A RECONNAISSANCE OF THE SAND AND GRAVEL DEPOSITS OF WYOMING

by
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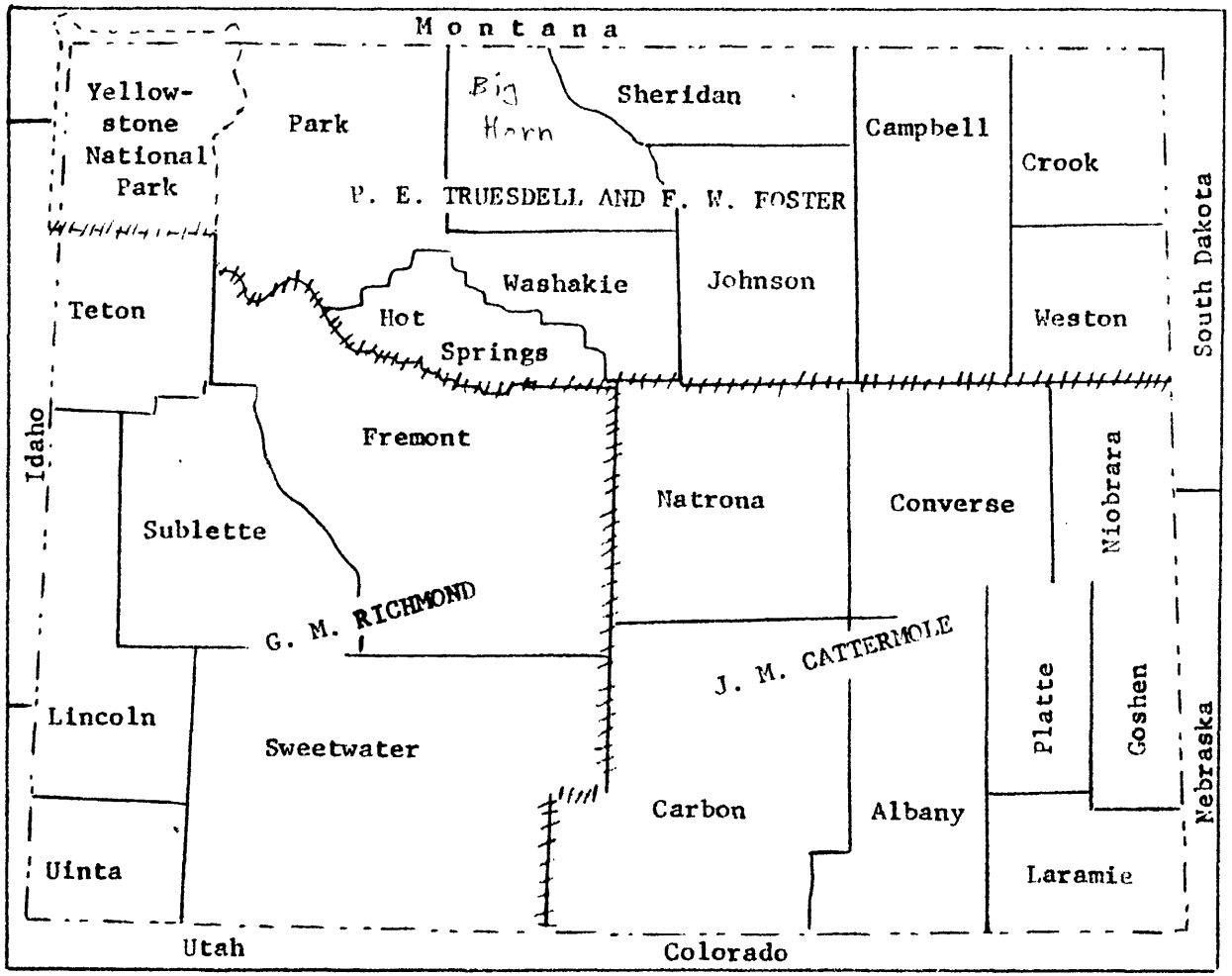

Figure 1. Index map of Wyoming showing counties and areas examined.

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Introduction

Scope and purpose.--This report is a reconnaissance study of the sand and gravel resources of Wyoming, designed to supply users of these materials with general information about the location, extent, and character of the deposits. The information is based on visual estimates and rough tests made in the course of field investigations during a period of six months in 1947. It does not, of course, supplant detailed tests and laboratory analyses prerequisite to specific use of the material, but may serve as a guide to delimit deposits in which such tests are to be made. The field investigations were conducted by three parties working in different parts of the state, as shown in figure 1.

Organization of information.--The information is arranged by counties, and, within counties, by drainage systems, because most of the important sand and gravel deposits occur along major streams. To obtain information about any particular area, locate the area on the map and determine what deposits, if any, are in or near the area. Then look up the county and drainage system in the table of contents where reference is made to that part of the report in which a description of the deposits and their topographic setting is given. Test data at specific localities are in tabular form for ready access and easy selection.

Acknowledgements

During the winter of 1946, before field investigations were begun, information as to the location of existing sand and gravel pits, and pertinent test data on materials from them, were gathered from the files of the Wyoming State Highway Department in Cheyenne by D. M. Larabee, R. H. King and R. G. Young of the U. S. Geological Survey. Thanks are due the officials of the Wyoming State Highway Department for their courtesy in making this information available. Many county road commissioners, highway engineers and local supervisors also provided data on the use of the materials.

R. E. Fincher of the U. S. Bureau of Public Roads, and E. A. Abdun-Nur of the U. S. Bureau of Reclamation made many helpful suggestions and criticisms, both as to the kinds of data to be gathered during the field investigations, and as to the organization of that data in the tables accompanying the report.

The whole hearted cooperation of C. F. Withington, R. G. Young, J. T. Robison, D. L. Emerson, and Will Kyselka as assistants during the field investigations assured completion of the work in the single season allotted.

Existing map information, both published and unpublished, was utilized where available, and grateful acknowledgement is due the many workers who contributed. Specific reference to the source of such data is made in the body of this report.

Sincere thanks are also due our several colleagues of the U. S. Geological Survey who have criticized the manuscript, especially E. B. Eckel, under whose general supervision the investigation was conducted.

Procedures used in mapping and testing

A rather full statement of the kinds of data gathered and procedures used is given here because the kinds of data gathered vary considerably from one user to another, and because methods and procedures for testing sand and gravel deposits vary with the desired use of the material.

Mapping.--Mapping was of a reconnaissance nature; that is, an attempt was made to find as many deposits of sand and gravel as possible within a given period of time. Of these deposits, all that were believed to have any potential value were mapped, and the locations of all field tests were plotted. Base maps used in the field consisted of topographic maps, planimetric maps and controlled aerial photo-mosaics at various scales, obtained from state and federal sources. Their accuracy varied greatly, but was consistent with the scale of the final compilation (plate I).

Location of tests.--Tests were made at as many existing sand and gravel pits as possible, some were currently operating, others had been operated in the past. Pits that were inaccessible, flooded, exhausted, or otherwise unsuitable were not tested. Tests were also made at localities where large undeveloped deposits were found, particularly in areas where federal or state engineering projects were known to be under consideration. In these localities tests were made, either from existing exposures, such as road cuts, stream banks or terrace scarps, or from pits dug through the overburden into fresh undisturbed material. Tests were also made at the junctions of large tributaries with major streams to determine whether significant variations in the material along the major streams had resulted from addition of different materials from

sources upstream along the tributary. Where deposits occurred on terraces one above the other along a stream or valley, tests were made on each terrace when possible.

Sampling.--In general only one sample was taken at each test locality. The exposure was examined and a representative section chosen. A channel was cut from top to bottom of the exposed face, and the material collected on a piece of canvas. This material was thoroughly mixed and split to a sample size of about 40 pounds for gravel, and 5 pounds for sand. Where a representative sample could not be obtained from one channel, two or more channels were cut and the material mixed together. At certain localities where the material varied greatly from one part of the deposit to another two or more samples were taken and tested separately.

Sieve analysis.--After a representative sample had been cut, it was sieved through a set of 3-foot diameter square opening U. S. Standard wire screens with opening diameters ranging from 3 inches to one-quarter of an inch. The fraction that passed through the one-quarter inch screen was spread on a canvas to air dry while the fraction retained on each of the larger screens was weighed on spring type scales graduated to one-tenth of a pound. The fraction passing the one-quarter of an inch screen, when dry, was weighed and split to an amount that could be accomodated by 8 inch diameter screens. The split was then sieved through screens having an opening diameter which ranged from 0.185 inches (U. S. Standard No. 40) to 0.0164 inches (U. S. Standard No. 40). The material was usually shaken by hand about 300 times, or until inspection showed that seiving was complete. The fraction retained on each screen was then weighed, and the recorded

weights were multiplied by the factor necessary to bring them into proper proportions of the original sample. All weights were then recalculated in terms of weight percent, and the proportions of gravel and sand were determined.

Clogging of the finer screens occurred in some tests where the material was clayey or where adequate drying was impossible. Under such conditions the fraction finer than one-quarter of an inch in diameter was retained and retested after more thorough drying and breaking up of the clay lumps. Samples containing a high proportion of sand tended to overload the No. 40 sieve and cause incomplete sieving. Under such circumstances, the material was resieved in small increments that could be more readily accomodated.

Properties of material passing a No. 40 U. S. Standard sieve.--It was not feasible to use screens finer than a No. 40 U. S. Standard sieve because moisture conditions could only be controlled by air drying. Consequently information on the fraction passing the No. 40 screen is based entirely on visual properties and simple field tests. The proportion of sand to silt and clay was estimated from examination of the material with a hand lens, as was also the mineral character and angularity of the grains. Plasticity was determined by moistening the material and rolling it between the fingers. If the material could be rolled to a thread it was considered to have a high clay content.

Pebble counts.--Pebble counts were made at each test locality to identify the kinds of rock in the gravel and to determine the percent of each kind. A comparison of these data with service records and laboratory tests of similar rock types may indicate the wearing qualities of the gravel and its suitability for aggregate.

Differences in rock types at different size ranges in a deposit were determined by making pebble counts of material ranging between 3 inches and 1½ inches in diameter, and on material ranging between three-quarters of an inch and three-eighths of an inch in diameter. In samples containing little coarse gravel only the three-quarters to three-eighths inches count could be made, and in sand deposits no pebble count was made.

One hundred or more pebbles were taken at random from the size range to be tested. Each pebble was broken and the fresh surfaces examined to determine kind of rock, texture, and hardness. Rock types were determined as closely as field criteria permit. Dark and light-colored fine-grained igneous rocks which could not be identified specifically by field methods were classified respectively under the general terms trap and felsite.

Reliability of the data.--A reconnaissance study of an area as large as the State of Wyoming in which the field work was done by three parties in 6 months is necessarily limited in its degree of reliability. Variations in data based on judgment or visual estimation were unavoidable. Two conferences were held during the field season to minimize these variations as much as possible.

Each party was furnished with similar equipment and each followed the same procedure in testing. Information was recorded on data sheets prepared in advance of the field work. Errors in weighing which resulted in loss or gain in the total weight percent of the sample were unavoidable because spring scales were used. This type of scale, however, was considered accurate within the limits of variation of the deposits. Small losses were probably incurred through evaporation during drying of the finer fraction, and through scattering of small amounts of the very fine

material by the wind. These losses were generally less than two percent of the total sample.

Variations in the uniformity of the deposit greatly influenced the reliability of the test data. Test data for a given deposit may not compare perfectly with test data for a specific sample taken at random from the deposit. However, as due care was taken to select a representative sample, the sample tested is considered reasonably indicative of the average conditions over the deposit as a whole. The data are naturally less reliable where a deposit varies greatly from place to place, or where the exposures were so small that representative samples could not be reliably chosen.

Definition of terms

The following definitions of terms used in the tables accompanying this report are arranged in the order in which they appear in the tables. Abbreviations of terms used in the tables are explained in footnotes at the bottom of each table.

1. Operational factors.--Data which may affect working of the deposit.
   a) Exposure tested. Kind of excavation from which sample was taken. (Pit, river bank, road cut, terrace scarp, test hole.)
   b) Accessibility. Existing means of approach to deposit. (Paved road, dirt road, truck trail, gravel road, etc.)
   c) Area (dim. in 100 yds.) Dimensions of surface area underlain by at least 3 feet of gravel that probably can be worked from the immediate vicinity of the test locality.
   d) Thickness (in ft.) Average observed thickness or range in thickness of the deposit. May be estimated thickness where total thickness cannot be seen.

e) Volume. Estimated amount of available material exclusive of the overburden. This figure may be less than the product of the area times the thickness where silt and clay lenses or other unsuitable material form a considerable part of the deposit. It includes material below the ground water table only where that material is being actively worked.

f) Reported use. This information is based on observations in the field and from questioning local operators.

g) Overburden. Soil material overlying the deposit tested.

Kind of soil.

stony soil:--sand, silt and clay mixtures having a moderate to high proportion of rock fragments.

sandy soil:--sand, silt and clay mixtures in which the particles are less than 2 mm in diameter and which have a granular texture.

clayey soil:--soil mixtures which form threads when moistened and rolled between the fingers.

silty soil:--soil mixtures which feel smooth but will not form threads when moistened and rolled between the fingers.

h) Ground water depth (in ft.) Estimated or observed depth to the ground water table at the time of examination. This is indicated only where the ground water table lies within or just below the deposit.

i) Available surface water. Nearest source of surface water which could be used for washing in the operation of the deposit.

2. General character of the deposit.

   a) Physiographic form. The type of land form on which the deposit occurs and with which it is associated in origin. (Terrace, pediment, flood plain, ridge top, moraine, kame, alluvial fan, stream channel, plain, etc.)

   b) Character of surface. Nature of the local topography which overlies the deposit in the vicinity of the test locality. (Even, rolling, dissected, pitted, hummocky, irregular.)

   c) Bedding. The relations between the layers of the material and the internal character of the individual layers. (Thick bedded, thin bedded, crossbedded, clay lenses, weak bedding, gradational bedding, lenticular, no bedding, etc.)

   d) Vertical and lateral variation. The extent of change in the material from one part of the deposit to another. As here used, it refers mostly to textural changes from top to bottom of a deposit, or laterally from one part of a deposit to another. The terms slight, moderate and great are used to express the degree of variation.

3. Weathering of material. Rocks are subject to two kinds of weathering, chemical disintegration (rotting) and physical breakdown (fracturing). Physical breakdown is of little economic significance in the gravel deposits of Wyoming, but chemical weathering may cause the material to be unsuitable for certain uses. With this in mind the following terms are used to define the degree to which particles in the deposits are chemically weathered.

a) Unaltered. Particles showing no effect of chemical deterioration. The particles may, however, be naturally soft in their unaltered state.

b) Slight. Particles showing external effects of oxidation (such as iron stain) and particles having a thin alteration rind.

c) Moderate. Particles showing internal effects of oxidation (such as iron stain) and particles partially deteriorated throughout,which are not as firm and hard as in their unaltered state.

d) Intense. Thoroughly deteriorated particles that are soft or crumbly, and disintegrate readily on crushing in the hand.

4. Cemented zones. Irregular layers or lenses of varying thickness in which the particles are bound together by a natural cement.

a) Kind of cement. Character of the material coating or binding the particles together. ($CaCO_3$, iron oxide, calcareous tufa, siliceous sinter, clay, "alkali," gypsum, caliche, etc.)

b) Thickness in inches. Thickness of the cemented zone.

c) Firmness. Degree of firmness or hardness to which the particles are bound together by the cement. (Slight, moderate, very hard.)

5. Deleterious matter. Substances which, if present in excess, are reported to weaken concrete in which the material is utilized as aggregate. The tables list the kinds of deleterious substances observed. No attempt was made to predict what amounts constituted

an excess for any given purpose, but where possible the general amount of each deleterious substance present is indicated.

a) Contaminating matter. Inherently weak substances which, if present in excess in material used in construction, are reported to weaken, stain, cause weathering, or otherwise contaminate the product. (Examples:--shale, soft fragments, mica, coal, organic matter, coated fragments, etc.)

b) Possible reactive matter. Substances which, if present in certain proportions in aggregate used with high alkali cements may react chemically with the cement causing deterioration of the concrete. (Examples:--chert, andesite, rhyolite, chalcedony, etc.)

6. Pebble characteristics. The shape and structure of the particles.

a) Rounded. A particle in which the bounding surfaces are smooth regular curves approaching a spherical or ellipsoidal shape.

b) Subrounded. A particle in which the surfaces are predominantly regular curves, but with one or two flat surfaces bounded by smooth curved edges lacking corners.

c) Subangular. A particle having flat or irregular faces bounded by a majority of smooth curved edges and corners.

d) Angular. A particle having flat or irregular faces that are bounded by a majority of sharp edges and corners.

e) Flat. A particle in which the intermediate dimension is at least three times the short dimension.

f) Elongate. A particle in which the long dimension is at least three times the intermediate dimension.

h) Cleavage. A tendency for particles to split along definite planes.

i) Fractured. Particles which are broken.

j) Friable. Granular particles which crumble or break down easily into individual grains.

k) Brittle. Fragments, commonly dense or very fine grained, which break readily with clean sharp edges and, under certain conditions, with a curved or conchoidal fracture.

l) Tough. Particles which resist pressure or force and do not break readily in any direction. They commonly show resiliency and a tendency to deform slightly before breaking.

7. Boulders, cobbles, gravel, sand, silt, and clay.

a) Boulders. Fragments greater than 6 inches in diameter.

b) Cobbles. Fragments from 6 inches to 3 inches in diameter.

c) Gravel. Particles from 3 inches to 2 mm in diameter. For purpose of field analyses this includes all particles passing a U. S. Standard sieve having a 3-inch diameter opening, and retained on a No. 10 U. S. Standard sieve.

Coarse gravel. Particles from 3 inches to 1½ inches in diameter.

Medium gravel. Particles from 1½ inches to 4.7 mm in diameter. (Particles passing a U. S. Standard sieve having a 1½ inch diameter opening, and retained on a No. 4 U. S. Standard sieve.)

Fine gravel. Particles from 4.7 mm to 2.0 mm in diameter. (Particles passing a No. 4 U. S. Standard sieve, and retained on a No. 10 U. S. Standard sieve.)

d) Sand. Particles from 2 mm to 0.05 mm in diameter. In field analyses only that part retained on a No. 40 U. S. Standard sieve (0.420 mm opening) could be accurately measured. However, the term sand as used in the report includes its full range in size as defined above.

Coarse sand. Particles from 2 mm to 0.5 mm in diameter.

Medium sand. Particles from 0.5 mm to 0.25 mm in diameter.

Fine sand. Particles from 0.25 mm to 0.05 mm in diameter.

e) Silt and clay. The proportions of silt and clay could only be very roughly determined in the field. The following definitions of these terms, however, is implied by their use in this report.

Silt. All particles from 0.05 mm to 0.002 mm in diameter.

Clay. All particles smaller than 0.002 mm in diameter.

8. Approximate maximum diameter. The estimated diameter of the maximum size of rock fragment that is common in the deposit.

9. Character of -No. 40 screen. The predominant character and texture of the material passing a No. 40 U. S. Standard sieve is indicated by the following terms:

a) Clean. Medium and fine sand with very little silt and clay.

b) Dirty. Medium and fine sand with moderate amounts of silt and clay.

c) Very dirty. Silt and clay with very little medium and fine sand.

Albany County

by

J. M. Cattermole

General distribution of deposits

Sand and gravel deposits are fairly numerous in the southern part of Albany County, but are less abundant in the northern part. The material composing these deposits has been derived almost entirely from the Laramie and Medicine Bow Mountains.

The core of the southern part of the Laramie Mountains is made up of the deeply disintegrated Sherman granite--a pink, very coarse granite composed of alkaline feldspars, interstitial quartz, mica and hornblende. The disintegration is worthy of mention because the feldspars, though thoroughly fractured, remain quite fresh and unweathered. In most places this disintegration extends at least 50 feet below the surface and in some areas to an even greater depth. The fracturing is so thorough that the granite can easily be excavated. This material has been used in large quantities by the railroad for ballast and is an abundant and readily available source of gravel suitable for road construction.

Another source of gravel in the county are deposits in the Laramie Basin. This material is composed mostly of Sherman granite and individual pebbles are mostly less than three-quarters of an inch in diameter. Some of these deposits occur on the higher erosion surfaces in the Laramie Basin. They consist for the most part of gravelly soil which in places contains enough pebbles for use as gravel. Below these high erosion remnants are local alluvial fan and slopewash deposits which locally

contain sand and gravel in usable quantities. The stream channels and flood plains of the southern part of the Laramie Basin contain the largest and cleanest deposits of sand and gravel, some of which are as much as 25 feet thick. However, thick layers of mud interbedded with these deposits limit the thickness of economically usable gravel to from 3 to 9 feet in places.

Terrace remnants along the streams in the southern and western part of the basin are locally capped with gravel 10 feet or more thick. Near the Medicine Bow Mountains these deposits contain abundant boulders 2 feet or more in maximum diameter. In the center of the basin most of the material is less than three-quarters of an inch in diameter.

In the northern part of the Laramie Basin deposits are scarce, for here the streams have traveled a long distance through soft, fine sediments where rock material resistant enough to provide a source of gravel is lacking.

Local descriptions

Laramie River.--The Laramie River from the point where it issues from the Medicine Bow Mountains, 6 miles north of Jelm, to Bosler has gravel in the river channel, and in some areas on the adjacent flood plains. The maximum diameter of the pebbles of these deposits is generally less than one inch. The deposits are clean and well graded, but lenses of sand or gravel are frequently present. About 70 percent of the gravel is of granite and is subangular; the rest of the material consists of subrounded particles quartz, gneiss, and limestone (see tests A-8, A-10, A-11, A-13). As a whole the material is moderately resistant to wear. The workable thickness of the deposits is from 3 to 9 feet below which, interbedded layers of mud or dirt 2 or 3 feet thick limit economic development.

Terraces along the Laramie River and its tributaries in the southern and western parts of the Laramie Basin are capped by gravel deposits represented by tests A-7, A-12, A-17, A-21, A-22, A-23. Most of these deposits are not as clean as those in the river channel and flood plain because clay derived from the nearby shale bedrock comprises a fairly large proportion of the minus-40 fraction. The overburden on these deposits has washed in from higher ground along the valley walls and therefore thins downslope. Test site A-7 is on the edge of a terrace that borders the north side of the Laramie River valley for some distance. At this locality pebbles in the gravel have a maximum diameter of 3 inches, but at other localities the deposits are wholly very coarse sand. Test locality A-9 is on the upper erosional surface and, though the thickness and cleanliness is variable, there is an unlimited quantity north toward Lake Hattie. The material in this deposit is composed of 50 to 80 percent granite, 5 to 10 percent gneiss, and minor amounts of limestone, schist, diabase, and quartzite. At test sites A-12, A-22, and A-23 a large part of the material is composed of the Sherman granite. Areas surrounding these test localities along the Laramie River flood plain and on adjacent terraces contain additional large quantities of gravel.

Streams of the east flank of the Medicine Bow Mountains.--The streams flowing east from the Medicine Bow Mountains have local small deposits of sand and gravel in their channels and on terrace remnants along their valleys. The coarse fraction in these deposits ranges in maximum diameter from 2 feet near the mountains to 3 inches out in the basin. The material is composed mostly of quartzite, siliceous schist, a medium and a fine grained granite, and some metamorphose limestone. The Little Laramie River,

largest of these streams, has small quantities of gravel beneath its flood plain, (test A-15). High terrace remnants south of James Lake are bordered by coarse, bouldery gravel having a matrix of dirty sand. The deposits at test locality A-27 and in the area east of Cooper Lake are composed of quartzite and quartz from the Medicine Bow Mountains. Although the deposits are only about 3 feet thick a large quantity of material is available.

Rock Creek.--Just south of the town of Rock River, the terrace on the north side of Rock Creek valley is capped by a deposit that is about 10 feet thick (test A-29). About 30 percent of the gravel is of hard fine-grained quartzite and an equal proportion is of hard, dark-colored, volcanic rock partly of medium texture and partly very fine grained. The maximum dimension of the gravel is 6 inches, and 66 percent by weight is larger than one-quarter of an inch. Six miles north of Rock River (tests A-33, A-34, and A-35) are smaller areas of similar material.

Western lower slopes of the Laramie Mountains.--Along the western lower slopes of the Laramie Mountains the higher erosional surfaces are capped with a thin veneer of gravelly soil. In scattered areas this material is sufficiently concentrated to provide gravel suitable for road construction. North of Red Buttes at test localities A-5 and A-6, and along the west side of Lonetree Creek, the deposits are composed almost entirely of Sherman granite, and individual fragments are mostly less than one inch in diameter. To the north, at test localities A-25 and A-28, the 25 to 50 percent of the material is anorthosite.

Laramie Mountains.--In the southern part of Laramie Mountains the widespread deeply weathered Sherman granite, is the best source of gravel, (tests A-2, and A-3). In the northern part of the Laramie Mountains, this rock is not exposed, and gravel deposits are consequently scarce and small. Most are at junctions of tributaries with main streams, and on small terraces along the wider portions of some streams. The deposits, however, are thin, and only small quantities of gravel are available at any single locality.

Bighorn County

by

Page E. Truesdell and Frank W. Foster

General distribution of deposits

The sand and gravel deposits of Bighorn County occur mostly in the broad valleys of the major streams on terraces and in the flood plains. Deposits also occur on high erosion surfaces such as Tatman Mountain at the headwaters of Elk Creek, and Table Mountain east of Burlington. Relatively dirty deposits containing angular fragments, are locally abundant on pediment surfaces along the flanks of the Bighorn Mountains. Gravelly till occurs in the higher parts of the Bighorn Mountains and extends well down along some of the larger canyons such as those of Paintrock Creek, Tensleep Creek, and Medicine Lodge Creek. Only a few deposits of till are shown on plate 1. Mapping of most of the sand and gravel deposits is generalized after detailed studies of Andrews (1947).

The most extensive deposits of sand and gravel are on a sequence of terrace segments which extend for long distances along the Bighorn River and its major tributaries from the west. Many of these terrace segments are as much as 5 miles wide. Deposits in the flood plains of the streams are mostly of sand, silt, and clay, though small gravel bars are present in places. East of the Bighorn River, terrace deposits along tributary streams are less extensive than west of the river, but supplies of sand and gravel are nevertheless abundant, particularly along Shell Creek and Nowood Creek. Gravel is also fairly abundant in the flood plains of these streams.

The deposits on Tatman and Table Mountains are very extensive, and composed mostly of basic igneous rocks.

Interstream areas throughout the county tend to lack deposits of sand and gravel. Such areas are fairly extensive in the southwest part of the county, and along U. S. Highway 310 between Dry Creek and the Shoshone River. The Bighorn Mountains also lack supplies of sand and gravel. Canyons in the southern part of the range contain some gravelly till, but in the northern part even this material is lacking.

Local descriptions

Bighorn River:--From Rairden to Greybull.--A sequence of four and locally five gravel-capped terraces border the Bighorn River between Rairden and Greybull at the confluence of the Greybull River. The higher terraces are mostly on the west side of the river; the lower ones occur along both sides, but those on the east side have the most extensive deposits of sand and gravel. The gravel on the lowest terrace, which is 60 to 160 feet above the river, is 4 to 6 feet thick. On the next higher terrace, 150 to 275 feet above the river, the gravel is 4 to 10 feet thick. On the higher terraces the deposits are in general 6 to 10 feet thick.

The ratio of gravel to sand in the deposits on all the terraces is about 2 to 1. Few cobbles are over 3 inches in diameter. The amount of silt and clay varies from 2 percent to about 15 percent. Hard quartzite makes up about 50 percent of the gravel; granite, trap, and felsite forming the dominant lesser proportions. Chert comprises 5 to 15 percent of the material under one inch in diameter. A little gypsum was noted. From 6 to 24 inches of sandy or stony soil covers the deposits.

Bighorn River:--from Greybull to Kane.--The Bighorn River between Greybull and Kane is bordered by a single terrace 60 to 160 feet above the river. This terrace is capped by extensive deposits of sand and gravel. Cobbles over 3 inches in diameter comprise about 10 percent of the material; silt and clay about 15 percent. The ratio of gravel to sand is about 4 to 1. Felsite is the predominant constituent, especially in the component less than one inch in diameter. Volcanic traprock comprises about a third of the material over one inch in diameter, but considerably less of the material under one inch in diameter.

The deposits are slightly to firmly cemented by calcium carbonate or gypsum to a depth of about 4 feet. The soil cover is stony and 6 to 24 inches thick.

Bighorn River:--at the confluence of Shoshone River.--An extensive deposit of bouldery gravel 6 to 8 feet thick, (test locality B-28) caps a broad pediment on the east side of the Bighorn River east of Kane. About 90 percent of the material is hard limestone. The deposit is covered by 6 inches of stony soil.

Greybull River.--The Greybull River is flanked by terraces 10 to 40, 60 to 160, and 110 to 225 feet above the river. Sand and gravel deposits on these terraces are extensive and average between 6 and 10 feet in thickness. They are composed mainly of basic volcanic traprock and felsite and consist predominantly of coarse gravel. Sand comprises about 15 percent of the material, silt and clay about 20 percent. Cobbles between 2 and 4 inches in diameter are common. A sandy soil overburden is 6 to 18 inches thick.

The flood plain of the Greybull River is underlain by large deposits of sand and gravel similar to that on the terraces.

Dry Creek.--Dry Creek is flanked by two high terraces; one, about 100 feet above the stream, is very extensive; the other, about 200 feet above the stream, is only locally preserved. The deposits on the lower terrace are 6 to 10 feet thick. Cobbles comprise about 5 to 15 percent of the material, silt and clay about 10 percent. The deposits on the higher terrace contain very few cobbles, but include about 20 percent of silt and clay. The gravel on both terraces is composed mostly of felsite, basic volcanic traprock, and quartzite. Gravel in the upper 1 to 2 feet of the deposits is slightly coated with calcium carbonate and gypsum. The soil cover is thin and stony.

Shoshone River.--Shoshone River is flanked by two terraces. The lower is 60 to 160 feet above the river, the higher 150 to 275 feet. Both terraces are capped by extensive deposits of sand and gravel that range from 3 to 10 feet in thickness. Cobbles comprise about 20 percent of the material on the higher terrace, silt and clay about 5 percent. On the lower terrace cobbles comprise only about 5 percent of the material, and silt and clay about 10 percent. The gravel is mostly of basic volcanic traprock and felsite. In the upper 6 to 18 inches of the deposits it is coated slightly with calcium carbonate and gypsum. A stony soil 6 to 18 inches thick covers the deposits.

Sage Creek.--Sage Creek is bordered by a single low terrace and several higher pediments capped by deposits of sand and gravel. The ratio of sand and gravel on the terrace is about 3 to 1, and the deposits contain large amounts of silt and clay. The gravel is principally of limestone, but about 10 percent is of chert. The deposits on the pediments consist of sand and gravel in about equal proportions and contain up to 30 percent of silt and clay. The gravel is subangular and similar in

composition to that on the terrace. The sandy soil, 6 to 18 inches thick, covers the deposits.

Shell Creek.--The south side of Shell Creek is bordered by five terraces. The higher four are capped by relatively thin deposits of sand and gravel, in many places only 3 feet thick. The lowest terrace is capped by extensive deposits 3 to 25 feet thick. The flood plains of Shell Creek and its tributaries also contain large supplies of sand and gravel. All of the deposits are gravelly and contain less than 15 percent sand. Most contain 5 to 10 percent of silt and clay. The gravel is predominantly of limestone, but also contains a little chert. The soil cover is stony and 6 to 24 inches thick.

Medicine Lodge Creek.--A low terrace along Medicine Lodge Creek near Hyattville is capped by extensive, but rather bouldery deposits about 10 feet thick. The gravel is mostly coarse and is mainly of granite but also contains minor amounts of limestone and as much as 10 percent is chert. The soil cover is 2 to 3 feet thick.

East Tensleep Creek.--In the upper part of the valley of East Tensleep Creek along U. S. Highway 16 (test locality B-1) is a deposit of till composed of about 65 percent gravel, 20 percent sand and, 15 percent silt and clay. It contains very few cobbles. The material is mainly of granite, about 30 percent of which is rotted.

Tatman and Table Mountains.--Tatman Mountain is a high tableland that lies about 8 miles south of the Greybull River near the southwest border of the county. It is capped by thick extensive deposits of sand and gravel composed mainly of basic igneous rock (traproçk). The material tends to be bouldery and is locally well cemented.

Table Mountain, another high tableland, lies between Dry Creek and Greybull River east of Burlington. Like Tatman Mountain, it has a thick cap of sand and gravel composed mainly of basic igneous rock (traprock). Neither the deposits on Tatman Mountain nor those on Table Mountain were tested.

Campbell County

by

Page E. Truesdell and Frank W. Foster

General distribution of deposits

Deposits of sand and gravel are scarce in Campbell County, and occur primarily on small terrace segments along streams in its southern part. Other small deposits occur in the flood plain of the Belle Fourche River and Spring Creek. These deposits are so limited in extent that they do not supply enough material to meet the needs of the county. According to local reports, most of the sand and gravel used in the county is brought in from other localities. Many of the unpaved roads, however, have been constructed with "scoria" from burned out coal beds in the region of the Rochelle Hills. The Chicago, Burlington and Quincy Railroad has also used this material for railroad ballast.

Local descriptions

Belle Fourche River.--Most of the sand and gravel in the county is found along tributaries and in the headwaters of the Belle Fourche River. An extensive deposit of sand and gravel examined at test locality CM-2 on a terrace in the headwaters of the Belle Fourche River is 8 to 10 feet thick. The gravel is composed mostly of limestone, but contains some sandstone, limonite, quartzite, and chert. Sand comprises about 45 percent of the material. Lenses of fine sand are interbedded with coarse gravel. The upper 2 feet of the deposit is slightly cemented with calcium carbonate and contains some rotted limonitic sandstone

concretions. A pit, in operation at the time the material was tested, supplied gravel for road construction. Stony soil, 1 to 2 feet thick, covers the deposit.

An isolated deposit on a terrace just west of the Rochelle Hills on the Belle Fourche River (test locality CM-4) is 3 to 4 feet thick and contains about 2,000 cubic yards of sand and gravel. The gravel is mostly of sandy limestone but also contains some calcareous sandstone, limonite, "scoria," and chert. A stony soil cover is 6 inches thick.

A flood plain deposit, (test locality CM-4) along the Belle Fourche River 6 miles southwest of test locality CM-3 is 2 to 3 feet thick, and contains about 1,500 cubic yards of sand and fine gravel. The gravel is predominantly of limestone, but includes some sandstone, chert, "scoria," and limonite. Though the number of limonite pebbles is small, most of the gravel has a limonitic stain. The overburden is a thin sandy soil.

An isolated terrace deposit on a knoll south of Rozet (test locality CM-5), along the Chicago, Burlington and Quincy Railroad, is 5 to 8 feet thick and contains about 20,000 cubic yards of sand and fine gravel. The gravel, is largely composed of sandstone and limestone, but also contains many limonite nodules and some chert. About 18 inches of stony soil overlies the deposit.

Spring Creek.--A limited amount of sand and fine gravel in the bed of Spring Creek, near State Highway 87 (test locality CM-1), is composed primarily of limestone with minor quantities of scoria, chert, and limonite.

Carbon County

by

J. M. Cattermole

General distribution of deposits

The sand and gravel deposits of Carbon County are principally in the valleys of the major streams; though a few occur in interstream areas. The latter consist principally of slope wash material derived from a conglomerate in the bedrock, or of thin deposits on high terraces.

Along the North Platte River, deposits occur in the channel and flood plain, and also in discontinuous gravel-capped terraces that border the river from the canyon where it cuts through the Medicine Bow Mountains to a point a few miles below Fort Steele. The terrace deposits have been used for road construction material, and material from those in the vicinity of Fort Steele, have been shipped long distances because of their proximity to the railroad. The flood plain deposits have been used for concrete aggregate.

The Little Snake River and Savory Creek are bordered by gravel-capped terraces, and clean well graded deposits underlie their channels and flood plains.

Gravel is scarce along U. S. Highway 30, from the east border of the county through Medicine Bow to Hanna. Near the town of Medicine Bow gravel has been obtained from terrace deposits along the Medicine Bow River. North of Como and between Hanna and Wolcott gravel deposits on the tops of certain hills have furnished material for road surfacing.

A few gravel deposits were found along U. S. Highway 87 between Rawlins and Muddy Gap. However, most of the road material in this area has been obtained by quarrying and crushing limestone and sandstone. There is very little gravel along U. S. Highway 30 west of Rawlins, or along Wyoming Highway 330 except in the valley of the Little Snake River.

Local descriptions

Little Snake River.--The Little Snake River in the vicinity of Baggs and Dixon is bordered by three well defined terraces which are capped by from 3 to 10 feet of sand and gravel. The gravel is subround to round. About 80 percent is of granite, quartz, quartzite, and volcanics in equal proportions. The remainder is of gabbro, diabase, and sandstone. The material contains some boulders ranging up to about one foot in diameter, 70 to 85 percent gravel and small amount of sand. Beneath the soil cover, most deposits are cemented by caliche to a depth of 2 feet or more. Test locality C-1 is on the lower terrace, test locality C-3 on the intermediate. Deposits on the highest terrace are similar in character to those on intermediate, but are only 3 to 4 feet thick, and are covered by 4 feet or more of overburden. Clean sand and gravel suitable for concrete aggregate underlie the river channel and flood plain locally. Data from test locality C-2 are incomplete but indicate the general character of these deposits in the vicinity of Dixon and at Baggs, where gravel pits have been operated.

