same bed is uncertain, as no other outcrops were found at this horizon in the township. A bed which appears to be the Healy coal outcrops in the NE. $\frac{1}{4}$ sec. 24 (No. 64) at an altitude of 4,445 feet. The bed is 25 inches in thickness and 12 feet above it is a second smaller bed 13 inches thick. If these beds really represent the Healy coal group it is apparent that the members of the group thin toward the east.

T. 50 N., R. 79 W.

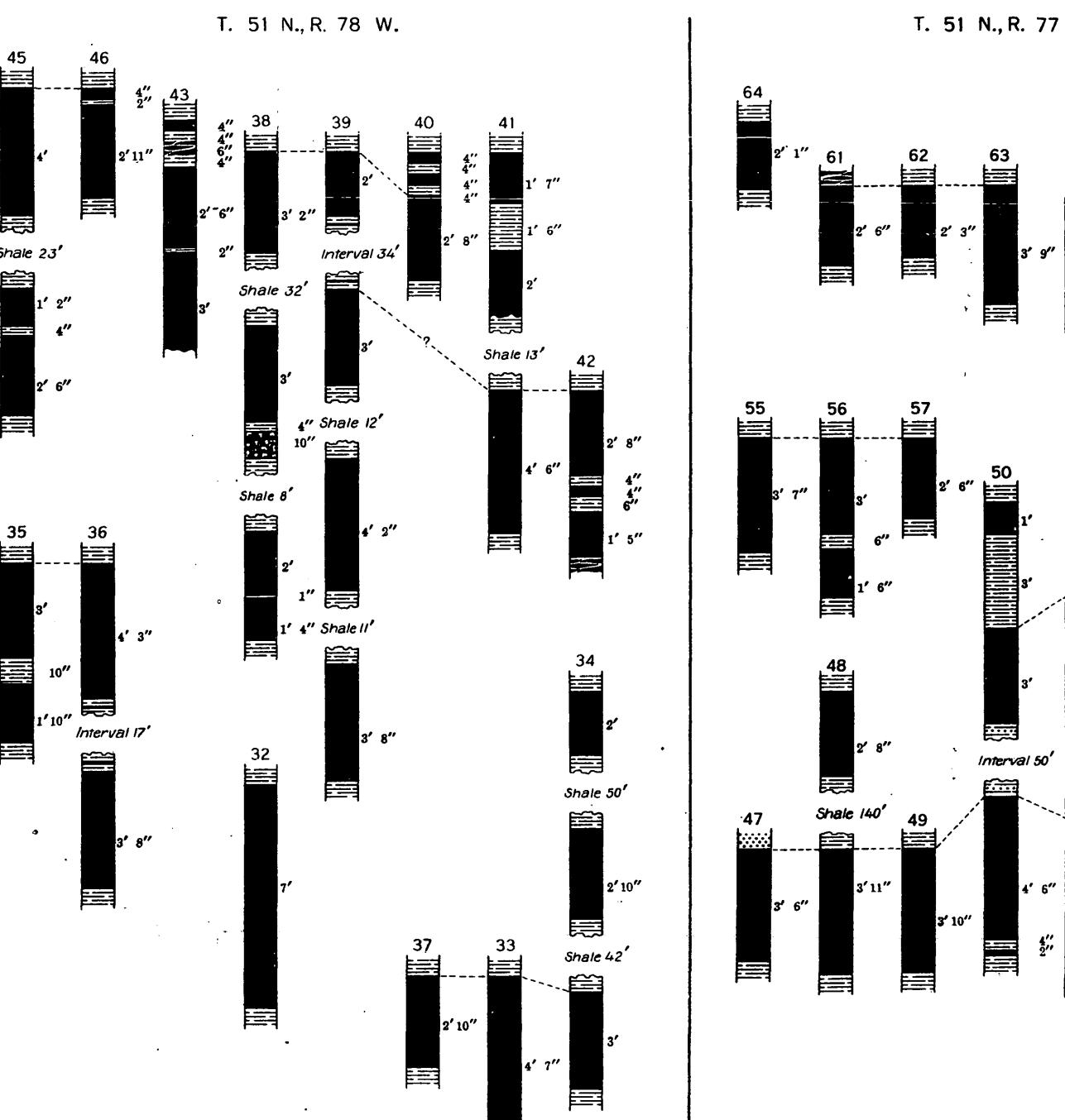
The lowest coal exposed in T. 50 N., R. 79 W., is a bed 30 inches in thickness (No. 65), which outcrops in the NW. $\frac{1}{4}$ sec. 7, a little above the level of Crazy Woman Creek, at an altitude of 4,115 feet.

¹ Stone, R. W., and Lupton, C. T., The Powder River coal field, Wyo.: Bull. U. S. Geol. Survey No. 381, 1910.

