OUTLINE FOR ATTACK ON FIELD PROBLEMS, SEASON OF 1924

O.P. JENKINS SAYS LEWISTON MONOCLINE AXIS IS 50 MILES LONG. 2000 FT VERTICAL DISPLACEMENT

TOUCHET— TERRACE AT 550 FT. A.T. JENKINS

PEBBLE COUNTS

PRESENT COLUMBIA RIVER GRAVELS TO INCLUDE BASALT— GNEISS, GRANITE, GRANITOID— QTZITE— PORPHYRY WITH PROM. FLDSPR FENOCRYST JASPER— VEIN QTZ— AGATE— DIORITE GABBRO— CONGLOMERATE

PORTLAND DELTA GRAVELS FOR COMPARISON WITH PRESENT COLUMBIA RIVER GRAVELS.

PORTLAND DELTA GRAVELS PORTLAND AND TROUTDALE SHEETS

PHOTO OF FORESETS— DEPTH OF FORESETS— TOP ON FORESET— PEBBLE COUNTS— SEE PRESENT COLUMBIA DREDGINGS TO SEE IF GRAVEL IS NOW GRAVELLING WITH THE COLUMBIA CURRENT.

CASCADE LOX TERRACE ABOUT 125 AT EXTENDS ABOUT 1 MILE EAST OF CASCADE LOX

COOKS ON SERPENTINE MAIN ROAD (EVERGREEN HIWAY) ABOVE COOKS. PEBBLE COUNT AND ALTITUDE

WHITE SALMON TERRACE ABT 650 AT (OLDER NOTES SAY 450) OF PORTLAND DELTA GRAVELS BEDDING SHOWS THAT CURRENTS ECDIED BACK FROM COLUMBIA AND EVEN UP THE COLUMBIA VALLEY, MUCH AS AT LYLE. GRAVEL LIES ON UNDERWOOD LAVA.

WIND MTN AND WIND RIVER, BETWEEN. PD GRAVELS AT 440 AT

HOOD RIVER IN SW PART OF TOWN, RECENT STREAM GRAVEL AT 450 AT SEE THIS. MAKE PEBBLE COUNT. E. OF RIVER ON HIGHWAY SERPENTINE 300 FT AT POORLY WORN, LARGELY BASALT. MAKE PEBBLE COUNT.

WIND RIVER, WEST BLUFF, ALONG HIWAY CUT. 150 FT EXPOSED. MUCH CROSS BEDDED. CONSIDERABLE FORESET BEDDING WHICH DIPS UP WIND RIVER COARSE SAND AND VERY FINE GRAVEL 350-400 FT AT

MOSIER JUST E OF HIWAY BRIDGE OVER MOSIER CREEK. FINE, SUBANGULAR FRESH GRAY BASALTIC GRAVEL— FORESET BEDDING DIPPING UP MOSIER CREEK. ALT. 450 MAKE PEBBLE COUNT.

ROWENA A MILE OR SO WEST OF ROWENA SERPENTINE, NORTH OF HIWAY, OVERLOOKING COLUMBIA. GET ALTITUDE AND PEBBLE COUNT.

LYLE FINE GRAVEL UP TO 300 AT FINE CURRENT BEDDING THIS PROBABLY DIRECTLY NORTH OF LYLE FORESET BEDDING DIPS EASTWARD, UP THE COLUMBIA. WEST OF KLICKATAT RIVER, THE PD GRAVELS LIE AT ABOUT 450 ON LYEE GRADE OF EVERGREEN HIWAY. GET ALL ALTITUDES AGAIN. PEBBLE COUNTS

DALLES FOUR MILES WEST. IN A TERRACE CROSSED BY NEW HIWAY 260 FT. AT

MARYHILL PD GRAVELS ABOVE COLUMBUS (MARYHILL RR OR PO) AT 600 FT. AT AND THENCE DOWN SLOPE FOR MORE THAN 100 FT.

ROCK CREEK. TERRACE AT MOUTH. SUMMIT ALTITUDE 750 AT COMPOSED OF MATERIAL WHICH HAS COME DOWN ROCK CREEK

CHAPMAN CREEK. TERRACE AT MOUTH, AND ALONG LOWER MILE OF LENGTH. LOCAL MATERIAL, AS AT ROCK CREEK.

ARLINGTON DELTA TERRACE IN ALKALI CANYON, AT MOUTH OF DISTRIBUTARY CHANNELS FROM WILLOW CR. VALLEY. ALTITUDE AT TOP OF DELTA 650 TO 700 AT FINE FORESET BEDDING IN PIT NEAR SCHUTTLERS GET PEBBLE COUNT.

STANFIELD, ETC.

GOLGOTHA BUTTE. NORTH OF WELL-STRATIFIED RIVER GRAVEL, DOMINANTLY BASALT BUT PLENTY OF QTZITE PEBBLES. ALT. 600-650

WALLULA GATEWAY. MOUTH OF JUNIPER CANYON. TERRACE FRAGMENT LARGELY OF LOCAL SUBANGULAR BASALT BUT SOME GRANITE PEBBLES. UPPER SURFACE 450 FT AT . GROUP OF ROCK HILLS ON EAST SIDE OF GATEWAY (THE GUARDIANS OR SENTINELS) HAVE SPOKANE TALUS. LOWEST CHANNELS AMONG THEM ARE 200 FT ABOVE RIVER OR 500 FT AT. NO GRAVEL TALUS ON GREAT BULFFS ON SOUTH SIDE OF COLUMBIA IS 2/3 OR 3/4 THE HEIGHT OF THE CLIFFS. JUNIPER CANYON GRAVEL ASSUMED TO BE A BAR DEPOSITED WHEN THE GUARDIANS WERE ERODED AND THE GREAT BASALT CLIFFS WERE CLEANED OFF. THEREFORE 3/4 TALUS/ IS POST-PD IF JUNIPER CANYON BAR BELONGS TO THE PD. THEREFORE, ALSO, PD GRAVEL IS SPOKANE IN AGE.

PASCO GRAVEL TERRACES NORTH OF PASCO TO ABOUT 650 FT AT AN ESPECIALLY PROMINENT ONE ABOUT 500 ON THE BRINK ALONG NPRR.

VISTA AND THE TERRACE FLANKING THE RATTLESNAKE ANTICLINAL PUCKERS TO THE NORTHWEST. LARGELY SAND AND SILT, GRAVELLY LENSES WITH QTZITE AND GRANITE PEBBLES. ALTITUDE AS EXPOSED IN CUTS IS BETWEEN 500 AND 600 CARRIES ABUNDANT SUBMERGENCE ERRATICS. GET UPPER LIMITS OF ERRATICS ON BADGER. GET UPPER LIMITS PD GRAVELS. PEBBLE COUNTS.

KENNEWICK TO WHITE BLUFFS GRAVEL TERRACE BETWEEN LIES 500 TO 600 550 AT GROSSCUP IT IS 650

TOUCHET TERRACE AT 550 ACCORDING TO JENKINS.