Muddy Creek.--Small deposits of sand and fine gravel occur in the channel of Muddy Creek and at the confluence of tributary gulches. A large deposit in the vicinity of test locality C-14 caps a terrace about 50 feet above the creek bed. The material in this deposit is weathered

and 25 to 35 percent is soft to crumbly. About 25 percent is granite, 20 percent quartzite, 20 percent quartz, and 18 percent soft sandstone. The remainder is limestone, chert, volcanics, and slate. Each of the several spurs of the deposit contain about 10,000 cubic yards of material. About 3 miles north of Baggs the Highway Department has stripped gravel from the tops of hills east of Muddy Creek, but these deposits are nearly exhausted.

North Platte River.--Gravel is abundant in the upper part of the valley of the North Platte River. Downstream, however, below the canyon northwest of Fort Steele, gravel deposits are scarce.

Material for road construction along Wyoming Highway 230 from Encampment to the state line has been taken mostly from terraces along tributaries of the North Platte River. Test locality C-4 is in a terrace deposit 50 feet above Big Creek. The gravel is composed of about 45 percent granite, 20 percent gabbro, 10 percent gneiss, and the remainder volcanics, schist, and quartzite. About 68 percent of the deposit is larger than sand size. Other remnants of this terrace in the area make the total amount of available material about 200,000 cubic yards. Test locality C-5 is in a terrace deposit along Antelope Creek. Over 75 percent of this deposit is sand. The material has been used for concrete aggregate. Near Saratoga and Fort Steele terrace deposits bordering the North Platte River have been used for road material and various construction projects. The gravel varies somewhat in lithology but is about 30 to 40 percent granite, 20 percent quartzite, 15 percent gneiss, and the remainder volcanics, quartz, and siliceous schist. Little chert or sandstone was found. The fine-grained component

contains a moderate amount of silt and clay, but some zones are of relatively clean sand. The deposit at test locality C-12 has been used as road material. It lies across the mouth of a tributary valley about 10 feet above the level of the North Platte flood plain. The material is 3 to 6 feet thick, and the maximum diameter of individual cobbles is about 4 inches. Test locality C-13, one-quarter of a mile east of Saratoga, is on a terrace about 30 feet above the North Platte flood plain. The deposit is 15 feet thick, and is covered by 12 to 24 inches of stony soil, and is composed of lenticular beds of sand alternating with beds of gravel. Individual cobbles in the gravel range up to about 4 inches in diameter. A terrace gravel deposit about 40 feet above the North Platte River is exposed intermittently from the U. S. Highway 30 bridge to the vicinity of Fort Steele along the east side of the river; a few remnants also occur on the west side of the river. Test localities C-20 and C-22 are in this deposit. The gravel is 9 to 20 feet thick, and consists of subround to round material, having a maximum dimension of about 6 inches. The deposit is covered by 12 to 24 inches of overburden and has a zone of caliche about 2 feet below the top of the gravel. Test locality C-21 is in the flood plain of the North Platte River. About 45 percent of the material is granite, 25 percent quartzite, 12 percent quartz, and the remainder volcanics, gneiss, and sandstone. Lenses of sand, 3 feet or more in thickness, alternate with lenses of gravel in some parts of the deposit, but the deposit as a whole contains about 75 to 80 percent of gravel. The material is clean, unweathered and resistant, and has had wide use as concrete aggregate.

Medicine Bow River.--The upper part of the Medicine Bow River is bordered by gravel-capped terraces that extend from the mountains to the vicinity of the town of Medicine Bow. From 60 to 80 percent of the cobbles in these deposits are quartzite; the gravel component averages 60 to 80 percent quartzite, 15 percent granite, 15 percent quartz, and minor amounts of schist and volcanics. Test locality C-17 is in a terrace east of the river at the town of Elk Mountain. The gravel here is about 9 feet, but thins to 2 feet upstream. Test locality C-16 is in a deposit on the valley floor at the confluence of a tributary stream with the Medicine Bow River. It is extensive, but covered with 4 to 7 feet of soil. Test locality C-24 is in a terrace about 20 feet above the Medicine Bow River, 3 miles south of the town of Medicine Bow. The material is similar to that of Elk Mountain but contains up to 13 percent of soft sandstone. Test locality C-26 is a deposit in the channel of the Little Medicine Bow River. About 80 percent of the material is sand, 30 percent is gravel. The gravel has a maximum diameter of three-fourths of an inch, and most of it is less than one-fourth of an inch in diameter. The deposit contains only about 10,000 cubic yards but it is replenished by floods. Test locality C-28 is in a terrace bordering a drainage depression 9 miles north of the town of Medicine Bow. Gravel is exposed about a mile along this terrace in the vicinity of the test locality and some smaller deposits may occur downstream. The deposit averages about 10 feet thick and is covered by 12 to 24 inches of sandy soil. The material is about 30 percent granite, 30 percent quartz, 14 percent quartzite, 15 percent sandstone, and 10 percent chert. The maximum diameter of the gravel is three-fourths of an inch.

U. S. Highway 30 from Como to Wolcott.--Test locality C-27 is on a gravel-capped ridge one-half mile north of Como Station. About 30 percent of the material is quartzite, 35 percent sandstone, 20 percent quartz, and 15 percent chert. Test locality C-19, between Hanna and Wolcott, is in a deposit on the slope of a hill; about 40 percent of the material is quartzite, 30 percent quartz, 18 percent volcanics, and 12 percent chert. The deposit is over 15 feet thick and covers an extensive area not only on this hill but also on hills to the west and north. The material is derived from a conglomerate bedrock, and other similar deposits probably occur elsewhere in the Hanna Basin.

U. S. Highway 287.--Test locality C-29 is in a deposit of gravel on an old erosion surface 3 miles south of Lamont. The gravel is 9 feet thick and is covered by 12 to 24 inches of silty soil. About 35 percent of the material is granite, 33 percent sandstone, and 23 percent quartzite. The maximum diameter of the gravel is 1½ inches. Test locality C-30 is in deposits of gravel on a high pediment surface, remnants of which are found between this locality and the Ferris Mountains. The gravel is 3 to 6 feet thick, and is covered by only a few inches of overburden. The material is quartzite and granite and is very variable in texture. It contains some boulders up to 2 feet in diameter.

North Slope of Ferris Mountains.--Test localities C-31 and C-32 are in terrace deposits along streams flowing north from the Ferris Mountains. The lithology of these gravels is variable but quartzite, granite, and quartz predominate. The material is largely subangular and has a maximum dimension of 4 to 6 inches. The deposits are extensive, and over 6 feet thick.

Converse County

by

J. M. Cattermole

General distribution of deposits

Most of the sand and gravel deposits in Converse County are along the valleys of the North Platte River and those tributaries that flow from the Laramie Mountains. In the vicinity of Parkerton, Glenrock, Douglas, and Orin the stream channel and flood plain of the North Platte River are underlain locally by gravel. The deposits tend to occur on the insides of bends in the channel opposite areas of active undercutting. Terrace remnants at various heights above the streams are locally capped by gravel, but the deposits are mostly small and tend to be restricted to the outer margins of the terraces. On Lightning Creek, in the east-central part of the county, three small terrace deposits of silty gravel were mapped, and it is probable that similar deposits cap other terraces in this area. North of Lightning Creek no gravel of consequence was noted, but Antelope, Sand, and Dry Creeks have some sand deposits in their channels. Scoria, sandy shale that has been baked by burning of underlying coal beds, has been widely used for road construction in this area. Sand and gravel deposits may be found in the stream channels and along valley floors in the Laramie Mountains. These deposits, though adequate for present local requirements, are neither large nor continuous.

Local descriptions

Glenrock-Parkerton area.--Deposits of sand and gravel in the Glenrock-Parkerton area are mostly in the valley of the North Platte River and along those tributaries that flow from the Laramie Mountains. Many of the deposits are on remnants of high terraces. The deposit at test locality CO-23 is of this type. It is located about 100 yards south of U. S. Highway 87 at a point one-half mile east of the Natrona-Converse County line. It is about 6 feet thick. Approximately 40 percent of the material is granite, 25 percent is quartzite, and the remainder is limestone, quartz, sandstone concretions, and chert. A two-foot layer of coarse pebbles in the upper part of the deposit is heavily coated with caliche. Test locality CO-18, is a terrace deposit at the water tank on the hill southwest of Glenrock. The material is about 25 feet thick and of variable character. An exposure displays 6 feet of sandy gravel at the top, underlain by 4 feet of clay containing thin gravel lenses, 7 feet of well-graded sand and gravel, and 8 feet of fine sand at the base. Pebble counts of the two gravel layers showed that both consist of about 55 percent granite, 20 percent dark volcanic rock, and the remainder quartzite and chert. East of Glenrock, another terrace deposit (test locality CO-17) is only 4 feet thick and is almost exhausted. Test locality CO-20 is on a high terrace remnant in a tributary valley south of the North Platte River. The material consists of about 30 percent granite, 30 percent limestone, and 15 percent volcanic rock. It is bouldery and more angular than gravel deposits along the North Platte River.

Other deposits are on low benches adjacent to and 20 to 25 feet above the flood plain of the North Platte River. Test locality CO-22 is north of U. S. Highway 87 near a railroad bridge. The deposit is extensive but the gravel fraction tends to occur in pockets of only about 5,000 cubic yards each. The material is about 6 feet thick, and is covered by an overburden that ranges from a foot in thickness on the downslope side to 4 feet or more on the upslope side. Test locality CO-16, 2½ miles east of Glenrock, was operated as a source of gravel for a railroad bed. The material is clean, well graded, and composed of hard durable rocks. About 40 percent of the gravel is granite, 25 percent is quartzite, and the remainder consists of limestone, volcanic rock, quartz, and chert.

Careyhurst.--Southwest of Careyhurst, deposits of gravel border the margins of a number of rolling hills that are remnants of an erosion surface. Each deposit contains only 5,000 to 10,000 cubic yards of gravel, but at least 50,000 cubic yards is present in the area. At test locality CO-15, the maximum diameter of the gravel is about 6 inches, though a few boulders as large as 2 feet in diameter occur in the deposit. About 35 percent of the gravel is granite, 35 percent is dark volcanic rock, 12 percent is quartzite, and small amounts are gneiss, quartz, sandstone, and limestone. Some parts of the area are underlain by fine-grained sand.

LaPrele Creek.--A few small deposits of sand and gravel were found in the valley of LaPrele Creek. Test locality CO-13 is on the edge of a high erosion surface, and a similar deposit is present on the hill to the north. About 50 percent of the gravel in these deposits is granite,

25 percent is volcanic rock, and minor amounts are quartzite, limestone, sandstone and quartz. The material includes some boulders up to 2 feet in diameter. Test locality CO-14 is on a low terrace about 35 feet above the stream level. The gravel contains similar amounts of granite and volcanic rock as at test locality CO-13, but limestone is not present in the fraction greater than 1½ inches in diameter. Other terrace deposits, similar to this, probably occur elsewhere along the creek.

Douglas.--In the neighborhood of Douglas, gravel has been obtained from the channel and flood plain deposits of the North Platte River and from various terrace deposits that border it. Test localities CO-10 and CO-11 are near the Douglas water tank on U. S. Highway 20-87 one mile west of town. Test locality CO-10 is at the edge of the higher of two terraces. The deposit is of coarse gravel 35 percent of which is granite, 20 percent quartzite, 15 percent quartz, and small amounts of sandstone and volcanic rock. Half a mile northeast of this deposit, a deposit on a slightly lower terrace has a similar lithologic composition. A deposit at test locality, CO-11, south of U. S. Highway 87, is 75 percent sand and 25 percent fine to medium gravel. The material is probably slope wash. Test locality CO-12, south of the Douglas Airport, is on the edge of a low terrace deposit. The material is about 35 percent granite, 35 percent quartzite, 30 percent volcanic rock, gneiss, and quartz. Only a trace of limestone and sandstone was found. Test locality CO-9 is a deposit in the bed of the North Platte River. About 50 percent of the material is granite, 20 percent quartzite, 15 percent volcanic rocks, and minor amounts are of sandstone and quartz. Some of the cobbles are as much as 4 inches in diameter. A large amount

of this gravel is available in the river channel. Test locality CO-8 is just above the flood plain of the North Platte River, on a low gravel terrace that extends for more than a mile upstream.

Orin.--At Orin abundant supplies of gravel occur in the channel and flood plain of the North Platte River, and on terraces along the north side of the valley. Test localities CO-1, CO-4, and CO-7 are typical of the terrace deposits. The material contains a somewhat higher proportion of dark volcanic rock than is found in flood plain of the river. About 45 percent is granite, 20 percent is volcanic rocks, 15 percent is quartzite, and minor amounts are of quartz, sandstone concretions, and chert. The gravel is moderately clean and well graded, and individual cobbles have a maximum diameter of about 8 inches. Test localities, CO-2 and CO-3 are typical of the river channel and flood plain deposits. About 40 percent of the material is granite, 35 percent quartzite, 15 percent quartz, and the remainder volcanic rocks, sandstone, and chert. The maximum diameter of cobbles is 3 inches. The deposits are clean, but contain numerous lenses of sand.

Lightning Creek.--Small ridges and benches along Lightning Creek are locally capped by gravel and gravelly soil. The deposits at test localities CO-24 and CO-26 are typical. The gravel is mostly of granite and quartzite and individual pebbles have a maximum diameter of 2 inches. Other deposits are probably present along the creek, but were not apparent because of the thickness of the overburden.

Antelope, Dry, and Sand Creeks.--Some deposits of sand similar to that at test localities CO-27 and CO-28 occur in the stream channels of Antelope, Dry, and Sand Creeks in the northern part of Converse County. The largest particles are about one-quarter of an inch in diameter. The material has been used as seal coat for oiled roads.

Crook County

by

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General distribution of deposits

Most of the sand and gravel deposits in Crook County are in the flood plains of major streams and on terraces that border them. Most are small, and many have been nearly exhausted. The only extensive deposits are along the Belle Fourche River in the western part of the county. Some deposits in the flood plain of the river were being exploited in 1947, and, according to local reports, are constantly being replenished by material carried by the river. In other valleys, thin and relatively small seposits occur on high terrace remnants, 200 to 500 feet above the streams.

Most of the deposits shown on plate 1 are generalized after unpublished maps by W. W. Rubey (personal communication, 1947).

Local descriptions

Belle Fourche River.--Along the Belle Fourche River deposits on remnants of high terraces 200 to 500 feet above the stream were examined at test localities CK-9, CK-15, CK-22. These deposits are 4 to 5 feet thick, and each contains about 2,000 cubic yards of sand and gravel. The material is mostly of limestone, sandstone, and limonite, but also contains minor amounts of felsite. Soft limonite nodules comprise almost 50 percent of the fine gravel in the deposits. Calcium carbonate weakly cements the upper few feet of the deposits beneath about a foot of stony soil overburden.

The extensive flood plain deposits along the Belle Fourche River, (test localities CK-4, CK-8, CK-14, CK-16, CK-21, and CK-23), are 2 to 8 feet thick, and are composed mostly of limestone, sandstone, and limonite. Limonite locally comprises 20 to 50 percent of the fine gravel fraction. Sand commonly comprises about 25 percent of the deposits, but locally, as at test localities CK-4 and CK-14, makes up as much as 50 percent. Coarse gravel averages 15 to 20 percent. The deposit at test locality CK-23 is composed of interlayered beds of coarse and fine material. The overburden is a sandy soil 8 to 12 inches thick that in places supports cottonwood and willows.

Inyan Kara Creek.--Deposits on low terraces along Inyan Kara Creek are from 3 to 5 feet thick. The deposit at test locality CK-1 contains about 3,000 cubic yards of sand and gravel. The gravel in both deposits is mostly coarse, and composed primarily of limestone, but also contains a little sandstone, felsite, shale, and gypsum. The overburden is a stony soil 6 to 18 inches thick.

Eight miles west and downstream from test locality CK-1 is an extensive deposit (test locality CK-3) of coarse gravel and interbedded sandy silt, 8 to 10 feet thick. The gravel is composed of sandstone, limestone, limonite, and small amounts of quartzite. Calcium carbonate weakly cements the upper few feet of the material which is overlain by a sandy overburden about 2 feet thick. This deposit is accessible by truck road and, in 1947, was being stripped of overburden in preparation for use on State Highway 585 (not shown on the map) south of Sundance.

Redwater, Sundance, and Sand Creeks.--Small, terrace deposits occur along the tributaries of Redwater Creek. Their thickness ranges from 4 to 10 feet, and their volume from 300 to 6,000 cubic yards. Gravel, composed predominantly of limestone, but containing also small amounts of sandstone, quartzite, and felsite, comprises about 50 percent of the material in these deposits. Along Sundance Creek the gravel at test locality CK-13 is largely of quartzite; at test localities CK-12 and CK-17, it is largely of felsite. All the deposits are readily accessible. The overburden is a stony soil, 1 to 6 feet thick. The deposits at test localities CK-12 and CK-17 are under cultivation.

A tributary to Sand Creek, that flows beside State Highway 585, 6 miles south of Sundance, has some sand and gravel in its flood plain (test locality CK-5). About 50 percent of the gravel is limestone; the remainder is a mixture of sandstone, felsite, basalt, and quartzite. The thickness and volume of these deposits are unknown.

Hay Creek.--Sand and gravel deposits on terraces bordering Hay Creek are from 3 to 4 feet thick (test localities CK-19 and CK-20). The gravel, comprising about 60 percent of the material is mostly of sandstone, but contains numerous limonite concretions and small amounts of chert. The deposits are weakly cemented with calcium carbonate in their upper few feet, and covered by from 6 to 24 inches sandy overburden. Some of the deposits support an open pine forest.

Bear Lodge Mountains.--Small deposits of sand and gravel cap local terrace remnants in the Bear Lodge Mountains. The deposit at test locality CK-18 is 10 to 15 feet thick and contains about 10,000 cubic yards. About 75 percent of the gravel is felsite, but minor amounts of syenite, limestone, sandstone, and quartzite are also present. The upper 12 inches of the material is slightly cemented with calcium carbonate. The overburden is a stony soil, 2 to 4 feet thick. In the summer of 1947, the State Highway Department was using this gravel for road construction.

Fremont County

by

Gerald M. Richmond

General distribution of deposits

Fremont County has abundant supplies of sand and gravel that are well distributed over the county. Adequate deposits are lacking only in the northwest part of the county along U. S. Highway 287, in the east-central part, and in the south-central part. In the headwater sector of the Wind River, small deposits of sand and gravel occur on low terraces along the river from the foot of Togwotee Pass to the confluence of Jakeys Fork, and along Horse Creek, a major tributary. In this area, the gravel contains an abundance of volcanic rock, notably andesite, and large amounts of rotted granite. Northeast of Dubois, a high erosion surface is capped by deposits of a fine gravel, composed mostly of limestone, that has weathered from underlying conglomerate beds.

Along the Wind River from the confluence of Jakeys Fork to that of East Fork, the deposits are very bouldery. From the confluence of East Fork to that of Dinwoody Creek, deposits of sand and gravel cap low terraces along the river and are present in the flood plain. Extensive, but relatively coarse deposits also cap terraces along East Fork as far upstream as its canyon in the Owl Creek Mountains. Other deposits occur along the lower reaches of North Fork and Bear Creek. The gravel in these various deposits is composed of granite, quartzite, limestone, dolomite and volcanic rock. Much of the granite and volcanic rock is rotted.

Along the Wind River from the confluence of Dinwoody Creek to that of Bull Lake Creek, deposits are present in the flood plain of the river and on four terraces along it. These deposits are almost continuous along the west side of the river, and contain a considerable amount of rotted granite and volcanic rock. From the confluence of Bull Lake Creek to Riverton small deposits occur in the flood plain of the Wind River, but more extensive deposits cap six terraces that border it. The deposits are all similar, and contain 5 to 15 percent of rotted granite.

Deposits of sand and gravel cap terraces along Crow Creek and Dry Creek, but are not present in the flood plain of these streams. Terrace deposits also border the Little Wind River above its confluence with the Popo Agie River and in the vicinity of Fort Washakie. Still other deposits occur on three terraces bordering the North and the Middle Popo Agie Rivers downstream from their canyons in the Wind River Mountains. Only small deposits are present on the Little Popo Agie River. All of the deposits along the Little Wind River and the Popo Agie River contain an abundance of rotted granite, but no volcanic rock.

The Wind River becomes the Bighorn River at Riverton. Remnants of five terraces along the Bighorn River between Riverton and the Wind River Canyon in the Owl Creek Mountains are capped by deposits of sand and gravel that are most readily available deposits along the outer margins of the terraces. The material contains volcanic rock and some rotted granite.

Sand and gravel deposits cap two terraces along the north side of Five Mile Creek, but the flood plain of the creek contains only silty material.

Muddy Creek and Dry Muddy Creek have relatively few deposits of sand and gravel along them. Extensive terraces bordering these streams, are capped by only a thin veneer of gravel. North of Dry Muddy Creek, extensive pediment surfaces sloping south from the Owl Creek Mountains are capped by deposits that contain an abundance of angular, slabby fragments, and silt.

Small, thin deposits of sand and gravel cap terraces along the lower part of Badwater Creek; large deposits occur above the confluence of Bridger Creek, especially between Lysite and Lost Cabin. The material in these deposits contains many cobbles and some rotted granite. Pediment surfaces north of Badwater Creek, along the edge of the Owl Creek Mountains, are capped by only thin deposits of gravel. West of Bridger Creek much of this gravel is angular and slabby.

Small deposits of sand and gravel, not shown on the map, occur on terraces in the middle sectors of Deer Creek, Canyon Creek, and Muskrat Creek. No deposits were found on Poison Creek or Beaver Creek.

Along the Sweetwater River downstream from the crossing of U. S. Highway 287 are terrace deposits of fine sand and gravel. From the confluence of Soda Creek east to the county line, sand and gravel occur on low terraces along the stream. The gravel contains an abundance of rotted granite. Pediments south of the Sweetwater River are capped for the most part by bouldery deposits, but silty fine gravel and sand is present locally along their lower extremities.

Local descriptions

Wind River - Headwaters to the confluence of Jakeys Fork.--The Wind River heads on the east side of Togwotee Pass and flows southeast through Dubois to the confluence of Jakeys Fork. Few deposits occur along it on the east side of the pass. Small deposits, 3 to 5 feet thick, occur in the flood plain of the creek draining Brooks Lake, above the falls. The gravel averages 1 to 3 inches in diameter, and is composed mostly of volcanic rock. Exposures of volcanic breccia along U. S. Highway 287 on the east side of Togwotee Pass, contain local lenses of gravel. These lenses have been exploited in places, but the deposits are small. The gravel is composed entirely of volcanic rock, mostly basalt.

From the foot of Togwotee Pass, for a distance of 8 miles downstream along the Wind River, deposits of gravel 15 to 20 feet thick cap discontinuous terrace segments 15 to 20 feet above the river. The largest of these deposits is just north of the confluence of Sheridan Creek. The material is variable in texture. At test locality F-63, it contains about 60 percent gravel, 30 percent sand, and 10 percent fine sand, silt, and clay. North of Sheridan Creek the material contains abundant sand.. The gravel is composed mostly of rhyolite, andesite, but includes small amounts of tuff, sandstone and quartzite. About 25 percent of the fraction less than 2 inches in diameter is of soft rock, mostly rotted volcanics.

A large moraine in the valley of the Wind River, just above its confluence with the Du Noir River, is bordered on its south side by a broad gravel terrace that extends southward on the west side of the river for over a mile. The gravel is about 20 to 30 feet thick, and contains abundant cobbles and boulders. (Test locality F-59.) The

material is composed mostly of basalt, rhyolite, and andesite, but also contains small amounts of tuff, sandstone, and quartzite. High benches east of the confluence of the Du Noir River, are capped by very bouldery deposits. From the narrows below the confluence of the Du Noir River to the confluance of Jakeys Fork, an extensive silty overburden covers sand and gravel deposits along the east side of the Wind River. The silt thickens from about 3 feet along the river to 10 feet or more near the the valley wall. West of the river are extensive remnants of two terraces, 10 to 15 feet and 40 to 60 feet above the river. Sand and gravel underlies the full height of the lower terrace and forms a cap about 15 feet thick beneath the surface of the upper terrace. Ten to 15 percent of the material on both terraces consists of cobbles greater than 3 inches in diameter, 65 to 70 percant is gravel, and 20 percent is sand. The gravel is composed of basalt, rhyolite, and andesite, with small amounts of quartzite, granite, hard sandstone, and hard limestone. About 10 percent of the material consists of soft rock, mostly rotted volcanics and rotted granite. The upper 3 to 4 feet of the deposit on the upper terrace is moderately coated with calcium carbonate; the upper foot of the deposit on the lower terrace is similarly coated. On Little Warm Springs Creek the full thickness of the gravel on the upper terrace is firmly cemented by travertine, a hot spring deposit. The overburden on both terraces is commonly less than a foot thick.

Remnants of a higher terrace, 400 to 600 feet above the river, occur locally along the flank of the Wind River Mountains, but have only a thin veneer of cobbles and gravel on them. Upstream from the confluence of the Du Noir River they are mantled with till in many places.

Du Noir River.--Sand and gravel occur in the flood plain of the Du Noir River, but are commonly covered by 2 to 5 feet of silty alluvium. The water table is near the surface. The deposits are probably 15 to 25 feet thick. At the upper end of the broad sector of the valley, deposits of coarse gravel and cobbles are exposed along the river. Low alluvial fans underlain by sand and gravel occur where tributary streams enter the east side of the valley. These deposits contain about 5 to 20 percent cobbles and boulders, 60 percent gravel, and 20 to 35 percent sand. The gravel is composed mostly of basalt, rhyolite, and andesite, with small amounts of quartzite, hard sandstone, and hard limestone. The amount of soft rock ranges from 10 to 60 percent in different deposits. The valley has been glaciated and the walls, particularly at the lower end, are mantled with till which is locally gravelly, but commonly contains 25 percent or more of fine sand, silt and clay (test locality F-56).

Horse Creek.--The valley of Horse Creek has been glaciated. Remnants of a lower moraine occur on the hill east of Dubois and an upper moraine lies across the valley about 3 miles upstream. Deposits of sand and gravel underlie the valley floor between the two moraines. The deposits are probably at least 15 to 20 feet thick, and contain abundant cobbles and boulders for a distance of about a mile downstream from the moraine. The gravel is composed of granite, gneiss, hard sandstone, limestone, quartzite, and basalt. Much of the granite is rotted. A cover of alluvial silt, though commonly less than 2 feet thick, ranges up to 15 feet thick in the middle of the valley. Due to irrigation, the water table is near the surface.

Segments of gravel-covered terraces lie along both sides of this part of the valley, about 80 to 100 feet above the stream. The deposits range from 3 to 20 feet in thickness. Near Dubois, the gravel on the terrace west side of the creek is composed of granite, gneiss, hard limestone,limestone, and quartzite, with no volcanic rock. Deposits on terrace upstream are similar, but contain up to 15 percent of volcanic rock, mostly basalt. All of these deposits contain much rotted granite. The material is silty, and locally includes abundant cobbles, 3 to 12 inches in diameter.

Only small deposits were found in the bed of the creek upstream from the upper moraine. The material in them is clean, well-graded sand and gravel with few cobbles. The gravel is mostly of volcanic rock, with small amounts of granite, gneiss, hard sandstone, quartzite, and limestone. Much of the granite is rotted. These small deposits are particularly abundant along the sector of the valley below T-Cross Ranch on terraces 20 feet above the stream.

Northeast of Dubois, the road to the airport traverses a high plain that slopes to the southwest. The plain is mantled in many places by 2 to 15 feet of material containing 40 to 50 percent gravel and 50 to 60 percent coarse to fine sand. The gravel is composed of dense, hard limestone, hard sandstone, and small amounts of chert. It contains no granite or volcanic rock. These deposits appear to have weathered from underlying conglomeratic bedrock.

The high terrace on which the Dubois Airport is located is underlain by extensive deposits of bouldery gravel about 40 feet thick. The material contains about 20 percent cobbles and boulders, 3 inches to 24 inches in

diameter, 60 percent gravel, 15 percent sand, and 5 percent silt and clay. Almost all of the gravel is composed of volcanic rock, (basalt, andesite, rhyolite, tuff, and breccia) though minor amounts of hard dense limestone and dolomite are also present. About 40 percent of the volcanic rock is rotted. The upper 3 to 8 feet of the deposits are firmly cemented with calcium carbonate.

Warm Springs Creek.--Sand and gravel deposits occur on each of three terraces in the middle sector of the valley of Warm Springs Creek. Deposits on the upper terrace are 3 to 5 feet thick, those on the middle terrace are 10 to 15 feet, and those on the lower terrace are 10 to 15 feet. All are similar in character and comprise about 30 percent cobbles, 3 to 10 inches in diameter, 50 percent coarse to fine gravel, and 20 percent arkosic sand. The gravel is composed for the most part of hard, well-rounded, varicolored quartzite, but includes small amounts of gneiss, basalt, tuff, and rhyolite.

Wind River.--Confluence of Jakeys Fork to confluence of Dinwoody Creek.--A series of four large moraines lie across the valley of Jakeys Fork near its confluence with the Wind River. The outermost of these moraines has forced the Wind River eastward against badland bluffs. From this outer moraine downstream to the confluence of East Fork, deposits of sand and gravel cap small remnants of three terraces 30, 200 to 250, and 270 to 300 feet above the stream. Similar deposits cap an extensive terrace lying between the Wind River and East Fork, and 200 to 250 feet above them, for a distance of 2 miles upstream from their confluence. These various deposits are 20 to 30 feet thick. They are, however, very bouldery and contain large amounts of silt and clay.

A deposit of gravel underlies the flood plain of East Fork at its confluence with the Wind River (test locality F-48), and small deposits are present locally in the flood plain of the Wind River downstream to the confluence of Dinwoody Creek. Throughout this same distance, and 30 to 40 feet above the Wind River are a series of low terrace segments capped by sand and gravel deposits that are 15 to 20 feet thick. Most of these deposits are on the south side of the stream. The material comprises 15 to 20 percent cobbles, 3 inches to 2 feet in diameter, 60 to 70 percent gravel, 15 to 20 percent sand, and small amounts of silt and clay. Near the confluence of East Fork about 50 percent of the gravel is basalt, 15 percent consists of other volcanic rock types, and there are small amounts of granite, hard limestone, quartzite, and hard sandstone. About 5 to 10 percent of the material is rotted volcanic rock. Downstream, toward Dinwoody Creek, the proportion of basalt decreases to about 25 percent, that of granite increases to about 25 percent and that of limestone increases to about 45 percent. Rotted rock decreases to about 5 percent. In places thin alluvial fans of silty material overlap these deposits. A higher terrace 200 to 250 feet above this sector of the Wind River is capped by only a veneer of gravel. A still higher terrace or pediment, about 300 feet above the river, is capped by thin deposits of sand and gravel. It forms an extensive upland east of the confluence of the Wind River and East Fork.

In the vicinity of the confluence of Dinwoody Creek the flood plain of streams tributary to the Wind River from the north contain moderately large deposits of arkosic sand and fine granitic gravel.

East Fork, North Fork, and Bear Creek.--Sand and gravel deposits occur in many places along the flood plains of East Fork, North Fork, and Bear Creek, and on terraces bordering these streams. Deposits also cap remnants of a high terrace or pediment surface lying between East Fork and the base of the Absaroka Mountains.

The deposits in the flood plains of the three streams are commonly overlain by from 2 to 5 feet of silty alluvium. Those along Bear Creek, for a distance of 2 miles above its confluence with East Fork, consist of a few cobbles and boulders up to 12 inches in diameter, 65 to 75 percent gravel, 20 to 30 percent sand, and 5 to 10 percent silt and clay. The material is mostly of limestone, dolomite, quartzite, granite, but also contains small amounts of volcanic rock. Deposits along East Fork and North Fork are similar to those along Bear Creek, but contain more volcanic rock, and more fine sand, silt, and clay. Terraces, capped by sand and gravel, border East Fork from its confluence with the Wind River upstream to the confluence of North Fork. Deposits on a terrace on the west side of the stream, and about 60 feet above it, are mostly covered by silty alluvium, but where exposed are 20 to 30 feet thick. They consist of 70 to 80 percent gravel, 15 to 25 percent sand, and small amounts of silt and clay. The gravel is mostly of hard limestone, granite, and basalt, but also contains small amounts of other volcanic rock types, quartzite, and sandstone. About 10 percent of the gravel consists of rotted granite and basalt. The upper 12 to 18 inches of the deposits are slightly coated with calcium carbonate. The overburden is thin and sandy.

Another terrace, capped by deposits similar to those just described, is extensively preserved on the north side of East Fork near its confluence with North Fork, where it is about 90 feet above the stream. (Test locality F-49.) Similar deposits also occur on three terraces that border both sides of North Fork above its confluence with East Fork, and lie 60, 75, and 90 feet above the stream respectively. Similar deposits also cap a low terrace that borders Bear Creek, for a distance of about 2 miles above its confluence with East Fork.

Small deposits of sand and gravel cap segments of a high terrace, 200 to 250 feet above the stream, that lies along the west side of East Fork from its confluence with the Wind River to the confluence of North Fork, and for a distance of about 4 miles up the west side of Nork Fork. More extensive deposits cap a broad remnant of this terrace between North Fork and East Fork near their confluence. The deposits are 15 to 20 feet thick. About 10 percent of the material consists of cobbles, 40 to 50 percent is gravel, 30 percent is sand, and up to 20 percent is silt and clay. The gravel is similar in lithology to that on lower terraces, described above. Their upper few feet are moderately coated with calcium carbonate. Deposits on remnants of this high terrace along Bear Creek are very bouldery, but extensive deposits on the same terrace along the north side of East Fork, above its confluence with Bear Creek, consist mostly of gravel 5 to 10 feet thick. Upstream, however, below the canyon through the granite ridge, the deposits are again bouldery. The material in each of these places is mostly of volcanic rock, but includes small amounts of granite, limestone, and sandstone. About 10 to 15 percent of the volcanic rock is rotted. The upper few feet of the deposits are moderately coated with calcium carbonate, and are overlain by 12 to 24 inches of silty sand.

Along East Fork, upstream from the canyon through the granite ridge, mentioned above, bouldery deposits, containing abundant coarse arkosic sand, cap pediment surfaces that head on the slopes of the Absaroka Mountains. The gravel in these deposits is angular to subangular.

Many of the flat summit areas in the badlands east of East Fork are capped by material that ranges from a thin veneer of cobbles to deposits 30 feet thick. These deposits contain abundant large boulders and cobbles, small amounts of coarse gravel, and fine gravel, coarse to fine sand, and silt. The gravel is composed of granite, hard sandstone, limestone, dolomite, and a very small amount of volcanic rock. Much of the granite is deeply rotted. The sand and fine gravel components contain abundant feldspar, much of which is crumbly.

North Mesa and Coulee Mesa are capped by deposits up to 150 feet thick, that consist of bouldery gravel, sand, and silt composed almost entirely of volcanic rocks.

Dinwoody Creek.--No important deposits of gravel occur along Dinwoody Creek. The three lower lakes are enclosed by large moraines, the outermost of which extends to the Wind River. Small deposits of arkosic sand occur on the downstream side of the moraines between the lakes, and small deposits of clean quartz sand occur in dunes at the east end of a small rock-enclosed lake upstream.

Wind River--Confluence of Dinwoody Creek to confluence of Bull Lake Creek.--From the confluence of Dinwoody Creek to the confluence of Bull Lake Creek, sand and gravel occurs in the flood plain of the Wind River, but the deposits are covered in many places by 1 to 5 feet of alluvial silt. Locally the bed of the river contains extensive bars of sand and gravel.

Four terraces border the river discontinuously. The upper two are capped by deposits of till or coarse bouldery gravel. The lower two terraces, 200 to 250 and 40 feet above the river respectively, are capped by deposits of sand and gravel which are almost continuous on the west side of the river. Deposits on the higher terrace are 15 to 20 feet thick, those on the lower only 5 to 8. Both consist of 5 to 15 percent boulders and cobbles, 55 to 60 percent gravel, 20 to 35 percent sand, and 5 to 10 percent sand, silt, and clay. The gravel is composed of granite, hard limestone, quartzite, and small amounts of sandstone, chert, basalt, and other volcanic rocks. About 5 to 10 percent is rotted granite, most of which is in the fraction less than one inch in diameter. North of the confluence of Bull Lake Creek, basalt and other volcanic rock types, derived from the south end of the Absaroka Mountains, comprise 40 to 55 percent of the deposits. (Test localities F-35, F-38.)

Deposits on the higher terrace are moderately coated, and in places well cemented, with calcium carbonate to depths of from 5 to 15 feet. The soil cover is commonly less than a foot thick, though along U. S. Highway 287 north of Bull Lake Creek 5 to 30 feet of bedded silt and clay cover the gravel over an area of about one-half a square mile. Deposits on the lower terrace are slightly coated with carbonate to a depth of 2 to 3 feet and are capped by only a veneer of soil.

Crow Creek.--The flood plain of Crow Creek is underlain mostly by fine sand and silt. A terrace on the west side of the creek and 300 to 350 feet above it is capped by extensive deposits of sand and gravel. Two higher terraces, which lie east of the river and grade into pediments at the foot of the Owl Creek Mountains, are covered by silty bouldery

deposits. A high terrace remnant east of the confluence of Crow Creek and the Wind River has only a thin veneer of cobbles and gravel on it.