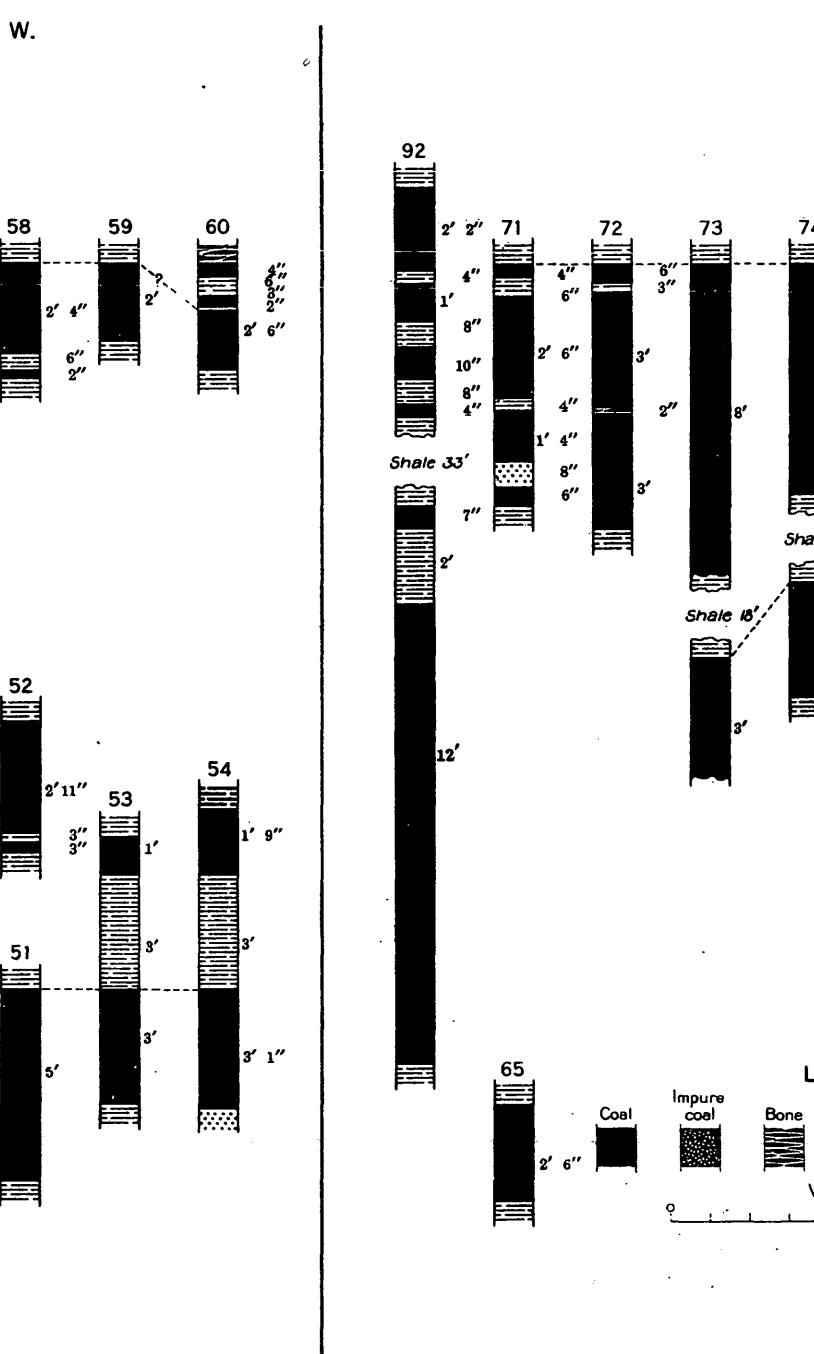
T. 51 N., R. 79 W.



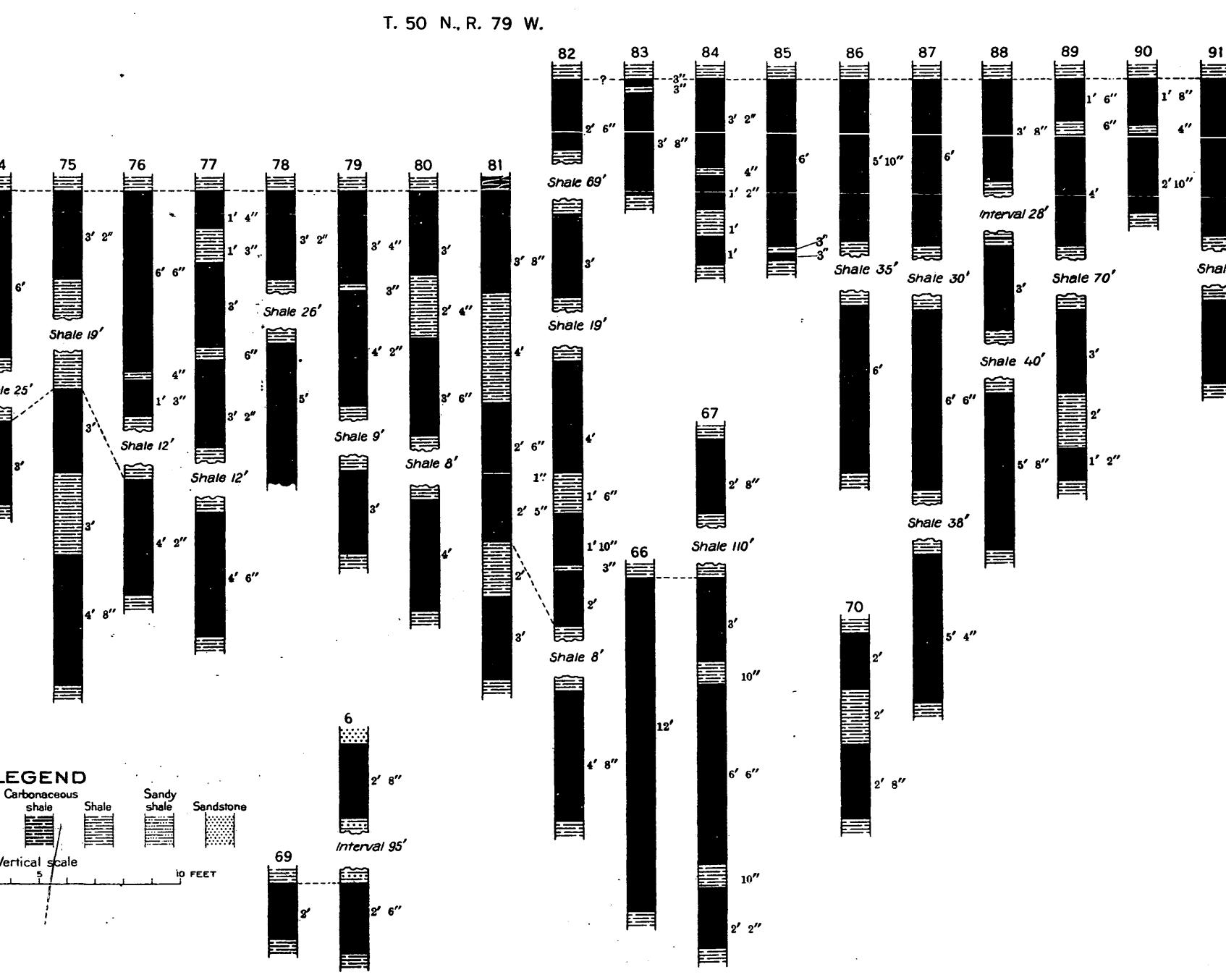
T. 51 N., R. 78 W.