KOONTZ COULEE MOUTH OF COULEE, ERODED IN WEAK RINGOLD SILTS, IS 200 FT ABOVE PRESENT COLUMBIA

BEVERLY TERRACE ALTITUDE 525-550 575+ IN MILWAUKEE CUT IN TOWN. GRAVEL TO BOTTOM OF PRESENT VALLEY NO WATERFALL HERE. BASALT FLOOR UNDER CRAB CREEK GRADES DOWN TO COLUMBIA LEVEL NOT THE KIND OF AN ENTRANCE INTO COLUMBIA VALLEY AS AT POTHOLES, PRESUMABLY BECAUSE

1- THE CRAB CREEK (SPOKANE) RIVER AND (SPOKANE) COLUMBIA WERE OF COMPARABLE SIZE,

2- CRAB CREEK RIVER HAD A GREAT LOAD OF DEBRIS, AND ERODED DEEPLY COMPARED WITH POTHOLES STREAM,

3- COLUMBIA LEVEL, THO 200 FT ABOVE PRESENT (KOONTZ COULEE LEVEL) WAS THAT OF A RIVER SURFACE, NOT A VALLEY FILL. COLUMBIA THEREFORE 200 FT DEEP AND CRAB CREEK RIVER ALSO 200 FT DEEP. THIS WOULD EXPLAIN RIVER GRAVELS AT JUNCTION CRAB AND COLUMBIA NORTH OF BEVERLY IN A BAR AT 575 (PROBABLY 600 MAX). ANOTHER INTERPRETATION FOR ABSENCE OF A ROCK LEDGE AT BEVERLY IS THAT WISCONSIN WATERS DID NOT FIND THE COLUMBIA SO FULL AND THE BASALT WAS ERODED THEN.

SPOKANE SCABLAND BELOW SNAKE RIVER JUNCTION, PREMISED FROM MAP STUDY AND OLDER NOTES.

WALLULA GATEWAY. SEE THESE AND PHOTOGRAPH IN MORNING FROM ABOVE.

HERMISTON AND UMATILLA BUTTES, AND HAT ROCK NEAR UMATILLA. THERE SHOULD BE PD GRAVELS WEST OF HERMISTON. TRAVERSE O-W RR CUT-OFF.

GOLGOTHA BUTTE, CROW BUTTE, CANOE RIDGE (ON BLALOCK ISLAND SHEET)

ROOSEVELT FLAT

FALLBRIDGE, WEST OF. DOUBTFUL. MAY BE TOO HIGH. SEE, IF POSSIBLE.

DALLES AND GRAND DALLES FLAT. PHOTOGRAPH AND GET ALTITUDES.

THE DALLES OF THE COLUMBIA HIGHER LEVELS FOR SPOKANE, NOT MODERN, SCABLAND

LYLE, WEST OF. VICINITY OF BALCH SCHOOL BLUFFS, BOTH SIDE, BETWEEN MOSIER AND LYLE.

ARLINGTON. CHANNELS SOUTHWEST OF. BETWEEN WILLOW CRREK AND ALKALI CREEK. CORRUGATED AND JAGGED FLATS OF BASALT, CLEAN OF DEBRIS, ABUNDANT IN THESE CHANNELS. ARE THERE GRAVEL BARS ASSOCIATED? ALKALI CANYON PIRACY? IS IT MERELY A SPOKANE FLOOD DISTRIBUTARY?

SNAKE RIVER GRAVELS DEVILS CANYON, MOUTH OF. GRAVEL TERRACE. MAY BE A DELTA FROM DEVILS CANYON. PERHAPS 200 FT ABOVE RIVER. GET ALTITUDE AND PEBBLE COUNTS.

JONES SCHOOL, NEAR SP AND S RR. FRANKLN CO SOIL MAP/ FOR LOCATION. HUGE GRAVEL BANKS SLONG BOTH SIDES OF SNAKE ~~HERE~~ EAST OF BEND NEAR THIS PLACE. GRAVEL TERRACES 3/4 TO 4/5 AS HIGH AS THE ROCK BLUFFS.

PERRY AND RIPARIA, BETWEEN GREAT GRAVEL DEPOSITS, MORE ON NORTH SIDE PROMINENT FLAT TOPS TO THE DEPOSITS ON THE SOUTH SIDE. THESE PROBABLY THE TERRACES REFERRED TO BY RUSSELL, AVERAGING 360 FT ABOVE THE STREAM. IN SECTIONS ALONG NORTH SIDE, SEEN FROM NPRR TRAIN, THE GRAVEL IS PREVAILINGLY FORESET AND PREVAILINGLY THE BEDDING DIPS UPSTREAM. EXCEPTIONS RARE, EXCEPT NEAR RIPARIA.

DEVILS CANYON TO PERRY ALONG SNAKE RIVER JULY 20-22 1924

A SMALL SPILLWAY FROM WASHTUCNA COULEE TO DEVILS CANYON IS IN SECTION 15, ABOUT 2 MILES SOUTH OF KAHLOTUS. BASALT OUTCROPS AT THE HIGHEST PLACE IN THE CHANNEL FLOOR, BUT PROBABLY DOES NOT OCCUR HIGHER IN CHANNEL WALLS. ALTITUDE OF HIGH POINT IN FLOOR IS NEARLY 1300. ORIGINAL ALTITUDE OF THE LOW PLACE IN HILL PROFILE, ACROSS WHICH THE GLACIAL WATERS FLOWED, COULD HARDLY HAVE BEEN LOWER THAN 1300 AND MAY HAVE BEEN 1350 USE THIS ITEM AS ADDITIONAL EVIDENCE OF DEPTH OF GLACIAL STREAM IN WASHTUCNA COULEE.

FEATURES AT MOUTH OF DEVILS CANYON ARE SINGULARLY INTERESTING. THE CANYON MOUTHS ABOUT 140 FT ABOVE SNAKE RIVER JULY LEVEL. IN THE MIDDLE OF THE FLARING MOUTH (WHICH VERY PROBABLY IS A RELIC OF A PRE-SPOKANE SHORT TRIBUTARY VALLEY) IS A BASALT BUTTE OF NO REMARKABEE PROPORTIONS BUT FLANKED BY POST-SPOKANE TALUS AND CLEARLY A SCABLAND KNOB, ERODED OUT OF THE PRE-SPOKANE FLOOR. FROM THE BROAD TOP OF THE KNOB AND THE LOWNESS OF THE EMINENCE, IT SEEMS THAT BUT LITTLE EROSION WAS DONE HERE.

PROJECTING IN PART BEYOND THE LINE OF THE SNAKE VALLEY WALL IS A GRAVEL DEPOSIT AT THE MOUTH OF DEVILS CANYON. IN GENERAL, IT IS ABOOT 160 FEET ABOVE THE RIVER, OR 120 FEET ABOVE THE RAILROAD, BUT IT BEARS A REMARKABLE RIDGE WHICH RISES SIXTY FEET HIGHER FOR ITS MAXIMUM. THIS RIDGE IS ∩ SHAPED LIKE A HORSESHOE WITH THE CONCAVITY UPSTREAM AND THE TWO ENDS ABUTTING AGAINST THE WALLS OF THE FLARING MOUTH OF THE CANYON. IN ADDITION, THIS GRAVEL RIDGE IS HIGHEST AT THE APEX OF THE CURVE AND SYMMETRICALLY LOWER ON BOTH LIMBS, THE LOWEST PLACES BEING NEXT TO THE ROCKY WALLS.