The deposits on the terrace, 300 to 350 feet above the creek, are 15 to 25 feet thick. They contain up to 20 percent cobbles and boulders, 50 to 70 percent gravel, and 15 to 25 percent sand, silt, and clay. The sand is arkosic. The gravel is composed mostly of basalt, other volcanic rocks, granite, and small amounts of hard sandstone and limestone. About 20 percent of the rock is soft. The upper 10 to 15 feet of the gravel is moderately coated with calcium carbonate, over which the sandy soil cover is 12 to 24 inches thick.

Along the county road on the west side of Crow Creek at a point about 10 miles north of the confluence of Crow Creek and Wind River is a large sand dune about 50 feet high and over 200 feet in length and width. This dune (test locality F-43) is composed of pink, coarse to medium, clean, quartz sand containing a very small amount of feldspar. It is one of the few clean quartz sand deposits in the county.

Wind River.--Confluence of Bull Lake Creek to Riverton.--A series of large moraines enclose Bull Lake and extend east to the Wind River. This morainal area contains no sand and gravel except for small deposits interbedded in the till.

Along the Wind River from the confluence of Bull Lake Creek to Riverton deposits of sand and gravel cap segments of six different terraces that occur discontinuously on both sides of the river. The deposits are more abundant on the southwest side of the river than on the southeast side. The most extensive are on the two highest terraces southwest of the river between Bull Lake Creek and Riverton, and north of the river northwest of Riverton.

The deposits on all six terraces are 15 to 20 feet thick and similar in character. The material comprises 5 to 15 percent cobbles, 60 to 70 percent gravel, 15 to 30 percent sand, and a little silt and clay. The quantity of cobbles and boulders in these deposits increases greatly within 1 to 2 miles of the moraines on Bull Lake Creek. The composition of the gravel is 10 to 30 percent granite, 5 to 15 percent quartzite, 45 to 70 percent basalt, 5 to 15 percent other volcanic rocks such as rhyolite and andesite, 5 to 15 percent hard limestone, and small amounts of hard sandstone, chert, and shale. From 5 to 15 percent of the granite and basalt or other volcanic rock is rotted.

On the lower two terraces, the upper 2 to 3 feet of the deposits is slightly coated with calcium carbonate; on the middle two terraces, the upper 6 to 10 feet is moderately to heavily coated; on the upper two terraces, the upper 10 to 15 feet of the deposits is moderately to heavily coated and veined with calcium carbonate. Some of the deposits on the two higher terraces, particularly those on the lower slopes of the Wind River Mountains, are very deeply weathered throughout. Such deposits have not been included on the map.

Extensive deposits of clean, wind blown, medium- to coarse-grained quartz sand occur on the southwest side of the Wind River 2 miles east of the bridge across the Wind River at the junction of U. S. Highway 287 and State Highway 287. The deposits lie just south of the terrace gravels along the river, and are derived from nearby fairly soft sandstone beds.

The flood plain of the Wind River contains bars of sand and gravel, but in most places these deposits are overlain by 2 to 5 feet of silty alluvium. Silty alluvial fans also encroach on the flood plain locally.

Dry Creek /.--The course of Dry Creek southeast from the Owl Creek

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_/ The map information for the upper half of Dry Creek is modified after Andrews, D. A., (1944) Geologic and structure contour map of the Maverick Springs area, Fremont County, Wyoming, U. S. Geological Survey Oil and Gas Investigations, Preliminary Map No. 13.

Mountains to the Wind River contains only sandy or silty alluvium. However, the creek is bordered discontinuously on both sides by three terraces on which are deposits of sand and gravel. The deposits on lower terrace are 3 to 8 feet thick and contain few boulders or cobbles. The gravel is composed of quartzite, granite, basalt, limestone, and hard sandstone. A small amount of the granite and basalt is deeply weathered. The soil cover is sandy and from 6 inches to 5 feet thick. The deposits on the middle terrace are similar to those on the lower, but contain more weathered material, and have a thicker soil cover. The deposits on the highest terrace lie on extensive flat to gently interstream divides. They are 10 to 50 feet thick, and contain numerous boulders which are as much as 10 feet in diameter near the mountain front. The matrix is an arkosic sand that is locally firmly cemented with calcium carbonate. These deposits on the highest terrace are not shown on the map.

Little Wind River.--Extensive deposits of angular feldspathic quartz sand occur upstream from moraines on the North Fork of the Little Wind River about 8 miles west of Fort Washakie. Downstream from these moraines are three terraces, 30, 60, and 80 feet above the river, on which are deposits of sand and gravel. The upper two terraces extend discontinuously as far east as Fort Washakie, and a gravel pit

(test locality F-28) has been developed in the deposits on the highest terrace along U. S. Highway 287 north of Fort Washakie. The lowest terrace extends almost continuously along the south side of the river from the moraines to Fort Washakie, and is also present on the southeast side of Mill Creek near its confluence with the Little Wind River.

The deposits on all three terraces contain abundant cobbles and boulders for a distance of about 4 miles downstream from the moraines. Below this point, the deposits on the upper two terraces are 10 to 15 feet thick, and contain 10 to 15 percent cobbles, 50 to 60 percent gravel, 20 to 25 percent sand, and 5 to 10 percent silt and clay. The gravel is composed of granite, granodiorite, gneiss, and small amounts of hard limestone. About 15 percent of the rock is rotted granite, granodiorite, gneiss, and small amounts of hard limestone. About 15 percent of the rock is rotted granite, granodiorite, or gneiss. The sand is arkosic and micaceous. These deposits are only slightly coated with calcium carbonate, and have a thin overburden.

The deposits on the lower terrace may be as much as 30 to 40 feet thick, but the ground water table is at a depth of approximately 20 feet. The material is similar in texture and composition to the deposits on the upper two terraces, but locally contains fewer cobbles and more sand. West of Fort Washakie, the deposits on the low terrace have only 1 to 2 feet of soil cover. East, from Fort Washakie to the confluence of the Popo Agie River, however, the deposits are covered by silty alluvium which ranges from a thin veneer at the edge of the terrace to as much as 15 feet thick along the valley wall.

Any sand and gravel deposits in the flood plain of the river are covered by several feet of silty alluvium.

North Fork of the Popo Agie River.--The North Fork of the Popo Agie River is bordered discontinuously by three terraces, 60 to 80, 40 to 50, and 15 to 25 feet above the stream, on which are deposits of sand and gravel, these terraces grade upstream into moraines located at the mouth of the canyon.

The deposits on the upper two terraces are 20 to 30 feet thick, and contain 10 to 20 percent cobbles and boulders, 50 to 60 percent gravel, 15 to 20 percent arkosic coarse and medium sand, and 5 to 10 percent fine sand, silt and clay. The gravel is mostly composed of granite, quartzite, and limestone. It includes 10 to 15 percent of soft rock, such as rotted granite, siltstone, shale, and soft limestone. (Test localities F-18, F-19.) The upper 10 feet of the deposits beneath the thin overburden are coated with calcium carbonate. Northeast of the river across U. S. Highway 287 toward Mill Creek, the deposits on the upper terrace are thin and bouldery.

The deposits on the lower terrace are at least 20 to 30 feet thick, and, except in the proximity of the moraines, contain fewer cobbles and boulders than those on the upper terraces. The gravel and sand are very similar lithologically to that on the upper terraces. The upper few of the deposits beneath the thin overburden are slightly coated with calcium carbonate. Owing to irrigation, the water table is locally near the surface.

Middle Fork of Popo Agie River.--The Middle Fork of the Popo Agie River, downstream from its canyon in the Wind River Mountains, is bordered discontinuously by remnants of three terraces, on which are deposits of sand and gravel. Upstream from Lander, the deposits on all three terraces are very bouldery.

Southeast of Lander, the upper terrace, 160 to 170 feet above the stream, is best developed on the south side of the stream at the rodeo grounds and near the cemetery. (Test locality F-15.) At Lander, the middle terrace forms a broad bench south of the river and about 60 feet above it. A similar terrace segment is also preserved on the north side of the Middle Fork at the confluence of the North Fork. The deposits on the upper and middle terraces are commonly 15 to 20 feet thick, but locally are only 6 feet thick. The material contains 10 to 20 percent cobbles, 50 to 70 percent gravel, 15 to 25 percent coarse and medium sand, and 5 to 10 percent fine sand, silt, and clay. The gravel, is composed of hard limestone, granite, granodiorite, gneiss, and quartzite with minor amounts of soft sandstone and shale. About 25 percent of the igneous rock is rotted. The sand is arkosic. Locally, as at test locality F-15, beds of sand 4 to 8 feet thick are interlayered with the gravel. The upper 10 feet of the deposits is commonly coated with calcium carbonate, beneath a sandy overburden, 6 inches to 3 feet thick.

The low terrace borders the north side of the river from the mouth of the canyon at the mountain front to the confluence of the North Fork. It lies about 35 feet above the stream and is the terrace on which Lander is located. The deposits on the lower terrace are similar to

those on the upper terrace, but contain fewer cobbles and boulders. The gravel also contains more granite, granodiorite, and gneiss, and less limestone and quartzite than that on the upper terrace. The upper 2 to 3 feet of the material is locally coated with calcium carbonate, beneath sandy overburden, 6 inches to 3 feet thick. The water table is near the surface of the terrace in many places, owing to irrigation. The flood plain of the river contains little commercial sand and gravel.

Popo Agie River.--From the confluence of the North Fork and the South Fork to Hudson, deposits of sand and gravel cap a terrace segment 60 feet above the river on the north side between Lander and Hudson (test locality F-17). Other deposits occur on a terrace 35 feet above the stream on the north side at Hudson. Than deposits are similar to those on the middle and lower terraces on the Middle Fork.

Between Hudson and the confluence of the Little Wind River there are no sand and gravel deposits along the Popo Agie River. Between the confluence of the Little Wind River and that of the Wind River deposits are lacking on the south side of the Popo Agie River, but occur on two terraces along the north side beneath a shallow cover of silt. The deposits on both terraces are 15 to 20 feet thick and similar in character. The material contains about 10 percent cobbles, 50 to 60 percent gravel, 30 to 35 percent sand, and a little silt and clay. About 50 percent of the gravel is granite, granodiorite, or gneiss, 40 percent is hard limestone, and minor amounts are of quartzite, sandstone and chert. About 15 percent of the rock is soft, most is rotted granite or granodiorite. Calcium carbonate coats the upper

few feet of the deposits on the lower terrace, and the upper 8 to 10 feet of the deposits on the upper terrace.

Gravel occurs locally in the flood plain of the Popo Agie River, as at test locality F-21. The deposits are similar to those on the terraces, except that they contain fewer cobbles and less rotted material. Where the flood plain of the Popo Agie River joins that of the Wind River, basalt and other volcanic rocks, such as andesite and rhyolite, make up about 30 percent of the gravel. (Test locality F-20.)

Little Popo Agie River.--Little gravel or sand of any consequence occurs along the Little Popo Agie River upstream from Hudson to the crossing of U. S. Highway 287. On the bluffs south of Hudson, at test locality F-16, a number of small pits have been opened in gravel that is weathered from an underlying conglomerate. The material is 5 to 10 feet thick, and contains about 70 percent gravel, 30 percent sand, and a little silt. The gravel consists mostly of limestone, but includes small amounts of chert, hard sandstone, quartzite, and quartz. The sand is composed of quartz and limestone. The deposits are moderately coated with calcium carbonate, and are covered by 18 to 24 inches of sandy soil.

From the crossing of U. S. Highway 287 upstream to the mouth of the canyon, deposits of sand and gravel cap at least two terraces along the river. (Test locality F-13.) The deposits are very dirty, and are overlain in many places by several feet of silt. The material contains about 50 percent gravel, 25 percent sand, and 25 percent silt and clay. The gravel is subangular to subrounded and consists of limestone, dolomite, and minor amounts of quartzite, hard sandstone, shale, granite, and chert.

Bighorn River - Riverton to Neble.--The Wind River and the Popo Agie River join at Riverton to form the Bighorn River. Along the northwest side of the Bighorn River, between Riverton and Neb[illegible], deposits of sand and gravel cap remnants of five terraces that are approximately 20, 30, 60, 80, and 400 feet above the river. Only small widely separated remnants of two of these terraces occur on the southeast side of the river. A silty overburden covers all of the terraces except the highest, with the result, that the sand and gravel is exposed only along a relatively narrow strip at the outer margin of each terrace. Only these exposed deposits of sand and gravel are shown on the map. The flood plain of the river also contains gravel, beneath several feet of silty alluvium.

The deposits on the lower four terraces are 10 to 15 feet thick. They contain 10 to 15 percent cobbles, 50 to 60 percent gravel, and 25 to 35 percent sand. About 5 percent of the particles are flat. About 20 to 25 percent of the gravel is granite, 10 to 25 percent quartzite, 40 to 50 percent basalt, 5 to 15 percent volcanic rock such as andesite and rhyolite, and 3 to 6 percent chert and chalcedony. About 5 to 15 percent of the rock is rotted granite, basalt, or other volcanic rock. The upper 8 to 10 feet of the deposits are coated with calcium carbonate.

The deposits on the highest terrace are very extensive north of the airport at Riverton, where they are 15 to 20 feet thick. In general they are similar to the deposits on the lower terraces, but contain fewer cobbles and boulders, and form 55 to 70 percent of the basaltic gravel. The upper 10 feet of these deposits are coated with calcium carbonate beneath a sandy overburden 3 to 5 feet thick.

Bighorn River - Neble to Wind River Canyon.--From Neble to the south end of the Wind River Canyon, the Bighorn River flows on a flood plain nearly half a mile wide. Sand and gravel deposits beneath the flood plain are overlain by at least 10 feet of silty alluvium. The flood plain is bordered on both sides by discontinuous segments of five terraces, 15 to 20, 30 to 40, 80 to 100, 140 to 160, and 450 to 480 feet above the stream. Extensive deposits of sand and gravel cover these terraces on the west side of the Bighorn River opposite the confluence of Muskrat Creek. On the east side of the river, large deposits occur south of the confluence of Poison Creek, between Poison Creek and Badwater Creek, and between Badwater Creek and the Wind River Canyon.

The deposits on the lower two terraces are 30 to 40 feet thick; those on the middle two terraces are mostly 3 to 5 feet thick, but locally as much as 15 feet thick. The deposits on the upper terrace are 10 to 15 feet thick. All of the deposits are similar in character. They contain less than 15 percent of cobbles, in places less than 5 percent (test localities F-31 and F-39). From 60 to 80 percent of the material is gravel, and 10 to 35 percent is sand. Silt and clay constitute only a very small component. South of Badwater Creek, the gravel is composed of basalt, granitic rock, and quartzite, with minor amounts of andesite, chert, sandstone, limestone, and dolomite. From 5 to 15 percent of the material is soft, rotted, granitic rock, basalt, or andesite. North of Badwater Creek the deposits contain less basalt and considerably more limestone, dolomite, and granitic rock.

The upper few feet of the deposits are commonly coated with calcium carbonate beneath a sandy overburden which varies in thickness from a

thin veneer as along the outer edges of the terraces to as much as 5 feet in thickness. North of Badwater Creek the overburden has two components, a lower sandy or silty alluvium and an upper silty angular gravel.

Five Mile Creek _/.--Five Mile Creek flows southeast and east

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_/ The map information for the north side of Five Mile Creek east of longitude 108°30' is modified after Tourtelot, H.A, and Thompson, R. M., (1948), Geologic map of the Boysen area, central Wyoming, U. S. Geological Survey, Oil and Gas Investigations, Preliminary Map no. 93.

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from the Owl Creek Mountains and joins the Bighorn River west of Shoshoni. Its flood plain is underlain by fine sand and silt. Remnants of two terraces, on which deposits of sand and gravel occur, border the stream.

The two terraces are most extensively preserved on the north side of the creek along its lower sector. The deposits on them are 3 to 5 feet thick and contain few cobbles. The gravel is composed mostly of quartzite, granite, and limestone, with minor amounts of basalt, chert, and sandstone. About 10 to 15 percent of the rock is soft. The sand is mostly quartz. The deposits are covered by 1 to 3 feet of fine sand and silt.

Only a few small deposits occur along the middle sector of Five Mile Creek. However, the divide between Five Mile Creek and Muddy Creek in this sector is underlain by extensive deposits of sand and gravel, 3 to 5 feet thick, that are similar to those along the lower sector of the creek.

Along the upper sector of Five Mile Creek, where it leaves the foothills, local deposits on a terrace, 40 to 60 feet above the stream, occur at intervals along the stream to its confluence with Maverick Springs Creek_/, and along the south side of that creek for a distance

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_/ The map information for Maverick Springs Creek and the headwater region of Five Mile Creek is modified after Andrews, D. A., (1944), Geologic and structure contour map of the Maverick Springs area, Fremont County, Wyoming, U. S. Geological Survey, Oil and Gas Investigations, Preliminary Map No. 13.

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of 3 miles upstream. In the headwater region of Five Mile Creek deposits of sand and gravel cap remnants of the higher terrace on the west side of the creek.

Muddy Creek _/.--Muddy Creek flows southeast and east from the Owl

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_/ The map information for that part of Muddy Creek east of latitude 108°30' is modified after Tourtelot, H. A., and Thompson, R. M., (1948), Geologic map of the Boysen area, central Wyoming, U. S. Geological Survey, Oil and Gas Investigations, Preliminary Map No. 93.

The map information for the headwater region of Muddy Creek is modified after Andrews, D. A., Geologic and structure contour map of the Maverick Springs area, Fremont County, Wyoming, (1944), U. S. Geological Survey, Oil and Gas Investigations, Preliminary Map No. 13.

Creek Mountains and joins the Bighorn River opposite the confluence of Badwater Creek. There is little sand and and gravel of commercial quality

on Muddy Creek. The flood plain is underlain by fine sand, silt, and clay, and low terraces adjacent to the flood plain have only a thin cover of sand and gravel overlain by several feet of silt. An extensive terrace on the north side of the east-trending sector of the creek is capped by deposits of sand and gravel, which, though only a veneer at the edge of the terrace, thicken west and northwest to from 3 to 10 feet. The deposits are very dirty, contain many cobbles, and an abundance of flat and angular fragments. Pediment surfaces in the headwater region of the creek have 5 to 10 feet of coarse cobbly gravel on them. The material contains many angular fragments and is silty. The gravel throughout the length of this stream is composed of a heterogeneous mixture of basalt, granite, diabase, quartzite, limestone, and dolomite, locally derived from the Owl Creek Mountains.

Dry Muddy Creek and pediment surfaces along the south flank of the Owl Creek Mountains west of the Bighorn River _/.--Dry Muddy Creek flows

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_/ The map information for Dry Muddy Creek and the pediments along the south flank of the Owl Creek Mountains west of the Bighorn River is modified after Tourtelot, H. A. and Thompson, R. M., (1948), Geologic map of the Boysen area, central Wyoming, U. S. Geological Survey, Oil and Gas Investigations, Preliminary Map No. 93.

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east along the base of the Owl Creek Mountains, and joins the Bighorn River just upstream from the Wind River Canyon through the Owl Creek Mountains. The creek is bordered by two terraces capped by a thin veneer of cobbles and gravel. The material is angular, and composed of basalt, quartzite, granite, dense metamorphic rocks, limestone, and

dolomite. Pediment surfaces, graded to these two terraces, extend north along all major tributaries into the Owl Creek Mountains. The deposits on these surfaces range in thickness from a veneer to 10 feet. The material contains many cobbles and boulders, many angular and slabby fragments, and is very dirty. Most of the deposits, particularly those on the terraces, are covered by a few feet of silty alluvium. Sand dunes along the north side of the lower 9 miles of Dry Muddy Creek consist mostly of fine sand.

Badwater Creek and pediments along the south flank of the Owl Creek Mountains east of the Bighorn River _/.--Badwater Creek rises in Natrona

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_/ The map information for Badwater Creek and the pediment surfaces along the south flank of the Owl Creek Mountains east of the Bighorn River is modified after Tourtelot, H. A., and Thompson, R. M., (1948), Geological map of the Boysen area, central Wyoming, U. S. Geological Survey, Oil and Gas Investigations, Preliminary Map No. 93, and also after Tourtelot, H. A., and Christman, R. A., (1952), Geology of the Badwater area, central Wyoming. U. S. Geological Survey, Oil and Gas Investigations, QM 124.

County and flows west along the southern margin of the Owl Creek Mountains to the Bighorn River. Little sand and gravel occurs along the lower course of the creek below the confluence of Dry Creek. Between the confluence of Dry Creek and the confluence of Bridger Creek, along the route of the Chicago, Burlington, and Quincy Railroad on the north side of Badwater Creek, 5 to 10 feet of arkosic sand and gravel cap segments of two terraces 35 to 45 and 60 to 80 feet above

the stream. From Lysite to Lost Cabin, deposits of sand and gravel occur on segments of four terraces along Badwater Creek that are 15 to 20, 20 to 25, 30 to 40, and 60 to 80 feet above the stream. The flood plain of the creek and the lowest terrace are underlain by fine sand and silt. Deposits on the upper three terraces are 10 to 15 feet thick. The materials consist of 60 to 75 percent gravel, 20 to 35 percent sand, and 5 to 10 percent silt and clay. In the vicinity of Lysite, the deposits contain fewer cobbles than in the vicinity of Lost Cabin. The composition of the gravel is about 40 percent quartzite, 25 percent granite, 15 percent limestone and dolomite, with small amounts of sandstone, chert, quartz, and diabase. About 5 to 10 percent of the rock is rotted granite. The sand is arkosic. Less extensive but otherwise similar deposits of sand and gravel occur on Lysite Creek and along some of the other tributary streams. The overburden on all these deposits is thin.

The pediment surfaces along the south slope of the Owl Creek Mountains east of the Wind River and in the area southeast of Badwater Creek along the Fremont County-Natrona County line are capped by deposits of sand and gravel that range from a thin veneer to 15 feet in thickness and contain a large proportion of sand and silt. The gravel is subrounded to subangular, and is composed mostly of quartzite, granite, limestone, and dolomite.

Region drained by Poison Creek, Muskrat Creek and Beaver Creek.--Only the briefest reconnaissance was made of the region drained by Poison Creek, Muskrat Creek and Beaver Creek, and no mapping was done because of lack of an adequate base. No deposits of sand and gravel were found on Poison Creek as far east as Richards. Sand and gravel deposits, 3 to 10 feet thick, occur on two terraces, 20 and 60 feet above the streams,

along Deer Creek and Canyon Creek, and on three terraces, 8 to 10, 20 to 30, and 60 to 80 feet above the stream, along Muskrat Creek. The deposits on the 8 to 10 foot terrace are mostly a silty sand. None of the deposits are extensive and all are dirty. The material contains about 15 percent cobbles, 50 percent gravel, and 35 percent arkosic sand and silt. The gravel consists mostly of subangular to angular fragments of granite, dense schist, and diabase.

No deposits of sand and gravel were found along Beaver Creek.

The high interstream divides south of Moneta are locally capped by thin deposits of coarse arkosic sand and gravel.

Sweetwater River - Headwaters to crossing of U. S. Highway 287.--The Sweetwater River flows in a narrow canyon from its headwaters to within a few miles of the crossing of U. S. Highway 287. Only small deposits of bouldery gravel occur in the headwater region, and very few deposits occur along the canyon. About 6 miles upstream from the crossing of U. S. Highway 287 the valley widens, and segments of seven terraces, not shown on the map, occur on the north side of the river. These terraces are 6, 20 to 25, 50 to 90, 140 to 160, 245 to 260, 460, and 540 feet above the river. The flood plain of the river and lowest terrace are underlain by silty alluvium. Fifteen feet of sand and gravel occur on the 20-foot terrace, 25 feet on the 50-foot terrace, 10 to 15 feet on the 140- and 245-foot terraces, and 1 to 5 feet on the 460- and 540-foot terraces. The material on all but the upper two terraces is composed of angular to subangular fragments of granite, gneiss, and schist. Cobbles up to 12 inches in diameter are common, but not abundant. About 60 percent of the material is gravel and 40 percent is micaceous arkosic

sand. The material on the upper two terraces consists of fine subangular granitic gravel and coarse arkosic sand.

Sweetwater River - Crossing of U. S. Highway 287 to confluence of Soda Creek.--Along the south side of the Sweetwater River, between the crossing of U. S. Highway 287 and the confluence of Soda Creek, are four terraces, capped by deposits of sand and gravel, that lie 25 to 40, 60 to 80, 100, and 200 feet above the stream. Only local segments of the lowest terrace occur on the north side of the river. The deposits on the lowest terrace are 6 to 10 feet thick, those on the three higher terraces are 3 to 5 feet thick. All of the deposits, for a distance of 6 miles downstream from the bridge at the crossing of U. S. Highway 287, contain about 10 percent cobbles, 50 to 60 percent gravel, and 30 to 40 percent sand. (Test localities F-10 and F-11.) From a point 6 miles below the bridge to the confluence of Soda Creek, where the Sweetwater River enters a canyon in the granite hills, the deposits consist mostly of fine gravel, sand, and silt. (Test localities F-6, F-8, F-9.) Locally, as at test locality F-5, certain deposits contain some medium and coarse gravel. The composition of the gravel in these various deposits is about 60 to 70 percent granite, 15 to 30 percent dense schist, 5 to 10 percent quartzite, and small amounts of diabase, chert, sandstone, quartz, feldspar, and volcanic rock. Over half of the granite is rotted. The sand is feldspathic and includes small amounts of magnetite, mica, epidote, and other minerals. Much of the feldspar crumbles easily.

The deposits are locally cemented with iron oxide; particularly those on the higher terraces. The upper 1 to 3 feet of the deposits on

the lower terraces are coated with calcium carbonate. On the upper terrace this zone of calcareous coating is as much as 10 feet thick in places. The overburden on all of the terraces is thin and silty.

Extensive pediment surfaces slope north to the higher terraces along the Sweetwater River from Crooks Mountain and Green Mountain. The material on these pediments is as much as 30 feet thick along the base of the mountains, and is bouldery. The texture becomes finer downslope, and the lower extremities of the pediments are commonly capped by 10 to 15 feet of gravelly sand. The gravel is mostly of granite, but includes small amounts of chert, quartzite, schist, diabase, sandstone, and fine-grained tuff. The material contains large amounts of silt and clay and is thickly coated with calcium carbonate.

East of the junction of U. S. Highway 287 and the road to the gap east of Crooks Mountain are numerous sand dunes 20 to 30 feet high. They are elongated in a northeast direction, and are composed of medium- to fine-grained sand. The dunes become smaller, and the material in them more silty, eastward along U. S. Highway 287.

Sweetwater River - Confluence of Soda Creek to the Fremont County-Natrona County line.--Near the confluence of Soda Creek the Sweetwater River enters a canyon along which, for a distance of 10 miles, there are deposits of sand and gravel cap scattered segments of a low terrace, 20 to 25 feet above the stream. The deposits are 10 to 15 feet thick and contain about equal parts of sand and gravel. The gravel is mostly of granite and dense schist, but contains small amounts of diabase, quartzite, chert, and sandstone. Soft or crumbly material,

mostly rotted granite, constitutes 30 to 40 percent of the material. A few deposits, similar to those on the terrace, also occur in the bed of the river. Extensive alluvial fans in the nearby hills contain large deposits of sand and gravel, but the material is silty and much of the gravel is rotted.

South of the confluence of Sage Hen Creek the Sweetwater River turns south to U. S. Highway 287 and its valley widens. Along this part of the river the flood plain is marshy, and underlain by several feet of silt. A low terrace, 20 to 25 feet above the river and preserved on both sides of it, is capped by 10 to 20 feet of sand and gravel. (Test localities F-1 and F-2.) The material contains 50 to 60 percent gravel, 35 to 45 percent sand, and a little silt or clay. The gravel is mostly of granite, but includes some dense schist, diabase, quartzite, chert, and sandstone. About a third of the granite is rotted. The sand is feldspathic and contains small amounts of magnetite, mica, and epidote.

Alluvial fans slope from hills north of the Sweetwater River toward the flood plain and in places, overlap the terrace deposits. The material composing these fans is a dirty granitic gravel. Broad pediment surfaces slope north from the mountains south of the river. The upper slopes of the pediments are covered by as much as 30 feet of dirty bouldery gravel that is heavily coated with calcium carbonate. The deposits on the lower slopes are about 2 to 5 feet thick, and contain a large proportion of cobbles. At test localities F-3 and F-4, however, most of the gravel is less than 2 inches in diameter, and the material contains less silt and clay than elsewhere. These deposits are heavily coated with calcium carbonate and iron oxide, but have been used for road construction.

Over 50 percent of the gravel on the pediment surface is composed of granite, and, at test locality F-4, 90 percent is granite. The deposits also contain a larger proportion of sedimentary rock, especially quartzite, sandstone, and limestone, than do deposits on terraces along the river. The sand in the pediment deposits is arkosic.

Goshen County

by

J. M. Cattermole

General distribution of deposits

Goshen County contains large deposits of clean, durable, well-graded sand and gravel along the North Platte River, but elsewhere deposits are scarce.

The large deposits underlie the channel and flood plain of the North Platte River. Extensive gravel deposits, border most of the north side and a few places on the south side of the North Platte River valley. These deposits occur on terraces, and cappings on ridges or hills, and were formed as lag concentrates from the erosion of channel conglomerates at the base of the Arikaree formation. Material from these deposits has been used for road construction, canal riprap, and concrete aggregate.

North of the North Platte River valley, gravel is scarce. In the area west of U. S. Highway 85 between 6 and 12 miles north of Lingle a few hills are capped with gravel weathered from the Arikaree conglomerate. Northwest of Jay Em a few small deposits occur in the channels and bordering terraces of streams flowing out of the Hartville Mountains. North and east of Torrington sand dunes consist of dirty very fine sand.

In the southern part of the county, gravel deposits are small and the material less durable than that along the North Platte River. In the southwestern part of the county, along Bear Creek, are high terrace-gravel deposits composed of anorthosite, and dark, coarse-grained igneous rocks. This gravel, though only moderately resistant to wear, has been

used for road construction. East and southeast of La Grange, a high terrace deposit has been used by the railroad for ballast. Horse Creek has small deposits of sand and gravel beneath its channel and flood plain.

Local descriptions

North Platte River.--Throughout much of its course in Goshen County the channel and flood plain of the North Platte River are underlain by deposits of gravel ranging from 3 to 20 feet or more in thickness. Most all are north of the river, though notable deposits occur on the south side of South Torrington and near the state line. The deposits range from 3 to 20 feet in thickness and except in the river channel are covered by from 1 to 3 feet of silty alluvium. The maximum diameter of the gravel in some of the deposits is 3 inches, but in most it is only 1½ inches. About 50 percent of the material is of granite, 10 to 15 percent is quartz, 15 percent is quartzite, and minor amounts are of anorthosite, limestone, siliceous schist, sandstone, and chert. Although lenses of silt and mud are locally present, the gravels on the whole are clean and well graded.

From Torrington westward and at a few localities east of Torrington, the valley of the North Platte River is bordered by terraces, ridges, and knolls, capped by gravel deposits. Most of these deposits are north of the river, but between Fort Laramie and Lingle some are south of the river. One occurs southwest of Torrington. The material in these deposits has been derived from conglomerate at the base of the Arikaree formation. Though the proportion of rock types in the deposits varies from one locality to another, at those tested, 30 to 55 percent

of the gravel is granite, about 20 percent is quartz, 20 percent is quartzite, and minor amounts are of volcanics, schist, and sandstone. Chert is always found and amounts in places to 5 percent. A zone of caliche is present in the upper part of most deposits. The material is made up of alternating lenses of sand and gravel; and is, as a whole, well graded, clean, and durable. It has been used for road construction, canal riprap, and concrete aggregate.

Rawhide Creek.--Rawhide Creek a tributary to the North Platte River, is bordered along the lower 12 miles of its course by gravel-capped hills and ridges. The material in these deposits is more weathered, has more dirt in the minus-40 fraction, and has a higher percentage of sandstone and weathered material than in deposits along the North Platte. The deposit at test locality G-17 ranges from 8 to 15 feet in thickness, is covered by 24 inches of overburden, and contains lenses of fine sand interbedded with the gravel. The gravel is about 30 percent granite, 15 percent quartz, 18 percent sandstone, and 18 percent schist; the sandstone and schist are soft. The deposit at test locality G-18 is the product of conglomerate at the base of the Arikaree formation. The gravel is thin and discontinuous. Most of the material is less than three-quarters of an inch in diameter, and the largest pebbles are 3 inches across. The minus-40 fraction is very dirty. Northwest of Jay Em, along Rawhide Creek and the upper part of Muskrat Creek, several small deposits of gravel occur on terraces along the streams. The pebbles of these deposits have a maximum dimension of 3 to 5 inches. About half are of granite and half of limestone, schist, gneiss and chert. Three to 7 percent of the pebbles larger than one inch in diameter are chert.

La Grange area.--On the slope east of the town of La Grange a gravel-capped terrace extends to the southeast for a distance of 4 miles. A deposit at test locality G-1, in a railroad ballast pit, is about 15 feet thick, a near-maximum thickness. About 70 percent of the gravel consists of subangular particles of Sherman granite three-quarters of an inch in diameter, about 10 percent is soft sandstone, and minor amounts are of anorthosite and granite gneiss. The maximum diameter of the gravel is 3 inches. Layers of clay and sandy clay 2 to 3 feet thick are interbedded with the gravel, and a large proportion of clay is present in the minus-40 fraction throughout the deposit.

Bear Creek Valley.--The valley of Bear Creek, in the southwest part of the county, is bordered by high terraces capped with 6 feet or more of gravel, though no gravel is present in the channel or flood plain of the stream. The terrace deposits are composed of subangular to subround pebbles and cobbles of anorthosite, granite, and sandstone. The maximum dimension of cobbles ranges up to 3 inches. The material is fairly well graded and contains a large amount of silt and clay. On the outer edges of the terraces the overburden is very thin, but increases to 3 feet or more in thickness upslope.

Horse Creek.--Along Horse Creek, from the vicinity of La Grange northward, there are small deposits of gravel in the stream channel and beneath the flood plain close to the stream, test localities G-5, G-7, and G-9 are representative. The material is 3 to 6 feet thick, moderately weathered, and contains about 15 percent of soft friable sandstone. Though the maximum dimension of the cobbles is 3 inches, only a small

proportion exceeds one inch. Test locality G-6 is a sand deposit on the inside of a bend of the stream. Very little of the material is over three-fourths of an inch in dimension and the deposit contains a moderately high proportion of silt and clay.

Hot Springs County

by

Page E. Truesdell and Frank W. Foster

General distribution of deposits

Most of the sand and gravel deposits of Hot Springs County occur in the flood plains of major streams and on bordering terraces. Those shown on plate I are generalized after detailed mapping by Andrews, et al._/ The valleys of the Bighorn River, Owl Creek, Cottonwood Creek, Grass Creek, and Gooseberry Creek contain the most important deposits. These valleys are bordered by from 2 to 4 gravel-capped terraces. The lower two are well developed, and extend continuously for long distances. Deposits on them range from 2 to 15 feet thick. The upper two terraces are preserved mostly as isolated segments, and deposits on them are thin.

_/ Andrews, D. A., Pierce, W. G., and Eargle, D. H., Geologic map of the Bighorn Basin, Wyoming and Montana, showing terrace deposits and physiographic features, U. S. Geol. Survey Oil and Gas Investigations, Preliminary Map no. 71, 1947.

Along the Bighorn River terrace deposits are abundant east of Minnesela and between Lucerne and Kirby. Large deposits also occur in the flood plain of the river, especially near Lucerne. Deposits along Owl Creek are very extensive on the north side of the valley, and widespread deposits also occur on both sides of Cottonwood Creek. Small deposits are common on terraces along the lower third of Grass Creek, and on Gooseberry Creek east of Dickie.

Local descriptions

Bighorn River; Fremont County line to Kirby.--No important deposits of sand and gravel occur along the Bighorn River between the Fremont County line and Minnesela. Between Minnesela to Kirby the valley is bordered by a widespread terrace 60 to 160 feet, above the river, on which are extensive deposits. East of Minnesela (test locality HS-2) these deposits are 10 to 15 feet thick and comprise 75 to 80 percent gravel and 20 to 25 percent sand. The gravel is mostly of quartzite, limestone, felsite and granite, but includes some chert, especially in the fraction less than one inch in diameter.

North of Minnesela, along the river, (test locality HS-1) similar deposits have a sandy overburden 7 to 8 feet thick.

Deposits on terraces along both sides of the river in the vicinity of Thermopolis are strongly cemented throughout by hot spring deposits.

A deposit about 5 miles north of Thermopolis (test locality HS-3) contains an unusually high proportion of felsite--about 70 percent.

Between Lucerne and Kirby are abundant terrace deposits especially east of the river. Cobbles comprise 5 to 10 percent of these deposits, gravel about 65 percent, sand 5 to 15 percent, sand, and silt and clay 10 to 20 percent. The gravel is of quartzite, granite, felsite, and limestone, in order of abundance. Locally, as much as 15 percent of the granite is rotted. The fraction less than one inch in diameter commonly contains 5 to 15 percent of chert. The upper few feet of the deposits are weakly cemented with calcium carbonate beneath 2 to 3 feet of sandy or silty overburden.

The flood plain of the Bighorn River contains large deposits of sand and gravel. At Lucerne, for example, are extensive deposits 3 to 5 feet thick consisting of lenses of fine sand interbedded with beds of gravel. The gravel is of quartzite, granite, felsite, and limestone. About 5 percent is of rotted felsite. A thin layer of silt covers the deposits in places.