T. 51 N., R. 77 W.



T. 50 N., R. 79 W.



No other exposures of this bed were found in the township, and it appears to be only a small local lens of coal.

A thick coal bed outcrops in the creek bank in the SW. $\frac{1}{4}$ sec. 30 (No. 67) at an altitude of 4,170 feet. This bed is believed to be the same as the Dry Creek bed, mapped and described in the report on the Buffalo coal field.¹ It can be traced south into the NW. $\frac{1}{4}$ sec. 31 (No. 66) and appears at intervals along Crazy Woman Creek to the southwest of the field as far as Trabing post office. No other exposures of the bed occur north of the SW. $\frac{1}{4}$ sec. 30, and it is probable that the coal decreases in thickness to the north and finally disappears. In the SE. $\frac{1}{4}$ sec. 15, T. 51 N., R. 79 W., a bed was found at an altitude of 4,150 feet which varies greatly in thickness from place to place. In the Powder River valley a bed has been observed at many places at about this horizon. It seems probable that, although coal is found at this horizon, the different outcrops do not represent one continuous bed, the coal having been deposited in several distinct basins, separated from each other, though lying at the same altitude. Two coal beds outcrop in the SE. $\frac{1}{4}$ sec. 32 (No. 68), the lower 30 inches thick, at an altitude of 4,285 feet, and the upper 32 inches thick, 95 feet above the first. The upper bed may be the lowest bed of the Healy coal group. The lower bed appears to be at the same horizon as the bed exposed at location 69 in sec. 31.

The most important bed in the township is known as the Healy coal. An exposure of the bed is found in the NW. $\frac{1}{4}$ sec. 11 (No. 71), but it is much broken by shale partings. In the SW. $\frac{1}{4}$ sec. 15 (No. 72) the Healy bed contains about 72 inches of coal. In the NE. $\frac{1}{4}$ sec. 8 (No. 73) there are two beds separated by 18 feet of shale. The lower, at an altitude of 4,400 feet, measures 36+ inches, and the upper measures 96+ inches. The bottom of neither bed was exposed. Half a mile southwest of this locality the beds are separated by 25 feet of shale (No. 74). At location 75, in the SW. $\frac{1}{4}$ sec. 17, the same group is exposed, and also at location 76, in sec. 16, where two thick beds are separated by 12 feet of shale. In the NE. $\frac{1}{4}$ sec. 28 (No. 77) the beds are but 12 feet apart, the lower bed contains 54 inches of coal, and the upper bed is separated into three benches by shale partings. In the SW. $\frac{1}{4}$ of the same section the two beds, 60+ and 38 inches thick, respectively, are 26 feet apart (No. 78). In the southern part of sec. 33 (No. 79) the distance between the two beds has decreased to 9 feet. The same beds are exposed at location 80. In the SW. $\frac{1}{4}$ sec. 32 the coal was measured at locations 81 and 82, the two measurements showing marked variation in the beds. On the east side of the divide, between Powder River and Crazy Woman Creek, the Healy coal outcrops along the heads of the valleys

¹ Gale, H. S., and Wegemann, C. H., The Buffalo coal field, Wyo.: Bull. U. S. Geol. Survey No. 381, 1910, p. 54.