THUS THE HORSESHOE ENCLOSES A BASIN, OR DID WHEN THE GLACIAL RIVER CEASD TO FLOW. POST-SPOKANE DRAINAGE TRRU DEVILS CANYON HAS CUT A RAVINE THRU THE RIDGE WHERE IT JOINS THE EASTERN VALLEY WALL.

THE SLOPES OF THE GRAVEL RIDGE ARE GENTLER TOWARD THE CONCAVITY I.E. UPSTREAM, THAN THEY ARE TOWARD SNAKE RIVER VALLEY.

THIS CURIOUS GRAVEL RIDGE IS A BAR. IT IS IDENTICAL WITH THE BARS FORMED ACROSS TORRENTIAL STREAMS WHERE THERE IS A SLACKENING OF VELOCITY FROM INCREASED WIDTH OF CHANNEL. IT IS DUPLICATED IN EVERY ROADSIDE GUTTER AFTER A HEAVY RAIN. IT IS THE SAME THING AS AT SOAP LAKE, EXCEPT THAT THE DIMENSIONS ARE MUCH SMALLER AND THE SLOPES MUCH STEEPER. BOTH SOAP LAKE AND THIS DEVILS CANYON AFFAIR HAVE ERODED ROCKY EMINENCES IN THE ENCLOSED BASIN, AS LOW AS, OR LOWER THAN THE RIM OF THE GRAVEL BAR.

THIS HORSESHOE-SHAPED BAR IS EVIDENCE INCONTROVERTIBLE THAT A GREAT TORRENT MADE DEVILS CANYON, THAT THAT TORRENT ABRUPTLY CEASED TO FLOW, AND THAT SNAKE RIVER SURFACE AT THAT TIME WAS AT LEAST 200 FEET HIGHER THAN AT PRESENT (JULY LEVEL) THE FACT THAT THE GRAVEL DEPOSIT ON WHICH THIS BAR RESTS CONTINUES DOWN TO THE RIVER LEVEL SHOWS THAT THE RIVER VALLEY THEN WAS ERODED TO PRESENT DEPTH AND AT THAT TIME WAS UNFILLED THE CORROLARY IS THAT THE RIVER WAS AT LEAST 220 FEET DEEP.

THE MATERIALS OF THE GRAVEL DEPOSIT ARE BUT POORLY SHOWN. IN RR CUTS AND IN THE POST-SPOKANE RAVINE, THE GRAVEL IS SHOWN TO BE POORLY SORTED AND LITTLE WORN. IT IS PRACTICALLY ALL BASALT. THE LARGE AMOUNT OF SILTY MATERIAL, FILLING ALL INTERSTICES, SUGGESTS ITS DERIVATION FROM DESTRUCTION OF LOESSIAL HILLS ON THE SCABLANDS FARTHER NORTH.

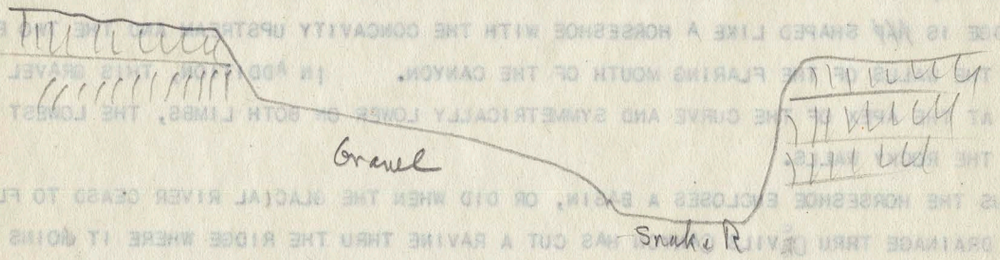
A CLOSER SCRUTINY OF THE DEVILS CANYON BAR SHOWS PORTIONS OF A LARGER OLDER FEATURE, ON WHICH THE ONE DESCRIBED HAS BEEN BUILT. THE TOPOGRAPHER WHO SKETCHED THIS WAS QUITE AT SEA AS TO ITS ORIGIN. HE SHOWS IT AS A MINOR RIDGE PROJECTING FROM THE WEST WALL, DUE TO POST-CANYON DISSECTION BY LOCAL DRAINAGE.

But I didnt recognize the giant ripples for what they are

A PROMINENT FLAT-TOPT GRAVEL TERRACE LIES ACROSS SNAKE RIVER FROM THE MOUTH OF DEVILS CANYON AND A LITTLE DOWN STREAM. GRAVEL SHOWS IN A CUT. TOP IS 800 FT AT., OR 350 ABOVE THE RIVER ACCORDING TO THE MAP. THIS IS THE ONLY FLAT-TOPT MASS OF GRAVEL IN SNAKE RIVER CANYON BETWEEN DEVILS CANYON AND THE MOUTH OF THE PALOUSE (EXCEPT DAVIN TERRACE). THE OTHERS ARE SUFFICIENTLY ALIKE TO BE DESCRIBED TOGETHER, IN A GENERALIZED FASHION. THEIR INDIVIDUAL DIFFERENCES, SO FAR AS DETECTED, ARE SLIGHT AND NOT SIGNIGICANT.

1- ALL OCCUR ON THE INSIDE OF THE BROAD CURVES IN THE RIVER. ONLY MINOR EXCEPTIONS.

2- ALL SLOPE FROM CONTACT AT BASE OF A BASALT CLIFF (AT 150 TO 200 FT ABOVE THE RIVER) DOWN TOWARD MIDDLE OF VALLEY. GENERALLY STEEPEST WHERE THE DEPOSIT IS CUT BY RIVER. NO REGULAR SLOPE AND ALMOST NO RAVINES OR EROSIONAL SLOPES EXCEPT THE RIVERWARD CLIFF. PROFILE ESSENTIALLY AS FOLLOWS.



3- WHERE CONTACT WITH BASALT CLIFF IS MISSING BECAUSE OF ABSENCE OF NOTABLE CLIFF, THE DEPOSIT IS HIGHEST A LITTLE DISTANCE OUT IN THE VALLEY.

NOTHING ABOUT THESE TOPOGRAPHIC SHAPES, SAVE THE RIVER SCARP AND MINOR GULLIES, CAN BE ASCRIBED TO EROSION SINCE THE GRAVEL WAS DEPOSITED. THEY ARE ORIGINAL DEPOSITIONAL FORMS AND SOME OF THEM SHOW FLUTING AND MOUNDING WHICH IS VERY SUGGESTIVE OF THE SHAPING BY SUBAQUEOUS CURRENTS OF A GREAT STREAM. THEY ARE BARS! THE ABSENCE OF FLATTOPS INDICATES FAILURE TO BE AGGRADED TO THE SURFACE OF THAT RIVER.