Owl Creek.--The north side of the valley of Owl Creek is flanked by four terraces on which are deposits of sand and gravel. In the headwater regions, two of these terraces extend up the North and South Forks of Owl Creek. The deposits range from 2 to 10 feet in thickness, and consist of about 60 to 70 percent gravel, 20 to 30 percent sand, and 3 to 15 percent silt and clay. Cobbles make up as much as 20 percent of the deposits in the headwater area but decrease in quantity downstream to about 5 percent. The gravel is composed mainly of felsite. The overburden on the deposits is thin and stony.

Cottonwood Creek.--The valley of Cottonwood Creek is flanked by three terraces on which are extensive deposits, 10 to 15 feet thick. The average deposit contains about 80 percent gravel, 10 percent sand, and 10 percent silt and clay. The gravel is composed of felsite, quartzite, basic volcanic rock, and limestone, in order of abundance. About 20 percent of the material less than one inch in diameter is soft. The overburden is thin and stony.

Grass Creek.--The lower part of the valley of Grass Creek is bordered on its south side by three terraces, too small to show separately on the map, on which are small deposits of sand and gravel. Other small deposits occur along the flood plain of the stream. The

material contains about 65 percent gravel, 25 percent sand, and 10 percent silt and clay. There are few cobbles. The gravel is composed predominantly of quartzite, but includes lesser amounts of felsite, limestone, and chert. About 25 percent of the rock is soft. A thin stony soil covers the deposits.

Gooseberry Creek.--The valley of Gooseberry Creek is bordered by two terraces on which are small deposits of sand and gravel, 4 to 6 feet thick. The material contains about 70 percent gravel, 10 percent sand, 20 percent silt and clay and a few cobbles. The gravel is of felsite, quartzite, basic volcanic rock (trap) and limestone in order of abundance. The overburden is a stony soil, 2 to 3 feet thick.

Deposits in the flood plain of Gooseberry Creek are small and isolated. Typical is that at test locality HS-11. This deposit contains about 70 percent gravel, 10 percent sand, and 20 percent silt and clay. The gravel is predominantly of quartzite but includes some felsite, limestone, and chert. A few cobbles are also present. The overburden ranges up to 4 feet in thickness.

Johnson County

by

Page E. Truesdell and Frank W. Foster

General distribution of deposits

Johnson County has extensive deposits of sand and gravel, which are for the most part along the east front of the Bighorn Mountains and in the valley of Clear Creek. Those shown on plate I are modified after Darton._/ Most of the deposits are on terraces and in the flood plains

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_/ Darton, H. H., U. S. Geol. Survey Geol. Atlas, Cloud Peak-Fort McKinney folio, no. 142, 1906.

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of the major streams such as the Crazy Woman Creek, Clear Creek, and Piney Creek and their tributaries. Other extensive deposits are derived from a bouldery conglomerate that occurs along the front of the Bighorn Mountains west of Buffalo or cap pediment surfaces bordering the foot of the mountains. Small bouldery deposits occur near moraines in the canyons and upland valleys in the mountains.

Almost no gravel was observed in the central and eastern parts of the county where the flood plains of the streams and the terrace that border them are mostly underlain by silty alluvium. "Scoria" associated with burned coal beds is, however, a local source of road metal.

In the southern part of the county small deposits of gravel occur on terraces along the Powder River in the vicinity of Kaycee.

Local descriptions

Powder River.--The Powder River flows eastward across the southern part of Johnson County, turns north at Sussex, and flows out of the northeast corner of the county. In the vicinity of Kaycee and Sussex, in the south-central part of the county, isolated terrace segments along the North and Middle Forks of the Powder River are capped by sand and gravel. The deposits are extensive, but most are only 2 to 6 feet thick. The gravel is composed primarily of limestone, but also includes sandstone, quartzite, granite, quartz, chert, and limonite. About one-third of the material is sand. The deposit at test locality J-4 contains about 20 percent silt and clay. In general, the upper few feet of the deposits are slightly cemented with calcium carbonate beneath a thin stony overburden.

Along a tributary of the North Fork of the Powder River, 11 miles north of Kaycee, is a high terrace capped by about 5 feet of sand and gravel (test locality J-6). The deposit contains about 2,500 cubic yards of material. The gravel is composed of quartzite, limestone, chert, sandstone, and minor amounts of limonite, quartz, feldspar, and granite. The upper 18 inches of the deposit is slightly cemented with calcium carbonate.

Crazy Woman Creek.--Crazy Woman Creek rises on the eastern slope of the Bighorn Mountains and flows northeast to join the Powder River in the northeast corner of the county. Just east of the mountains, along the North Fork of Crazy Woman Creek and its tributaries, several broad, gently sloping pediment surfaces are capped by sand and gravel (test localities J-7, J-8, and J-10). The deposits are from 2 to 12

feet thick, clean, and very extensive. About 80 percent of the gravel is of limestone, and dolomite. Sandstone, granite, quartzite, quartz, gneiss, chert, limonite, and basalt are minor constituents. The upper 18 inches of the material is slightly cemented with calcium carbonate, beneath a stony overburden, 1 to 3 feet thick. All of the deposits are near paved roads.

Along a tributary to Crazy Woman Creek 8 miles south of Buffalo is an extensive pediment capped by sand and gravel. The deposits are 10 to 15 feet thick and comprises at least 60,000 cubic yards. At test locality J-9 about 70 percent of the material is gravel, 20 percent is sand, and 5 percent is silt and clay. The gravel is mostly of limestone, but includes minor amounts of chert, gneiss, quartzite, granite, sandstone, and claystone. The overburden is about a foot thick.

Clear Creek.--Extensive conglomerate deposits extend northwest and southeast of the mouth of the canyon of Clear Creek at the foot of the Bighorn Mountains, 6 miles west of Buffalo. Sharp_/ reported that these

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_/ Sharp, R. P., Early Tertiary fanglomerate, Bighorn Mountains, Wyoming, Jour. Geol., v. 56, p. 6, 1948.

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deposits may be locally as much as 1,200 feet thick. At test locality J-12, the material is mostly fine gravel and sand, but contains some large boulders and cobbles and small amounts of silt and clay. The gravel is entirely of granite except for minor amounts of quartz-diorite and basalt.

High pediment surfaces along French Creek and Rock Creek, tributaries of Clear Creek, have thin but extensive sand and gravel deposits on them. The gravel at one of these deposits (test locality J-13) is mostly of granite, but contains some gneiss, trap, quartz-diorite, quartz, quartzite, and chert. The material consists of about 45 percent gravel, 45 percent sand, and 10 percent silt and clay.

Deposits of sand and gravel also occur in the flood plain of a north-flowing tributary to Clear Creek along U. S. Highway 87, 6 miles south of Buffalo (test locality J-11). The material is abundant and exceeds 6 feet in thickness. The gravel is mostly of limestone and contains some percent granite, and minor amounts of sandstone, quartzite, scoria, chert, and quartz.

Piney Creek.--Deposits of sand and gravel occur along Piney Creek west of Kearney, and large deposits of sand and fine gravel extend over a large area around the north end of Lake De Smet (test locality J-14). The gravel is mostly of limestone but contains minor amounts of "scoria," granite, and quartz. The upper 4 feet are slightly cemented with calcium carbonate.

(p. 90 follows)

Laramie County

by

J. M. Cattermole

General distribution of deposits

Deposits of sand and gravel are fairly abundant in the south and western parts of Laramie County, but are scarce in the northern part.

The high plains south and east of Cheyenne are covered by gravelly material, and the valleys of the streams incised into the high plains are locally bordered by gravel-capped terraces. From Cheyenne west to the edge of the mountains, the interstream divides are remnants of the high plains surface and are covered by the same gravelly material as that on the high plains to the east. In the north part of the county, a few deposits of gravelly material occur on the surface of the plains, and the stream channels and flood plains have local deposits of clean sand and fine gravel. In the western part of the county, the core of the Laramie Mountains is composed of deeply, disintegrated Sherman granite that is an abundant and readily available source of gravel material that has had wide use for many construction purposes.

Local descriptions

High Plains.--The high plains south and east of Cheyenne are mantled by a heterogeneous mixture of gravel, sand, silt and clay. Within this mantle, gravel is concentrated locally in pockets or channels. South and east of Cheyenne the mantle ranges from a few feet to over 100 feet in thickness, but is thin or lacking along the

east border of the county. East of U. S. Highway 87 north of the Union Pacific Railroad, the mantle is thin and concentrations of gravel are more widely separated.

The concentrations of gravel within this mantle have been used for road construction. The most readily located deposits are along the rims of the valley dissecting the high plains. The gravel material is composed mostly of Sherman granite, but also contains some gneiss, schist, and quartz. The granite component of the gravel is largely less than three-fourths of an inch in diameter and is subangular; material composed of other rock types ranges up to 6 inches in diameter in the western part of this area but only 2 inches in the eastern part, and are subround. Test localities La-5, La-6, La-11, La-12, La-13 and La-14 are representative of the high plains deposits in the southern part of the area; and test localities La-17, La-18, La-20, La-22, La-24, La-25, La-26, La-30, and La-31 represent those in the northern part.

West of Cheyenne gravelly deposits cap ridges and knolls that are remnants of the high plains surface. These deposits are variable both in thickness and lithology of material. Some are very similar to those of the high plains farther east, but others are coarser and contain more gneiss, schist, and limestone.

Crow Creek.--Local deposits of sand and gravel occur in the flood plain and channel of Crow Creek; and, in the vicinity of Carpenter, on a terrace 20 feet above the creek. The deposits (La-1 and La-4) are similar in composition to those of the high plains, but contain little silt and clay. This gravel has been used for concrete aggregate.

Lodgepole Creek.--In the vicinity of Pine Bluff and Egbert the channel and flood plain of Lodgepole Creek are underlain by small deposits of clean, well graded sand and gravel, test localities La-9 and La-10. The gravel fraction less than three-quarters of an inch in diameter is mainly Sherman granite; that over three-quarters of an inch (about 10 percent of the total) is largely gneiss, schist, and quartz. Similar deposits occur on remnants of a terrace along the upper part of Lodgepole Creek (test localities La-19 and La-28), and one of its tributaries (test locality La-8).

Horse Creek.--Terrace remnants capped with sand and gravel occur along the valley of Horse Creek. The deposits are composed of granite, gneiss, schist, and anorthosite (a dark coarse grained rock). Individual boulders range up to 2 feet in diameter at test locality La-32, but downstream the size of the material decreases to a maximum diameter of about 3 inches at test locality La-33. The available volume of each deposit ranges from about 50 to 100 thousand cubic yards.

Little Bear, South Fork of Bear, Bear Creeks.--The channels and flood plains of Little Bear, South Fork of Bear, and Bear Creek in the vicinity of U. S. Highway 87 are underlain by deposits of sand and gravel that average about 30 yards in width and 200 to 400 yards in length. The gravel fraction of these deposits less than three-quarters of an inch in diameter is mostly granite and anorthosite; the coarser fraction (over three-quarters of an inch) is anorthosite and sandstone. All the deposits contain large amounts of fine sand, silt, and clay.

Laramie Mountains.--West of the foothills the bedrock core of the Laramie Mountains is mostly Sherman granite. This granite is made up of coarse crystals of feldspar, interstitial quartz, and mica.

Weathering causes the Sherman granite to disintegrate into angular fragments of feldspar and quartz. The gravel fraction is about three-quarters of an inch maximum diameter and is about 65 percent (sand size about 35 percent) of the deposits. The disintegration extends to a depth of 50 feet or more in most of the areas of exposure. The disintegrated granite is readily excavated, and has been widely used as railroad ballast and construction aggregate. Subjected to the geologic processes of erosion, transportation, and redeposition a large part of the material of most of the gravel deposits in Laramie County is composed of fragments of Sherman granite.

Lincoln County

by

Gerald M. Richmond

General distribution of deposits

Lincoln County has abundant supplies of sand and gravel that are mostly on terraces along the major streams. Deposits cap six sets of successively higher terraces along the Green River. Along Hams Fork, from its headwaters to Diamondville, most deposits occur on low terraces along the stream. Downstream, especially below Opal, extensive deposits cap high terraces that border the valley. Numerous small deposits of gravel occur on low terraces throughout the valleys of Smiths Fork and Greys River almost to their headwaters. Twin Creek has a few small deposits along it.

Gravel deposits, overlain by 2 to 4 feet of silty alluvium, occur in the flood plain of Bear River, but many underlie irrigated hay fields. Small alluvial fans containing limestone gravel occur at the mouths of the larger tributary canyons, such as that of Twin Creek. Material in alluvial fans at the mouths of small tributary canyons is mostly of shale.

On the west side of the valley of Bear River, south of Cokeville, are extensive conglomerate deposits which in places are so loosely cemented that gravel can be readily excavated from them. Some gravel also occurs on low terraces along the east side of the river north of Cokeville.

Throughout Star Valley, the flood plain of Salt River contains abundant gravel. Extensive deposits also occur in broad alluvial fans that extend east and west from the river to the foot of the mountains. In general, the gravel on the east side of the river is more resistant to wear than that on the west side. The hills which separate the northern and southern basins, of Star Valley, are underlain by conglomerate that is locally unconsolidated enough to serve as a source of gravel. Low terraces along the river in the northern basin of Star Valley also have extensive deposits of gravel on them.

Along the canyon of the Snake River, in the northern part of the county most gravel deposits are small and very bouldery.

Local descriptions

Green River-Lincoln-Sublette County line to Labarge Creek.--The Green River from the Lincoln-Sublette County line to the confluence of Labarge Creek is bordered on the west side by two gravel-capped terraces 25 to 30 feet and 50 to 60 feet above the river.

The deposits on both terraces are 10 to 20 feet thick. Five to 10 percent of the material consists of cobbles, 60 to 80 percent is gravel, 8 to 20 percent is sand, and 5 to 15 percent is silt. In general, 10 to 25 percent of the gravel particles are flat. In the vicinity of test locality LN-51, over 90 percent of the gravel is limestone. Elsewhere, 30 to 50 percent of the gravel on both terraces is quartzite, 25 to 45 percent is limestone, 10 to 30 percent is sandstone, 2 to 7 percent is granite, and 5 to 10 percent is of soft rock types, mostly rotted granite and mostly concentrated in the fraction less than 1 inch in diameter. The deposits at test

localities LN-55 and LN-56 contain no granite, and thus less soft material than other deposits. The material in the upper 3 to 10 feet of the terraces is moderately coated with calcium carbonate but is not strongly cemented. In general, overburden ranges from 1 to 1.5 feet in thickness, but west of Labarge it is considerably thicker on deposits of the upper terrace. Most deposits have a sagebrush vegetation.

Green River-Labarge Creek to Fontanelle Creek.--From Larbarge Creek to Fontanelle Creak the Green River is bordered by two and locally three gravel-capped terraces, 15 to 20; 30; and 80 feet above the river. The deposits on the terraces east of the river are less than 3 feet thick. Those on the terraces west of the river are 3 to 6 feet thick between test locality LN-34 to test locality LN-38, but southward, they thicken to an average of 15 feet in the vicinity of the bend in the river at T. 25 N., R. 112 W. and at test locality LN-40 they are about 30 feet thick. In general about 60 to 80 percent of the material is gravel, 15 to 30 percent is sand, and 3 to 10 percent is silt and clay. An exception, test locality LN-34, is one of few deposits containing abundant sand. It consists of fine gravel and sand in about equal proportions and a small amount of silt and clay.

About 40 to 60 percent of the gravel in most deposits is of quartzite, 15 to 30 percent is granite, 15 to 20 percent is hard limestone, 5 to 15 percent is hard sandstone, and, in general 5 to 10 percent is of soft rock types. The soft material, mostly rotted granite, is largely in the fraction less than 1 inch in diameter.

At test locality LN-43 it makes up as much as 20 percent of the deposit. About 5 percent of the gravel particles are flat. Most of these are limestone. The upper 2 to 3 feet of the deposits is slightly to moderately coated with calcium carbonate, but none are tightly cemented. The overburden ranges in thickness from 0.5 feet to 2 feet. The vegetation is sagebrush or hay.

Green River-Fontanelle Creek to the Lincoln-Sweetwater County line.--Along U. S. Highway 189 south of Fontanelle Creek, extensive remnants of two high terraces, 335 and 360 feet above the Green River, are capped by 15 to 20 feet of sand and gravel in which pits have been developed (test localities LN-29 and LN-30). About 60 to 70 percent of the material in these deposits is gravel, 20 to 30 percent is coarse- and medium-grained sand, and 5 to 10 percent is fine sand and silt. Sixty to 70 percent of the gravel is quartzite, 5 to 15 percent is granite, and about 5 to 10 percent is of soft rock type including some rotted granite. The soft rock occurs mostly in the fraction less than one inch in diameter. Commonly about 5 percent of the particles are flat, though locally, as at test locality LN-30, about 10 percent are flat. Most of these particles are limestone. The upper 3 to 5 feet of the deposits are moderately to heavily coated with calcium carbonate. The overburden is from 1 to 1.5 feet thick, and supports sagebrush.

Remnants of four lower levels of gravel-capped terraces are extensively developed along this section of the Green River. The deposits on them range from 5 to 20 feet in thickness, but average about 10 feet in thickness. About 3 to 5 percent of the material

consists of cobbles, 70 to 75 percent is gravel, 15 to 20 percent is sand, and 5 to 10 percent is fine sand, silt, and clay. The gravel is largely of quartzite, hard sandstone and hard limestone, though a little is granite. The limestone and a small amount of soft rock types are concentrated in the fraction less than 1 inch in diameter. The upper few feet of the deposits is slightly to moderately coated with calcium carbonate. The overburden is from 1 to 2 feet thick along the terrace scarps, but thickens gradually away from the scarp to as much as 6 feet.

Just upstream from the crossing of U. S. Highway 189 small deposits of gravel occur on Sheep Creek, a tributary to the Green River south of Fontanelle Creek. Because these deposits are nearly exhausted, these deposits were not mapped in detail. They are about 6 feet thick and about 50 percent of the material is gravel, 30 percent is sand, and 20 percent is silt and clay. The coarse gravel is of quartzite and soft shaly limestone in about equal proportions. However, over 90 percent of the fine gravel is of soft rock, and a considerable amount of gypsum is present. Over 30 percent of the particles are flat.

Labarge Creek and Fontenelle Creek. _/--Along Labarge Creek and

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_/ The deposits shown on Labarge Creek and Fontenelle Creek were not examined in detail. The map information for this area is modified after Rubey, W. W., unpublished maps, and after Schultz, A. R., Geology and Geography of a portion of Lincoln County, Wyoming. U. S. Geol. Survey Bull. 543, plate 1, 1914.

Fontenelle Creek, narrow and rather widely separated segments of gravel-capped terraces occur about 20, 50, and 10 feet above the stream. Deposits on them are commonly small, and range from 6 to 15 feet in thickness. The gravel is composed predominantly of hard limestone, quartzite, sandstone and a little soft rock. The material contains relatively small amounts of sand, silt, and clay. The upper two feet of the deposits is commonly coated with calcium carbonate, and the overburden is everywhere thin. The deposits were not tested or examined in detail.

Hams Fork-Headwaters to Kemmerer.--The valley of Hams Fork is from 0.5 to 1.5 miles wide and most of the available gravel caps three low terraces which border it discontinuously. These terraces are about 20, 40, and 60 feet respectively above the stream and the deposits on them range from 4 to 12 feet in thickness. About 65 to 75 percent of the material is gravel, 15 to 25 percent is sand, and 10 to 25 percent is fine sand and silt. There is very little clay. Fifty to 65 percent of the gravel is of quartzite, 20 to 30 percent is of soft rock types, concentrated in the fraction less than one inch in diameter, and lesser amounts are of hard sandstone and limestone. About 3 percent is of chert. Downstream from the confluence of Willow Creek, the proportion of quartzite increases to about 75 percent, that of soft rock types decreases to less than 10 percent. About 15 percent of the particles are flat. The upper part of the deposits are slightly coated with calcium carbonate.

Similar small deposits occur in the flood plain of Hams Fork. In most places they are covered by silty alluvium and are seasonally under irrigation.

The Kemmerer Airport, test locality LN-14, is located on a high terrace, about 400 feet above the river, on which are deposits of sand and gravel about 10 feet thick. About 65 percent of the material is gravel, 25 percent is sand, and 10 percent is silt. Most of the gravel is of quartzite, but the pebbles are thickly coated and moderately cemented with calcium carbonate. Test locality LN-15 is a smaller, but similar high terrace deposit.

Some of the extensive high erosional surfaces on either side of Hams Fork have thin deposits of stream gravel on them, but, most are underlain by conglomerate bedrock. Where the cobbles in the conglomerate have been sufficiently loosened by weathering, the material is used as a source of gravel for local road construction. These areas have not been mapped.

Hams Fork-Diamondville to Lincoln-Sweetwater County line.--From Diamondville to the Lincoln-Sweetwater County line the flood plain of Hams Fork, about half a mile wide, is bordered by five gravel-capped terraces. The lower two terraces form narrow benches and spurs that closely parallel both sides of the valley; the third occurs as extensive, but widely separated remnants. The fourth terrace is very extensive on both sides of the valley, but are locally, as west of Opal, its remnants are widely separated. The fifth or highest terrace forms extensive narrow remnants north and west of Opal on the north side of the river, and along U. S. Highway 30 N. near the Lincoln-Sweetwater County line.

The gravel on all these terraces is 5 to 10 feet thick. About 55 to 65 percent of the material on the terraces west of Opal is gravel, 20 to 35 percent is sand, and 8 to 15 percent is calcareous silt and clay.

Sixty-five to 75 percent of the gravel is of quartzite, 15 to 20 percent is of hard sandstone and limestone, and 10 to 20 percent is of soft rock types. East of Opal about 80 to 85 percent of the terrace deposits consists of gravel, 8 to 10 percent is sand, and 10 percent is calcareous silt and clay. Seventy to 85 percent of the gravel is quartzite, 10 to 25 percent is hard sandstone and limestone, and 3 to 5 percent is of soft rock types. The upper few feet of the material on all of the terraces is coated with calcium carbonate. These coatings are thickest on deposits of the highest terrace. The overburden is in general only 6 to 12 inches thick.

The flood plain of Hams Fork is underlain by gravel which in most places is covered by 2 to 5 feet of silty alluvium. Much of the flood plain is under irrigation.

Blacks Fork.--Blacks Fork flows across the southeast corner of Lincoln County in T. 19 N., Rs. 112 and 113 W. Gravel caps two remnants of a terrace close to the river and about 30 feet above it. Higher terraces in this vicinity have no gravel on them. The gravel on the 30-foot terrace is 6 to 10 feet thick, and is predominantly of quartzite and hard limestone, though about 20 percent is of soft rock types concentrated largely in the fraction less than one inch in diameter. Silt and clay comprise about 10 percent of the deposits. The upper 2 feet of gravel are slightly coated with calcium carbonate, and the overburden is about 2 feet thick.

Cumberland Creek.--U. S. Highway 189 follows the west bank of Cumberland Creek from a point one mile west of Diamondville to the confluence of Cumberland Creek and Little Muddy Creek at the southern

boundary of the county. Gravel for this highway was obtained from several pits in terrace gravels which cap rolling hills 30 to 60 feet above the stream along the west side of the highway. The deposits are mostly small, and range in volume from 3,000 to 100,000 cubic yards. About 60 percent of the material is of gravel, 20 to 25 percent is sand, and 15 to 20 percent is calcareous silt and clay. The gravel is predominantly of quartzite, hard limestone, and sandstone, and about 15 percent of the particles are flat. The amount of soft or friable rock varies greatly from place to place. At test locality LN-4 it comprises as much as 50 percent of the gravel fraction less than one inch in diameter; at test localities LN-1 and LN-3 only 10 percent. The material in the upper two feet of the deposits is slightly coated with calcium carbonate and the overburden is about a foot thick.

Twin Creek.--Deposits of sand and gravel in the drainage of Twin Creek are few and most are small. Five miles west of Kemmerer and south of the point where U. S. Highway 30 N overpasses the Union Pacific Railroad tracks, is a small gravel-capped terrace about 75 feet above the stream (test locality LN-13). The material on this terrace is mostly derived from higher, most extensive deposits on flat-topped hills west of and 500 to 550 feet above the stream. The deposits average only 3 feet in thickness. About 80 percent of the material is gravel, 10 percent is sand, and 10 percent is calcareous silt and clay. About 80 percent of the gravel is of quartzite, 15 percent is of hard sandstone and limestone, and 5 percent is of soft rock types.

In the broad basin east of Fossil, and in a few places along Twin Creek above its canyon west of Fossil, small deposits of gravel occur

on terrace segments 8 to 15 feet above the stream. The deposits average 4 to 6 feet thick. About 60 percent of the material is gravel, 10 to 20 percent is sand, and 20 to 30 percent is calcareous silt and clay. The gravel is almost wholly of dense brittle limestone fragments, about 30 percent of which are flat. It has been used locally for road surfacing. The overburden is about a foot thick. These deposits have not been mapped in detail, and the area in which they occur as shown on the map is modified after the geologic map of Wyoming._/

_/ Campbell, M. R., and others, Geologic map of Wyoming, U. S. Geol. Survey, Geol. Atlas of the United States, State of Wyoming, 1925, Scale 1:500,000.

Deposits of gravel in the canyon of Twin Creek are small and very bouldery. They are mostly at the mouths of tributary streams, and are not shown on the map.

Two gravel pits have been developed in an extensive alluvial fan at the mouth of Twin Creek canyon, where it enters the Bear River valley (test localities LN-18 and LN-19). These deposits are overlain by 2 to 5 feet of silty alluvium, and the water table is at a depth of about 15 feet. The texture varies from one part of the fan to another, but in general 60 to 80 percent of the material is gravel, 10 to 20 percent is sand, and 5 to 15 percent is silt and clay. About 50 percent of the gravel is of hard limestone, 20 to 35 percent is of quartzite, and 15 to 30 percent is of soft rock types. Calcium carbonate forms a slight coating on the upper few feet of the deposits.

Bear River.--The Bear River flows north through the southwestern part of Lincoln County in a valley from one-half to 1½ miles wide. Although gravel is probably abundant in the valley, readily available deposits are scarce because of a thick alluvial cover which is mostly under irrigation. Four kinds of deposits are available: deposits in the flood plain of the river, deposits on low terraces bordering the valley, alluvial fan deposits at the mouths of streams tributary to the valley, and deposits of poorly consolidated conglomerate bedrock.

Some gravel pits have been opened in the flood plain of the Bear River in T. 25 N., R. 119 W. These were examined only at test locality LN-49 because in most places irrigation made them inaccessible at the time of this survey. By locally shutting off irrigation or by dredging, gravel could probably be obtained in many places along the river, though fine sand locally underlies the surface to a depth of a few feet. At test locality LN-49, where the water table is about 6 feet below the surface, about 70 percent of the material is gravel, 25 percent is sand, and 5 percent is fine sand and silt. The gravel is predominantly of hard limestone and quartzite, but the fraction less than one inch in diameter contains 15 to 20 percent of soft rock types.

Terrace gravel deposits occur on local segments of a bench on the east side of the valley 15 to 20 feet above the river. The largest of these segments lies north of Smiths Fork one mile north of Cokeville. Smaller terrace deposits occur at test localities LN-23, LN-33, and LN-48. The material at test localities LN-20, LN-33, and LN-48 is typical of most of the terrace deposits. About 70 to 80 percent of it is gravel, 10 to 20 percent is sand, and 10 to 15 percent is fine sand and calcareous silt. The material at test locality LN-23 is

predominantly coarse and medium sand and less than 25 percent of it is gravel. The gravel at all these localities is mostly of quartzite and hard limestone, though 15 to 20 percent is of soft rock types. The material in the upper few feet of the deposits is slightly to moderately coated with calcium carbonate, and the overburden is in most places less than 2 feet thick.

Alluvial fan deposits occur both north and south of Cokeville. North of Cokeville (test locality LN-47) a large deposit consists of material about 75 percent of which is gravel, 15 percent is sand, and 10 percent is calcareous silt and clay. About 50 percent of the gravel is of hard limestone and quartzite, and 50 percent of soft or friable rock types. The fragments are mostly angular to subangular.

South of Cokeville on the east side of the valley a number of small alluvial fan deposits, such as that east of Backwith (test locality LN-26), have been exploited as a source of chips for road surfacing. About 60 to 75 percent of the material is gravel, 15 percent is sand, and 10 to 25 percent is silt and clay. The gravel is shaly limestone and a small amount of quartzite. The particles are flat, angular, and brittle.

Alluvial fan deposits on the west side of the valley tend to be very thin and therefore have not been shown on the map. A few are as much as 5 feet thick. The material is mostly gravel composed of quartzite, hard limestone, and a small amount of soft rock. About 15 percent is of sand, and 10 percent is of calcareous silt, and clay.

Much of the west side of the valley is underlain by conglomerate. In places this rock is sufficiently unconsolidated to be a source of

gravel. The material is composed of quartzite, hard limestone, and a small amount of soft rock. About 20 percent is of coarse and medium sand and 10 to 15 percent is of fine sand, calcareous silt, and clay. Test locality LN-32 southwest of Cokeville is a pit developed in this loosely consolidated conglomerate.

Smiths Fork.--Smiths Fork flows south in a relatively narrow valley between two mountain ranges, and joins the Bear River at Cokeville.

In its headwater sector the flood plain of the stream contains small deposits of gravel up to 6 feet thick that have been used locally in road construction (test locality LN-59). The material is variable in texture, but only a few percent is of coarse cobbles and, in general, less than 15 percent is silt and clay. The gravel is mostly of quartzite, hard sandstone and hard limestone.

Other small deposits occur along Hobble Creek, a tributary of Smiths Fork, on terraces about 60 and 120 feet above the creek. The material on remnants of the higher terrace is very bouldery; that on the lower terrace is clean gravel and sand. The deposits are about 6 feet thick.

Below Hobble Creek, the valley of Smiths Fork is locally bordered by remnants of two terraces about 20 feet and 60 feet above the stream. The gravel on these terraces is 6 to 10 feet thick, and clean. The cobbles are composed predominantly of quartzite and hard limestone, and about 15 to 20 percent of the material is of soft sandstone and shaly limestone. Gravel underlies thin silty alluvial deposits on the adjacent flood plain, but is under irrigation.

The lower sector of the valley of Smiths Fork is bordered to the east by extensive remnants of a high terrace about 200 feet above the stream. The thickness of the deposits mantling this terrace ranges from 3 to as much 6 feet. Pits have been opened at test localities LN-45 and LN-46. Over 80 percent of the material is gravel, 10 to 15 percent is sand, and less than 10 percent is silt and clay. Most of the gravel is of quartzite and hard limestone, but about 15 percent is of soft rock types. Southeast of Cokeville a few other remnants of this terrace are capped by similar gravel. The overburden is commonly less than 2 feet thick.

Salt River.--The Salt River, for most of its length, flows north through two broad basins, known together as Star Valley, and joins the Snake River in Idaho just across the Idaho-Wyoming state line. Extensive deposits of sand and gravel occur throughout both basins.

In the southern basin broad alluvial fans extend from the bordering mountains to the Salt River. Extensive gravel deposits occur in these alluvial fans on both sides of the river. The thickness of the deposits given at tested localities is the depth to which the gravel has been excavated, or the observed thickness of the gravel. The true thickness may be much greater. In general throughout the basin 75 to 85 percent of the material in the deposits is gravel, 7 to 15 percent is coarse and medium sand, and 5 to 15 percent is fine sand, calcareous silt, and clay. Near the mouths of canyons, along the sides of the basin, the deposits are bouldery, but in the central part of the valley there is little material over 3 inches in diameter. The gravel is subround to subangular, and is composed

predominantly of hard limestone and quartzite. In deposits east of the river 15 to 30 percent of the material is of soft rock type, such as soft sandstone, shale, and crumbly or shaly limestone; west of the river 15 to 55 percent of the material is of soft rock type. West of Auburn and west of Fairview soft rock is particularly abundant and up to 50 percent of the gravel particles are flat.

Throughout the southern basin the deposits have only a slight coating of calcium carbonate. In most places the overburden is only a few inches to 2 feet, but along the west side of the basin it is as much as 5 feet thick. Because of irrigation the water table throughout much of the basin tends to be near the surface.

Deposits of conglomerate, locally unconsolidated enough to be used as a source of gravel, occur along the west side of the southern basin, and in the hills between it and the northern basin. These deposits are not shown on the map.

The northern basin is also underlain by extensive deposits of sand and gravel that occur in three different kinds of deposits: Alluvial fans, terrace gravels, and unconsolidated areas of a conglomerate bedrock.

Alluvial fans extend from the foot of the mountains along the east side of the basin nearly to the edge of the Salt River. The gravel underlying them is composed almost wholly of limestone. It tends to be bouldery near the mountains, but decreases in size towards the river at a distance of about a mile from the mountain front less than 10 percent of the material consists of cobbles. In most places, about 60 percent of the material is gravel, 10 to 20 percent is sand and less than 10 percent is calcareous silt. The overburden covering these deposits is thin.

Terrace gravel deposits form a narrow bench 15 to 20 feet above the flood plain of the Salt River in the southern part of the basin. In the northern part, gravel underlies segments of three sets of terraces, 15 to 20, 40, and 60 feet above the river. About 10 to 15 percent of the material in these deposits consists of cobbles 3 to 6 inches in diameter, 60 to 80 percent is gravel, 10 to 25 percent is sand, and, 10 to 20 percent is calcareous silt. In general, 50 to 75 percent of the gravel in the terrace deposits is of limestone, 10 to 20 percent is quartzite, 5 to 10 percent is hard sandstone, and 15 to 20 percent is soft rock. Near the confluence of the Salt River and the Snake River the terrace gravel contains a small amount of granite and basalt, some of which is rotted (test locality LN-69). However, these rock types do not occur within the Salt River drainage. The overburden on all the terrace deposits is rarely over 2 feet thick.

The overburden on both alluvial fan and terrace deposits is commonly 1 to 2 feet thick.

Gravel deposits in the flood plain of the Salt River in the northern basin are similar in character to the deposits on the terraces. The water table, however, is close to the surface of the flood plain.

Deposits of conglomerate at the south end of the northern basin are locally unconsolidated enough to be a source of gravel. Such deposits occur in the ridges north of Thayne, in the hills between Thayne and Willow Creek, along the front of the mountains south of Strawberry Creek, and bordering the valley south of Turnerville. The cobbles and pebbles in the conglomerate are composed predominantly of limestone and quartzite, and the matrix is characteristically silty. The areas underlain by conglomerate are not shown on the map.

Little Greys River and Greys River.--The Little Greys River flows west through a narrow canyon to its confluence with the Greys River. Near this confluence small deposits of gravel occur on terraces 15 and 50 feet above the stream. The material is rather bouldery and contains abundant angular and slabby fragments derived from slide rock cones along the valley wall. The gravel is composed predominantly of limestone and sandstone.

The Greys River _/ flows north through a narrow canyon between rugged

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_/ Much of the map data for the terraces along Greys River is modified after unpublished maps by W. W. Rubey, U. S. Geological Survey.

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mountain ranges to its junction with the Little Greys River, from which point it turns west through a mountain gorge to the Snake River. Its course is bordered by discontinuous narrow remnants of three gravel-capped terraces 5 to 10, 15 to 20, and 40 to 60 feet above the stream. Higher rock benches 400 to 500 feet above the stream occur along the canyon walls, but have only a local thin veneer of gravel or scattered boulders on them.

The gravel on the terraces is commonly 6 to 10 feet thick; but in a few places is 20 feet thick. Most of the deposits range from 2,000 to 15,000 cubic yards in volume. The texture of the material varies greatly from place to place owing to the influx of coarse gravel from tributary alluvial fans which spread out over, and merge into, the terrace deposits. The deposits on the upper terraces commonly contain more coarse material than those on the lower terraces, and the

proportion of coarse material is greatest near the mouths of canyons. Between tributary canyons, less than 10 percent of the material in the terrace deposits is 3 inches in diameter, about 60 percent is gravel, 15 to 20 percent is sand, and less than 10 percent is fine sand, calcareous silt, and clay. The gravel is mostly subangular to subrounded, but about 20 percent of the particles are flat and shaly. Though most of the gravel is of hard limestone and hard sandstone, 15 to 35 percent is of soft or friable sandstone and brittle calcareous shale. The overburden is thin. The vegetation on the deposits in the lower part of the canyon consists mostly of sage, but in the upper part of the canyon many of the terraces support an open pine forest.

Snake River.--The Snake River from the Lincoln-Teton county line to the Wyoming-Idaho state line flows through a canyon along which are small remnants of at least three different terrace levels. The deposits on the terraces range from 6 to 15 feet in thickness but tend to be very bouldery. The gravel is and are composed predominantly of quartzite, but small amounts are of granite, gneiss, schist, limestone, sandstone, basalt, and rhyolite. Some of the granite is deeply rotted.

Extensive deposits of bouldery gravel occur east of the Wyoming-Idaho state line where the canyon opens onto a broad plain . Ten to 15 feet of gravel caps remnants of at least four terraces along the river near Alpine. The material is composed largely of quartzite, but minor amounts are of other rock types as in the deposits in the canyon upstream. About 25 percent of the material in most of these deposits consists of cobbles. Though the deposits were not tested in detail, they appear to contain very little silt and clay.

Natrona County

by

J. M. Cattermole

General description of deposits

Sand and gravel is relatively scarce in Natrona County. In the southern part, deposits are most numerous along the valley of the North Platte River where they occur in the flood plain and on terrace remnants bordering the river. Extensive gently sloping surfaces along the mountain fronts are covered with gravelly material, but it is mostly thin and very dirty.