which drain into Powder River. The most northern exposure noted is in the NE. $\frac{1}{4}$ sec. 12, where the coal measures 44 inches (No. 83). In the SE. $\frac{1}{4}$ of the same section the thickest bench measures 38 inches (No. 84). In the SE. $\frac{1}{4}$ sec. 24 (No. 70) a lower bed of the Healy coal group is exposed at an altitude of 4,410 feet. At this place the bed is divided into two benches, 24 and 32 inches thick, separated by 24 inches of shale. In the SW. $\frac{1}{4}$ sec. 23 a bed at an altitude of 4,510 feet contains 72 inches of coal (No. 85). This bed is believed to be the Healy coal, though it lies at a somewhat higher horizon, owing to the slight fold of the strata, which is present in this township. In the NW. $\frac{1}{4}$ sec. 26 the same bed (No. 86) is found at an altitude of 4,505 feet and another 70 inches in thickness appears 35 feet above it. At location 87 three beds are exposed, the two upper beds being the same as those at location 86. The top bed is probably to be correlated also with the bed exposed at location 91 in sec. 35. In the SE. $\frac{1}{4}$ sec. 26 (No. 88) three coal beds are exposed, the lowest 68 inches in thickness at an altitude of 4,390 feet, the second (40 feet above the first) 3 feet in thickness, and the third (28 feet above the second) 44 inches in thickness. These three beds, distributed through a stratigraphic distance of about 75 feet, probably represent the Healy coal group and are the same beds as those exposed at location 87. Three beds, which appear to form the same group, outcrop just south of this township in the NW. $\frac{1}{4}$ sec. 2, T. 49 N., R. 79 W. Exposures are concealed at many places along Flying E Creek valley, and the identification of beds is made somewhat more difficult by the fact that the beds dip slightly to the northeast. The upper and lower beds of the Healy coal group can be traced across the southern part of sec. 25, but in this area the middle bed seems to have disappeared (Nos. 89 and 90).

The Walters coal outcrops in two of the highest points along the divide between Powder River and Crazy Woman Creek. In sec. 1 this coal bed is 12 feet thick (No. 92), and a second bed in four benches, the thickest of which measures 26 inches, lies 35 feet above it. In sec. 22 the two beds are exposed and are of about the same thickness as in the northern exposure above mentioned. No other exposures of these high coal beds occur in the township, and the area underlain by them is thus very small.

T. 50 N., R. 78 W.

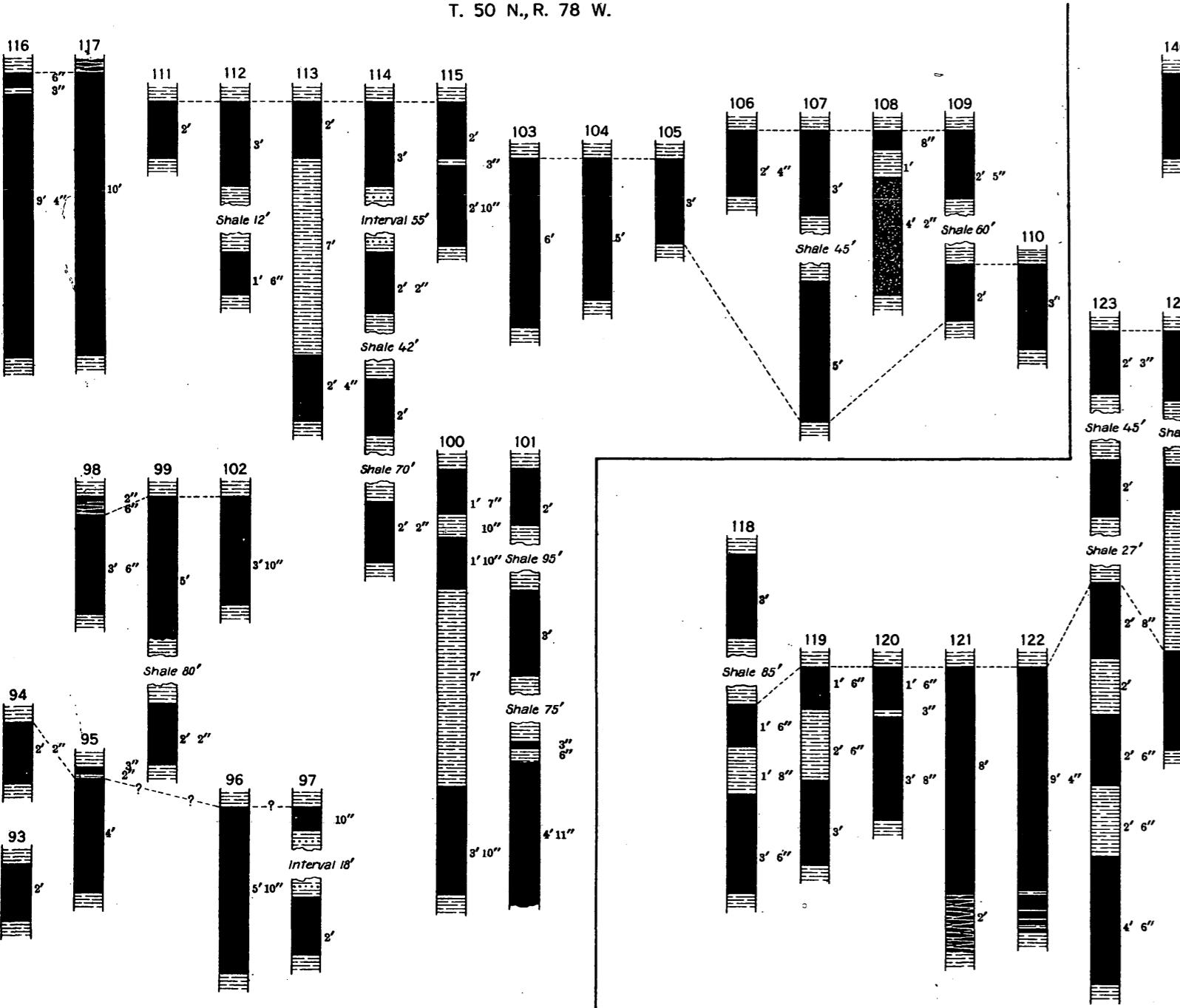
In the NE. $\frac{1}{4}$ sec. 12, T. 50 N., R. 78 W., a coal bed 24 inches in thickness outcrops at an altitude of 3,960 feet (No. 93). This coal is at about the same altitude as a coal bed which appears in T. 50 N., R. 77 W. In sec. 12, T. 50 N., R. 78 W., this bed could not be traced beyond the single outcrop. A little north of this exposure a higher bed 26 inches in thickness (No. 94) outcrops at an altitude of 4,040