TWO DEPOSITS OF EXCEPTIONAL CHARACTER NOTED. ONE ON SOUTH SIDE, A LITTLE ABOVE MOUTH OF DEVILS CANYON, HAS AN ELONGATION ALONG VALEY SIDES BUT DAMS A TRIBUTARY OR A LOCAL BROADENING. SUBSEQUENT DRAINAGE HAS GASHED IT THRU.

ANOTHER IS ESSENTIALLY A DELTA TERRACE, AT DAVIN STATION, ON NORTH SIDE OF VALLEY. THE TOP IS NOT FLAT, BUT FLATTISH, AND ABOUT 200-240 FEET ABOVE THE SNAKE. A DEFINITE CHANNEL LEADING FROM SCABLANDS TO THE NORTH, CROSSES THIS DELTAIC TERRACE. IT IS 30 TO 40 FEET DEEP AND HAS A REAL KNOB OF BASALT IN IT CLOSE TO THE EDGE OF THE SNAKE. THE WHOLE SETTING INDICATES THAT THE LEVEL OF THE SNAKE WHEN TERRACE WAS DEPOSITED AND CHANNEL ERODED WAS AT LEAST 200 FEET ABOVE THE PRESENT JULY LEVEL. OTHERWISE THE CHANNEL WOULD HAVE HAD A STEEPER GRADIENT ACORSS THE DEPOSIT AND WOULD HAVE BITTEN MORE DEEPLY INTO BASALT BACK OF THE TERRACE WITH THIS AND OTHER EVIDENCE OF A SNAKE RIVER SURFACE 200 TO 250 BEET ABOVE THE PRESENT, THE DEEP SCABLAND CHANNELS OF THE PALOUSE CANYON AND AN OPEN VALLEY AS DEEP AS AT PRESENT, SEEM OUT OF HARMONY.

THEY MUST HAVE A SPECIAL EXPLANATION. HAPPILY, A LOGICAL ONE SEEMS AVAILABLE. IT IS THAT THE VOLUME OF THE GLACIAL PALOUSE WAS SO GREAT AND ITS GRADIENT DOWN THE SLOPE OF THE PREGLACIAL DIVIDE SO GREAT THAT IT ERODED FAR BELOW THE SURFACE OF THE FLOODED SNAKE. THE HILL OF BASALT IN THE MOUTH OF THE PALOUSE IS ALL OF 400 FEET HIGH (FOR THE O-W RR AND N BRIDGE IS MORE THAN 200) BUT IT IS OFF-CENTER CONSIDERABLY AND THE SMALLER CANYON WHICH HELPS TO ISOLATE IT ISNT AS DEEPLY CUT AS THE CANYON ON THE EAST WHERE THE PALOUSE NOW FLOWS. IT SEEMS THAT A MINOR HIGH-GRADIENT TRIBUTARY DID ENTER THE SNAKE HERE, BUT THAT THE GLACIAL FLOOD WAS SO GREAT THAT IT ERODED THE SUBSIDIARY CANYON AS A PART OF THE SCABLAND COMPLEX.

FORESET BEDDING, DIPPING DOWN THE SNAKE, IS EXHIBITED IN EVERY CLEAN SECTION BETWEEN DEVILS CANYON AND PERRY. THE SORTING ISNT VERY GOOD, MUCH SAND AND SILT FILLING ALL INTERSTICES, AND THE MATERIAL ISNT WELL WORN. BASALT IS THE DOMINANT CONSTITUENT. WHERE THE DEBRIS HAS COME DIRECTLY FROM THE SCABLANDS, AS AT DAVIN, THE PERCENTAGE OF NON-BASALTIC MATERIAL IS ONLY A SMALL FRACTION OF 1%. ONLY 10 OR 12 PEBBLES, COBBLES AND BOULDERS OF NON-BASALT WERE SEEN IN SECTIONS AT DAVIN, THO MY EYE PROBABLY RECOGNIZED 10,000 TO 20,000 FRAGMENTS OF VARIOUS SIZES, ALL OF BASALT.

BUT ALONG THE LOWER TERRACE, WHERE THE SNAKE HAS PRESUMABLY WORKED OVER THE GRAVEL, THE PERCENTAGE OF FOREIGN MATERIAL RUNS AS HIGH AS 2% TO 3% (PEBBLE COUNTS) AND THIS NON-BASALT CONTAINS A GREAT VARIETY OF ROCK NOT FOUND IN THE SCABLAND GRAVEL. MUCH DENSE SILICEOUS GREEN MATERIAL, CONSPICUOUS PHANERITES AND PHOPHYRIES, IDENTIFY IT AS DERIVED FROM DRAINAGE AREAS WHICH DID NOT USE THE SCABLAND ROUTES.

SNAKE RIVER VALLEY BETWEEN PERRY (MOUTH OF PALOUSE) AND RIPARIA. JULY 21 1924

A GREAT GRAVEL DEPOSIT ON THE NORTH SIDE OF THE SNAKE, EXTENDS FROM ABOUT THREE MILES ABOVE THE MOUTH OF THE PALOUSE ALMOST TO THE RR JCT AT RIPARIA. MUCH OF IT IS FLAT-TOPT AND FROM 200 TO 260 FEET ABOVE THE STREAM. NO BAR FORM, AS BETWEEN THE PALOUSE AND DEVILS CANYON. AND THE FORESET BEDDING, ALMOST WITHOUT EXCEPTION, DIPS UP THE SNAKE. IN SOME PLACES THE PERCENT OF FOREIGN (SNAKE RIVER) MATERIAL IS AS HIGH AS 1/5 THE TOTAL, BUT THIS IS RARE. MOST OF IT IS 99% OR MORE OF BASALT. AND IT IS MUCH WORN AND WELLSORTED, IN GENERAL. AND ITS TEXTURE IS PROGRESSIVELY FINER WITH INCREASING DISTANCE UP THE SNAKE UNTIL, JUST WEST OF RIPARIA, WHERE THE TERRACE TERMINATES UPSTREAM AT ABOUT 150 FEET ABOVE THE RIVER, THE MATERIAL IS FINE ENOUGH TO PUT ON ROADS WITHOUT CRUSHING. THIS ASSOCIATION OF UPSTREAM DIP OF FORESET BEDS AND FINER GRADE IN SAME DIRECTION IS VERY SIGNIFICANT.

THERE ARE SOME THICK BEDS OF SILT AND SAND BEAUTIFULLY STRATIFIED, IN THE GRAVEL. THESE DEPOSITS REST ON IRREGULAR SURFACES OF THE GRAVEL, MUCH ~~AS/HERE~~/ OF THESE SURFACES BEING THE FORESET SLOPE BUT SOME BEING EROSIONAL.