In the north and central parts of the county, deposits of sand occur in the flood plains of some major streams. Thin gravelly deposits cap local terrace remnants and upland surfaces, but such deposits are mostly small.

Local descriptions

North Platte River valley.--Deposits of sand and gravel along the flood plain and channel of the North Platte River are found generally where the river is meandering and flowing slowly. Test locality Na-2 below Alcova and Na-12 above Casper are examples of such deposits. At these localities the gravel averages 10 to 15 feet thick, beneath 1 to 3 feet of overburden. The maximum particle diameter is about 3 inches and the composition of the deposits average 25 to 30 percent granite, 30 to 40 percent quartzite, and the remainder trap, sandstone, and gneiss. Deposits in the upper parts of the valley have a higher content of trap than those in the lower parts.

Bordering the North Platte River are remnants of terraces locally capped by deposits of gravel. The gravel deposits are more numerous along the lower part of the valley in the vicinity of Casper than they are in the southcentral part of the county. The composition of the deposits averages 40 to 45 percent granite, 30 percent quartzite, 15 percent trap, and small amounts of sandstone, quartz, and chert. All of these rock types except the sandstone are hard and resistant to wear. The maximum particle diameter is about 5 inches. In general the overburden is about 1 foot thick, but may be as much as 4 feet.

The slope at the foot of Casper Mountain is covered by gravelly material that contains much silt and clay. These deposits are extremely variable in texture and are predominantly limestone, sandstone, and red granite.

Muddy Creek.--An extensive terrace bordering Muddy Creek is capped by workable deposits composed of about 35 percent granite, 30 percent quartzite, 6 to 10 percent chert and the remainder sandstone and trap. At test locality Na-4 the thickness of the gravel is 8 feet. The deposit is covered by about a foot of overburden and the upper 24 inches of the gravel is slightly cemented by carbonate. These deposits extend east along Muddy Creek into Converse County.

Casper Creek.--An extensive deposit of sand and fine gravel occurs in the valley of Casper Creek at and southeast of test locality Na-9 where it covers a terrace about 30 feet above the stream. The material has a maximum diameter of about 1 inch and its composition averages about 30 percent granite, 20 percent quartzite, 20 percent sandstone, 12 percent chert, and the remainder trap and quartz. A large amount

of silt and clay is present in the fraction passing a U. S. Standard No. 40 sieve.

Along the valley of South Fork of Casper Creek another terrace deposit is at test locality Na-19. The material is similar to that at test locality Na-9, except that the maximum particle diameter is about 3 inches.

South Fork of Powder River.--Deposits along the South Fork of the Powder River occur at test localities Na-20 and Na-21. The maximum particle diameter at these localities is 1½ inches, except for a small amount of larger soft sandstone concretions. The composition of the material averages 35 to 40 percent chert, 20 to 25 percent quartzite, 25 percent sandstone (soft), and the remainder granite, trap, and shale. West of U. S. Highway 20 no deposits of gravel were found and the only sand is in fine-grained windblown deposits.

High erosion surfaces.--Some high erosion surfaces are capped by sand and gravel. At test localities Na-14, Na-15, and Na-16 the composition of the gravel averages about 25 to 30 percent granite, 15 to 25 percent sandstone, 12 percent trap, and the remainder quartz, limestone, and chert. The maximum particle diameter is 1 inch but most of the material is less than three-quarters of an inch in diameter.

Northern part of the County.--No significant deposits of gravel were found in the northern part of Natrona County, and the only sand is in small deposits in the beds of somesstreams.

Niobrara County

by

J. M. Cattermole

General distribution of deposits

Large sand and gravel deposits are scarce in Niobrara County although there are a number of widely scattered small deposits. Much of the road surfacing material used in this county has been obtained by crushing quarried limestone, sandstone, or granite from localities in the southern and central part of the county.

Local descriptions

Niobrara River valley.--The Niobrara River valley is bordered by remnants of terraces a few of which are capped by sand and gravel deposits from 2 to 6 feet thick. Test localities Ni-2 and Ni-3 are on a terrace about 25 feet above the stream. At these localities the deposits are about 45 to 50 percent gravel fraction; disseminated through the sand fraction is a large amount of silt and clay. A small hill a few hundred feet east of Ni-3 is an isolated remnant of a higher terrace capped by gravel about 3 feet thick. Test locality Ni-1 is on the flood plain of the Niobrara River one-half a mile west of the town of Van Tassell. The material of this deposit exceeding three-quarters of an inch is soft friable sandstone that readily breaks down into sand. Of the gravel component less than three-quarters of an inch about 60 percent is sandstone, 18 percent granite, 15 percent chert and 6 percent schist. The deposit is 6 to 9 feet thick and is covered by a thin sandy clay soil.

Test localities Ni-4 and Ni-5 are in a normally dry drainage course leading from the Hartville Uplift area to Niobrara Creek. Near these test sites, a bench 30 feet above the stream channel is capped by 3 to 6 feet of gravel. For a distance of 20 to 30 feet back from the edge of the bench there is no overburden, but farther back, up to 6 feet of loess soil covers the deposit. About 45 percent of the gravel is limestone, 30 percent schist and the remainder quartz, quartzite, volcanics and chert.

Lance Creek.--A few gravel deposits lie along the channel and flood plains of Lance Creek, others are on high erosion remnants bordering the drainage. The deposits at test localities Ni-6 and Ni-7 are in the channels of dry tributaries of Lance Creek. The material composing these deposits is largely derived from channel conglomerates at the base of the Arikaree sandstone which crops out in the highlands west of Lance Creek. About 63 percent of the gravel is granite, 15 percent soft sandstone, 14 percent quartzite. About 70 percent of the deposits are gravel; the sand fraction is clean. Material from these deposits has been used for concrete aggregate. Test locality Ni-11 at the town of Lance Creek is a deposit in the flood plain of Lance Creek. The lithology is very similar to that at test locality Ni-6, but only about 40 percent is gravel.

Test locality Ni-9 is on a high erosion remnant capped by gravel 6 to 9 feet thick that is derived from the Arikaree formation. Hills north of test locality Ni-9 are capped with similar material. Test locality Ni-10 is on a pediment surface capped with 3 feet of gravel.

Old Woman Creek and Hat Creek.--The flood plains and channels of Old Woman Creek and Hat Creek contain deposits of sand and gravel of which test localities Ni-8 and Ni-12 are representative. These deposits are largely sand, only 10 to 15 percent of the material is larger than one-quarter of an inch in diameter. The sand fraction locally contains some silt and clay, but in general the deposits are moderately clean and have been used for concrete aggregate and plaster sand.

Deposits on high benches in this drainage area are represented by test locality Ni-13. About 44 percent of the gravel is soft sandstone, 18 percent ironstone concretions, and the remainder is chert, granite, quartzite, and quartz. Several pits have been operated in this deposit and some are now exhausted, but large amounts of gravel still border the summit. The sand fraction contains a large amount of silt and clay. Other deposits of this kind cap a high bench 6 miles to the east in SE¼ sec. 1, T. 38 N., R. 61 W.

Cheyenne River valley.--The Cheyenne River valley and the lower part of Lance Creek are bordered by terrace remnants that are locally capped by gravel. At test locality Ni-15 the deposit is 3 to 6 feet thick and is composed of about half gravel and half sand. Of the gravel fraction about 35 percent is soft sandstone, 17 percent concretion, and the rest quartz, granite, chert, and quartzite. Some small deposits of gravel occur in the channel and flood plain of the Cheyenne River.

Park County

by

Page E. Truesdell and Frank W. Foster

General descriptions of deposits

Park County contains abundant supplies of sand and gravel, most which occur on terraces along streams, and on high benches along interstream divides.

The Greybull River, which flows northeast through a broad valley in the southeastern part of the county, is flanked throughout most of its length by several levels of gravel-capped terraces. The lower are very broad, and extend continuously for long distances along the river; the upper are represented by discontinuous segments and short flat-topped ridges. Extensive deposits of sand and gravel may be found on all of these terraces.

The valley of the Shoshone River, which flows northeast across the county from the Absaroka Mountains, contains the most extensive deposits of sand and gravel in the County. Two high gravel-capped terraces extend along the north side of the valley of the North Fork at, and upstream from, the Shoshone Reservoir. Other deposits occur on two terraces along the valley of the South Fork. In the vicinity of Cody and eastward, the Shoshone River is bordered on both sides by broad, nearly continuous terraces on which are unlimited quantities of sand and gravel. The gravel in all these deposits is composed mainly of basic volcanic rock (traprock) and felsite.

In the northern part of the county Clark Fork and its tributaries are bordered near the front of the Beartooth Mountains by three gravel-capped terraces, the highest of which forms the intersterm divides. The gravel in these deposits is mostly of limestone and granite.

Many other high divides and table lands are similarly capped by gravel. Extensive deposits composed of basic volcanic rock (traprock) and felsite cap the divide northeast of Meeteetse Creek and the broad high bench that trends northeast along the north side of the Greybull River. Other thick deposits of similar composition cap a high bench 3 to 5 miles wide and 20 miles long, and trends northeast, north of the town of Powell. Much of the rock in these high bench deposits may be glassy.

The deposits of Park County shown on plate I are modified from detailed maps by Andrews, et al._/

_/ Andrews, D. A., Pierce, W. G., and Eargle, D. H., Geologic map of the Big Horn Basin, Wyoming and Montana, showing terrace deposits and physiographic features, U. S. Geol. Survey Oil and Gas Investigations, Preliminary Map 71, 1947.

Local descriptions

Clark's Fork.--The valley of Clark's Fork is bordered by three gravel-capped terraces. The lowest is about 25 feet above the river, the intermediate is about 50 feet above the river, and the highest, and most extensive, is 75 feet above the river. Most of these terrace deposits are extensive and range from 10 to 40 feet in thickness.

They contain 55 to 90 percent gravel and 10 to 25 percent sand. Some, as at test locality PK-30, are bouldery but most contain very few cobbles more than 3 inches in diameter. Almost all of the terrace- and flood plain deposits on Clark's Fork and on Pat O'Hara Creek are composed predominantly of hard limestone. At test locality PK-30, however, the material contains about twice as much granite as limestone. Only about 6 inches of stony soil covers the deposits.

North Fork of the Shoshone River.--Two terraces border the North Fork of Shoshone River west of Cody. The lower is 60 to 160 feet above the river, and the higher is 150 to 275 feet above the river. The terraces are capped by very extensive deposits of sand and gravel that are 35 to 45 feet thick. The material averages about 70 to 80 percent gravel, 10 percent sand, and 10 percent silt and clay. Cobbles decrease in abundance away from the mountains, but the content of silt and clay does not vary much downstream. Near the mountains, about two-thirds of the gravel is of hard volcanic traprock and one-third is of hard limestone. Farther away from the mountains and on the banks of Shoshone Reservoir the gravel is mostly of medium hard limestone. Only about one foot of stony soil covers the deposits.

The flood plain of the North Fork of Shoshone River is underlain by extensive deposits of sand and gravel 6 to 8 feet thick. The proportion of sand to gravel is about the same as on the terraces described above, but silt and clay are notably less abundant. Basic volcanic rock is the most abundant constituent of the gravel and the fine gravel fraction contains about 60 percent of rotted material. The deposits are covered by 1 to 3 feet of stony soil.

South Fork of the Shoshone River.--The valley of the South Fork of Shoshone River is flanked by two terraces capped by extensive deposits of sand and gravel 35 to 60 feet thick. Gravel comprises 60 percent to 90 percent of the deposits and is mostly of basic volcanic rock. Cobbles diminish in abundance and silt and clay increase in abundance downstream from the mountain front. A stony soil 12 to 36 inches thick covers the deposits.

Sand and gravel occurs locally in the flood plain of the South Fork of Shoshone River. The material averages about 70 percent gravel and 20 percent sand and 10 percent silt and clay. About 80 percent of the gravel is basic volcanic rock and about 15 percent is felsite. Nearly one-fourth is rotted to varying degrees. A layer of silt 6 to 18 inches thick covers the deposit.

Shoshone River from Cody to the Bighorn County line.--The valley of the Shoshone River is flanked by three major gravel-capped terraces. The lowest is 60 to 160 feet, and the intermediate 150 to 275 feet above the river. The highest terrace is more than 200 feet above the river, but is present only at the eastern border of the county.

The lowest and intermediate terraces are capped by very extensive deposits of sand and gravel, 10 to 40 feet thick. The ratio of gravel to sand is about 2 to 1. There are no cobbles over 3 inches in diameter, but silt and clay locally comprise 5 to 15 percent of the deposits. Felsite is the most abundant constituent of the gravel near Cody, and basic volcanic rock is the most abundant constituent downstream near Powell. The deposits on the intermediate terrace are firmly cemented with calcium carbonate in some places. The highest terrace, in the eastern part of

the county, is locally capped by about 10 feet of gravel. A stony soil 6 to 36 inches thick covers the deposits on all the terraces.

Large alluvial fans containing sand and gravel like that on the terraces, but composed mostly of limestone, occur locally on the intermediate terrace. At test localities PK-22 and PK-25, such deposits are 6 to 10 feet thick. The pebbles are coated with calcium carbonate and gypsum. A stony soil 6 to 8 inches thick covers the deposits.

A pediment surface southeast of Cody is capped locally by large deposits of sand and gravel, 6 to 10 feet thick. The gravel beds contain about 10 percent silt and clay and there are also interbedded lenses of silt and clay. More than 80 percent of the gravel is composed of hard felsite and basic volcanic rock. A stony soil 1 to 3 feet thick covers the deposits.

Divide between Clark's Fork and Shoshone River.--North of Powell, a high flat bench, about 800 feet above the Shoshone River, forms the divide between Clark's Fork and Shoshone River, and extends for a distance of 20 miles in a northeastly direction. Extensive deposits of sand and gravel, 15 to 20 feet thick, cap the bench. About 70 percent of the material is gravel, 15 to 20 percent is sand, and 10 to 15 percent is silt and clay. Felsite and dark volcanic rock are the predominant rock types. However, much of the gravel is rotted. The overburden consists of 6 to 36 inches of stony soil. Alluvial fan on the south scarp of the bench (test locality PK-29) contain some gravel, but also numerous cobbles over 3 inches in diameter. The material is mostly of dark volcanic rock, felsite and limestone.

Greybull River.--The valley of the Greybull River is flanked by three gravel-capped terraces. The lowest is 10 to 40 feet above the river and only local remnants of it are preserved in Park County. The intermediate terrace is 110 to 225 feet above the river and flanks the river from its junction with Francs Fork to the Bighorn County line. The highest terrace is 400 to 550 feet above the river and the largest remnant of it is north of the river at the eastern edge of the county. There are also local deposits of gravel in the flood plains of the stream. Gravel comprises about 75 percent of all the deposits, but at only one locality, test locality PK-9, is there much coarse material over 3 inches in diameter. Sand comprises 5 to 10 percent of the material, and silt and clay 10 to 15 percent. Dark volcanic rock and felsite are the most abundant constituents in most of the deposits, and about 30 percent of the material is rotted. At test locality PK-6, hard quartzite makes up one-half of the material more than 1 inch in diameter. About a foot of stony or sandy soil covers the deposits.

Sage Creek.--Sage Creek is flanked by small gravel-capped segments of a terrace along the divide between the Greybull and the Shoshone rivers. The deposits are 4 to 5 feet thick. About 80 percent of the material is gravel, 5 percent is sand, and about 15 percent silt and clay. Most of the gravel is dark volcanic rock and felsite. Rotted felsite and limonite comprise 60 percent of the fine gravel. A stony soil 6 to 18 inches thick covers the deposits.

Dry Creek.--A pediment surface near the junction of the South Fork of Dry Creek and State Highway 120 (test locality PK-5) is capped by a small, thin deposit of sand and gravel. Most of the material is

coarse gravel, and about 15 percent is silt and clay. About half of the gravel is composed of hard quartzite, the other half is rotted felsite, rotted basic volcanic rock and soft limonite. One to 3 feet of stony soil covers the deposit. On the northern tributaries of Dry Creek along U. S. Highways 14 and 20 are a number of knolls capped by large deposits of sand and gravel (test localities PK-13 and PK-12). About 70 percent of the material is gravel, 15 to 20 percent is sand, and 10 to 15 percent is silt and clay. The gravel is almost entirely of limestone. The deposits are thinly coated with calcium carbonate to a depth of 4 feet and are covered by 6 to 18 inches of stony soil.

Platte County

by

J. M. Cattermole

General distribution of deposits

Groups of sand and gravel deposits are scattered throughout Platte County. The lithologic composition of the gravels in general is similar for each group of deposits but varies among the groups, depending on the source of the materials. In a few places the channels and flood plains of streams and dry gulches are underlain by small deposits of clean, well graded sand and gravel. Locally, terrace remnants along the valleys of rivers and streams are capped with gravel containing moderate amounts of silt and clay. The broad stepped surfaces between the high plains and the river valleys are bordered in some localities by gravel. This gravel is generally more weathered and contains a higher pooportion of silt and clay than that on the terraces and in the stream channels. The most extensive deposits are those bordering the North Platte River valley, though a number of deposits occur along Sybille Creek and the Laramie River. Other streams have only a few deposits along their courses.

Local description

Chugwater Creek and tributaries.--Gravel deposits on remnants of terraces border the valley of Chugwater Creek, but those near the town of Chugwater are small. About 30 to 50 percent of the material is anorthosite (a dark coarse-grained crystalline rock), 30 percent is granite, and the remainder limestone, sandstone, and schist. The maximum particle diameter is about 3 inches and the deposits contain a moderate amount of fine sand and clay.

The valley of Chugwater Creek east of Wheatland is bordered by terraces capped by 25 feet of gravel. The maximum dimension of this gravel is about 3 inches and its grading is variable. Some deposits contain considerable quantities of fine sand, silt, and clay; others are relatively clean. The material has been used for concrete aggregate as well as for road material.

The flood plain of Reschaud Creek is underlain by moderately coarse gravel composed of granite, quartzite, anorthosite, and limestone. Some boulders in this deposit are a foot or more in diameter, but the largest common size is 8 inches. The flood plain is only about 90 feet wide but the gravel is extensive along the stream. Bordering Hunton Creek a few terrace remnants are capped with 6 feet or more of gravel composed of granite, limestone, and anorthosite with minor amounts of sandstone, schist and chert.

Sybille Creek and tributaries.--Gravel-capped terrace remnants along the valley of Sybille Creek are irregular in thickness, ranging from a veneer to as much as 15 feet. About 50 to 60 percent of the gravel is granite, 10 to 30 percent is of anorthosite, and minor amounts of limestone, sandstone, trap and chert. Boulders are commonly 8 to 10 inches in maximum dimension, though a few are 2 feet or more in diameter. The overburden is from 1 to 4 feet in thickness.

At the junction of Sybille Creek and Muleshoe Creek, and upstream along the latter drainage are abundant flood plain and channel deposits of gravel composed of disintegrated granite similar to the Sherman granite. Test locality P-7 is in these deposits.

Laramie River valley.--Numerous gravel-capped terrace remnants border the valley of the Laramie River. In the western part of the county, where the river emerges from the Laramie Mountains, extensive deposits overlie a high terrace south side of the river and smaller ones occur on terrace segments north of the river. The valley in the vicinity of U. S. Highway 87 is bordered by two narrow terraces capped with 5 to 10 feet of gravel. East of this area the terraces are not continuous, and few gravel capped remnants occur. About 40 to 50 percent of the gravel in these deposits is hard granite, 10 to 20 percent anorthosite, and the remainder trap, schist, and some quartzite. The sand fraction contins moderate amounts of silt and clay.

Dwyer to Cassa.--Between Dwyer and Cassa, deposits of gravel occur in stream channels and along the edges of the higher benches. Most of this material is derived secondarily from a conglomerate at the base of the Arikaree formation. The deposits are quite variable in thickness, extent, and grading. About 60 to 70 percent of the gravel is granite, and the remainder quartz, volcanic, and schist.

North Platte River valley.--The valley of the North Platte River and some of its tributary streams are bordered by terrace deposits of sand and gravel, that are fairly clean, well-graded and up to 15 feet thick. From the town of Guernsey east to the county line about 40 to 50 percent of the gravel in these deposits is granite, 15 to 20 percent quartzite, about 15 percent volcanics, and small amounts of quartz, schist, limestone, sandstone, and chert.

In Tps. 29 and 30 N., R. 68 W. gravel deposits border several high erosion surfaces. As in the Dwyer-Cassa area, the gravel is derived secondarily by weathering from conglomerate beds at the base of the Arikaree formation. Some contain a moderately large amount of silt and clay.

East of Glendo, the flood plain of the North Platte River is underlain by gravel composed predominantly of granite and quartzite with lesser amounts of volcanics, limestone, sandstone, and chert. This gravel has a maximum diameter of 3 inches, and is well graded, hard material.

Deposits in the stream channel of Elkhorn Creek have been used by the Burlington Railroad for ballast (test locality P-31). The material is hard, well graded and is predominantly granite. The maximum particle diameter is about 8 inches.

Sheridan County

by

Page E. Truesdell and Frank W. Foster

General description of deposits

Sheridan County contains abundant supplies of sand and gravel along the eastern front of the Bighorn Mountains. Only small deposits are known in the mountains and in the southeast part of the county; and almost none were observed in the northeast part of the county.

Along the Bighorn Mountain front, extensive terrace deposits occur along Little Goose Creek, Goose Creek, Soldier Creek, and the Tongue River. Some sand and gravel is also present along the flood plains of these streams. Extensive deposits cap the high, gently sloping erosion surfaces west of Little Goose Creek, between Goose Creek and Soldier Creek southwest of Diet, north of Columbus Creek near its confluence with the Tongue River, and near Banner in the south-central part of the county.

In the Bighorn Mountains, deposits of rotted granite were found on low rounded ridges and in some of the mountain meadows along U. S. Highway 14. Small deposits of very bouldery till were noted but not tested.

In the southeast part of the county a few small deposits of sand and gravel cap terraces along Clear Creek, and others occur along the Powder River just north of Arvada.

In the northeast part of the county, outcrops of "scoria," a clinker derived from the burning of coal beds, is used as a source or road metal.

The deposits shown in Sheridan County on plate 1 are modified after maps by Darton _/.

_/ Darton, N. H., U. S. Geol. Survey Atlas, Bald Mountain-Dayton folio, (no. 141), 1906.

Local descriptions

Powder River.--The Powder River, which flows north across the eastern part of the county, is bordered by small segments of two different levels of stream terraces too small to show at the scale of the map. These are capped by sand and gravel north of Arvada. The deposits on the lower terrace are 5 to 6 feet thick and comprise about 35,000 cubic yards. At test locality SH-3 about 30 percent of the material is gravel, 60 percent is sand, and 10 percent is silt and clay. The gravel is composed predominantly of limestone with lesser amounts of limonite, quartzite, sandstone, chert, and hematite. Calcium carbonate weakly cements the upper foot of the deposit which is overlain by 1 to 2 feet of stony soil.

Deposits on the higher terrace are 8 to 10 feet thick. At test locality, SH-8, 4 miles north of Arvada, about 40 percent of the material is gravel composed predominantly of limestone.

Clear Creek.--Scattered small gravel-capped terrace segments border the course of Clear Creek between Ucross and its confluence with Powder. The deposits, are 3 to 12 feet thick and relatively small, for example 10,000 cubic yards at test locality SH-9. At most 65 percent or more of the material is gravel. Layers of coarse pebbles are interbedded with fine sugary sand. Granite is the primary

constitute of the gravel, with some limestone, volcanic traprock, quartzite, "scoria," sandstone, quartz, and chert. The upper 2 feet of the material is slightly cemented with calcium carbonate, and are covered by a stony or sandy soil about 18 inches thick.

Deposits in the flood plain of Clear Creek are 5 to 10 feet thick and of relatively small volume. That at test locality SH-1 contains about 7,000 cubic yards of sand and gravel. The gravel is mostly of "scoria," with minor amounts of limestone, granite, quartzite, quartz, chert, and traprock. Fine, soft fragments of charcoal make up about 18 percent of the fine gravel fraction. Only about 6 inches of stony soil covers the deposits.

Goose Creek.--Goose Creek rises in the southwest corner of the county, flows northeast through Sheridan and empties into the Tongue River at Acme. An extensive deposit lies on the divide between Goose Creek and Soldier Creek (examined at test locality SH-15). About 80 percent of this material is gravel, most of which is of limestone, though a small amount is of quartzite, sandstone, chert, and granite. Calcium carbonate weakly cements the upper 3 feet of the deposit which is overlain by 6 inches of sandy soil.

Terraces capped by sand and gravel 3 to 8 feet thick occur along Goose Creek north of Sheridan. The deposit at test locality SH-17 contains about 6,000 cubic yards; that at test locality SH-21 only about 900 cubic yards. Granite is the primary constituent of these deposits, with limestone, sandstone, quartzite, dolerite, chert, quartz, and volcanic traprock as minor constituents. About 20 percent of the material is fine silt and clay. The overburden, a stony soil is commonly about 10 inches thick.

The material in the flood plain of Goose Creek is coarser near the Bighorn Mountains than north of Sheridan. An extensive deposit examined at test locality SH-14 is 3 feet thick and about one-third of the material is coarse gravel. A deposit 3 miles north of Sheridan (test locality SH-16) has an area of 600 square yards, but only 6 percent of the material is gravel. The gravel in both deposits is composed of limestone and granite in about equal proportions, with lesser amounts of sandstone, quartzite, quartz, volcanic traprock, chert, and limonite.

Little Goose Creek.--Terrace segments along Little Goose Creek are capped by extensive deposits of sand and gravel 3 to 10 feet thick (test localities SH-6, SH-10). The gravel near the mountains is of limestone and granite in about equal proportions in the vicinity of Sheridan. about two-thirds is of limestone and one-third of granite. The deposits tend to be weakly cemented with calcium carbonate to a depth of about 4 feet, and are covered by 18 inches of stony soil.

A high erosion surface southeast of Big Horn (test locality SH-7) is covered by an extensive deposit of sand and gravel composed predominantly of fine grained granite and containing about 20 percent fine silt and clay. Deposits on other high erosion surfaces in the drainage of Little Goose Creek are of similar character.

Workable deposits in the flood plain of Little Goose Creek were examined at test localities SH-6 and SH-12. The gravel is composed of limestone and granite, in about equal proportions, with minor amounts of sandstone, quartzite, dolerite, and chert. About 40 percent of the material is sand. The available volume of these flood plain deposits varies greatly along the creek. The deposit at test locality SH-12 is in the creek bed and was being dredged in July 1947.

Tongue River.--Extensive deposits on terraces along the Tongue River were examined at test localities SH-18, SH-22, SH-24, SH-25. Most are relatively clean, but some contain up to 20 percent fine silt and clay. Limestone is the primary constituent of the gravel, though it decreases in proportion with distance from the mountains. Chert, sandstone, and quartzite are present in minor amounts. About 12 percent of the gravel at test locality SH-22 is of granite. Most of the deposits are covered by about a foot of stony soil which supports a grass and sagebrush cover.

An extensive deposit in the flood plain of Tongue River (test locality SH-23) is 3 to 4 feet thick. The gravel is mostly of limestone, with lesser amounts of granite, chert, quartzite, sandstone, limonite, and volcanic traprock. About 20 percent of the material is of fine silt and clay. The deposit is covered with a thin sandy soil that supports a stand of cottonwood trees.

Vicinity of Banner.--A long narrow ridge capped by sand and gravel lies just north of the town of Banner, east of the U. S. Highway 87. The deposit (test locality SH-5) is 6 to 10 feet thick and contains about 6,000 cubic yards of sand and fine gravel. The gravel is composed mostly of granite, but contains minor amounts of limestone, sandstone, quartzite, and feldspar. Most of the material is weakly cemented, and some lenses are tightly cemented, by calcium carbonate. The deposit is mantled by about a foot of sandy soil that supports a grass cover.

Bighorn Mountains.--Widespread deposits of rotted granite and slopewash derived from rotted granite underlie the broad uplands of the Bighorn Mountains. Two deposits in mountain meadows along U. S. Highway 14 were being exploited for road material in July 1947 (test

localities SH-19 and SH-20). These materials are mostly of feldspar and quartz. Large fragments tend to break down readily to smaller sizes although very fine material is rare. A very thin stony overburden supporting pine and spruce covers the deposits.

Small deposits of bouldery till occur in some of the canyons but were not examined.

SUBLETTE COUNTY

by

Gerald M. Richmond

General distribution of deposits

Sublette County has abundant and widely distributed resources of sand and gravel. Only in the south-central and southeast parts of the county, where existing deposits are thin, sandy, and in many places very silty, are adequate supplies lacking.

Local deposits of rather bouldery gravel occur on low terraces along the upper part of Green River from the foot of Green River Lakes to the big bend where the river turns south. The least bouldery deposits occur in kames (gravel mounds) about 1½ miles downstream from the lakes and in the vicinity of the bend. Just south of the big bend extensive deposits of sand underlie a terrace about 30 feet above the river. Along the Green River, from the mouth of Wagon Creek to the mouth of Big Twin Creek, deposits of small and rather bouldery gravel cap many narrow discontinuous terrace remnants. From Big Twin Creek southward the Green River flows through a till-floored basin, and passes through a large end moraine upstream from Bronx. Little accessible gravel occurs in this area except for inconspicuous deposits on small terrace segments close to the river. Gravel is, however, interbedded with the till in the end moraine.

South of the moraine and east of Bronx a broad outwash plain extending south-southeast for 8 miles to Cora is underlain by abundant gravel which, however, is bouldery, particularly near the moraine.

West of Bronx, along North, Middle, and South Beaver Creeks there are abundant deposits of terrace gravel composed mostly of quartzite pebbles and cobbles. This same kind of gravel occurs in small quantities on terraces adjacent to the Hoback River along U. S. Highway 187-189, and in greater quantities along Fish Creek, Dell Creek, and in the basin between Jack Creek and Dell Creek.

From Bronx, at the U. S. Highway 187-189 crossing of the Green River, to the point where the Green River turns east to Daniel, a low terrace east of the river contains extensive deposits of gravel. The deposits on small remnants of higher terraces in this area are bouldery.

At the bend in the river west of Daniel, extensive deposits of gravel cap a terrace along the north side of the river; and where the river bends to the southeast of Daniel, gravel caps a terrace along the south side of the river. Gravel is also plentiful in the flood plain of the river between these localities.

From Daniel south to Big Piney, numerous small terrace remnants border the Green River. The deposits on the upper terraces are thin, those on the lower terraces are thicker and more extensive.

Gravel occurs in the flood plains of Horse Creek, Cottonwood Creek, and North, Middle, and South Piney Creeks, in terraces along these streams, and locally on some of the interstream divides.

For about 10 miles south of Big Piney, many small gravel deposits cap terraces along the west side of the Green River. Southward to the county line, only very small deposits of terrace gravel were found on the west side of the river, though considerable supplies may be obtained

from the flood plain. On the east side of the river large deposits of gravel cap an extensive high terrace about 6 miles north of the county and 2 miles east of the river.

The New Fork River flows from New Fork Lakes along the southwest base of the Wind River Mountains as far south as the town of New Fork before turning southwest to join the Green River. Moraines border the New Fork River to a point about 4 miles north of Cora. Upstream from this point there is very little gravel; downstream, terraces bordering the river contain an abundance of gravel. Many of the terraces are broad, and extend east or northeast from the New Fork River for several miles up tributary streams where they grade into moraines at the foot of the mountains. The gravel in these terraces is coarse and bouldery in the vicinity of the moraines. Small deposits of clean sand form beaches at the upper and lower ends of many of the large lakes retained by the moraines.

From the town of New Fork to the confluence with the Green River numerous small deposits of sand and gravel cap segments of two low terraces along the New Fork River. Both terraces are most extensive on the north side of the river. Above them are remnants of at least one and possibly two higher terraces which have only a thin veneer of gravel on them, and are greatly dissected by gullies.

Along Sandy Creek small deposits of gravel have accumulated in the hummocky plains at Big Sandy Opening, and on terraces along the stream just below moraines at Lecke Ranch. Downstream from these moraines Sandy Creek passes through a narrow canyon, along which are only a very few small deposits. Deposits of sandy fine gravel cap terrace

segments along the stream from the lower end of the canyon to the Sublette County-Sweetwater County line.

Along the South Pass highway in the southeast corner of the county there are residual deposits of silty sand and fine gravel. This material has been used in local highway construction.

Local descriptions

Green River--headwaters to Wagon Creek.--Upstream from Green River Lakes a low gravel terrace, 6 to 20 feet above the river, occurs in a few places along the Green River and Clear Creek. These deposits consist of coarse gravel and sand with a few boulders. The gravel is composed mostly of granite and gneiss, though on Clear Creek small amounts of limestone and sandstone are present.

Downstream from the moraine at the lower end of Green River Lakes are discontinuous remnants of two gravel terraces containing bouldery material, and along the Forest Service access road, 1½ miles west of the lake, is a group of kames or mounds underlain by sand and gravel (test locality SB-51). About 50 percent of the material in the kames is gravel, 45 percent is sand, and 5 percent is silt and clay. The deposits are considerably cleaner than those on the adjacent terraces. The gravel, both in the kames and on the terraces is mostly of granite and gneiss, though small amounts are of hard limestone and sandstone, and about 15 percent is soft rock types, mostly rotted granite.

Two narrow terraces 30 and 45 feet above the Green River border both its banks at the big bend near the confluence of Wagon Creek. The gravel on the upper terrace is bouldery; that on the lower is sandy. About 70 percent of the material on the lower terrace and in an irregular gravel ridge at test locality SB-53 is gravel, 20

percent is sand, and 10 percent is fine sand. About 80 percent of the gravel is granite and gneiss; smaller amounts are of hard limestone, sandstone, and locally, white, brittle, siliceous tuff. About 20 percent of the gravel is soft rock, mostly rotted granite.

Green River-Wagon Creek to Big Twin Creek.--From the confluence of Wagon Creek south to the confluence of Tosi Creek the terrace deposits along the Green River are very sandy. For example, only about 10 percent of the material at test locality SB-56, a typical deposit, is of gravel. The sand is medium to coarse grained, and composed of quartz, feldspar, magnetite, and mica.

Along the Green River from Tosi Creek to Big Twin Creek are abundant remnants of three gravel terraces. The deposits on the highest terrace are dirty and locally overlain by a few feet of stony alluvium derived from gullies in the valley wall. About 65 to 70 percent of the material in the deposits is of gravel, 20 to 25 percent is sand, and 5 to 10 percent is fine sand, silt, and clay. The deposits differ from those upstream in that they contain more gravel and less sand, owing to an influx of coarse material from tributary streams, especially from the west. About 30 to 40 percent of the gravel is of granite and gneiss, 30 to 40 percent of hard limestone, 5 to 10 percent of hard sandstone, and 5 to 10 percent of shale, mostly red shale. From 30 to 35 percent of the gravel is soft rock, of which 3 to 5 percent is rotted granite.

Green River-Big Twin Creek to Beaver Creek.--On the east side of the Green River, north of Black Butte and west of the county road, is a knoll underlain by conglomerate composed of pebbles and cobbles of hard quartzite (test locality SB-42). The material is in part loosely consolidated, and has been used as a source of gravel for local road construction. About 60 percent of the quartzite cobbles are fractured

and angular. The deposit is small. Similar material underlies the north slope of the hill east of the road at this locality. In addition to quartzite, the gravel contains small amounts of deeply rotted granite and volcanic rock, probably rhyolite.

From Big Twin Creek to the mouth of Beaver Creek there is very little gravel along the Green River. Over most of this area the river flows in a shallow trench through a till plain. In places along the stream narrow terrace remnants are capped by small deposits of gravel 4 to 10 feet thick. About 50 to 60 percent of the gravel is granite and 40 to 50 percent of hard limestone, sandstone, and shale. Five miles above the confluence of Beaver Creek, Green River passes through a large end moraine in a canyon along which there is very little gravel. About a mile above the confluence of Beaver Creek where the river emerges from the canyon, segments of three terraces border the stream. The gravel on these terraces is 8 to 15 feet thick. A fourth, higher terrace, east of the river, extends south from the moraine for several miles. The gravel on it, however, is very bouldery and contains an abundance of silt, clay, and rotted granite.

From the southern margin of the broad moraine referred to above, an outwash plain extends to the south for about 4 miles, and southeast for about 8 miles in the direction of Cora. The plain is at about the same altitude as the third highest terrace along the river. The gravel on the plain is at least 15 to 20 feet thick. It is bouldery for a distance of about 2 miles from the moraine, and is generally coarse throughout its extent. The higher hills south of this plain are capped by thin deposits of coarse gravel and cobbles composed mostly of quartzite.

Green River-Beaver Creek to Daniel.--From Beaver Creek to Daniel the Green River flows on a broad, irrigated flood plain underlain by 15 to 20 feet of sand and gravel. The deposits are overlain by 6 to 18 inches of sandy soil. On either side of the flood plain, as far south as the point where the river turns east, there are extensive remnants of a gravel-covered terrace about 30 to 40 feet above the stream. The gravel on this terrace is 20 to 30 feet thick. To the east, along U. S. Highway 187-189, are higher terrace deposits which have been used as a source of gravel, but which contain many large boulders and much rotted granite.