feet. This coal bed could not be traced beyond the one exposure, but a coal bed (No. 95) appears half a mile to the south at an altitude of 4,086 feet, which possibly may represent the same coal. The bed is here 48 inches in thickness and is probably to be correlated with the coal bed that outcrops in the SE. $\frac{1}{4}$ sec. 18, T. 50 N., R. 77 W. Two more beds (No. 99) outcrop in the NE. $\frac{1}{4}$ sec. 12, the lower, 26 inches in thickness, at an altitude of 4,120 feet, and the upper, 60 inches thick, at an altitude of 4,200 feet. These beds can probably be correlated with the two beds that outcrop in the NE. $\frac{1}{4}$ sec. 35, T. 51 N., R. 78 W. Their correlation to the south in the township under discussion is more uncertain. The upper bed seems to be the one that outcrops in the SW. $\frac{1}{4}$ sec. 13 (No. 98) and the NW. $\frac{1}{4}$ sec. 24 (No. 102), where it is 42 and 46 inches in thickness. Two coal beds at about this horizon outcrop in the S. $\frac{1}{2}$ sec. 4 (No. 100), and in the SW. $\frac{1}{4}$ sec. 3 (No. 101) three beds are found in a stratigraphic distance of 180 feet. It seems probable that one of these beds may be identical with that already described in the SE. $\frac{1}{4}$ sec. 12, although the coal was not found between these two points. A thick bed of coal is exposed in the bank of Flying E Creek in the NE. $\frac{1}{4}$ sec. 21, where it measures 72 inches (No. 103). A quarter of a mile downstream the same bed (No. 104) is only 60 inches thick. At this location it lies at an altitude of about 4,100 feet. In the SW. $\frac{1}{4}$ sec. 22 there appears to be a second bed above the 60-inch bed. In the SW. $\frac{1}{4}$ sec. 23 (No. 106) this upper bed measures 28 inches in thickness and occurs at an altitude of 4,163 feet. In the SE. $\frac{1}{4}$ sec. 22 only 36 inches of coal was found at the horizon of the thick bed (No. 105), but in the NW. $\frac{1}{4}$ sec. 26 (No. 107) the lower bed measures 60 inches and the upper bed 36 inches in thickness, the distance between the beds being about 45 feet. In the SW. $\frac{1}{4}$ sec. 25 (No. 109) a bed, probably the equivalent of the lower bed, measures 24 inches in thickness, a marked decrease as compared with the last measurement. The upper bed contains 50 inches of rather poor coal in the NW. $\frac{1}{4}$ sec. 35 (No. 108), but is 29 inches thick in the SW. $\frac{1}{4}$ sec. 25 (upper bed of No. 109), and a bed which is probably the same as the lower bed of No. 109 measures 36 inches in thickness in the NE. $\frac{1}{4}$ sec. 3 (No. 110) of the township to the south. The thick bed mentioned in the NE. $\frac{1}{4}$ sec. 21 could not be satisfactorily traced along the north side of the Flying E Valley, and it probably thins to the north. One of the coal beds described in the NE. $\frac{1}{4}$ sec. 12 may represent it, and a thick bed which outcrops in the NW. $\frac{1}{4}$ sec. 3 is at the same horizon (No. 96). Here the coal is 70 inches in thickness, but it decreases in half a mile to the southeast to 10 inches (No. 97) and a bed 24 inches in thickness appears a little below it. Just north of the township line in the SE. $\frac{1}{4}$ sec. 33, T. 51 N., R. 78 W. (No. 32), it measures 84 inches, but can not be traced beyond these exposures.