ONLY TWO GRAVEL DEPOSITS LIE ON THE SOUTH SIDE OF THE SNAKE IN THIS STRETCH. ONE IS ABOVE PERRY A FEW MILES, THE OTHER LIES BACK IN A TRIBUTARY VALLEY. THE BIG DEPOSIT HAS A STEEP SCARP TOWARD THE RIVER, AS HAS THE LARGE TERRACE ON THE NORTH SIDE. APPARENTLY, THE TWO WERE ONCE A CONTINUOUS DEPOSIT FOR THEIR SUMMITS ARE THE SAME ALTITUDE AND THE SNAKE LIES IN A RELATIVELY NARROW VALLEY HERE WITH LITTLE OR NO BASALT IN THE CLIFFS. THE TRIBUTARY VALLEY DEPOSIT IS LOWER AND CLEARLY SLOPES DOWN, UP THE TRIBUTARY. IT HAS COME FROM THE NORTH SIDE OF THE SNAKE.

CONNECTION WITH SCABLAND TO THE NORTH IS INDICATED BY GRAVEL WITH A FEW GRANITES AND SCHISTS WHICH DESCENDS FROM GAPS IN THE BASALT CLIFFS BACK OF (NORTH OF) THE BIG TERRACE. BUT THERE ARE NO NOTEWORTHY CHANNELS CUT HERE AND MOST OF THE GRAVEL SEEMS TO HAVE EDDIED UP THE SNAKE FROM A POINT NOT FAR ABOVE THE MOUTH OF THE PALOUSE. THE INTERPRETATION WHICH SEEMS BEST FOR THE SITUATION IS THAT THE SNAKE WAS PONDED ABOVE THE PALOUSE JUNCTION, IN PART BY THE ENORMOUS VOLUME OF THE GLACIAL PALOUSE AND IN PART BY ITS GREAT BAR DEPOSITS WHICH SOMEWHAT DECREASED CAPACITY OF THE MASTER VALLEY, AND THAT CONSEQUENTLY A DELTA WAS BUILT HERE, EXTENDING UP THE SNAKE FOR AT LEAST FIVE MILES.

IF THIS INTERPRETATION IS CORRECT, NO GREAT GRAVEL TERRACES SHOULD BE FOUND FOR SOME MILES ABOVE RIPARIA, AT LEAST AS FAR AS THE PONDING EXTENDED. BUT SILT DEPOSITS SHOULD EXIST, THO NOT AS HIGH ABOVE THE STREAM.

THE LARGE PERCENTAGE OF FOREIGN MATERIAL PROBABLY MEANS REWORKED SNAKE RIVER GRAVEL OR PERHAPS A LATER REWORKING IN PART BY THE SNAKE. IN THE LATTER CASE, HOWEVER, FORESET BEDS SHOULD DIP DOWN THE STREAM, AND THIS IS RARELY, IF EVER, THE CASE.

A TRAVERSE TOMORROW UP THE SNAKE ABOVE RIPARIA WILL AFFORD A CONCLUSIVE TEST OF THE INTERPRETATION HERE ADVANCED.

TALUS AND CLIFFS—— STRUCTURE OF BASALT—— ABSENCE OF SCABLAND——

TOMORROW; TOO TIRED TONIGHT.

SNAKE RIVER VALLEY RIPARIA TO LEWISTON ON CAMAS VALLEY RAILROAD JULY 22 1924

CATALOG AND DESCRIPTION OF SALIENT FEATURES OF TERRACES IN SNAKE RIVER VALLEY SEEN IN THIS TRAVERSE.

RIPARIA TERRACE—— EXTENDS EAST OF JUNCTION FOR THREE MILES. 40–60 FEET ABOVE JULY LEVEL OF RIVER. MOSTLY OF GRAVEL. SOME LENSES OF SILT AND SAND. NO FORESET BEDDING NOTED. STRATIFICATION EXPOSED IS HORIZONTAL. NON-BASALT PEBBLES COMPOSE 25% TO 50%. PROBABLY ALL OF 50% IF DARK PEBBLES NOT OF COLUMBIA BASALT WERE RECKONED. WELL-ROUNDED AND MUCH LARGER THAN THOSE IN HIGH TERRACE JUST WEST OF RIPARIA. TOP NOT FLAT; SLOPES DOWN FROM BLUFFS TOWARD THE RIVER. SCARP ABOUT 40 FT HIGH.

FLAGPOLE—— TERRACE ON SOUTH SIDE OF RIVER NOT 30 FT ABOVE JULY LEVEL, FLAT-TOPT, FINE SAND AND GRAVEL.

RIDPATH TERRACE—— ABOUT 50 FEET ABOVE RIVER. FLAT TOPPED. ESTIMATED 50% OF MATERIAL IN THE GRAVEL IS LIGHTER COLORED THAN COLUMBIA BASALT. HENCE IT IS SNAKE RIVER GRAVEL, NOT SCABLAND GRAVEL. WELL-ROUNDED. ALL BEDDING SHOWN IS FORESET WITH DIP UPSTREAM. LENSES OF SILT REST ON SLOPES OF THE FORESET BEDDING.

MILEPOST 12 (OUT OF RIPARIA)—— ON SOUTH SIDE OF RIVER IS A BROAD TERRACE 30 FT ± ABOVE JULY LEVEL. TOP IS ROUNDED LIKE A MID-CURRENT BAR, HIGHEST OUT FROM CONTACT WITH BLUFFS NEAR HERE IS TRIB VALLEY FROM SOUTH WITH NO GRAVEL DEPOSIT IN IT.

MILEPOST 14 TO CENTRAL FERRY STA.—— ON SOUTH SIDE IS A FLAT-TOPT TERRACE 1 MI. LONG.

PURRINGTON TERRACE—— THIS STATION (MILEPOST 19) AT UPSTREAM END OF TERRACE. TERRACE ABOUT THREE MILES LONG. TOP FLATTISH BUT SLOPES TOWARD RIVER, 30 FT SCARP. 60 FT ABOVE RIVER AT CONTACT WITH BLUFF. COMPOSED OF COARSE AND FINE GRAVEL, SILT AND SAND LENSES. SILT IS LIGHT BROWN, ALMOST A YELLOW BUFF. SAND IS DARK GRAY. GRAVEL WELL ROLLED AND SNAKE RIVER MATERIAL. HIGHER SLOPES ARE LARGELY OR WHOLLY ALLUVIAL FANS.

MILEPOST 22

MILEPOST 22—— ON SOUTH SIDE IS A TERRACE, FLAT-TOPT, LESS THAN 30 FT ABOVE RIVER. FLOODPLAIN TERRACES FROM HERE UP TO LEWISTON IN MANY PLACES. PENAWAWA ON FLOODPLAIN TERRACE.

PENAWAWA, ONE MILE ABOVE——— ON SOUTH SIDE AN ALLUVIAL FAN TERRACE WHICH GRADES INTO RIVER TERRACE. 20-30 FT SCARP AT EDGE. ALLUVIAL FAN TERRACES HAVE CONCAVE PROFILES WHILE THE GREAT BARS INSIDE THE RIVER CURVES BELOW PERRY HAVE CONVEX PROFILES. THEY ARE NOT ALLUVIAL FANS

SWIFT STATION (MILEPOST 29)——— TERRACE 30 FT ABOVE RIVER. FLAT. SNAKE RIVER GRAVEL. STRATIFICATION HORIZONTAL. ALLUVIAL FAN BUILT ON TOP OF PART, 1 1/2 MILE LONG.