Where the river flows east through Daniel abundant gravel lies beneath the irrigated flood plain. At the west end of this east-trending segment an extensive, gravel-capped terrace lies on the north side of the river and about 125 feet above it. Small local segments of lower terraces occur between it and the river. The gravel on the high terrace is 20 to 30 feet thick, but its upper 3 to 5 feet is locally firmly cemented with calcium carbonate. The overburden along the outer margin of the terrace is only 6 to 12 inches thick, but thickens northward to as much as 3 to 5 feet. The State Highway Department has a pit in a segment of one of the lower terraces near the junction of U. S. Highways 187 and 189 north of Daniel (test locality SB-39). The gravel there is only about 10 feet thick and contains many large boulders.

The gravel on the lower terraces and in the flood plain of the Green River in this section is different from that above the confluence of Beaver Creek in that 60 to 70 percent of it is of quartzite,

derived mostly from North, Middle, and South Beaver Creeks. In addition, 10 to 15 percent of the gravel is of hard granite, 2 percent is deeply rotted granite, small amounts are of hard sandstone and hard limestone, and about 5 percent is of soft rock. About 10 percent of the material consists of boulders and cobbles, and about 5 percent is silt and clay. The ratio of sand to gravel varies greatly. In places there are many thin lenses of sand; in other places 10 to 25 percent of the total deposit is sand mixed with the gravel. Small remnants of higher terraces northeast and south of Daniel have only a thin veneer of dirty gravel composed mostly of quartzite, with small amounts of rotted granite and volcanic rock. In many places this gravel has been washed downslope to form small accumulations.

Green River-Daniel to North Piney Creek.--From Daniel to the confluence of North Piney Creek the flood plain of the Green River is one-fourth to three-fourths of a mile wide. It is underlain by sand and gravel capped by 6 to 18 inches of sandy soil. The deposits are probably 15 to 20 feet thick. Most of the flood plain is under irrigation, and the water table is commonly within 3 to 5 feet of the surface.

The valley walls are 400 to 500 feet high, and are bordered discontinuously by six gravel-capped terraces. The terraces are narrow and parallel the river. At only a few places do all six occur one above the other.

East of Daniel, on the southwest side of the bend where the Green River turns south, there is an extensive remnant of a terrace 125 feet above the river. The gravel on this terrace is about 30

feet thick, and is covered by from 6 to 18 inches of sandy soil. The upper 2 to 5 feet of the gravel is locally firmly cemented with calcium carbonate. This cementation is well exposed in a pit at test locality SB-35, but does not appear to be continuous throughout the deposit. Boulders and cobbles comprise about 10 percent of the deposit, gravel, 70 percent, and sand, silt, and clay about 20 percent. About 80 percent of the gravel is quartzite, 10 percent of granite, and 10 percent of sandstone and limestone. Only about 5 percent of the material is soft or rotted.

Southward, for about 10 miles along the Green River, ther is more gravel on the west side of the valley than on the east side; in the next 12 miles, to the confluence of the New Fork River, there is more gravel on the east side than on the west. Deposits in the two highest terraces along the river contain more quartzite than those in the lower four.

From the confluence of the New Fork River to Big Piney gravel deposits and numerous bars of medium-grained sand underlie the flood plain of the Green River. There are also small deposits of gravel on terrace remnants along the north side of the valley. At test locality SB-14 about 70 percent of the material in the flood plain is gravel, 20 percent is sand, and 10 percent is silt and clay. There are relatively few cobbles or boulders. The gravel below the confluence of New Fork River contains about 25 percent granite, 60 percent of quartzite, and small amounts of hard limestone and sandstone. The granite is largely concentrated in the fraction less than 1 inch in diameter. The 5 percent

of soft material in the deposits is mostly rotted granite. A terrace on the north side of the river, and about 125 feet above it is locally underlain by gravel about 10 feet thick. The upper 3 feet of the material is coated with calcium carbonate. A lower terrace about 35 feet above the river has only a thin veneer of gravel.

Green River-North Piney Creek to Sublette-Lincoln County line.--From the mouth of North Piney Creek to the mouth of Dry Piney Creek three extensive terraces occur along the west bank of the Green River. U. S. Highway 89 crosses the middle of these three terraces and descends onto the lower about 2 miles south of South Piney Creek. The thickness of the gravel material capping the terraces averages about 20 feet. However, the deposits on the highest terrace are thinnest downstream, and those on the lowest terrace are as much as 50 feet thick in places. About 80 to 90 percent of the material is gravel, 8 to 10 percent is sand and up to 10 percent is silt and clay. Commonly less than 10 percent consists of cobbles larger than 3 inches in diameter.

For a distance of 2 miles downstream from the mouth of South Piney Creek the gravel on the three terraces is mostly of quartzite, hard sandstone, limestone, and a very small amount of soft material concentrated in the fraction less than one inch in diameter. In the western part of the flood plain the gravel, like that on the terraces, is mostly quartzite. Along the eastern part of the flood plain, about one-fourth of the gravel is granite.

From the mouth of Dry Piney Creek to the Sublette County-Lincoln County line there is almost no gravel along the Green River except at a few places in the flood plain. Exposed bars of sand and gravel are

being exploited at test localities SB-5, SB-6, and SB-6A, but in most places the flood plain is underlain by 6 to 10 feet of silt. Along the west side of the river extensive silty alluvial fans extend from the valley wall outward to the river. Also on the west side of the river as for example about 4 miles north of the county line there are many dunes of silt and fine sand, oriented in a northwest-southeast direction. Test locality SB-11 is in a small low terrace. The material there is about 20 feet thick and composed of quartzite, hard sandstone, hard limestone, and a very little granite. The upper 3 feet of the deposit is coated with calcium carbonate.

About three-fourths of a mile north of the county line there is another small low terrace deposit (test locality SB-7). The material is only 4 feet thick, but has a volume of about 250,000 cubic yards. About 10 percent is cobbles, 60 percent is gravel, 20 percent is sand, and 10 percent is fine sand, silt, and clay./ Over half the gravel is of quartzite; small amounts are of granite, hard sandstone, and hard limestone. Very little soft material is present. The material in the upper 2 feet of the deposit is coated with calcium carbonate. The overburden is 2 to 8 feet thick.

Six miles north of the county line and about 2 miles east of the Green River is an extensive terrace about 200 feet above the river. It is capped by 15 to 20 feet of gravel composed mostly of quartzite, though in part of granite, hard sandstone, and limestone. This is the only large deposit east of the river between South Piney Creek and the county line.

Hoback River.--Deposits in the flood plain of the Hoback River are bouldery, and along most of the river in Sublette County are overlain by several feet of sandy alluvium. Two terraces along the Hoback River are capped by gravel. One is about 30 feet and the other about 60 to 80 feet above the river. Most of the deposits are on the south or west side of the stream, and range from 10 to 20 feet in thickness. The materials on both terraces are similar in character. About 10 to 30 percent consists of cobbles, 60 to 70 percent of gravel, 15 to 25 percent of sand, and 10 to 15 percent of silt and clay. Over 90 percent of the gravel is of massive, varicolored quartzite; small amounts are of hard sandstone, hard limestone, and shale. The sand is clean and mostly of quartzite. Upstream from the point where U. S. Highway 187 leaves the river, all of the deposits are small, and those on the upper terrace are bouldery.

Fish Creek.--Fish Creek is the tributary of the Hoback River up which U. S. Highway 187 trends after it leaves the river. Along the lower two miles of Fish Creek there is no gravel, but in the next 3 miles abundant gravel forms two terraces on the north side of the creek. In the upper 3 miles gravel is abundant on terraces on both sides of the stream. Two miles above the confluence of the Hoback River and Fish Creek a broad valley containing no stream extends northwest from Fish Creek. This valley represents a former course of Fish Creek; and is underlain by about 15 feet of gravel composed mostly of quartzite. Its upper end is undercut about 60 feet by the present course of Fish Creek. The terraces along Fish Creek are capped by similar deposits 10 to 15 feet thick.

Jack Creek,--Jack Creek has very little gravel along it. Eight miles above the confluence of Jack Creek and the Hoback River, a broad valley containing no stream extends to the west from Jack Creek to Dell Creek. It has been undercut about 80 to 100 feet by Jack Creek, and is a former course of that stream. The bottom of this broad valley is underlain by 10 to 15 feet of gravel over 90 percent of which is quartzite.

Dell Creek.--The north side of Dell Creek is bordered by numerous terrace segments 40 to 60 feet above the stream. The deposits on these terraces near the stream contain clean sand and gravel, but the material becomes increasingly bouldery and dirty toward the north. About 60 percent of the gravel is quartzite, 30 percent is hard sandstone and hard limestone, and 10 percent is soft rock types.

North, Middle and South Beaver Creeks.--North of the crossing of U. S. Highway 187, North Beaver Creek flows along the outer margin of a large lateral moraine bordering the west side of the valley of the Green River. Deposits of sand and gravel along the creek near the moraine contain many boulders, and are overlain by about 2 feet of alluvium. In the headwater regions of North Beaver Creek, and along streams tributary to it, there are terrace gravel deposits 30 to 50 feet thick. In places these deposits have been exploited for their placer gold content. About 10 to 20 percent of the material consists of cobbles, 50 to 80 percent of gravel, 10 to 30 percent of sand, and a very small amount of silt and clay.

For a distance of about 7 miles south of the crossing of U. S. Highway 187, broad gravel terraces extend along both sides of North

Beaver Creek and about 20 feet above it. The terrace deposits are locally covered by 2 to 3 feet of silty alluvium, but in many places gravel is at the surface. Up to 30 percent of the material consists of cobbles over 3 inches in diameter, 50 to 60 percent is gravel, 20 to 30 percent is sand, and 10 to 20 percent is silt and clay. About 60 percent of the gravel is of quartzite, 20 percent is of granite, and 20 percent is hard limestone and hard sandstone. Up to 20 percent of the rock, (mostly the granite) is soft or rotted. The proportion of quartzite pebbles in the deposits increases greatly near the mouth of Middle Beaver Creek.

Middle and South Beaver Creeks are bordered by broad gravel terraces 20 to 35 feet and 80 to 100 feet above the stream. These terraces are extensive, and occur as discontinuous segments far into the headwaters of the streams. The gravel in the terraces was not tested, but is similar in most respects to that on North Beaver Creek and Fish Creek. More than 90 percent of it is of quartzite. Ten to 20 percent consists of cobbles greater than 3 inches in diameter, 60 to 70 percent is gravel, and 20 to 30 percent is fairly clean quartz sand.

Horse Creek and Cottonwood Creek.--Deposits along Horse Creek and Cottonwood Creek were examined only in very brief reconnaissance. The flood plains of both streams are underlain by extensive deposits of gravel, covered by 4 to 20 feet of silty alluvium. Two and possibly three terraces that discontinuously flank the valley walls have 10 to 30 feet of gravel on them. The broad dissected ridges between the valleys are underlain in large part by a conglomerate composed of

cobbles and pebbles of quartzite. This conglomerate is in many places sufficiently disintegrated to serve as a source of gravel. About 50 percent of the material on the terraces and in the flood plains of Cottonwood Creek and Horse Creek is of quartzite derived from this conglomerate, and 50 percent of sandstone and limestone. About 10 percent of the cobbles in the gravel are flat. In contrast to the deposits along the main stream, nearly all of the material in deposits along the tributaries is composed of quartzite. Up to 20 percent of the cobbles are flat, and as much as 40 percent are subangular.

North, Middle, and South Piney Creeks.--Deposits along North, Middle, and South Piney Creeks were also examined only in very brief reconnaissance, and those shown on plate 1 along North, Middle, and South Piney Creeks are modified after unpublished maps by W. W. Rubey,_/

_/ Rubey, W. W., U. S. Geological Survey, personal communication, 1947.

The conditions are generally similar to those on Cottonwood Creek and Horse Creek. The flood plains are underlain by gravel but in most places a cover of silty alluvium, 4 to 20 feet thick, renders most of the deposits inaccessible. Discontinuous segments of two and possibly three different terraces which commonly are underlain by 10 to 20 feet of gravel border the flood plains. About 50 to 60 percent of the gravel is of quartzite and 40 to 50 percent of hard sandstone and limestone. Many of the quartzite pebbles are flat. The interstream divides are largely underlain by conglomerate composed of pebbles and cobbles of quartzite and limestone. In many places the matrix of this rock is sufficiently disintegrated to permit excavation of gravel. Such

deposits, though commonly only a thin veneer, are locally 3 to 15 feet thick.

New Fork River-New Fork Lakes to Pinedale.--New Fork River, from New Fork Lakes at the edge of the mountains, to a point about 5 miles north of Cora, flows in a relatively narrow valley that cuts across a series of extensive moraines. The flood plain contains only a few small deposits of sand and gravel most of which contain many boulders. Small terrace deposits along the side of the valley also are bouldery.

From a point 5 miles north of Cora southward to Pinedale, the New Fork River flows on a narrow flood plain that is bordered by an extensive low terrace 6 to 10 feet above the stream. Gravel of undetermined thickness, probably at least 20 to 30 feet, underlies this terrace. Because of irrigation, the water table is near the surface.

North of Cora the terrace deposits contain coarse gravel and numerous cobbles; south of Cora they contain coarse gravel with numerous bars of sand. About 20 percent of the gravel is of granite, 50 percent of quartzite, 15 percent of hard sandstone, 15 percent of hard limestone, and 5 to 10 percent of soft rock, mostly rotten granite. The deposits are covered by 6 to 12 inches of silty soil. Northwest of Cora there are extensive remnants of two terraces about 30 and 50 feet above the stream. The lower of these two terraces forms the floor of a broad streamless valley that extends northwest to the Green River. Coarse gravel underlies these terraces. (Test locality SB-40.)

South of Cora to within 1½ miles of U. S. Highway 187, the segments of the two terraces become more narrow, and the gravel on them becomes finer (test locality SB-37). About 30 to 40 percent of the material is

of gravel, 40 to 50 percent is sand, and 10 to 15 percent is silt and clay. About 50 percent of the gravel is granite, 40 percent is quartzite, and 10 percent is hard sandstone, limestone, and shale. Soft rock, mostly rotted granite, makes up as much as 20 percent of the material. The upper three feet of the deposits is moderately coated with calcium carbonate. The overburden is thin.

Remnants of a higher terrace, thinly veneered with gravel composed of quartzite, occur about 400 feet above the stream on the east side of the New Fork River, 5 to 6 miles north of Cora and just south of the moraines along the river.

Willow Creek.--Willow Creek flows west and south of the moraines enclosing Willow Lake and joins the New Fork River about 2½ miles northwest of Pinedale. Small deposits of iron-stained gravel cap terrace segments along the upper reaches of the stream, and underlie parts of the narrow flood plain. Small deposits of iron-stained gravel cap terrace segments along the upper reaches of the stream, and underlie parts of the narrow flood plain. Small deposits of sand and gravel are also present at the foot of Willow Lake, and deposits of sand form terraces around Soda Lake three miles south of Willow Lake. Downstream from the moraines enclosing Willow Lake, Willow Creek flows on a gravel-floored plain about half a mile wide. On the west side of the flood plain and 6 to 10 feet above the stream a terrace extends west to the New Fork River. The gravel underlying the terrace is several feet thick but, owing to irrigation, the water table is near the surface. The overburden is only a few inches thick. From Willow Creek as far east as the moraines enclosing Soda Lake is bordered by a sequence of

four gravel-capped terraces about 15, 30, 55, and 70 feet above the stream. The deposits on these terraces are 20 to 40 feet thick. The material is bouldery within a mile of the moraines enclosing Willow and Soda Lakes, but elsewhere, the deposits consist of coarse to fine gravel and less than 30 percent of sand, silt, and clay. About 80 percent of the gravel in the lower three terraces is granite and gneiss, about 20 percent is quartzite. About one-fourth of the granite is rotted. The material in the upper 3 feet of the deposits is moderately coated with calcium carbonate. The deposits on the fourth, or highest terrace are, in general, thinner than those on the lower three. About 30 percent of the gravel is granite, much of which is rotted, 70 percent of quartzite, and less than 1 percent of deeply weathered volcanic rock, probably rhyolite or andesite. The deposits contain more silt and clay than do those on the lower three terraces. The upper 5 to 8 feet of the material is moderately coated with calcium carbonate.

Pine Creek and Fremont Lake.--Pine Creek flows from Fremont Lake southward through Pinedale and joins New Fork River 2 miles south of that town. Small sand deposits form beaches at the foot of Fremont Lake which is enclosed by large moraines. Gravel deposits in outwash channels between the moraines contain abundant large boulders.

Downstream from the moraines Pine Creek flows on a broad flood plain underlain by gravel in which, because of irrigation, the water table is near the surface. Southwest of Pinedale low knolls 10 to 15 feet above the flood plain contain deposits of clean gravel, with local bars of arkosic sand. Terrace deposits immediately east of Pinedale and 35 feet above the river, are mostly coarse and bouldery, but at test locality SB-36, about 60 to 70 percent of the deposits is coarse to fine gravel and 30 to 40 percent is sand. The gravel is

composed entirely of granite and gneiss, about half of which is rotted. The sand is of quartz and feldspar, with small amounts of mica and other dark minerals. The material is only slightly coated with calcium carbonate, and the soil cover is very thin.

New Fork River-Pinedale to Boulder.--Between Pinedale and Boulder the flood plain of the New Fork River is about half a mile wide. It is underlain by gravel, covered by several feet of silty alluvium. The water table is near the surface, because of irrigation. West of the river remnants of two terraces about 20 and 35 feet above the stream are capped by gravel. The upper is the more continuous and extensive. East of the river remnants of five terraces about 20, 35, 60, 80, and 270 feet above the stream are likewise gravel-capped. The second and third terraces above the stream are the most continuous, and extend for long distances to the northeast along Pole Creek. The deposits capping the lower four terraces average 20 to 30 feet thick, and in several places are as much as 60 feet thick. The material in the upper 2 to 4 feet of the deposits is commonly coated with calcium carbonate. The overburden is only about a foot thick (test localities SB-24, SB-25, SB-30, SB-31, SB-33). About 5 to 10 percent of the material on the lower four terraces consists of cobbles larger than 3 inches in diameter, 50 to 65 percent is gravel, and 30 to 45 percent is sand, and a very small amount is silt and clay. Eighty-five to 95 percent of the gravel is of granite and gneiss, less than 10 percent of quartzite, and a small amount of hard sandstone and hard limestone. Soft rock, mostly crumbly granite and gneiss, makes up 30 to 40 percent of the deposits between Pinedale and Pole Creek, but only 10 to 25 percent between Pole Creek and Boulder.

The fifth or highest terrace, about 270 feet above the stream, forms flat interstream divides 3 to 5 miles east of the New Fork River. Deposits on this terrace are 10 to 20 feet thick and consists of coarse gravel, numerous cobbles 3 to 6 inches in diameter, and arkosic sand. More silt and clay is present than in the lower terrace deposits. About 30 percent of the gravel is quartzite, 65 percent of granite and gneiss, 2 to 5 percent of hard sandstone and limestone, and less than 1 percent of decomposed volcanic rock, probably rhyolite or andesite. About one-third of the granite is crumbly. The material in the upper 5 to 8 feet of the deposit is loosely cemented with calcium carbonate, and covered by an arkosic sandy soil less than 1 foot thick.

Pole Creek and Burnt Creek.--Pole Creek flows from the east end of Half Moon Lake through a series of moraines and southeastward to the Green River. Its tributary, Burnt Creek, flows from Burnt Lake through a similar series of moraines before joining Pole Creek. The flood plains of these streams contain only small deposits of sand and gravel. Large deposits cap 5 different terrace surfaces about 20, 35, 60, 80, and 300 feet above the streams. Extensive remnants of the lowest two terraces lie northeast of the confluence of Pole Creek and Burnt Creek, and form the broad streamless valley, underlain by gravel which extends north from Pole Creek toward the west end of Half Moon Lake. The deposits underlying this valley are well sorted and less than 10 to 15 percent of the material consists of cobbles greater than 3 inches in diameter. From 20 to 35 percent of the material is arkosic sand. The gravel is composed almost entirely of granite and gneiss, about 15 to 25 percent of which is crumbly. The upper foot or two of the material is coated with calcium carbonate.

West of the streamless valley are extensive remnants of the three higher gravel-capped terraces, remnants of the fifth or highest terrace lie to the east. South of the confluence of Pole Creek and Burnt Creek

remnants of the fourth and fifth highest terraces occur on bedrock bluffs that stand above the stream. All these terraces are capped by sand and gravel.

The gravel in the third and fourth terraces is composed almost entirely of granite and gneiss, 30 to 50 percent of which is deeply disintegrated. The deposits on the fifth or highest terrace are bouldery. About 60 to 70 percent of the gravel is of granite and gneiss, about half of which is crumbly, 30 to 40 percent is quartzite, and about 3 percent is hard sandstone, hard limestone, and deeply rotted volcanic rock, probably rhyolite or andesite. The deposits on the three highest terrace range from 20 to as much as 60 feet in thickness. The upper 3 to 8 feet is moderately coated with calcium carbonate. The overburden is sandy and commonly less than a foot thick.

Boulder Creek.--Boulder Creek breaches a series of moraines enclosing Boulder Lake and flows south to join the New Fork River near the town of Boulder. The map information (pl. 1) for Boulder Creek and the area to the east is modified after G. W. Holmes._/

_/ Holmes, G. W., 1948, unpublished field maps.

Small deposits of sand form beaches at the west end of the Boulder Lake. Below the moraines the stream flows in a narrow trench, both east and west of which are remnants of six terraces underlain by gravel. The lowest terrace is preserved only as small remnants close to the stream. The second is the most extensive. The third and fourth terraces are not extensive on the west side of the stream, but are very extensive over an area 3 miles east of the stream and south of the moraines on the south side of Boulder Lake. The fifth

and sixth terraces are restricted to the crests of the higher ridges west of the stream.

The flood plain of Boulder Creek contains but little gravel. Deposits on the lower four terraces range in thickness from 20 to more than 40 feet. About 20 to 30 percent of the material consists of cobbles over 3 inches in diameter, 40 to 50 percent is coarse to fine gravel, 20 to 25 percent is arkosic sand, and 5 to 10 percent is silt and clay. Large cobbles and boulders are numerous within about a mile of the moraines enclosing Boulder Lake. Over 80 percent of the gravel is of granite; small amounts are of quartzite, hard sandstone, and limestone. From 10 to 20 percent of the material is soft rock, mostly rotted granite. The overburden ranges up to 2 feet thick in thickness.

The deposits on the two highest terraces are similar in thickness and texture to those just described, but differ lithologically. About 65 percent of the gravel is of granite, 35 percent is quartzite 2 to 5 percent is hard sandstone and limestone, and less than 1 percent is rotted volcanic rock, probably rhyolite or andesite. Nearly half of the granite is partly disintegrated or deeply stained. Coarse arkosic sand and fine gravel, locally as much as 16 feet, covers these deposits.

On all the terraces the upper few feet of the deposits is slightly to moderately coated with calcium carbonate. The thickness and compactness of this cemented zone tend to be greater on the higher terraces.

East Fork River and tributaries.--The East Fork River flows through a series of moraines at the front of the Wind River Mountains, turns northwest along the foot of the mountains to about the latitude of Boulder, and then flows southwest to join the New Fork River near the town of New Fork. Tributary to it along its northwesterly course are Silver Creek, Cottonwood Creek, and Muddy Creek each of which flow from canyons through the moraines at the foot of the mountains. The map information shown on plate 1 for the East Fork River as far upstream to Cottonwood Creek is modified after G. W. Holmes _/.

_/ Holmes, G. W., 1948, unpublished field maps.

Southeast of Fremont Butte extensive remnants of four gravel-capped terraces extend from the East Fork River east to moraines along the mountain front. Bedrock hills lie west of the river. The lowest terrace forms narrow benches along the stream. The next higher terrace is the most extensive, and the uppermost two terraces form ridges that extends westward from the moraines toward the river. The gravel on these four terraces is commonly 20 to 40 feet thick and composed mostly of granite though a small amount is of quartzite. About 20 percent of the granite disintegrates easily, up to 30 percent of this material consists of cobbles more than 3 inches in diameter, and about 30 percent is arkosic sand.

North of Fremont Buttes, where the East Fork River turns southwest, extensive remnants of two high terraces are capped by about 40 feet of sand and gravel. About 60 percent of the gravel is granite, 40 percent is quartzite, and a very small amount is rotted volcanic rock and fossil wood. About half of the granite is rotted and disintegrates easily.

Southwest of Fremont Butte two gravel-capped terraces border the East Fork River. The lower occurs as small discontinuous segments along the flood plain of the stream, the upper forms only a narrow discontinuous bench on the southeast side of the stream, but on the northwest side it forms a broad surface which extends west to the New Fork River and north to Boulder Creek. The deposits on both terraces are 20 to 40 feet thick. About 20 percent of the material consists of cobbles over 3 inches in diameter, and 30 to 50 percent is arkosic sand. Over 80 percent of the gravel is of granite; small amounts are of quartzite, hard sandstone and limestone. Throughout this area along the East Fork River and its tributaries the upper few feet of the deposits are moderately coated with calcium carbonate. The thickness of this zone and its degree of cementation tends to be greater on the higher terraces. The overburden is sandy, and 12 to 18 inches thick on both terraces. The flood plains of the streams are underlain by sand and gravel, but the water table is near the surface.

New Fork River-Boulder to confluence with Green River.--The flood plain of the New Fork River, from the town of Boulder to the confluence of the Green River, is about half a mile wide and underlain by sand and gravel beneath 6 to 24 inches of silty soil. Bars of gravel also occur in the bed of the river. However, these deposits are not readily accessible because the water table is near the surface.

Both sides of the river are bordered by segments of three gravel-capped terraces, about 20, 35, and 60 feet above the stream. The terraces are more nearly continuous along the north side of the river than on the south side where there are numerous bedrock bluffs. The deposits on the lower two terraces are 15 to 20 feet thick; those on the upper terrace range from a veneer to a few feet in thickness. The largest deposits, some of which exceed 500,000 cubic yards, lie just

down stream from Boulder. Deposits along the lower 7 miles above the junction of the Green River are small, many less than 10,000 cubic yards. All deposits are slightly coated with calcium carbonate and have a very thin overburden.

The texture of the material varies with the location of the deposit. At and immediately downstream from the mouths of tributaries 5 to 10 percent of the material consists of cobbles, 3 to 6 inches in diameter, 60 to 70 percent is gravel, 30 to 35 percent is sand, and up to 10 percent is silt and clay. Between tributaries there are few cobbles, 35 to 60 percent of the material is gravel, 30 to 50 percent is sand, and about 10 percent is silt and clay.

The lithology of the gravel varies in a similar pattern. At and immediately downstream from the mouths of tributaries 50 to 70 percent of the gravel is quartzite, 25 to 40 percent is granite, minor amounts of hard sandstone and hard limestone, and 3 to 7 percent of soft rock, mostly rotted granite. Between tributaries only 2 to 5 percent of the gravel is quartzite, 75 to 95 percent is granite, small amounts are of hard sandstone and limestone, and up to 10 percent is of soft rock, mostly rotted granite.

High terrace deposits between the New Fork River and the Green River.--Four to 5 miles north of the New Fork River and about 2 miles east of the Green River, in the area north of their confluence, is a very extensive, high terrace 10 miles long and more than a mile wide. This terrace is capped by 8 to more than 20 feet of sand and gravel of which cobbles make up not more than 10 to15 percent. Most of the gravel is of quartzite, though small amounts are of granite, limestone, and sandstone. Up to 10 percent of the material is soft and rotten.

The upper 5 to 8 feet of the deposits is moderately coated with calcium carbonate and the overburden is thin. Scattered over the surface of this terrace, especially at its southern end are long, low, sand dunes oriented in a general north-south direction. The sand is fine- to medium-grained and composed mostly of quartz with small amounts of feldspar, magnetite, and other dark minerals.

Sandy Creek.--Sandy Creek rises at the crest of the Wind River Mountains and flows southwest to the Green River. Map information on the sand and gravel deposits of this area is incomplete because adequate base maps are not available. Small deposits of granitic gravel form a hummocky plain along the stream at Big Sandy Opening. Below Lecke Ranch other deposits of granitic sand and gravel cap terraces bordering the stream. These deposits are 10 to 25 feet thick and about 30 percent of the material consists of cobbles. The upper few feet of the deposits is streaked and coated with iron oxide.

Downstream from these deposits, Sandy Creek enters a canyon cut in sandstone and shale along which there is very little gravel. Below the canyon and just upstream from test locality SB-8 are discontinuous segments of four, and in places five terraces. The lower two terraces, 20 and 35 feet above the stream, are underlain by relatively thin deposits which are in many places only a thin veneer. The material at test locality SB-8 is only four feet thick, 60 percent is gravel, most of it less than one inch in diameter, and 40 percent is sand. Downstream, the deposits at test locality SB-4 are 10 feet thick, those at test locality SB-3 are only 3 feet thick. About 30 to 40 percent of the material is gravel, most of it fine gravel, and 60 to 70 percent is sand. Over 80 percent of the gravel is of granite; minor amounts are

of quartzite, shale, and sandstone. Thirty-five to 50 percent of the material consists of soft rock, predominantly rotted granite. The sand is of quartz, feldspar, and small amounts of mica. The overburden on these deposits ranges from 6 inches to 2 feet in thickness. Calcium carbonate coating on the gravel is negligible.

In general the higher terraces are underlain by only a thin veneer of gravel, which, however, is sufficiently thick to be workable in a few places. About 60 percent of the gravel is of quartzite, 35 percent is of granite, much of which is rotten, and 2 to 5 percent is of soft sandstone, quartz, chalcedony, fossil wood, and rotted volcanic rock.

Along U. S. Highway 187, 18 to 26 miles south of Boulder, are deposits of fine gravel and sand which are the residual product of weathering of a soft conglomeratic sandstone. The material at test localities SB-9, SB-12, and SB-13 has been used in local highway construction. About 20 to 25 percent is of fine, granitic gravel, 60 to 70 percent is coarse, arkosic sand, and about 10 percent is fine sand, silt, and clay. Numerous clay lumps are included. The deposits are thin and form pockets 3 to 10 feet thick. They range in volume from a few hundred cubic yards to as much as 30,000 cubic yards. The largest observed was at test locality SB-9.

Highway from Farson to South Pass City.--The highway from Farson to South Pass City traverses the southeast corner of the county. Along it are extensive deposits of silty sand and fine gravel (test localities SB-1, SB-2) which are residual from the weathering of a silty, arkosic sandstone. The material is very variable in texture, but about 30 to 70 percent is gravel, 30 to 50 percent is coarse and medium arkosic sand, and 5 to 25 percent is fine sand and silt. It has been used in local road construction.

Sweetwater County

by

Gerald M. Richmond

General distribution of deposits

Most of the gravel in Sweetwater County occurs on six terraces that border the valley of the Green River. These terraces are more extensive and more continuous on the west side of the river than on the east side. They extend downstream to a point about 8 miles above the town of Green River. From this point to the town only two low terraces along the river have gravel on them. South of the town of Green River, only small deposits of gravel were found on low terrace remnants along the river. However, the road south from the town crosses high terrace remnants which are capped by extensive but thin gravel deposits.

Sandy Creek has only small thin gravel deposits occurring locally along it between Farson and the Green River. Deposits of silty sand cover most of the terraces. Upstream from Farson, deposits of sand and fine gravel occur on terraces along Sandy Creek and Little Sandy Creek, and along the lower course of Pacific Creek near its junction with Little Sandy Creek. Along the highway northeast of Farson the slopes rising gently toward the Wind River Mountains are covered with a rather dirty fine gravel, residual from underlying bedrock. The material has been used for road construction locally.

East of Eden is a large area of sand dunes which extends to the east for nearly 50 miles as a gradually narrowing belt.

Along Blacks Fork most terraces are gravel-capped. Upstream from Granger, the deposits of the highest terraces are worked by the State Highway Department. In the vicinity of Granger, and downstream from the town, only the lower two or three terraces have over 3 feet of gravel on them. The higher terraces in this vicinity are cut on rock, and have only a thin veneer of gravel.

Along Henrys Fork gravel-capped terraces occur in the vicinity of Burnt Fork, and near the junction of Henrys Fork and the Green River.

Upstream from Rock Springs, very dirty gravel deposits cap low terrace remnants locally along Bitter Creek and Killpecker Creek, and along Salt Wells Creek at the confluences of tributary streams. The flood plains of these creeks contain no gravel.

In the headwater region of Little Bitter Creek, the conglomerate capping the high divides has been worked where it is deeply weathered.

North of Wamsutter, and north and east of Creston extensive deposits of silty fine gravel and coarse sand cap the uplands.

Local descriptions

Green River-Sweetwater County-Lincoln County line to confluence of Sandy Creek.--The Green River, from the Sweetwater County-Lincoln County line to the confluence of Sandy Creek is bordered by six gravel-capped terraces which rise in step-like succession on either side of its broad valley. The lowest terrace, about 20 feet above the river, occurs as discontinuous segments bordering the foood plain. The second lowest terrace, about 30 feet above the river, is nearly continuous on both sides of the valley. The third and fourth terraces, about 80 and 100 feet above the river, are most extensive and continuous on the

southwest side of the river, though broken locally by draws and gullies. The two highest terraces, about 380 and 420 feet above the river, are the most restricted in distribution, but are commonly capped by extensive gravel deposits.

The deposits on the lower five terraces are 8 to 15 feet thick; those on the sixth or highest terrace are 20 to 30 feet thick. The deposits on all the terraces are commonly well graded, though there are many lenses of cobbles over 3 inches in diameter. About 15 to 20 percent of the material is cobbles and boulders, 35 to 40 percent is gravel, 25 to 35 percent is sand, and 10 to 15 percent silt and clay. The gravel is composed largely of quartzite, sandstone, granite, and limestone. Limestone is particularly abundant in the fine gravel. Soft rock comprises 5 to 15 percent of the material, but is largely concentrated in the fine gravel fraction. Quartzite is most abundant in the coarse gravel fraction; granite in the fine gravel fraction. Quartzite is also most abundant in the deposits of the higher two terraces; granite in those of the lower four. On the lower four terraces the upper 1 to 2 feet of gravel is commonly coated with calcium carbonate; on the upper two, the top 2 to 4 feet of the material is moderately to heavily coated. The overburden on the lower four terraces is 6 to 16 inches thick along the terrace margins, but tends to thicken to a maximum of 6 feet along the back side of the terraces. On the upper two terraces the overburden is very thin. Sagebrush and grass are the dominant vegetation.

Gravel underlies the flood plain of the river but is commonly overlain by 1 to 6 feet of silty overburden. Bars of clean gravel occur in places in the bed of the river.

Green River-confluence of Sandy Creek to the town of Green River.--From the confluence of the Green River and Sandy Creek to the mouth of Alkali Creek, the Green River is bordered by a succession of six gravel-capped terraces, that are extensions of those described upstream from the mouth of Sandy Creek. In the vicinity of Big Island, these terraces are 25 to 55, 95 to 125. 135 to 215, 240 to 250, 340 to 390, and 400 to 460 feet above the stream.

The largest deposits of gravel occur on the west side of the river and the county road from U. S. Highway 30 northwest to U. S. Highway 189 crosses these deposits for most of its length. The lower four terraces are nearly continuous, and are broken only by draws which drain the hills to the west. The upper two terraces are less extensive but are present over a large area 3 miles north of Peru on U. S. Highway 30. The two lower terraces have 8 to 15 feet of gravel, the middle two terraces 5 to 8 feet, and the upper two terraces 3 to 6 feet.

On the east side of the river the distribution of the gravel is very irregular. The lowest terrace, in the vicinity of Big Island, has an extensive sand dune cover. The second terrace is very poorly developed, and the third and fourth terraces have, in most places, only a thin veneer of gravel. The upper two terraces have only a veneer of cobbles and sand. In those places shown on the map as sand and gravel deposits, the lower 2 terraces have 3 to 5 feet of gravel, and the middle two terraces 5 to 8 feet.

Downstream from Alkali Creek only the lower two terraces are present. These are capped by 8 to 15 feet of sand and gravel which has been exploited in the vicinity of the U. S. Highway 30 bridge over the Green River (test localities ST-10, ST-11, ST-13).

In general, all of the terrace deposits between the mouth of Sandy Creek and the town of Green River are well graded, though there are local, small lenses of sand or cobbles. The deposits of the upper four terraces tends to be a little coarser than those of the lower two terraces. Most of the deposits contain about 3 to 5 percent of the material is of cobbles larger than 3 inches in diameter, 60 to 70 percent is gravel, 25 to 35 percent is sand, and 5 to 10 percent is silt and clay. Exceptions to this are the deposits on the lower two terraces for a distance of about 4 miles south of the mouth of Sandy Creek. About 1 to 3 percent of these deposits are of cobbles, 30 percent is gravel, 60 percent is sand, and 5 to 10 percent is silt and clay. The amount of silt and clay increases markedly where material from tributary streams merges with the terrace deposits along the Green River.

The gravel of all the terraces is composed predominantly of quartzite, and of small amounts of granite, medium hard sandstone, and limestone. The deposits of the high terraces contain more quartzite than those of the low terraces. Soft rock comprises 5 to 15 percent of the material, but is concentrated in the fraction less than one-half inch in diameter.

The upper 3 to 5 feet of gravel of the highest two terraces is commonly heavily coated with calcium carbonate, though in places, as at test locality ST-23, there is only 6 inches to 1 foot of coated material. The upper3 feet of gravel in the middle two terraces is also heavily coated. In the lower 2 terraces the upper 6 to 18 inches of gravel are slightly coated.