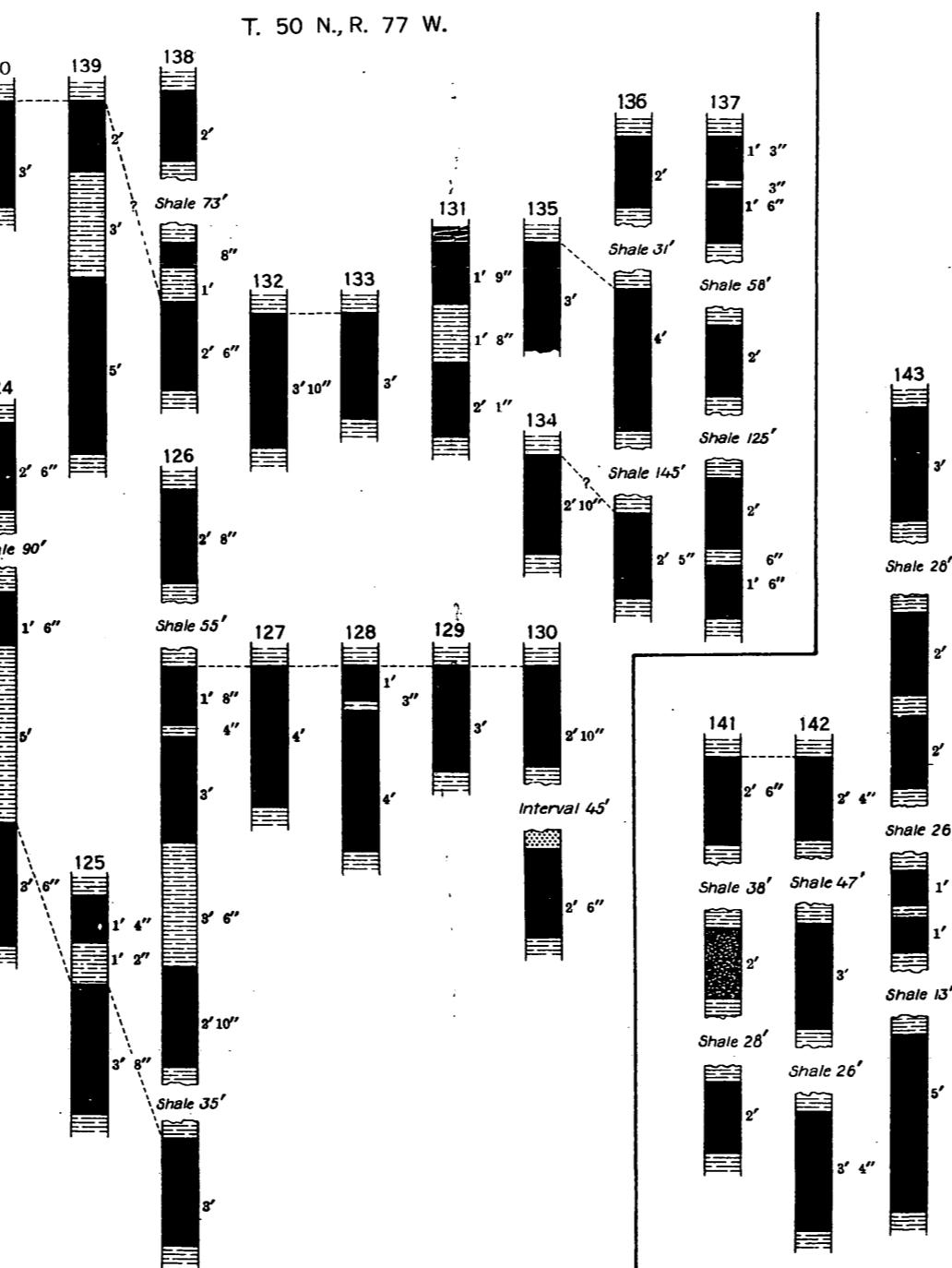
The Healy bed outcrops in the SE. $\frac{1}{4}$ sec. 9 (No. 111) at an altitude of 4,440 feet, the bed in this locality being only 24 inches in thickness. In the NW. $\frac{1}{4}$ sec. 17 the bed is 36 inches thick (No. 112), with an 18-inch bed 12 feet below it. In the NE. $\frac{1}{4}$ sec. 19 (No. 113) the lower bed is 28 inches and the upper bed 24 inches thick, the two being separated by 7 feet of shale. One-half mile northwest of this locality a group of beds is exposed (No. 114) at about this horizon. In the SW. $\frac{1}{4}$ sec. 29 (No. 115) the Healy bed contains 58 inches of coal, but is broken by a 3-inch shale parting. The only exposures of the Walters coal are in sec. 6 (Nos. 116 and 117), where the bed measures about 10 feet in thickness.