SCHULTZ SPUR~~AAA/SIMILAR~~ ONE MILE BELOW———OPP. MP. 32——— TERRACE ON SOUTH SIDE. FLAT. 20-25 FT ABOVE RIVER.

SCHULTZ SPUR——— SIMILAR TERRACE BUT WITH ALLUVIAL FANS ON TOP. EXTENDS TO MP 33.5 (DIKES IN LOWER BASALT FLOWS ON SOUTH SIDE, OPPOSITE MP 34)

ALMOTA (MP 35.5)——— TERRACE ON SOUTH SIDE. FLAT. 30 FT ABOVE RIVER. EAST OF ALMOTA AND WEST OF HUNTS SPUR, A BIG SHOULDER OF GRAVEL WITH CONVEX PROFILE ON SOUTH SIDE OF RIVER. NO GULLY BACK OF IT AND CHARACTER OF MATERIAL, AS SEEN FROM NORTH SIDE, INDICATES THAT IT IS NOT THE RRMNANT OF A TALUS PILE. NOR IS IT AN ALLUVIAL FAN, APPARENTLY. MAX. ELEVATION ABOVE RIVER ABOUT 75 FT. LOCATED ON INSIDE OF RIVER CURVE. LOOKS RATHER LIKE THE GREAT BARS BELOW PERRY BUT PROBABLY IS REMNANT OF A TERRACE WITH SLOPE WASH AND ALLUVIAL FAN MATERIALS TO RAISE ITS BLUFF CONTACT ALTITUDE. SHOULD BE EXAMINED IN DETAIL.

HUNTS SPUR. EAST OF——— MPS 39 AND 40 ON TERRACE OF SNAKE RIVER GRAVEL. 30-40 FT ABOVE RIVER AT SCARP. ROLLING TOP WITH AL. FANS. SOME SILT POCKETS, SOME FORESET BEDS, DIP UP-STREAM. HIGHEST PART MAY BE 100 FEET ABOVE RIVER.

DIKES ON NORTH SIDE, NEAR 41.31

INTERIOR—— OPPOSITE THIS STATION, AND OPP. MPS 41 AND 42, IS A LOW TERRACE ON SOUTH SIDE 20-25 FT. ABOVE RIVER. AL. FANS ON PART OF IT.

WAWAWAI—— AT MOUTH OF LARGE TRIB FROM NORTH, A SIMILAR TERRACE. TWO MILES ABOVE WAWAWAI ON NORTH SIDE IS A TERRACE WITH 40-50 FT SCARP. COARSE, WELL-ROLLED, LIGHT-COLORED GRAVEL. FORESET BEDS DIP UPSTREAM. A SHORT AFFAIR. ALLUVIAL FAN TOP.

GRANITE OUTCROPS AT UPSTREAM EDGE OF THIS TERRACE AND FOR 1/2 MILE TO MP 46. ALT. OF GRANITE NOT 100 FT ABOVE RIVER STANDS OUT IN ROUNDED KNOBS AND PINNACLES. AT RIVER LEVEL, IT IS BORED BY POTHOLES, A FEATURE RARELY SEEN IN BASALT BECAUSE OF RAPIDITY WITH WHICH IT IS PLUCKED AWAY.

TRUAX STA.—— MPS 47-48—— SLOPING TERRACE, UPPER PART COMPOSED OF GENTLY SLOPING TALUS NO TRIB. VALLEYS THUS FAR CONTAIN GRAVEL DEPOSITS, HENCE NO EPOSODE OF GREAT SUPPLY OF GRAVEL TO MAIN STREAM SUCH AS SCABLAND EPISODE BROT TO TRIB VALLEYS BELOW RIPARIA.

MILEPOST 49—— TERRACE ON SOUTH SIDE WITH RIVERWARD SCARP. 30 FT± ABOVE JULY LEVEL. ALLUVIAL FAN ON TOP. ALL BASALT FLOWS APPEAR ESSENTIALLY HORIZONTAL THUS FAR. BOTH WALLS OF CANYON SAME HEIGHT.

BISHOP, EAST TO MP 51 !!!——— LOW TERRACE WITH FLOOD CHANNEL OF SNAKE. 1 MI. LONG

MILEPOST 52, APPROXIMATELY——— ALLUVIAL FAN TERRACE ON BOTH SIDES OF RIVER.

MILEPOSTS 53 TO 58—— TERRACES ALL APPEAR TO BE TALUS AND ALLUVIAL FAN AFFAIRS. LITTLE RIVER GRAVEL, SO FAR AS SECTIONS SHOW.

MILEPOST 58—— TERRACE OF SNAKE RIVER GRAVEL ON BASALT 60 FT ± ABOVE RIVER.

M MILEPOST 60—— ON SOUTH SIDE, FLOODPLAIN TERRACE. THREE FINE AL.FANS BLT ON IT.

MOSES STATION (MP 62)—— SLOPING TERRACE ON NORTH SIDE. COMPOSED OF WELLROUNDED LIGHT-COLORED SNAKE RIVER GRAVELS & (HIGHEST PART OF SCARP IS 50 FT ABOVE JULY LEVEL)

ALPOWA;—— HERE VALLEY BROADENS AS LEWISTON SYNCLINE IS REACHED. TERRACE ON NORTH SIDE AT MP 68 IS 40 FT ABOVE RIVER. OF SNAKE RIVER GRAVEL AND SILT. ON SOUTH SIDE ALSO 40 FT. ABOVE RIVER. NORTH LIMB OF SYNCLINE IS VERY NARROW AND STEEP, SOME BASALT FLOWS DIPPING AS MUCH AS 75 TO 80° RIVER AND RAILROAD ALONG THE ZONE OF INCLINED FLOWS. RIVER HAS SHARP ANGLE IN ITS COURSE WHERE IT PASSES FROM SYNCLINAL AXIS TO UPLIFTED PLATEAU TO NORTH. WESTWARD EXTENSION OF FOLD, BEYOND WHERE RIVER LEAVES IT, NOT SHOWN WELL FROM RAILROAD. HOGBAX SHOW WELL IN VALLEY'S NORTH WALL.

LEWISTON-CLARKSTON STRUCTURAL VALLEY. ONLY THE LOWEST TERRACE (40 FT) IS OF GRAVEL. ALL HIGHER ONES ARE STRUCTURAL AFFAIRS OF THE BASALT. THE VERY HIGH BLUFFS (2000 ABOVE RIVER) FOR MILES BELOW MP 60 ARE IN HIGHEST PART OF THE LEWISTON UPLIFT NORTH OF THE SYNCLINE. TO CUT OUT OF SYNCLINE AT ALPOWA, AND TO TRAVERSE THIS GREAT UPLIFTED AREA, THE SNAKE MUST HAVE BEEN ANTECEDENT TO THE FOLDING.