The overburden is in most places a silty sandy soil. It is commonly only 6 to 13 inches thick on the highest two terraces. On the lower four terraces it is 6 to 12 inches thick along the terrace margins, but thickens gradually to as much as 5 or 6 feet along the back side of the terraces. The flood plain of the river contains clean gravel similar to that of the lower terraces, but is, in most places, overlain by 1 to 4 feet of silty alluvium.

Green River-from the town of Green River to the Utah State line.--The Green River enters a canyon just south of the town of Green River and, although the floor of the canyon is in places as much as a mile wide, deposits of gravel along it are small and irregular in their distribution. Most are accessible with difficulty. The gravel deposits are on segments of two low terraces, which, in many places, are covered by alluvial fans composed of silt, sand, and fragments of soft sandstone and shale. The gravel deposits of the upper terrace south of the town of Green River (test locality ST-12) are being exploited only after stripping of 8 feet of dirty, angular, gravel containing much soft rock. Gravel in the flood plain of the river is in most places covered by thick deposits of fine sand and silt. This condition persists throughout the canyon to the mouth of Henrys Fork, beyond which the river enters a steep-walled gorge that contains no gravel deposits.

About 60 percent of the gravel in the terrace deposits south of the town of Green River is of gravel, 30 percent is sand, and 5 to 10 percent is silt and clay; little material is coarser than 3 inches in diameter. The gravel is predominantly of quartzite, but small amounts are of granite, and medium hard sandstone. Soft rock comprises about 10 percent of the material, but is concentrated in the fraction less than one-half inch in diameter.

Four miles south of the town of Green River, the county road crosses a high terrace that forms the divide between the Green River and Blacks Fork. This terrace is locally capped by deposits 2 to 6 feet thick. The deposits are thickest on the east side of the terrace, and thin westward. About 45 percent of the material is gravel, 30 percent is sand, and 25 percent is silt and clay. The gravel (test locality ST-7) is composed almost entirely of quartzite but about 5 percent of soft rock types. The upper 6 to 14 inches of material is coated with calcium carbonate, and the overlying silty overburden is 6 to 18 inches thick.

Sandy Creek.--Sandy Creek between Farson and its confluence with the Green River flows in a shallow canyon bordered by three sets of narrow rock terraces. These occur as disconnected segments along both sides of the canyon. The terraces are for the most part barren, or have only a thin veneer of sand or gravelly sand. Only those deposits more than 3 feet thick have been shown on the map. The material is predominantly a silty sand. The fine gravel fraction is composed mostly of granite, quartzite, soft shale, and sandstone. Much of the granite is rotted. In the vicinity of Farson, over 60 percent of the material is fine sand, silt, and clay; downstream, up to 90 percent is

fine sand, silt, and clay. At test localities ST-52 and ST-54, about 45 percent of the deposit is coarse and medium sand. At test locality ST-52, near the junction Sandy Creek and the Green River, up to 50 percent of the deposit is fine gravel. This locality is close to coarser and cleaner deposits along the Green River (test locality ST-51).

Sand caps two low narrow terraces that border Little Sandy Creek and Pacific Creek. These terrace deposits extend up both streams about 4 miles above their confluence. Along Little Sandy Creek 5 to 10 percent of the material is fine gravel, 65 percent is coarse and medium sand, and 25 percent is fine sand, silt, and clay. Along Pacific Creek 5 to 10 percent of the material is fine gravel, 40 to 55 percent is coarse and medium sand, and 40 percent or more is fine sand, silt, and clay.

Commonly three, and in places five terraces border Sandy Creek upstream from Farson. Only the lower two terraces have any extensive deposits on them. The upper are covered by a thin veneer of material of which 80 to 90 percent is silty sand and 10 to 20 percent is pebbles of quartzite, granite (in part rotted), chert, chalcedony, fossil wood, and soft sandstone. The material has been worked in a few places where it has a thickness greater than 3 feet. The lower two terraces are capped by 2 to 8 feet of sand, and fine gravel in the proportion 3 to 1. The sand is arkosic. About 50 to 60 percent of the gravel is granite, one-fourth of which is rotted, 25 to 30 percent is shale; and minor amounts are of quartzite, chert, fossil wood, soft sandstone, and a volcanic rock, probably rhyolite.

Highway from Farson to South Pass City.--The highway from Farson to South Pass City extended for about 8 miles across the southwest corner of Sweetwater County. Along this highway are extensive deposits of silty sand and fine gravel (test localities ST-63, ST-64, ST-65, ST-66, ST-68) that are the residual weathering product of a silty arkosic sandstone bedrock. About 15 to 25 percent of the material is fine gravel, 50 to 60 percent is coarse and medium sand composed mostly of quartz and feldspar, and 6 to 25 percent is fine sand, silt, and clay. In the vicinity of test locality ST-67 are sand dunes in which 85 to 90 percent of the material is clean medium- to coarse-grained sand and 10 to 15 percent is clean fine sand. The sand is composed predominantly of quartz, but some is of feldspar and dark minerals.

Eden.--Six miles east of Eden is the western border of a large area of sand dunes which extends eastward as a broad, but gradually narrowing band for a distance of nearly 50 miles. The material, 6 miles east of Eden, is coarse to medium-grained, clean, quartz sand. It becomes increasingly fine-grained in an eastward direction.

Hams Fork-Sweetwater County-Lincoln County line to Granger.--Hams Fork from the Sweetwater County-Lincoln County line to Granger flows in a valley nearly 2 miles wide. It is bordered by four gravel-capped terraces 20 to 30, 60 to 70, 180 to 220, and 250 to 300 feet above the stream. The most extensive segments of these terraces are on the southwest side of the valley. On the north side, there is only one remnant of the lowest terrace, but many of the next higher. The third occurs as two extensive segments on both sides of U. S. Highway 30 N. 2 miles northwest of Granger. The fourth, or highest terrace, forms a very extensive flat that is crossed by U. S. Highway 30 N. 6 miles northwest of Granger.

The gravel on the lowest terrace is 4 to 6 feet thick; that on the second terrace, 8 to 12 feet; that on the third, 2 to 5 feet; and that on the fourth, 4 to 20 feet. The material is similar on all the terraces. Up to 5 percent is of cobbles 3 to 6 inches in diameter, 60 to 80 percent is gravel, 7 to 15 percent is sand, and 10 to 20 percent is silt and clay. About 80 percent of the gravel is quartzite, 10 to 15 percent is hard sandstone and limestone, and 5 to 10 percent is of soft rock types which are concentrated in the fraction less than one inch in diameter. The upper 2 feet of the material on the lower two terraces is slightly coated with calcium carbonate; the upper 3 feet of the material on the higher two terraces is thickly coated. The overburden is a silty sand, 6 to 10 inches thick on the lower two terraces, 10 to 30 inches thick on the upper two.

The flood plain of Hams Fork contains gravel similar to that on the terraces and probably 15 to 20 feet thick. It is overlain in most places by 2 to 3 feet of silty soil. Much of the flood plain is under cultivation.

Blacks Fork-Sweetwater County-Lincoln County line to confluence with the Green River.--Blacks Fork from the Sweetwater County-Lincoln County line to a point 8 miles south of Bryan flows in a valley nearly 2 miles wide. It is bordered by discontinuous segments of two gravel-capped terraces, 20 to 30 feet, and 60 to 80 feet above the stream. The deposits on these terraces are 6 to 8 feet thick. Local segments of still higher terraces have only a thin veneer of gravel. Eight miles south of Bryan, Blacks Fork enters a narrow winding canyon along which two low gravel-capped terraces occur along the inside of the bends or meanders. Remnants of higher terraces back from the canyon rim are covered only by a thin veneer of material, or are barren rock benches.

Upstream from the mouth of Hams Fork about 55 percent of the material in the workable deposits is gravel, 20 to 25 percent is sand, and 15 to 25 percent is silt and clay. Downstream from the mouth of Hams Fork about 60 to 75 percent of the material is gravel, 15 to 25 percent is sand, and 8 to 15 percent is silt and clay. This difference in the amount of gravel and sand is due to the addition of coarse material by Hams Fork to the more silty material in the Blacks Fork drainage. Only a few cobbles 3 to 6 inches in diameter are present in any of these deposits. Above the mouth of Hams Fork 25 to 45 percent of the gravel is quartzite, 35 to 40 percent is hard limestone, 7 to 8 percent is medium hard sandstone, and 15 to 30 percent is soft rock type, concentrated mostly in the fraction less than one inch in diameter. Downstream from the mouth of Hams Fork 70 to 80 percent of the gravel is of quartzite, 10 to 20 percent is limestone, 7 to 8 percent is sandstone, and 8 to 16 percent is soft rock types. At the crossing of the county highway south from Green River (test locality ST-6) 45 percent of the gravel in the deposits is quartzite, 50 percent is limestone, and 5 percent is soft rock types. The upper 1 to 2 feet of the material is slightly coated with calcium carbonate and is covered by a silty sandy soil 6 inches to 2 feet thick.

Alluvial fans composed mostly of silt and small amounts of angular rock fragments cover many of the gravel deposits along Blacks Fork, particularly where tributary streams join it along the canyon south of Bryan.

The flood plain of the river is underlain by deposits similar to those on the terraces, but in most places the material is overlain by 1 to 4 feet of silty alluvium. In many places the flood plain is seansonally irrigated, in others it is covered by a dense growth of willow.

Henrys Fork.--In the southwest corner of the county gravel deposits cap a terrace 15 to 20 feet high on the south side of Henrys Fork and on both sides of Birch Creek from its confluence with Henrys Fork upstream to the state line. The deposits are 6 to 10 feet thick. The material is bouldery, and composed predominantly of quartzite, some hard arkose, and limestone. About 10 to 15 percent is soft rock and 5 percent is of silt and clay.

The high flat-topped divides north of Henrys Fork are underlain by indurated coarse conglomerate. Weathered phases of this rock in T. 16 N., R. 104 W. have been used in construction of the county highway southwest of Rock Springs. The material contains a large number of boulders at this locality. Prospecting would be necessary to locate areas where the normally hard conglomerate had weathered to a sufficient depth to form a source of gravel.

Two miles east of the town of Burnt Fork, Henrys Fork enters a canyon along which there are no gravel deposits. This canyon opens into a broad valley 4 miles above the confluence of Henrys Fork with the Green River. A low terrace, 20 to 30 feet above the stream, locally borders both sides of the valley. It is capped by 6 to 10 feet of clean sand and gravel containing few boulders. The gravel is composed mostly of quartzite, some hard limestone, sandstone. About 10 percent is soft rock types. These deposits were not tested in detail.

Bitter Creek.--There is no sand or gravel along Bitter Creek between its confluence with the Green River and Rock Springs. Two terraces, bordering the stream are capped by silty and clayey alluvium. East of Rock Springs, for a distance of about 4 miles, the stream is in a narrow canyon along which are no deposits. Between Point of Rocks and the Union Pacific Railroad siding to Gunn are small deposits of sand and gravel on local low ridges and knolls about 20 feet above the stream. Similar small deposits were found on Ten Mile Creek and along the road to Superior (test localities ST-15 to ST-19, ST-35, ST-36, ST-37, and ST-49). These deposits are 3 to 5 feet thick, and are very dirty. About 35 to 70 percent of the material is gravel, 20 to 40 percent is sand, and at least 15 to 25 percent is silt and clay. About 60 percent of the gravel is composed of sandstone, half of which is friable, 15 to 25 percent is limestone, and small amounts are of other rock types.. From 25 to 40 percent of the gravel is of soft rock types, about two-thirds of which is in the fraction less than one-half inch in diameter. Seventy to 90 percent of the particles are flat, and 50 to 80 percent are angular. Most of the deposits are small, and range from 5,000 to 30,000 cubic yards in volume.

South of the town of Bitter Creek is an extensive deposit about 6 feet thick that contains over 1½ million cubic yards of material (test locality ST-8). About 60 percent of the material is fine to medium gravel, 20 percent is coarse- and medium-grained sand, and 20 percent is fine sand, calcareous silt and clay. The gravel particles are mostly subrounded. Over 60 percent are of sandstone, more than half of which of which is friable, about 30 percent are of hard limestone, and 10 percent of other kinds of rocks. About 40 percent of the gravel is soft.

South of Bitter Creek, a high mesa, on which the Rock Springs Airport is located, is underlain by 2 to 3 feet of material about 40 percent of which is gravel, 35 percent is sand, and 25 percent is fine sand, silt, and clay. The gravel is composed of quartzite, hard sandstone, friable sandstone, and quartz. About 35 percent is of soft and friable rock types (test locality ST-20).

Salt Wells Creek.--A gravel deposit occurs along the county road, locally known as the Salt Wells Creek road, 6.5 miles southeast of Rock Springs. (Test locality ST-9.) It is located on the crest of a divide 200 feet above a tributary to Bitter Creek. The deposit is 4 to 8 feet thick. It contains about 200,000 cubic yards of material of which approximately 65 percent is of gravel, 25 percent of sand, and 10 percent of fine sand, silt, and clay. About 45 percent of the gravel is quartzite, 55 percent of soft sandstone, and small amounts of other rock types. About two-thirds of the quartzite is in the fraction greater than one inch in diameter. Two-thirds of the soft sandstone is in the fraction less than one inch in diameter. The material in the deposit, though cemented with calcium carbonate, can be readily excavated. The overburden is 6 to 10 inches thick.

Thick deposits of silty alluvium underlie the flood plain of Salt Wells Creek. However, at a few places (test localities ST-1, ST-2, ST-5) small deposits of sand and gravel occur on terraces at the confluence of streams tributary to Salt Wells Creek, or on small terrace remnants at bends in the creek. The material at each locality is similar; about 70 percent is of gravel, 10 to 20 percent of sand, and 10 to 20 percent of silt and clay. The gravel is subangular to

angular, and 35 to 40 percent of the particles are flat. Most are of sandstone, but some are of limestone and shale. About 35 percent of the pebbles are soft.

Test locality ST-5 is an exception. Here quartzite comprises 70 percent of the deposits and soft rock only about 20 percent. The soft rock is concentrated largely in the fraction less than one inch in diameter. The largest deposits along Salt Wells Creek are on a low terrace on the south side of the creek near its confluence with Bitter Creek. These deposits were not readily accessible at the time of the survey because there was no bridge over either Bitter Creek or Salt Wells Creek at this point.

The high divides west of Salt Wells Creek in the headwater region of Little Bitter Creek are underlain by a hard, well-cemented conglomerate. This rock is composed almost entirely of quartzite, pebbles and cobbles, about 20 percent of which are rotted and friable. Test locality ST-4 is a pit that was opened in an area where the conglomerate is about 30 feet thick. The upper 3 to 8 feet has weathered to an unconsolidated gravel. About 5 to 10 percent of the material is of cobbles, 3 to 8 inches in diameter, 70 to 75 percent is gravel, 15 to 20 percent is sand, and 5 to 10 percent is silt and clay. A gravel access road extends from the paved road along Salt Wells Creek to the pit at test locality ST-4, but, at the time of examination, the bridge at the east end of this access road was washed out.

Killpecker Creek.--On the east side of Killpecker Creek are small deposits of very dirty gravel. Most are alluvial fan deposits, located where tributary streams enter the valley from the east. A few are deposits on terrace remnants 35 to 60 feet above the stream. The

material ranges from 5 to 20 feet in thickness and, at most of the localities, about 50 percent is of gravel, 20 to 30 percent is sand, and 20 to 30 percent is silt and clay. The gravel is composed almost entirely of sandstone, 50 to 70 percent of which is soft and friable. A small amount of moderately weathered volcanic rock is also present. All of the material is angular or subangular and 60 to 90 percent of the particles are flat. Finely divided coal and iron oxide are abundantly disbursed throughout most of the deposits, and the material is coated with calcium carbonate to a depth of from 3 to 10 feet. The overburden is commonly less than one foot thick.

This kind of deposit also occurs locally along streams tributary to Killpecker Creek, as at test locality ST-44 on the road to Reliance, and at test locality ST-42 on the road to Stansbury.

Wamsutter and Creston.-- Extensive deposits of fine gravel occur in the vicinity of Wamsutter and Creston along U. S. Highway 30 in the southeast part of the county. The county road north from Wamsutter crosses a high flat divide about 8 miles north of U. S. Highway 30. The divide is underlain by fine gravel which has been exploited at test locality ST-48, at the western edge of the deposit. The deposit is 3 to 8 feet thick and an unlimited quantity of material is available. The material is poorly graded. About 75 percent is fine gravel, 10 percent is sand, and 10 percent is silt. The sand is medium- to fine-grained. About 25 to 30 percent of the gravel is of quartzite, 15 to 20 percent is chert, 10 to 15 percent is quartz, and small amounts are of several other rock types. About 10 percent is of soft rock. The material in the upper 18 inches of the deposit is slightly coated with calcium carbonate. The overburden is 6 to 8 feet thick and consists mostly of silty soil with a few rock fragments.

The high flat divides in the vicinity of Creston, particularly to the north and east, are capped by extensive deposits of sand and gravel. South of Creston at test locality ST-34, about 50 to 55 percent of the material is gravel, 25 to 30 percent is coarse and medium-grained sand, and 10 to 15 percent is fine-grained sand and silt. This is the coarsest material in the area. Eastward, toward test localities ST-33 and ST-47, the material becomes finer and at test locality ST-46 about 30 percent is fine gravel, 50 percent is sand, and 15 percent is silt. Throughout these deposits 50 to 80 percent of the gravel is granite, over half of which is rotted, 10 to 20 percent is quartzite, 10 to 20 percent is quartz, 4 to 8 percent is chert, and minor amounts are of other rock types. As much as 40 to 50 percent of the material is soft. The material in the upper 1 to 3 feet of the deposits is slightly coated with calcium carbonate, and 1 to 3 feet of overburden covers most of the deposits.

Teton County

by

Gerald M. Richmond

General distribution of deposits

Teton County contains abundant supplies of sand and gravel. The most extensive deposits underlie the flood plain of the Snake River and the broad terraces bordering it from Jackson Lake to the point where the river enters its narrow canyon in the southern part of the county.

Along the Snake River between the south boundary of Yellowstone National Park and Jackson Hole gravel deposits occur in a terrace near the Park boundary, and north of the river near the crossing of U. S. Highway 89-287. Gravel also underlies the flood plain of the river downstream from this crossing to Jackson Lake. East of the old alignment (1947) of U. S. Highway 89-287 along the east side of Jackson Lake is a shallow valley underlain by deposits of sand and gravel. Gravel terraces also border the lower part of Pilgrim Creek, and part of the upper valley nearly to its headwaters. Across the divide to the northeast, extensive deposits underlie Atlantic Creek and the broad valley of the Yellowstone River. The gravel in these localities is mostly of quartzite derived from nearby bedrock conglomerate. Two gravel terraces locally border the north side of Buffalo Fork from its confluence with the Snake River upstream to the 1947 crossing of U. S. Highway 287. Small deposits also occur along the more open parts of the canyon above this point and along Black Rock Creek near U. S. Highway 287 west of Togwotee Pass. Broad fans underlain by gravel occur along Spread Creek, from the mouth of its canyon to the Snake River, and gravel terraces border the upper tributaries of Spread Creek east of Mount Leidy.

Only small gravel deposits, are known along the Gros Ventre River. The most extensive cap terraces along Cottonwood Creek and Fish Creek near their junction with the Gros Ventre River. At these localities the gravel is composed largely of quartzite and contains numerous boulders.

Gravel-capped terraces occur locally along the Hoback River from the lower end of its canyon to its confluence with the Snake River. In most places the deposits on the lower terraces are less bouldery than that on the high terraces.

Along Snake River, below the confluence of the Hoback River to the county line, gravel underlies the flood plain near the turnoff of the county road to Wilson and also caps a high terrace north of Hoback. Sand covers a low terrace along the east side of the river south of Hoback.

Local descriptions

Snake River-south entrance of Yellowstone National Park to Jackson Lake.--Along both sides of the Snake River at the south entrance to Yellowstone National Park are gravel terrace segments about 25 feet above the stream. The deposits are about 15 feet thick and composed predominantly of coarse gravel having an average diameter of about 2 inches. Most of the pebbles are rhyolite, but some are quartzite. A similar gravel underlies the broad flood plain of the river.

A quarter of a mile south of the Park boundary a narrow, gravel-covered terrace extends along the west side of the river through a moraine that is half a mile wide and 100 to 150 feet high. North of the river at the crossing of U. S. Highway 89-287 a pitted gravel plain slopes southward from the moraine to form a bluff about 35 feet above the river. About 15 percent of the material underlying the plain consists of cobbles greater than 3 inches in diameter, 60 percent of gravel, 25 percent of sand, and

a little of silt and clay (test locality T-30). The upper part of the deposit contains many sand lenses. The gravel is composed mostly of rhyolite and basalt, but also includes some quartzite, sandstone, and volcanic tuff. From 5 to 10 percent of the material is soft, and much of the rhyolite is glassy.

Between the U. S. Highway 89-287 crossing of the Snake River and Jackson Lake, gravel is abundant in the flood plain of the river. At test locality T-31 about 75 percent of the material is gravel, 25 percent is sand, and a very little is silt and clay. There are fewer cobbles in it than in the gravel on the terraces upstream.

Along the east side of Jackson Lake is a shallow gravel-floored channel about a quarter of a mile wide that is traversed by U. S. Highway 89-287 three-quarters of a mile north of Pilgrim Creek crossing. Deposits at the north end of the channel are very bouldery. Southward, however, there is an abundance of sand and gravel. The material is composed mostly of rhyolite, but includes small amounts of basalt, quartzite, and soft sandstone.

Pilgrim Creek.--From the mouth of its canyon southwest to Jackson Lake, Pilgrim Creek is bordered by broad flats up to 2 miles wide. The lower reaches of these flats are marshy, but east of U. S. Highway 89-287 they are relatively well drained and underlain by an unknown thickness of sand and gravel. About 60 to 75 percent of the material is gravel, 15 to 20 percent is sand, and up to 10 percent is silt, and clay. Most of the gravel is less than 3 inches in diameter, although there are local bouldery lenses. The gravel is composed almost wholly of quartzite, but includes small amounts of weathered and unweathered basalt and brittle shale.

Pacific Creek.--Along Pacific Creek are two levels of gravel terraces, 25 to 30 feet and 60 to 75 feet above the stream. Deposits on the lower terrace are extensive in the wider parts of the valley nearly to its headwaters. Those on the upper terrace are most extensive in the open part of the valley about 8 miles above its confluence with Buffalo Fork. The proportion of gravel to sand on both terraces is about 3 to 1. The gravel is almost wholly of quartzite though very minor amounts are of basalt, andesite, andesitic breccia, hard limestone, and soft sandstone. Test locality T-27 is on the lower terrace.

A plain underlain by gravel extends south from Two Ocean Lake to Buffalo Fork. The material, however, contains abundant cobbles and boulders and is covered by several feet of alluvium.

Atlantic Creek and the Yellowstone River. _/--Extensive gravel deposits, which underlie the flood plain of the Yellowstone River and adjacent terraces in the southeast part of Yellowstone National Park, extend upstream into Teton County. Smaller deposits also extend up Atlantic Creek to the low divide which separates it from Pacific Creek. The gravel is well-graded and is composed of andesitic breccia, andesite, and basalt. It contains local sand lenses.

_/ Atlantic Creek and the Yellowstone River in Teton County were not examined in the field. The map information for this area is based on mapping by Arnold Hagne, W. H. Weed, and J. P. Iddings, U. S. Geological Survey Atlas, Yellowstone National Park folio no. 30, 1896, which has been modified as to detail from aerial photographs.

Buffalo Fork.--The lower reaches of Buffalo Fork, for a distance about 3 miles above the confluence with the Snake River are bordered on the north side by remnants of two gravel-capped terraces. The upper terrace is about 100 feet and the lower 30 to 40 feet above the Buffalo Fork river. Further upstream, as far as the canyon, gravel deposits occur in the flood plain on local remnants of the lower terrace and in many small alluvial fans at the mouths of small tributary streams. The material in the fans is angular, bouldery, and dirty. The gravel in both the terraces and in the flood plain of the river is composed almost wholly of quartzite, but includes minor amounts of basalt, andesite, hard limestone, and soft sandstone. About 5 to 20 percent of the material is of cobbles, 3 to 6 inches in diameter, 65 to 80 percent of gravel, 5 to 15 percent of sand, and 5 to 10 percent of silt and clay. The overburden ranges in thickness from a few inches to 3 feet, and commonly bears a sage brush and grass vegetation. The water table is near the surface beneath the flood plain.

At the confluence of the North Fork of Buffalo Fork a segment of the lower terrace on the south side of the main stream contains cobble gravel mixed with sand. The gravel is mostly of quartzite, basalt, and andesite. A little over a mile west of the county line on Buffalo Fork another segment of the lower terrace is capped by bouldery gravel composed /of basalt, andesite, andesitic breccia, and granite.

Blackrock Creek.--In the broad meadows 3.5 miles west of Togwotee Pass are small remnants of a gravel terrace 30 feet above Blackrock Creek. (Test locality T-18). The deposits are about 15 feet thick.

About 65 to 70 percent of the material is gravel, 25 percent is sand, and up to 10 percent is silt. The gravel is composed predominantly of basalt, andesite, and rhyolite, but a small amount is of quartzite. About 20 percent of the volcanic rocks are deeply weathered, and most of the rotted pebbles are less than one-half inch in diameter.

At the west end of the meadows, where the stream plunges into a narrow gorge, are a few irregular low mounds underlain by gravel. A pit in the largest of these mounds has nearly exhausted the supply of gravel in this vicinity.

At the sharp bend in the road that descends from Black Rock Creek to Buffalo Fork, a pit has been opened in a local pocket of gravel on the steep slopes east of the road. (Test locality T-24). About 5 percent of the material at this locality is of cobbles up to 8 inches in diameter, 65 percent is gravel, and 35 percent is sand. The gravel is composed of basalt, andesite, rhyolite-breccia, limestone, and a small amount of granite. About 8 percent of the gravel is deeply weathered, but most of the rotted pebbles are less than one-half inch in diameter.

Spread Creek.--A broad alluvial fan underlain by well rounded gravel with numerous sandy lenses extends from the mouth of the canyon of Spread Creek to the Snake River, a distance of about 4 miles. Though most of the gravel is 2 to 4 inches in diameter, some boulders are up to 12 inches in diameter and the deposits contain considerable admixed silt. Quartzite is the predominant constituent of the gravel; lesser amounts are of soft sandstone, calcareous shale, and granite. Most of the boulders are of granite. The overburden is thin.

Along the middle course of Spread Creek are a few gravel-covered benches 100 feet or more above the stream which is in a narrow canyon. The material on these benches is very bouldery and dirty.

Along the south fork of Spread Creek, east of Mount Leidy, are extensive remnants of two terraces 20 and 40 feet above the stream, that are underlain by clean sand and gravel. The gravel is predominantly of rounded quartzite pebbles, 1 to 4 inches in diameter.

Snake River and plains in Jackson Hole. _/--The broad plains of Jackson Hole comprise a series of four gravel-covered terraces, of which the highest was found only in the southeastern part of Jackson Hole, south of Game Creek. Its surface is 400 to 600 feet above the Snake River. The deposits on it are thin and bouldery, and are composed mostly of coarse quartzite cobbles. This material is mixed with a considerable amount of silty slope wash.

_/ The map information for much of the Jackson Hole area is modified after F. M. Fryxell, Glacial features of Jackson Hole, Wyoming, Augustana Library Publication no. 13, 1930.

The upper intermediate terrace is about 270 feet above the Snake River in the northern part of Jackson Hole. It slopes southward at a steeper gradient than the river. Along the southwest side of Jackson Hole, south of Wilson, it is 175 to 200 feet above the river, and in the southeastern part of Jackson Hole is only 50 feet above the river.

The deposits in this terrace are thick. About 10 percent of the material is cobbles, 60 to 70 percent is gravel, 10 to 20 percent is sand, and 5 to 10 percent is silt and clay. In the central and southern parts of Jackson Hole the average large cobble is 6 to 8 inches in diameter. Near moraines in the northern part of the basin, however, boulders up to 12 inches in diameter are common.

About 80 to 95 percent of the gravel on the upper intermediate terrace is quartzite, 3 to 10 percent is granite and gneiss, and small amounts are of rhyolite, basalt, sandstone, chert, and schist. Commonly up to 5 percent of the material is of rotted granite or rhyolite, soft sandstone or clay lumps.

In general the gravel on the upper intermediate terrace is mantled by less than 18 inches of silty overburden though along Ditch Creek an alluvial cover of mixed fine sand, silt and clay is several feet thick in many places. Locally there is a zone of calcium carbonate cementation in the upper few feet of the deposit.

The lower intermediate terrace is about 100 feet above the Snake River at the mouth of Buffalo Fork, and extends downstream at a steeper gradient than the river. At the crossing of U. S. Highway 89-187 at Moose it is 40 to 50 feet above the river but at Wilson it is only 10 feet above the river. The deposits of the lower intermediate terrace are similar in texture to those of the upper intermediate terrace. About 10 percent of the material is cobbles, and boulders up to 12 inches in diameter, 60 to 70 percent is gravel, 10 to 20 percent is sand, and 10 percent is silt and clay. The proportion of boulders increases somewhat, but near the moraines enclosing Jackson Lake 90 to 95 percent of the gravel is of quartzite, 4 to 5 percent is of granite, 2 to 3 percent is of rhyolite, and small amounts are of other rock types. Less than 5 percent of the material is soft or weathered. The overburden is generally less than 6 inches thick and no zone of lime cementation was noted in the gravel. North of Jackson along Flat Creek the water table is high and the land is marshy. Several feet of alluvial silts have accumulated over the gravel in this area.

The lowest terrace is restricted in its distribution to narrow segments along the Snake River. Near its northern end, east of Moran, it is 35 to 40 feet above the river. At Moose two segments of it are 25 and 35 feet above the river, and downstream the terrace merges with the flood plain deposits. The full height of the terrace is underlain by gravel similar in all respects to that of the lower intermediate terrace.

Gravel is also abundant in the flood plain of the Snake River. Upstream from the narrows along the river east of Jenny Lake the material is rather bouldery. It becomes less bouldery downstream and, below Moose, the flood plain contains many bars of sand as well as gravel (test localities T-11, T-12). At the mouth of the Gros Ventre River and upstream along that river the gravel is bouldery, though pits have been operated in it locally. Abundant deposits occur along the Snake River from the mouth of the Gros Ventre River to near the mouth of Game Creek at the south end of Jackson Hole.

The material in the flood plain deposits is composed mostly of quartzite but small amounts are of granite, gneiss, and rhyolite.

Till in morainal ridges in the northern part of Jackson Hole, though bouldery, is also very gravelly, and is used locally as a source of gravel. The material is composed mostly of quartzite. In the west-central and southwestern parts of Jackson Hole the morainal ridges contain many large boulders of granite and gneiss, and much silt and clay. They are also mantled with from 5 to as much as 30 feet of loess.

Gros Ventre River.--Gravel deposits are not abundant along the Gros Ventre River except where it crosses the plains of Jackson Hole. In this area, gravel terraces extends from the U. S. Highway 89-187 bridge over the River westward to the Snake River; and eastward along the north side of the river to the foot of the Gros Ventre Mountains. The gravel is composed predominantly of quartzite, but small amounts are of granite, limestone, sandstone, shale, and rhyolite. About 10 to 20 percent of the material is cobbles and boulders, 3 to 18 inches in diameter. The overburden ranges up to 18 inches in thickness. No gravel of any consequence occurs along the Gros Ventre River from the canyon mouth upstream to Crystal Creek. Small terrace deposits occur on the north side of the river above the slide area, but the gravel is bouldery and dirty.

Other small bouldery terrace deposits occur near the confluence of Crystal Creek and on the south side of the Gros Ventre River upstream from this, but below the upper slide area.

Remnants of two gravel-capped terraces, about 20 and 40 feet above the stream respectively, occur along the Gros Ventre river near the confluence of Fish Creek and this point and the confluence of Cottonwood Creek. The deposits also extend for at least 2 miles up both Fish Creek and Cottonwood Creek. They are 6 to 15 feet thick, and are composed mostly of rounded quartzite pebbles and cobbles. The overburden is thin, and the vegetation mostly sagebrush. No important deposits of gravel occur farther up the Gros Ventre River. Deposits of a conglomerate composed of quartzite pebbles and cobbles underlie the hills bordering both Fish Creek and Cottonwood Creek. The material is tightly cemented in some places, loose and readily excavated in others. These deposits of conglomerate are not shown on the map.

Hoback River and Granite Creek.--Deposits of sand and gravel underlie remnants of three terraces along the Hoback River in Teton County in the broader parts of the valley west of Hoback Canyon. The material is bouldery, quite dirty, and in places is covered by several feet of silty angular alluvial fan material.

The flood plain deposits of the Hoback River are bouldery, except the confluence of Willow Creek. Here, about 80 percent of the material is gravel, 10 percent is sand, and 10 percent is silt. About 50 percent of the gravel is hard limestone, 25 to 35 percent is quartzite, 15 percent is hard sandstone and 10 percent of soft rock types.

On Granite Creek narrow terraces rise 20 to 30 feet above the stream along the broader parts of the canyon. The deposits of these terraces are 10 to 20 feet thick. Locally, the gravel is bouldery and contains a high proportion of silt and clay. A pit has been developed in the 20-foot terrace at test locality T-2. About 75 percent of the material in this pit is gravel, 20 percent is sand, and 5 percent is silt and clay. About 85 percent of the gravel is limestone, and small amounts are of quartzite, granite, hard sandstone, and basalt. Five to 10 percent is of soft rock. Alluvial fans composed of silty, stony material overlie the terrace deposits in places.

Canyon of the Snake River from the Hoback River to the Teton County-Lincoln County line.--Gravel underlies the flood plain and adjacent terraces along the wider parts of the canyon of the Snake River in Teton County. At the mouth of the Hoback River the gravel on a terrace about 80 feet above the stream is very bouldery. In the vicinity of the junction of U. S. Highway 89 and the state secondary road north to Wilson

the flood plain contains abundant gravel (test locality T-3). South of Hoback on the east side of the river the flood plain is underlain mostly by sand. A terrace 160 feet above the river north of Hoback is capped by about 20 feet of gravel which is locally bouldery. The composition of the gravel at all points along the river is similar, approximately 70 to 85 percent quartzite, 5 to 10 percent granite (in part weathered), small amounts of volcanic rock, and about 5 percent of soft rock types.

West slope of the Teton Mountains in Teton County.--Gravel on the west slope of the Teton Mountains in Teton County occurs in two different types of settings. It underlies terraces which slope west from moraines in the canyons of Darby Creek, Teton Creek, and North and South Leigh Creeks. It also caps the gently sloping plains and interstream divides in the northwest part of the county.

The gravel on Darby Creek near the margin of Teton County is bouldery. Abundant well-graded gravel containing only a small proportion of boulders underlies the plains northwest and southwest of Alta. The texture of the material commonly becomes coarser upstream toward the moraines in the canyons. At test locality T-21 the deposit is about 30 feet thick. About 85 percent is gravel and 15 percent is sand and silt. About 60 percent of the gravel is hard limestone, 25 to 30 percent is granite, and small amounts are of hard sandsone and other rock types. About 10 percent of the granite is deeply rotted, but the deposit as a whole contains only about 5 percent of soft material. Calcium carbonate coats the gravel slightly throughtout the deposit, and from 2 to 3 feet of silty overburden covers most of them.

In the northwest part of the county many broad plains and gently sloping interstream divides are underlain by gravelly till or gravel. Most of these areas are not shown on the map. South of the North Fork of Teton Creek the material is composed predominantly of limestone and granite, and much of the granite is deeply weathered. North of the North Fork of Teton Creek it is composed mostly of quartzite, basalt, and rhyolite.

Abundant gravel also underlies the plains adjacent to South Boone Creek and west to the state line. The overburden on these several deposits is silty and commonly 1 to 3 feet thick. However, over small areas it is as much as 10 feet thick.

Uinta County

by

Gerald M. Richmond

General distribution of deposits

Uinta County has abundant sources of sand and gravel though they are irregularly distributed.

In the western half of the county deposits occur on terraces along the Bear River, and locally in its flood plain. Operations in and around Evanston derive gravel from these sources, and from the residual weathered debris of conglomerate bedrock.

In the north-central part of the county, clean, well-graded gravel is scarce. Small deposits of dirty, shaly material cap low hills and terrace remnants west of Albert Creek along U. S. Highway 189, and a similar material occurs locally on benches bordering Muddy Creek along the route of the Union Pacific Railroad.

In the southeast part of the county gravel is plentiful on the six terraces that locally border Blacks Fork, Smiths Fork, and Cottonwood Creek._/ South of Mountainview, however, the deposits contain a large

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_/ Deposits shown on plate 1 along the north flank of the Uinta Mountains are in part modified after Bradley, W. F., Geomorphology of north flank of the Uinta Mountains, U. S. Geol. Survey Prof. Paper 185-I, plate 34, 1936.

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proportion of cobbles and boulders. Along Henrys Fork in the vicinity of the town of Lonetree, small deposits occur on low terraces along the stream.

Moraines in the canyons along the front of the Uinta Mountains are composed of bouldery till that contains abundant silt and clay. This material, though used locally for road surfacing, is not shown on the map (pl. 1).

Local descriptions

Bear River-Upstream from Evanston.--Above the construction of the valley of the Bear River south of Knight, the proportion of gravel in the floodplain of the river is 55 to 65 percent, that of sand, 25 to 35 percent, and that of silt and clay as much as 10 percent. Cobbles are mostly less than 3 inches in diameter, and most are of quartzite. The thickness of these deposits is unknown, but probably ranges from 20 to 30 feet in the wider parts of the valley. The deposits are overlain in most places by 2 to 6 feet of silty clay soil tend to be irrigated for agriculture.