T. 50 N., R. 77 W.

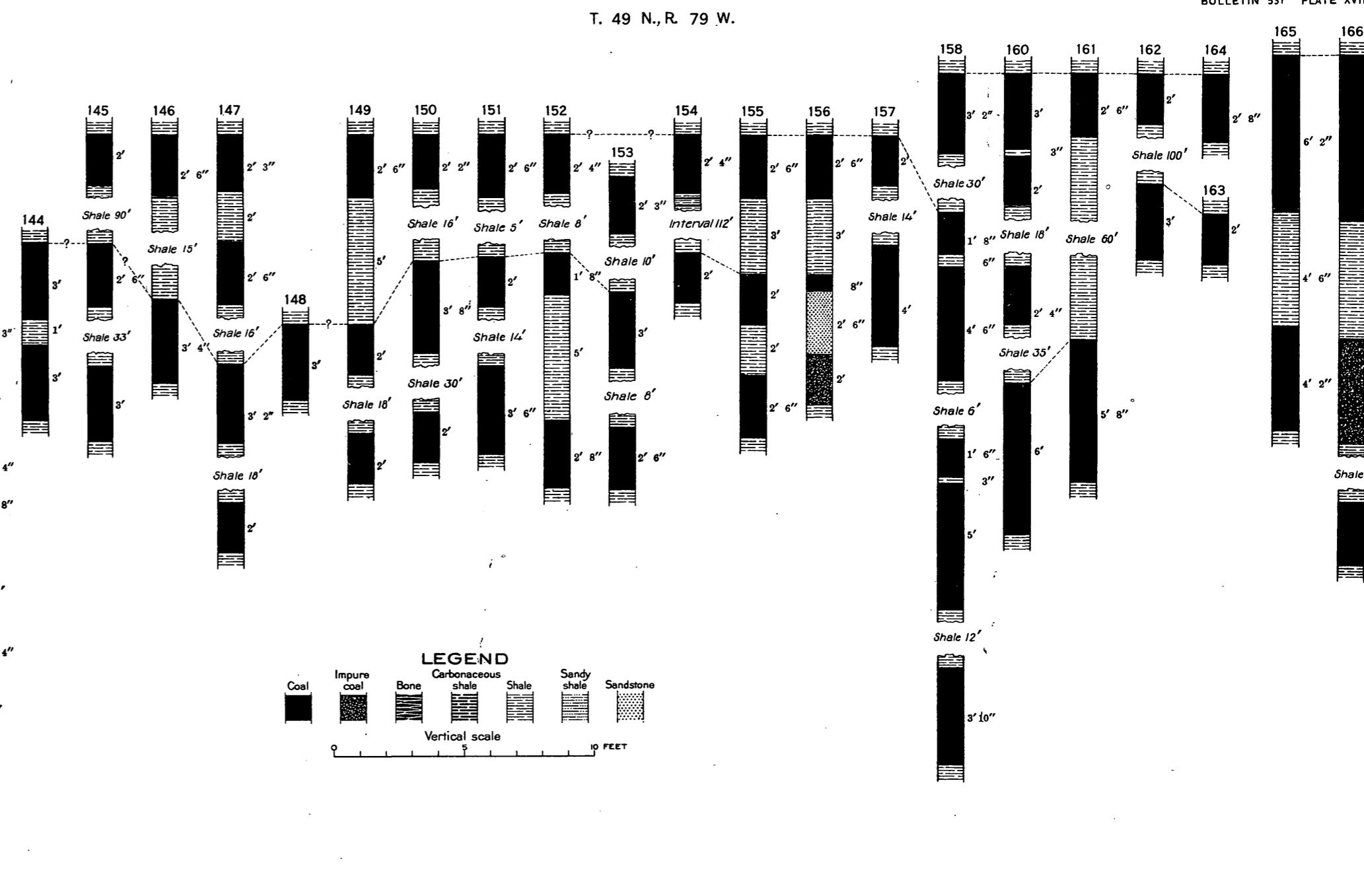
The lowest as well as the most important bed in T. 50 N., R. 77 W., lies at an altitude of a little over 3,900 feet, being the same bed which crosses T. 51 N., R. 77 W., from north to south on the east side of the Powder River valley. The most northern exposure of this bed in T. 50 N., R. 77 W., is in the SE. $\frac{1}{4}$ sec. 5 (No. 118). Here the bed is divided into two benches by 20 inches of shale, the lower bench 42 inches and the upper bench 18 inches in thickness. The same beds are exposed at location 119. About 85 feet above this bed, at location 118, is another bed, 36 inches in thickness. In the NW. $\frac{1}{4}$ sec. 10 (No. 120) the bed seen at location 119 is exposed. The shale parting has here decreased to 3 inches in thickness and the whole bed contains 62 inches of coal. The same bed attains a thickness of 8 or 9 feet in the SE. $\frac{1}{4}$ sec. 11 (Nos. 121 and 122). In the SW. $\frac{1}{4}$ sec. 11 (No. 123) two beds appear above the principal bed, the three being distributed through a stratigraphic distance of about 90 feet. The principal bed is here divided into three benches by two thick shale partings. The two upper beds measure 24 and 27 inches in thickness, respectively. In the SW. $\frac{1}{4}$ sec. 9 (No. 124) three beds appear, the highest of which is to be correlated with the highest bed of No. 123, the others probably representing the lowest bed of that section. In the NE. $\frac{1}{4}$ sec. 21 (No. 125) the principal bed contains 44 inches of coal. In the SW. $\frac{1}{4}$ sec. 23 (No. 126) three beds are distributed through a stratigraphic distance of 100 feet. The lowest bed can be traced across the western side of sec. 27 but is not exposed south of that section. A bed which seems to be the same as the middle bed outcrops at two places (Nos. 127 and 128) in sec. 33, where it measures 48 inches. Exposures of these beds are poor on the west side of Powder River. A 36-inch bed of coal outcrops in the SW. $\frac{1}{4}$ sec. 8 (No. 129) at an altitude of 3,930 feet, and the same bed measures 34 inches in the SE. $\frac{1}{4}$ sec. 18 (No. 130). At this locality a second bed, 45 feet below the first, measures 30 inches in thickness. Coal is exposed in the NW. $\frac{1}{4}$ sec. 28 at about the horizon of the upper