THIS SURVEY OF SNAKE RIVER VALLEY NEEDS LITTLE, OF ANY, MORE TO MAKE THE CASE FOR A GREAT SCABLAND FLOOD IN THE SNAKE VALLEY UNASSAILABLE. SNAKE RIVER GRAVELS ARE VERY DIFFERENT FROM SCABLAND GRAVELS. THEY OCCUR (ABOVE FLOODPLAINS AND LOW TERRACES) NO FARTHER DOWN THAN THE SOUTH END OF RIPARIA BRIDGE. THE TERRACES WHICH THEY MAKE ARE NOWHERE MORE THAN 50 FT ABOVE THE STREAM (DEDUCTING FOR AL.FAN AND TALUS ADDITIONS NEXT TO THE BLUFFS) AND IN MOST CASES ARE 40 FT OR LESS ABOVE THE SUMMER LEVEL. THEIR ALTITUDE ABOVE THE RIVER IS GRADUALLY LESS WITH INCREASING DISTANCE UP THE RIVER. RIVER DROPS ABOUT 175 FT BETWEEN LEWISTON AND RIPARIA. MATERIAL OF THE SNAKE RIVER TERRACES IS WELL ROUNDED AND WELL SORTED.

THE SCABBAND TERRACES ARE CHIEFLY GREAT BARS, WITH CONVEX TOPS. THEY ARE MUCH HIGHER, EXTENDING 100 TO 200 FEET ABOVE THE STREAM, THO NOT AS HIGH AS THE FLAT-TOPT TERRACES ASSOCIATED WITH THEM. THREE SUCH TERRACES NOW LOCATED; ONE OPPOSITE DEVILS CANYON, ONE AT DAVIN AND ONE BETWEEN RIPARIA AND PERRY. THIS LATTER IS NOT UNIFORMLY FLAT. IT RECEIVED GRAVEL APPARENTLY FROM SCABLAND CHANNELS AT SEVERAL PLACES ALONG ITS LENGTH AND ITS SUMMIT VARIES ACCORDINGLY. NOT 1% OF SCABLAND GRAVEL IS NON-COLUMBIA BASALT. 50% OF SNAKE RIVER GRAVEL IS NON-BASALT. NO SNAKE RIVER TERRACE REACH BACK UP TRIBUTARY VALLEYS. SCABLAND GRAVELS DO. SEE TUCANNON VALLEY (KELLOGG CR VALLEY) AT STARBUCK. HERE THE BASALT GRAVEL REACHES 4 MILES BACK. IT IS PROGRESSIVELY FINER AS IT GETS FARTHER BACK FROM THE RIVER AND ITS BEDDING INCLINES UP THE TRIB. VALLEY. AT ONE PLACE ON EAST WALL OF THIS VALLEY, THE WHOLE SLOPE IS MANTLED WITH GRAVEL AS THO THE FLOODED SNAKE HAD POURED OVER INTO IT HERE BECAUSE IT WAS COMPLETELY DAMMED JUST BELOW RIPARIA. ALTITUDE OF THIS GRAVEL OVER THE EAST WALL APPEARS TO BE EVEN HIGHER THAN IN BIG TERRACE BETWEEN PERRY AND RIPARIA.

THE EPISODE OF SCABLAND FLOODING WAS RELATIVELY SHORT AND THE CONTRIBUTION OF GRAVEL WAS MADE RAPIDLY. ELSE THE SNAKE WOULD HAVE RAISED ITS BED WITH ITS OWN GRAVEL, ABOVE RIPARIA, TO EQUIVALENT ALTITUDES. WHETHER THE SNAKE RIVER TERRACES ABOVE RIPARIA ARE OF THE SAME AGE AS THE SCABLANDS, OR OLDER, OR YOUNGER, ISNT CLEAR. THEY BEAR CONSIDERABLE TALUS AND FAN DEPOSITS BUT THE TALUS ISNT DISTINCTIVE ENOUGH IN ITS RELATIONS TO USE AS A CRITERION AND FANS

GROW AT GREATLY DIFFERENT RATES AND CANT BE USED.

THERE IS NOTHING INHERENTLY INHARMONIOUS IN THE ENTIRE EXPLANATION. NOR IS THERE ANYTHING CONTRADICTARY IN THE FIELD EVIDENCE. NOR ANYTHING LACKING, EXCEPT SILT DEPOSITS ABOVE RIPARIA. ONE FEATURE, HOWEVER, REMAINS UNEXPLAINED. IT IS THE UPSTREAM DIP OF THE FORESET BEDDING EAST OF RIPARIA. THIS IS LACKING IN THE SCABLAND GRAVEL BELOW PERRY, WHERE THE DIP IS DOWN THE VALLEY CONSISTENTLY. IT IS PRESENT IN THE SCABLAND GRAVEL ABOVE PERRY, WHERE THE HYPOTHESIS PERMITS IT; ALMOST REQUIRES IT. BUT WHY SHOULD IT APPEAR IN THE SNAKE RIVER GRAVELS ABOVE THE INFLUENCE OF THE SCABLAND DEPOSITS AND CURRENTS? THERE IS NO POSSIBLITY OF REVERSING THE SNAKE. EVEN THO THIS MIGHT BE DONE, AND THE STREAM ABOVE RIPARIA DURING THE SPOKANE FLOOD MIGHT HAVE FLOWED TO THE COLUMBIA BY WAY, SAY, OF THE WESTWARD EXTENSION OF THE LEWISTON SYNCLINE (TO WHERE?) THE REVERSED STREAM COUNDNT CONSTRUCT AN UPHILL SET OF TERRACES NOR COULD IT BE SUPPLIED WITH ITS OWN CHARACTERISTIC GRAVEL. THE ONLY WAY OUT OF THE QUANDRY IS TO EXPLAIN ALL THESE AS EDDIES IN WHICH A BACK-SETTING CURRENT DEPOSITEC THE GRAVEL—— WHICH SEEMS IMPOSSIBLE TO APPLY EXCEPT IN RARE CASES—— OR TO CALL THE FORESET BEDDING IMBRICATED ON THE UPCURRENT SLOPES OF ACCRETING BARS—— OR TO FIND SOMETHING NEW IN BAR GROWTH.

THE IMBRICATION HYPOTHESIS FALLS DOWN WHERE SAND ALSO IS FORESET BEDDED UPSTREAM, ESPECIALLY WHERE THAT SAND (OR A LAYER OF SAND) IS THIN AND LIES ABOVE AND BELOW HORIZONTALLY BEDDED SILTS. AT PRESENT THE PHENOMENON IS A DEEP PUZZLE, THO ITS ONLY EFFECT ON THE HISTORY I AM HERE ENDEAVORING TO CONSTUCT IS TO WEAKEN THE ARGUMENT FOR A DELTA ABOVE PERRY AND BELOW PERRY, A DELTA IN A PONDED SNAKE OR A GREATLY FLOODED SNAKE, WITH BACKWATER FROM THE GLACIAL PALOUSE AND OTHER SPOKANE STREAMS.