On the west side of Sulphur Creek a broad low terrace, 9 miles long and 2 miles wide, is capped by about 30 feet of gravel similar to that described above. The deposit is overlain by 4 to 24 inches of silty clay soil. At its south end, a higher terrace, 300 to 400 feet above Mill Creek, (sec. 16, T. 12 N., R. 119 W.), is also capped by a thick deposit of gravel which is coarse and silty. To the west another high gravel-capped bench, 400 feet above the Bear River, slopes north for about 6 miles. The deposits on it are 3 to 20 feet thick and composed almost wholly of quartzite. Cobbles average only about 3 inches in diameter, and the material includes large amounts of sand and silt. The overburden is 6 to 20 inches of silty clay soil. All deposits on high terraces in this area are moderately to firmly cemented with calcium carbonate.

Two miles south of Knight a low bench, about 50 feet above stream level and about 1.5 miles long, extends from the Bear River to Lachapelle Creek. Gravel on the bench is about 30 feet thick and mostly of quartzite.

From Knight to Evanston, the south bank of Bear River is bordered by two gravel-capped terraces. The lower is 60 to 100 feet and the upper 180 to 200 feet above the river. On the lower terrace, the deposits are from 15 to 30 feet thick and their proportion of gravel to sand is about 3 to 1. The gravel is mostly of quartzite. The upper 5 feet of the deposits are moderately cemented with calcium carbonate, and covered by 4 to 18 inches of silty soil.

The deposits on the upper terrace are thin and of very local extent.

Bear River at Evanston and downstream to the Idaho-Wyoming State line.--Southeast of Evanston, several small pits have been opened in gravel residual on beds of well-cemented conglomerate composed of quartzite pebbles. The workable material is thin and not extensive. The largest pit is at test locality U-7.

The flood plain of the Bear River at Evanston and downstream is underlain by coarse gravel that is mostly of quartzite. The material is locally bouldery, about 20 percent is sand and up to 10 percent is silt and clay. The deposits are probably 20 to 30 feet thick, and are overlain by from 6 inches to 3 feet of silty soil. Many are under seasonal irrigation. The State Highway Department has used material from test locality U-5.

A terrace 60 feet above the stream on the south bank of the Bear River west of Evanston is capped by about 50 feet of coarse gravel composed mostly of quartzite. A large commercial pit is operated at test locality U-6. The upper 5 to 8 feet of the deposit is moderately cemented with calcium carbonate, and is overlain by about 3 feet of silty soil.

Along the west bank of the Bear River 3 miles south and 4 miles north of Almy are two segments of a gravel-capped terrace 30 feet above the stream. The gravel on both segments is 10 to 15 feet thick, and composed of quartzite. At test locality U-17 the material is thickly coated with calcium carbonate. Similar deposits flank both sides of the valley of Yellow Creek 5 miles above its junction with the Bear River.

Albert Creek.--Sand and gravel deposits cap rolling hills along the west side of Albert Creek 40 to 100 feet above it. They are 3 to 10 feet thick, and, in general, range in volume from 5,000 to 50,000 cubic yards. At test locality U-21, however, nearly 5,000,000 cubic yards are available. The gravel in the deposits is mostly smaller than 2 inches in diameter, and composed of hard limestone, quartzite, soft sandstone, siltstone, and soft limestone. From 30 to 50 percent is of soft rock. The deposits also contain from 25 to 50 percent of fine sand, silt and clay. Numerous pits were opened in this material for use nearby on U. S. Highway 189.

A deposit of gravel on the divide between Albert Creek and Bear River, south of U. S. Highway 189, is approximately 30 feet thick, and contains about 2,500,000 cubic yards (test locality U-4). The material is composed of well-graded, clean, hard, quartzite gravel, and small amounts of sand. In 1947 it was being hauled to points along U. S. Highway 30 N., east of Kemmerer.

Muddy Creek.--Gravel along Muddy Creek, on the route of the Union Pacific Railroad, is confined to a vew small widely separated segments of two terraces, 75 and 30 feet above the stream.

Deposits on the higher terrace in the vicinity of Carter (test locality U-20) are 4 feet thick. About 85 percent of gravel is one-half to 1 inch in diameter; 15 percent is fine sand, silt, and clay. The gravel is mostly of quartzite, hard sandstone, and hard limestone, but contains some soft rockand a small amount of chert. Upstream from Carter, the deposits on remnants of this terrace are thin, coarse, and bouldery, In the vicinity of LeRoy only a veneer of boulders in a matrix of fine sand, silt, and clay covers the terrace.

Deposits on the lower terrace in the vicinity of Carter are 3 to 5 feet thick. About 65 percent of the material is gravel; 35 percent is sand, silt, and clay. The gravel consists of quartzite, hard sandstone, hard limestone, and small amounts of soft rock. Upstream, a segment of this terrace, on the west side of U. S. Highway 30 S at the crossing of Muddy Creek, is capped by similar gravel, as much as 30 feet thick. Downstream from Carter the terrace is covered only by thin deposits of shaly material.

High bench west of Fort Bridger.--Six miles west of Fort Bridger U. S. Highway 30 S. crosses a high bench that slopes to the northeast, and is 400 to 500 feet above Blacks Fork. The bench extends both north and south of the highway for about 10 miles and the Fort Bridger Airport is located at its northeast end. Southeast of the airport are several subsidiary benches 30 to 50 feet that have little gravel on them. In the vicinity of U. S. Highway 30 S., the high bench is capped by 15 to 20 feet of gravel. This deposit thins northeast to from 3 to 6 feet at the airport. At test localities U-2, U-10, and U-15 cobbles, greater than 3 inches in diameter, make up 10 to 25 percent of the material,

gravel 45 to 50 percent, coarse and medium sand 15 to 30 percent, and fine sand, silt, and clay about 10 percent. The gravel is composed predominantly of quartzite, hard arkose, hard limestone, and hard sandstone. The fraction smaller than 1 inch in diameter contains about 15 percent of soft rock and 10 percent of chert. The upper 4 feet of the material is moderately cemented with calcium carbonate and about 2 feet of stony silty soil covers the deposit.

About 2 miles south of U. S. Highway 30 S. the deposits on this high bench are very bouldery, and about 3.5 miles south of the highway, they grade into a very bouldery till which caps much of the bench south of this point. Bridger Butte, east of the bench, is capped by a gravel similar to that on the bench.

Blacks Fork-Canyon mouth to Fort Bridger.--Blacks Fork, from the mouth of its canyon in the Uinta Mountains north to Fort Bridger is bordered by four gravel-capped terraces at successively higher elevations above the stream but all lower than the high bench described in the preceding paragraph. All of the terraces head upstream at moraines. The deposits are 15 to 20 feet thick. Those on the lower two terraces are bouldery to a point about 15 miles south of Fort Bridger; those on the upper two terraces to a point about 10 miles south of Fort Bridger. Farther downstream, cobble lenses comprise about 15 percent of the deposits. About 70 percent of the gravel is of quartzite; 30 percent is of hard sandstone, arkose and limestone. Chert comprises about 10 percent of the fraction less than one inch in diameter and soft rock 15 to 20 percent. The content of silt and clay is very variable from place to place. The upper 2 to 4 feet of the deposits are weakly cemented with calcium carbonate and are overlain by 6 inches to 2 feet of stony soil.

Clean gravel underlies the flood plain of the river. In most places it is beneath about 2 feet of sandy silty soil. Much of the flood plain is seasonally irrigated.

Blacks Fork-Fort Bridger to confluence of Smiths Fork.--From Fort Bridger to the confluence of Smiths Fork there are very few deposits on the north side of Blacks Fork. A little quartzite gravel, not over 4 feet thick, caps isolated remnants of a low bench 30 feet above the stream. The gravel in the flood plain of the river contains much silt, and has an increasingly thick silty overburden in a downstream direction.

On the south side of Blacks Fork are two extensive terraces 30 feet and 80 feet above the stream, below and north of the high bench on which the town of Lyman is situated. The deposits on these terraces are 3 to 8 feet thick. About 5 percent consists of cobbles greater than 3 inches in diameter, 60 to 70 percent of gravel, 15 to 25 percent of coarse sand, and 5 to 10 percent of fine sand, silt, and clay. About 75 percent of the gravel is of quartzite, 15 percent of hard sandstone and arkose, and a small amount of hard limestone (test locality U-11 and U-12). About 15 percent, the fraction less than 1 inch in diameter, is of soft rock and a small amount is of chert. In general, the material in the upper 3 to 4 feet of the deposits is weakly cemented by calcium carbonate and overlain by about a foot of sandy silty soil. Much of the area is irrigated.

Blacks Fork-Confluence of Smiths Fork to the Uinta County-Lincoln County line.--From its confluence with Smiths Fork to the Uinta County -Lincoln County line, Blacks Fork is bordered discontinuously by four gravel-capped terraces, the most extensive remnants of which are on the west bank of the stream. The gravel on the lower two terraces, respectively

30 and 50 feet above the stream, is 6 to 10 feet thick; that on the upper two terraces is from 2 to 6 feet thick. The material on all four terraces is composed predominantly of quartzite and hard limestone. About 15 percent is of soft rock, concentrated largely in the fraction less than one inch in diameter. About 10 percent of the material is silt and clay. Practically all of the gravel on the upper two terraces is coated with calcium carbonate, but only the upper 2 feet of that on the lower two terraces is so coated. The overburden consists of 6 inches to 2 feet of silty soil.

The flood plain along this stretch of the river is narrow, and is underlain mostly by thin deposits of rather silty gravel covered by silty clay overburden.

Smiths Fork.--Smiths Fork flows north from the Uinta Mountains. It has two branches, West Smiths Fork and East Smiths Fork, which join about 8 miles north of the county line. South of Robertson the gravel on the several terraces bordering these streams contains a large amount of boulders. Deposits of commercial quality are small.

From Robertson downstream, extensive deposits on four different terraces border the valley. The lowest terrace, 6 to 10 feet above the stream between Robertson and Mountainview, is irrigated in many places. Of the other three terraces, the uppermost is the broad bench on which the town of Lyman is situated; the next lower forms a broad bench south of Lyman, and the third forms a broad flat adjacent to Smiths Fork.

The deposits on these terraces range from 2 feet to 20 feet in thickness, but in most places are 5 to 8 feet thick. South of Mountainview the gravel is composed predominantly of quartzite and hard arkose in about equal proportions, a little medium-hard limestone, and about 5 percent chert.

About 15 to 20 percent of the material is cobbles greater than 3 inches in diameter, 35 to 50 percent of gravel, 15 to 25 percent of coarse and medium sand, and 15 to 20 percent of fine sand and silt. The fraction greater than 1 inch in diameter contains about 10 percent soft material; that less than 1 inch in diameter up to 50 percent soft material. The gravel in the upper 2 feet of the deposits is lightly coated with calcium carbonate, and is overlain by less than 6 inches of soil.

Northeast of Mountainview, and in the vicinity of Lyman, about 80 percent of the gravel is of quartzite, about 20 percent of hard arkose and sandstone. About 10 to 15 percent of the material is of cobbles greater than 3 inches in diameter, 40 to 60 percent of gravel, 15 to 25 percent coarse and medium sand, and 3 to 10 percent of fine sand and silt. Shale, soft sandstone, decomposed arkose, and soft limestone comprise 10 to 20 percent of the fraction less than 1 inch in diameter. The upper 2 feet of these deposits is weakly cemented by calcium carbonate. The overburden is a sandy silty soil 1 to 2 feet thick. Much of the area underlain by these deposits is irrigated.

Smiths Fork from its confluence with Little Dry Creek to its junction with Blacks Fork, is bordered on the west side of the stream by four gravel-capped terraces. Most are narrow. The gravel on these terraces is 3 to 8 feet thick, and though composed predominantly of quartzite and hard limestone contains about 10 to 15 percent of soft rock and as much as 5 percent chert, concentrated largely in the fraction less than 1 inch in diameter. The deposits contains a few cobbles as much as 6 inches in diameter, 50 to 70 percent gravel, 20 to 40 percent sand, and 5 to 10 percent silt, and clay. The upper 2 feet of the deposit is lightly coated with calcium carbonate, and overlain by 1 to 2 feet of sandy soil.

Cottonwood Creek and Sage Creek.--At the head of Cottonwood Creek and 300 to 400 feet above the stream is a high bench which extends to the west along the front of the mountains as far as Smiths Fork. The bench is capped in most places by 15 to 30 feet of sand and gravel, but is locally covered by thick till. The material contains numerous boulders up to 12 inches in diameter; about 20 percent is of cobbles over 3 inches in diameter. 40 percent of gravel, 30 percent coarse and medium sand, and 30 percent fine sand, silt, and clay. The gravel is predominantly of quartzite and arkose; a small amount is of chert, about 30 percent of the arkose is decomposed. The upper 4 to 5 feet of the deposits tend to be firmly cemented with calcium carbonate and overlain by about 2 feet of silty soil.

Along the west bank of Cottonwood and Sage Creeks are local segments of four gravel-capped terraces of four different levels. The most extensive segments of these terraces are along Sage Creek 2 miles above its junction with Cottonwood Creek, and along Cottonwood Creek below its junction with Sage Creek and about 2 miles above its junction with Smith Fork.

The gravel on these four terraces ranges from 6 to 15 feet in thickness, and is composed mostly of quartzite and arkose, together with some hard limestone and sandstone. Fifteen to 25 percent of the material is of soft rock, mostly rotted arkose. About one-third of this soft material is in the fraction greater than one inch in diameter; about two-thirds is in the fraction less than one inch in diameter. From 10 to 15 percent of the material is fine sand and silt. Calcium carbonate weakly cements the upper 1 to 2 feet of the deposits, and the soil is 6 to 12 inches thick. The gravel in the flood plains of both creeks is very silty.

Henrys Fork.--Gravel deposits along Henrys Fork and its tributaries occur mostly within a radius of 3 miles of Lonetree on two low terraces bordering the streams. These terraces extend upstream to moraines in the canyons. The deposits are 6 to 10 feet thick, and are composed predominantly of quartzite and hard limestone. About 15 percent of the rock is soft. The material was not tested, but contains a considerable number of boulders and cobbles and about 5 percent is of silt and clay.

The high flat-topped mountains north of Henrys Fork, which are shown as gravel areas on the map, (pl. 1) are underlain by hard coarse conglomerate. Material that has weathered from a similar conglomerate in Sweetwater County has been used as a source of gravel. However, the conglomerate here may contain too many boulders and too much silt and clay to be of commercial use.

Washakie County

by

Page E. Truesdell and Frank W. Foster

General distribution of deposits

Washakie County contains extensive deposits of sand and gravel, most of which are on terraces along the broad valleys of the major streams. Smaller deposits occur locally in the flood plains of these streams. Minor streams and interstream areas have little or no gravel in them.

The most extensive and readily accessible deposits cap five successive levels of terraces along the Bighorn River. The lowest terraces are the most continuous, and have the largest deposits on them. Two levels of terraces capped by sand and gravel occur along Cottonwood Creek, Gooseberry Creek, and Fifteen Mile Creek, which are tributary to the Bighorn River from the west. These deposits are locally extensive, but less continuous than those along the Bighorn River.

East of the Bighorn River the only large terrace deposits are along Nowood Creek above the confluence of Tensleep Creek. Small discontinuous deposits of sand occur on terraces along Sand Creek.

Flood plain deposits are relatively unimportant as sources of sand and gravel in Washakie County, but local extensive deposits do occur in the flood plains of the Bighorn River and Cottonwood Creek. Tensleep Creek has local small deposits in its narrow channel where it flows from the mountains.

The deposits shown on plate I in Washakie County are modified after detailed mapping by Andrews, et al._/

_/ Andrews, D. A., Pierce, W. G., and Eagle, D. H., Geologic map of the Bighorn Basin, Wyoming and Montana, showing terrace deposits and physiographic features, U. S. Geol. Survey Oil and Gas Investigations, Preliminary Map 71, 1947.

Local descriptions

Bighorn River.--The valley of Bighorn River is bordered on the west by five gravel-capped terraces of which only the lower two are present east of the river. The deposits on the lowest terrace is 60 to 160 feet above the stream, 10 to 12 feet thick, and extensive. Deposits of gravel on the next higher terrace, 150 to 275 feet above the stream are only 2 to 6 feet thick and areally small. Deposits on the upper three terraces are 6 to 10 feet thick, and though extensive, are discontinuous. The flood plain of the river also contains local large deposits.

In all these deposits gravel is about twice as abundant as sand. Cobbles 3 to 6 inches in diameter comprise up to 20 percent of the material, silt and clay up to 10 percent. Hard quartzite is the predominant constituent of the gravel. Felsite, though abundant, is almost entirely limited to the material less than 1 inch in diameter, as is soft shale and sandstone. Much of the felsite is rotted. About 10 percent of the fine gravel fraction is chert. A sandy or stony soil, 6 to 36 inches thick, covers the deposits.

Cottonwood Creek.--Terrace segments 150 to 275 feet above Cottonwood Creek northwest of Winchester are capped by small deposits of sand and gravel 3 to 4 feet thick (test locality WK-1). More extensive deposits occur in the flood plain of the creek, (test localities WK-3 and WK-6).

About 65 to 75 percent of the material both on the terraces and in the flood plain is gravel, 10 percent is sand and about 10 to 15 percent is silt and clay. There are few cobbles. Fine silt layers are interbedded with the sand and gravel at test locality WK-3. Most of the gravel over 1 inch in diameter is composed of hard quartzite. Rotted felsite, chert and volcanic trap rock make up 60 to 70 percent of the material less than 1 inch in diameter. The deposits are covered by silty stony soil up to 2 feet thick.

Gooseberry Creek.--Terrace segments 100 feet above Gooseberry Creek are capped by deposits 3 to 4 feet thick (test locality WK-10). About 70 percent of the material is gravel with very few cobbles, 15 percent is sand, and 15 percent is silt and clay. The coarse gravel is composed predominantly of hard quartzite. Material 1 inch in diameter and smaller is composed of hard quartzite, hard felsite, and brittle chert. Small amounts of soft shale and gypsum are also present. The upper few feet of the gravel is locally well cemented with calcium carbonate and is overlain by about 18 inches of stony soil.

Fifteenmile Creek.--A high flat terrace along Fifteenmile Creek is covered locally by deposits 5 to 6 feet thick in which the ratio of gravel to sand is roughly 3 to 1. About 5 percent of the material consists of cobbles over 3 inches in diameter and about 10 percent is of silt and clay. Hard quartzite is the major constituent of the gravel over 1 inch in diameter. Material less than 1 inch in diameter is a mixture of quartzite, rotted felsite, and medium hard limestone. The gravel is coated throughout with calcium carbonate, and is overlain by about 6 to 18 inches of stony soil.

Nowood Creek.--The valley of Nowood Creek is bordered by 2 terraces, The higher consists of long narrow remnants capped by extensive deposits, 4 to 5 feet thick (test locality WK-11), in which the ratio of gravel to sand is approximately 4 to 1. Silt and clay make up about 10 percent of the material. Limestone is the major constituent of the gravel, but some chert, soft limonite and sandstone are present in the fraction less than 1 inch in diameter. One to 2 feet of stony soil covers the deposits.

The lower terrace is capped by extensive deposits 8 to 10 feet thick (test locality WK-7). About 65 percent of the material is gravel, 15 percent is sand, and 20 percent is silt and clay which tends to occur as lenses interbedded with the sand and gravel. Sandstone and quartzite are the predominant constituents of the gravel over 1 inch in diameter; soft sandstone, limestone, shale, and chert comprise most of the finer gravel. The deposits are covered by 2 to 3 feet of stony soil. Deposits in the flood plain of the stream appears to be similar to those on the terraces.

Tensleep Creek.--Small deposits occur in the bed of Tensleep Creek, northeast of Tensleep. About three-fourths of the material is gravel, one-fourth is sand. There are no cobbles, and only about 5 percent is of silt and clay. Medium hard limestone, dolomite, and granite are the major constituents of the gravel.

Sand Creek.--Deposits of medium to fine sand and some gravel occur both on terraces along Sand Creek and in the bed of the stream. The material contains much silt and clay, but was not tested in detail.

Weston County

by

Page E. Truesdell and Frank W. Foster

General distribution of deposits

Deposits of sand and gravel in Weston County are confined almost exclusively to its eastern part. They are of two general types; terrace deposits that are largely restricted to tributaries of Beaver Creek, and deposits on high, rounded knolls and ridges that are remnants of an earlier drainage system. The high deposits are of varying size and extent, but in most places are only a thin mantle with indefinite boundaries. Exploitation has nearly exhausted many of these deposits, and in a few cases, as in Sec. 7, T. 44 N., R. 60 W. and in Sec. 3, T. 47 N., R. 61 W., only the screened fines remain. Many of the deposits shown on the map are generalized after information supplied by Rubey._/

_/ Rubey, W. W., personal communication, 1947.

Local descriptions

Stockade Beaver Creek.--Scattered deposits of sand and gravel occur along Stockade Beaver Creek. They range from 4 to at least 10 feet in thickness, and from 900 to 7,500 cubic yards in volume. Sixty to 80 percent of the material is gravel (about one-fourth of which is fine gravel) composed largely of limestone and sandstone (test localities WT-1, WT-2, WT-3, and WT-4). The material, however, contains silt and humus in rather high proportions as well as small amounts of shale, limonite and chert. The deposits are covered with stony soil, commonly only 6 inches thick, but locally as much as 2 or 3 feet thick.

Oil Creek.--A deposit of sand and gravel occurs near the headwaters of Oil Creek. It is 3 to 4 feet thick, but areally small. (Test locality WT-7.) About 75 percent of the material is gravel; about 25 percent is of calcareous silt and sand, The gravel, much of which is subangular, is composed mostly of hard limestone, with minor amounts of sandstone and chert. Some particles in the upper part of the deposit are lime-coated. The soil is about a foot thick, stony and supports a grass vegetation.

Skull Creek.--Deposits of sand and gravel, 4 to 8 feet thick, cap scattered terrace remnants along Skull Creek, about 3 miles east of Osage (test locality WT-6), and south of U. S. Highway 16 about 12 miles west of Newcastle, (test locality WT-5). About 50 to 70 percent of the material is gravel, 30 to 40 percent is sand, and about 10 percent is silt and clay. At test locality WT-5, lenses of fine sandy silt are interbedded with the coarser material. The gravel is composed mostly of sandstone and limestone, with limonite and a little chert present as deleterious matter. The soil is 1 to 1½ feet thick and stony.

Cold Springs Creek.--Sand and gravel mantles a terrace along Cold Springs Creek on the south side of the town of Buckhorn, in the northeast corner of the county. The deposit (test locality WT-8) is 6 to 8 feet thick, and comprises at least 10,000 cubic yards. About 80 percent of the deposit is subangular gravel, less than 20 percent is sand. Lenses of clay and calcareous caliche are scattered throughout. Cobbles are numerous. The gravel is composed primarily of limestone, with lesser amounts of sandstone, igneous rock, and gypsum. The upper 12 inches of the deposit are slightly cemented with carbonate, and capped by about 2 feet of stony soil that supports a grass cover. A small amount of the material has been used locally for road building and cement.

Mason Creek.--A terrace deposit along Mason Creek near the northern boundary of the county (test locality WT-9) is 5 to 6 feet thick, and contains about 5,000 cubic yards of material. Lenses of sand alternate with lenticular beds of gravel. Some clay is present in the matrix and occurs also in scattered thin seams. The gravel is composed mainly of sandstone, though about 30 percent of it consists of limonite nodules, and small amounts of quartzite, limestone, gypsum, and soft rock types occur throughout. The upper part of the deposit is slightly cemented with calcium carbonate, and is covered by 2 to 3 feet of stony soil that supports a grass cover. A pit in this deposit has yielded material for road repairs and concrete.

Yellowstone National Park

by

Page E. Truesdell and Frank W. Foster

General distribution of deposits

Sources of sand and gravel are well distributed over Yellowstone National Park. Gravelly till occurs throughout the northern part, from the valley of the Lamar River and its tributary, Soda Butte Creek, to the west slopes of the Gallatin Range. Gravelly till is also found along the Madison Junction-West Yellowstone road.

Along the highway from Canyon to Norris, from Madison Junction to Old Faithful, from Old Faithful to Thumb, and from Thumb to Lewis Lake are numerous deposits of stratified sand and gravel that contain little silt and clay. At the time of this survey, 1947, these deposits were being used as a source of material for blacktop mix in the Park. Terraces and beaches around Yellowstone Lake contain isolated but extensive deposits of sand and gravel, and other deposits occur in the vicinity of Trout and Alum Creeks between Yellowstone Lake and Canyon, large quantities of sand and gravel may also be obtained from the flood plains of the streams in many places.

Since Yellowstone National Park is set aside for its scenic beauty, exploitation of sand and gravel in the park is under the control of the National Park Service. Pits are opened only where they can be out of sight of the highways, and when abandoned the scars are backfilled and landscaped. The deposits shown on plate I in Yellowstone National Park are modified after Hague, et al.,_/ and Howard._/

_/ Hague, Arnold, Weed, W. H., and Iddings, J. P., U. S. Geol. Survey Atlas, Yellowstone National Park folio, no. 30, 1896.

_/ Howard, A. D., History of the Grand Canyon of the Yellowstone, Geol. Soc. America Spec. Paper 6, 1937

Local descriptions

Lower Lamar River valley and Soda Butte Creek.--The flood plain of the lower part of Lamar River and of its tributary, Soda Butte Creek, contain large amounts of clean sand and gravel, the proportions of which are roughly 3 to 2. Cobbles are relatively abundant, but less than 10 percent of the material is silt and clay (test localities YP-1, YP-2, YP-3). The overlying sandy soil is up to 18 inches thick. Grass and trees cover the deposits near the margins of the flood plains.

Between 3 and 5 miles southwest of the northeast entrance to the Park, gullies along Soda Butte Creek are floored with well-washed and well-sorted cobbles of felsite and dark volcanic traprock. No test was made of this material.

Extensive deposits of gravelly till occur on benches along the Lamar River for a distance of about 6 miles east of the Tower Falls Ranger Station (test localities YP-4 and YP-5). About 10 percent of the till is cobbles, 50 percent is gravel, 25 percent is fine sand, and 10 to 15 percent is silt and clay. The gravel fraction is of granite, felsite, basalt or other traprock, and limestone.

As far as is known, none of the sand and gravel along the Lamar River and Soda Butte Creek has been exploited.

Mammoth Hot Springs to Tower Falls.--Local deposits of gravelly till occur along the road from Mammoth Hot Springs to Tower Falls (test localities YP-6 and YP-7). About 75 percent of the material is gravel and 25 percent sand. The gravel is of felsite, dark volcanic traprock, granite, and a small amount of chert. The overburden is about 2 feet thick beneath a grass, sage or forest cover. None of the deposits are extensive.

Mammoth Hot Springs area.--Sand and gravel in the Mammoth Hot Springs area may be obtained from extensive deposits of gravelly till underlying a sequence of high terraces, 300 to 500 feet above the Gardiner River. These cover a wide area, and appear to contain unlimited quantities of sand and gravel. Rock fragments in the till are composed largely of unweathered limestone and felsite (test locality YP-9). Approximately 60 percent of the deposit is of gravel; the remaining part is about half sand and half silt. The silt is primarily calcareous, and most of the gravel has a calcareous coating. The overburden is thin, and supports a dense grass cover. None of these deposits was being worked at the time of this investigation, but similar deposits were being worked by the National Park Service near Gardiner, Montana, just outside the north entrance to the Park.

Lower terraces along the Gardiner River contain small deposits of sand and gravel, 4 to 5 feet thick, and overlain by less than a foot of stony soil (test locality YP-10). About 50 percent of the material is gravel, 40 percent is sand, and 10 percent is silt and clay. Over 50 percent of the gravel is of dark volcanic traprock, 25 to 30 percent is felsite, and lesser amounts are limestone, quartzite, and obsidian. The deposit (test locality YP-10) has been worked by the Park Service for road materials.

Mammoth Hot Springs to Norris.--Discontinuous, but extensive deposits of gravelly till, having a rolling, hummocky topography, occur along the northern part of the Mammoth Hot Springs-Norris road. Easy access has enabled the Park Service to use this material for road construction (test localities YP-11 and YP-12). The gravel is subangular to subround,

and is composed of dark volcanic traprock, felsite, and limestone, with minor amounts of granite, obsidian, and quartzite. About 30 percent of the fragments are rotted, and 30 percent of the deposits is silt and clay.

Northwest boundary.--Sand and gravel is present in the flood plain of the Gallatin River for a few miles south of the Gallatin Ranger Station. The deposits, though discontinuous, are extensive; in places from one-eighth to one-fourth of a mile wide. That at test locality YP-13 is 3 to 5 feet thick. About 85 percent of the material is subangular gravel, 15 percent is sand and small amounts are silt and clay. The gravel is composed of felsite, limestone, quartzite, dark volcanic traprock and sandstone. The deposits are accessible by paved road, but are inconspicuous because of a thin silty overburden.

Terrace deposits border Grayling Creek where it parallels the Wyoming State line. They consist of poorly-sorted sand and gravel and lenses of well sorted sand. The gravel is predominantly fine, and fine sand comprises more than 30 percent of the deposit. Test locality YP-14 is at a pit in one of these terraces that was being worked for road material in 1947. More than 600,000 cubic yards of sand and gravel are available.

Canyon to Norris.--Extensive but discontinuous deposits of well-sorted sand and fine gravel mantle most of the plateau from Canyon to Norris. In the vicinity of the hotel at Canyon these deposits are 5 to 10 feet thick and composed of obsidian and rotted rhyolite. The low rolling terrain west of Canyon, for a distance of at least 5 miles, is underlain by similar deposits about 4 feet thick in which basalt is also a constituent of the gravel. About 2 miles east of Norris are

other similar deposits. More than half of the gravel in these areas is less than one-quarter of an inch in diameter. The deposits are used in the Park for blacktop mix and are accessible by paved road.

Norris to Madison Junction.--Two deposits of gravelly till occur near the big bend in the Gibbon River along the road from Norris to Madison Junction. One, in the valley tributary to the river from the west at the bend (test locality YP-21) is a large deposit. The gravel fraction is predominantly coarse, and sand constitutes only 15 percent of the material. Large boulders are common. The rock fragments are mostly of felsite and basalt, with minor quantities of quartzite and obsidian. The deposit is mantled by a thin overburden and supports a pine forest.

The second deposit is a mile and one-half north of the bend on a terrace along the Gibbon River. It comprises about 25,000 cubic yards of sand and fine gravel. The gravel is of obsidian, rotted rhyolite, and basalt.

Madison River.--Along most of its course the Madison River is flanked by two terraces on which in most places there are only thin deposits. However, workable deposits of sand and gravel may be found locally (test localities YP-22, YP-23, and YP-24). The material is mostly of fine gravel and contains almost 50 percent of obsidian sand. However, at test locality YP-23 there is a deposit of till containing an abundance of coarse gravel composed of rhyolite, basalt, and obsidian. Much of the rhyolite is rotted. These deposits range from 50,000 to 70,000 cubic yards in volume.

Madison Junction to Old Faithful.--Terrace deposits between Madison Junction and Old Faithful are located along the canyon walls adjacent to the road (test localities YP-25 and YP-26). They consist of alternating beds of clean gravel and obsidian sand. The gravel is predominantly fine, and is mostly of felsite, much of which is rotted. The deposits range from 3 to 40 feet in thickness, and average 15 to 20 feet. They are covered by from 1 to 3 feet of sandy soil. In 1947 the National Park Service was using these materials for blacktop mix. All of the deposits are readily accessible and easily excavated.

Old Faithful to Thumb.--Between Old Faithful and Thumb a large pit was being worked in an extensive deposit of sand and gravel interbedded with till. The material closely resembles that in the terrace deposits between Old Faithful and Madison Junction. The pit is on the now abandoned part of Old Faithful-Thumb road, which branches from the north side of the new road about 1 mile west of DeLacey Creek.

Thumb to Snake River.--From Thumb to the south entrance of the Park at Snake River are many deposits of sand and gravel (test localities YP-31 to YP-34). In the vicinity of the ranger station at Thumb, on a terrace 20 to 30 feet above Yellowstone Lake, are deposits at least 15 feet thick that consist of clean crossbedded sand, well-sorted fine gravel and a few interbedded lenses of coarse gravel. The sand is predominantly of obsidian. The gravel is of felsite, basalt, obsidian, and other volcanic traprock, together with a minor amount of quartzite. A large pit has been opened at test locality YP-31 near the ranger station. Forest covers most of these deposits.

Deposits of obsidian sand and fine gravel, as much as 10 feet thick, occur in relatively flat terrain around the north and west sides of Lewis Lake (test localities YP-32 and YP-33). They are extensive and easily accessible from the main road. A thin sandy overburden supports a forest cover.

The flood plain of the Snake River near its junction with the Lewis River contains almost unlimited quantities of coarse gravel and sand. Fine sand occurs only in minor amounts. Over 80 percent of the material consists of coarse, subangular, poorly sorted gravel. The gravel is composed predominantly of felsite and quartzite, but includes minor amounts of basalt, limestone, and sandstone. A thin silty overburden covers much of the area. This flood plain is several feet below the level of the surrounding terrain but is readily accessible.

Thumb to Lake Outlet.--Along the northwest shore of Yellowstone Lake are extensive lake terrace deposits containing almost unlimited amounts of clean fine gravel and sand. Test locality YP-29 is in these deposits on a large promontory approximately 6 miles southwest of Lake Outlet. The low nearly flat area west of the road is mantled with similar extensive deposits. The sand is predominantly of obsidian, the gravel of felsite and dark volcanic traprock. The overburden is thin, and most of these areas are covered with an open stand of pine. The deposits are easily accessible from the road.

Beaches that border much of the lake also contain almost unlimited quantities of sand and gravel (test locality YP-30). The gravel is in general well graded, but pebbles larger than three-fourths an inch in diameter are rare. The amount of sand ranges from 1 percent to 13 percent.

Felsite and trap are the most common rock types in the gravel, and obsidian is the main constituent of the sand. Small amounts of rotted material are present locally. The beaches are easily accessible, and pits have been opened in them to obtain material for road construction.

Two miles north of Thumb, and about a half mile west of the main road, a large pit has been opened in a moraine of gravelly, sandy till. The till contains a number of huge angular boulders, but has been worked for sand and gravel. The deposit covers a large area along a steep south slope. The gravel is mostly of rhyolite and perlitic obsidian, the sand is of obsidian.

Lake Outlet to Sylvan Pass.--Along the northeast shore of Yellowstone Lake the beaches contain extensive deposits of clean sand and gravel, composed mostly of felsite and basalt. A pit in operation at test locality YP-18 has yielded several thousand cubic yards of sand and gravel for road construction.

About one-half mile east of test locality YP-18 is a terrace 50 to 75 feet above the lake that is underlain by 50,000 to 70,000 cubic yards of gravelly and sandy till (test locality YP-17). The till is 10 to 12 feet thick and consists of small pebbles and sand in a silt-clay matrix. Felsite and dark volcanic traprock are the predominant rock types, and much of the material is rotted. Pebbles in the upper foot of the deposit are coated with calcium carbonate. The soil is 2 to 3 feet thick, sandy, and supports a dense growth of pine and brush. A pit in operation during the summer of 1947 yielded material for road construction.

Near Sylvan Lake, at the headwaters of Clear Creek, are local deposits of loosely consolidated, well sorted sand and gravel (test locality YP-28). The upper 3 to 4 feet of the deposits are of coarse gravel and cobbles composed of felsite, traprock, and quartzite. Much of the material is rotted. Under this coarse material is 7 to 8 feet of fine sand, silt and clay interbedded with coarse sand. The overburden is about 3 feet thick, and trees and brush cover the area. A pit opened in these deposits has yielded material for road construction. The steep slopes of the rugged terrain restrict operations to deposits near the road.

The stream bed of Middle Creek, along the road 2 miles west of Sylvan Pass, contains an undetermined amount of clean sand and gravel, some of which has been used for road material. Numerous cobbles up to 8 inches in diameter are present. The gravel is composed mostly of felsite, dark volcanic traprock, and quartzite.

A large talus slope at Sylvan Pass contains large angular boulders of syenite porphyry, a sample of which was sent to the Public Roads Administration, Washington, D. C. for testing and was found "satisfactory material for riprap or general road work." It was recommended that this material should not be used with bituminous surfacing without testing with the bituminous material proposed for use.

Lake Outlet to Canyon.--The floodplain of the Yellowstone River a few miles north of the outlet of Yellowstone Lake contains large deposits of clean gravel and sand. About 80 percent of the material is gravel, 20 percent is sand. The gravel is composed of felsite and volcanic traprock, of which approximately 30 percent is rotted. The sand is predominantly of obsidian. A stony soil about a foot thick supports a grass and open forest cover.

Between Trout Creek and Alum Creek are local deposits of clean coarse sand and gravel interlayered with bouldery material. Exclusive of the boulders, about 80 percent of the deposit is of gravel and 20 percent of sand. The sand is predominantly of obsidian. Two-thirds of the gravel is of felsite, one-third of basalt and other dark volcanic traprock. Test locality YP-20 is in a rounded hill about 70 feet high and 100 feet long. The upper 6 inches of the deposit is moderately cemented with calcium carbonate, and the overburden consists of 1 to 2 feet of sandy soil.