S OF COAL BEDS IN T. 49 N., R. 79 W., AND T. 50 N., RS. 77 AND 78 W., BARBER COAL FIELD, WYOMING



T 49 N R 7



bed just described, but no measurement was here obtained. South of Flying E Creek, in the SE. $\frac{1}{4}$ sec. 30, this bed is only 22 inches thick. In secs. 7, 18, and 19 (Nos. 131, 135, and 136) three coal beds are exposed, ranging in altitude from 4,000 to 4,230 feet. The same beds are probably exposed in the NE. $\frac{1}{4}$ sec. 12, T. 50 N., R. 78 W., and they underlie a comparatively small area. One of these beds is probably to be correlated with the bed exposed at locations 132 and 133 on the east side of Powder River. A coal bed 34 inches thick outcrops at an altitude of 4,085 feet in the SE. $\frac{1}{4}$ sec. 30 (No. 134), but the bed was not noted elsewhere. It may correspond to one of the beds in sec. 18. A group of three beds at an altitude of 4,200 to 4,300 feet underlies a small area in sec. 1 (No. 137) and may be equivalent to the highest beds in sec. 18. A bed 36 inches thick outcrops in the SE. $\frac{1}{4}$ sec. 23 (No. 140) at an altitude of 4,410 feet. A bed which seems to be the same outcrops in the SE. $\frac{1}{4}$ sec. 24 (No. 139), where it is separated into two benches by 3 feet of shale. The lower bench is 60 inches and the upper 24 inches in thickness. In the NW. $\frac{1}{4}$ sec. 1 of the township to the south a bed 30 inches in thickness outcrops at an altitude of 4,475 feet, and a second bed, 24 inches thick, lies about 70 feet above the first (No. 138). Whether or not the bed exposed in sec. 25, T. 50 N., R. 77 W., is to be correlated with the lower bed in sec. 1, T. 49 N., R. 77 W., is somewhat doubtful. The Healy coal should come at about this horizon and these beds probably represent the Healy coal group.

T. 49 N., R. 79 W.

In the NW. $\frac{1}{4}$ sec. 6, T. 49 N., R. 79 W., a group of three coal beds is exposed at altitudes ranging from 4,320 to 4,390 feet (No. 141). The lowest bed is 24 inches thick, the middle is the same thickness, but is poor in quality, and the top bed is 30 inches thick. Three beds, which are probably to be correlated with these, outcrop in the NW. $\frac{1}{4}$ sec. 18, where they measure 40, 36, and 28 inches in thickness, respectively (No. 142). The same group outcrops in the SW. $\frac{1}{4}$ sec. 19 and in sec. 24 of the township to the west, but the beds have here increased in number (No. 143). The lowest bed lies at an altitude of 4,305 feet.

The principal coal bed in this township is the Healy coal. This bed is exposed in the NE. $\frac{1}{4}$ sec. 9, where it is divided by 1 foot of shale into two benches, each containing 36 inches of coal (No. 144). In the central part of sec. 6 three beds occur in a stratigraphic distance of 130 feet, the middle bed, 30 inches in thickness, which outcrops at an altitude of 4,420 feet (No. 145), probably corresponds to the bed just described in sec. 9. Two beds are exposed at location 146, the lower of which probably corresponds to the middle bed at location 145. In the SW. $\frac{1}{4}$ sec. 8 the Healy coal group is represented by three beds (No.

147). The lowest, at an altitude of 4,415 feet, is 24 inches in thickness; the second, 18 feet above it, measures 38 inches; and the top bed at an altitude of 4,460 feet, is separated by 24 inches of shale into two benches, the lower bench 30 inches and the upper 27 inches in thickness. The same group of beds outcrop at locations 148 and 149 in sec. 17 and in the NW. $\frac{1}{4}$ sec. 21 (Nos. 150 and 151). In the SW. $\frac{1}{4}$ sec. 22 (No. 152) the group is exposed, a slight undulation of the strata raising the beds above their usual altitude. In the NE. $\frac{1}{4}$ sec. 29 (No. 153) the Healy coal is represented by three beds. The lowest bed is 30 inches thick; the second bed, 8 feet above it, is 36 inches thick, but the quality is poor; the top bed, 10 feet above the second, measures 27 inches. Two beds, 112 feet apart, outcrop in the NE. $\frac{1}{4}$ sec. 19 (No. 154), but their correlation with the foregoing is doubtful. In the SE. $\frac{1}{4}$ sec. 18 (No. 155) the Healy coal is represented by a bed which is separated into three benches by partings of shale. This coal again outcrops at Nos. 156 and 157. In the NW. $\frac{1}{4}$ sec. 31 (No. 158) the Healy coal is represented by four beds distributed through a stratigraphic distance of 50 feet. This horizon may be traced to the south to location 159 in sec. 6, T. 48 N., R. 79 W., where a single bed 30 inches thick is exposed. On the Powder River side of the divide the Healy coal group outcrops in the NW. $\frac{1}{4}$ sec. 2 (No. 160), being here represented by three beds, one of which is 72 inches in thickness. In the SW. $\frac{1}{4}$ sec. 1 (No. 161) two beds of the group appear, the lower being 68 inches thick. In secs. 25 (lower bed of No. 162) and 36 (No. 163) the Healy coal is represented by a single bed 2 to 3 feet in thickness. Just east of the township line, however, another bed (No. 164) appears about 60 feet above the first, and in the NE. $\frac{1}{4}$ sec. 36 (top bed of No. 162) a bed 24 inches in thickness is exposed.

The Walters coal outcrops in sec. 3 (Nos. 165 and 166) at one of the highest points along the divide between Powder River and Crazy Woman Creek. The bed is here separated into two benches by 4 $\frac{1}{2}$ feet of shale. The lower bench, 50 inches thick, is rather poor in quality; the upper bench ranges from 74 to 78 inches in thickness. At location 166 a bed 30 inches thick appears 130 feet below this bed. The Walters coal outcrops at intervals along the divide to the south, but it apparently grows thinner in that direction and the area underlain by it is comparatively small.



MAP OF THE BARBER COAL FIELD, JOHNSON COUNTY, WYOMING
By Carroll H. Wegemann
1913