SNAKE RIVER VALLEY EUREKA TO SNAKE RIVER JCT. JULY 23 1924

EUREKA FLAT IS A CURIOUS, ALMOST AN ANOMALOUS, AREA AMONG THE MUCH DISSECTED LOESSIAL HILLS. IT ISNT FLAT, IT IS DISSECTED BY A DRAINAGE PATTERN, BUT SHALLOWLY INTRENCHED. THE ONLY RELATIONSHIP THE WATERWAYS BEAR TO IT IS THAT THEY FOLLOW IN GENERAL ITS LINEAR EXTENT. SOME HEAD ON ONE SIDE AND CROSS TO THE OTHER, SOME ARE MARGINAL BETWEEN HIGHER HILLS AND THE FLAT, AND SOME ENTER IT FROM THE HILLS, SOME LEAVE IT FOR THE HILLS AND ONE (TOUCHET RIVER) ENTERS, FLOWS MARGINALLY FOR A FEW MILES AND THEN LEAVES. IT. THE FLAT IS AT LEAST 25 MILES LONG, ELONGATED IN PARALLELISM WITH THE PECULIAR LINEAR DRAINAGE PATTERN OF THE REGION, SLOPES 500 FT ALONG ITS LENGTH AND IS 2 MILES WIDE AT PLEASANT VIEW, ITS UPPER END, AND 5 MILES WIDE AT LOWER END WHERE IT MERGES INTO THE BROAD WALLULA-PASCO BASIN. WELLS ON THE FLAT ENCOUNTER BASALT AT SURPRISINGLY DIFFERENT DEPTHS. AT EUREKA ONE DUG WELL IS 190 FT DEEP WITHOUT REACHING BEDROCK, AND A DRILLED WELL IS 250 FEET TO ROCK. AT BABCOCK, TWO MILES FARTHER UP THE MEDIAN LINE OF THE VALLEY, BEDROCK IS ENCOUNTERED AT 40 FT BELOW THE SURFACE. THERE IS LESS THAN 50 FT DIFFERENCE IN ALTITUDE BETWEEN THE TWO STATIONS. A MILE WEST OF CLYDE, BEDROCK OUTCROPS IN A SMALL WATERWAY. TWO MILES NORTH OF EUREKA, THREE WELLS FIND ROCK AT 80, 127 AND 150 FT RESPECTIVELY. ALL THREE ARE 50 FT OR SO BELOW THE GENERAL LEVEL, IN VALLEYS. NO GRAVEL REPORTED. BLUE CLAY OR SOAPSTONE ENCOUNTERED AT EUREKA ABOVE THE BASALT.

THE MOST SATISFACTORY EXPLANATION FOR EUREKA FLAT IS THAT IT IS AN UNDISSECTED REMNANT OF THE ORIGINAL LOESS COVER AND THAT IT HAS ESCAPED DISSECTION BECAUSE OF ITS LOW GRADIENT AND THE STEEPENED GRADIENTS OF ADJACENT, SLIGHTLY UPFOLDED TRACTS. THERE IS NO EVIDENCE, OTHER

THAN TOPOGRAPHY, FOR AN UPLIFT, BUT IT SEEMS IMPOSSIBLE TO ACCOUNT FOR THE HILLS BETWEEN EUREKA AND THE SNAKE TO THE NORTH BY ANY OTHER EXPLANATION.

SCABLAND IN SNAKE RIVER VALLEY NOW ESTABLISHED! AND THE ALTITUDE TO WHICH IT REACHES IS ASTOUNDING. A WONDERFUL VIEW OF IT IS OBTAINED FROM THE HILLS SOUTH OF SNAKE RIVER JCT. THE GLACIAL WATERS, IN PRODIGIOUS VOLUME, REACHED AT LEAST 1000 FT AT. THO THE SNAKE HERE IS NOT 400 FT A.T. AND WAS AN OPEN VALLEY WHEN OCCUPIED. NOR WAS THIS PONDING, FOR THE WATERS CARRIED HUGE AMOUNTS OF BASALT GRAVEL AND ERODED THE BASALT LEDGES IN TYPICAL SCABLAND FORMS. ALL THE FEATURES OF SCABLAND ARE HERE. BLUFFS OF LOESS WITH 30° SLOPES FACE THE SCABLAND AREAS. ISOLATED LOESSIAL HILLS WTTH PROWS ARE HERE. CLIFFS OF THE SCABLAND, FACING AWAY FROM THE SNAKE IN THE ABANDONED ACCESSORY CHANNELS, HAVE TYPICAL 3/4 SPOKANE TALUS. BARS WITH THE ROUNDED FORMS SO OFTEN SEEN IN THE PLATEAU SCABLANDS LIE IN PROTECTED PLACES, INSIDE CURVES OR ON THE DOWNSTREAM SIDE OF SCRUBBED BASALT HILLS. ONE OF THESE BARS, ON THE LEE OF THE BASALT HILL IN SECTION 35, 11N., 33E., (HILL OVERLAPS INTO ADJACENT SECTIONS) IS 250 FEET THICK. NO GOOD SECTIONS IN IT BUT IT IS ALMOST ALL BASALT GRAVEL. ANOTHER BAR IN THE SOUTH PART OF SECTION 23, 11N., 33E., AND NORTH PART OF SECTION 26 IS RINGED BY THE 800 FT CONTOUR AND EXTENDS DOWN TO THE RIVER LEVEL. IT IS 400 FEET THICK. THE SP AND S RR CUT IN IT EXPOSES AT LEAST 200 FT OF GRAVEL. GRAVEL HAS SLIDDEN SO MUCH ON THE FACE THAT STRUCTURE IS UNDECIPHERABLE.

STANDING AT AN ALTITUDE OF 1000 FT, ONE SEES IN EVERY DIRECTION, UP AND DOWN THE RIVER, ON BOTH SIDES, THE SCRUBBED BASALT LEDGES AND GENTLE SLOPES OF BAR DEPOSITS BELOW HIM, AND STEEP CLIFFS OF LOESS FACING THE RIVER ABOVE HIS LEVEL. THE VIEW HAS EVERY TYPICAL FEATURE OF THE SCABLANDS, SAVE ONLY THE VERY DEEP SNAKE RIVER CANYON IN THE MIDDLE. IT IS ABSOLUTELY CONVINCING TO ME AND I SHALL NEVER AGAIN HESITATE IN MY STATEMENTS ABOUT THE ENORMOUS VOLUME OF WATER CARRIED ACROSS THE PLATEAU AND INTO THE SNAKE DURING THE SPOKANE EPISODE. NO ONE WITH AN EYE TRAINED FOR PHYSIOGRAPHIC FORMS CAN RESIST THE ARGUMENT PRESENTED IN THIS VIEW.

GRAVEL FOUND AS HIGH AS 900 NEAR THE BASE OF LOESS CLIFFS ON SOUTH SIDE OF SNAKE IN THIS TRAVERSE. WATERS WERE HIGHER, FOR THE ISOLATED 1200-FOOT HILL IN SECTION 11, 10N., 33E., HAD TO HAVE A FLOOD REACHING 1050 OR SO TO TRAVERSE THE PRE-SPOKANE VALLEY WHICH HAS BEEN WIDENED AND DEEPENED TO LEAVE THE HILL IN ISOLATION. THE FLOOR OR THE CHANNEL HERE IS ABOVE 1000. BUT AT THE FOUR CORNERS OF SECTIONS 1,2,11 AND 12 (10N.,33E) IS ANOTHER PREGLACIAL VALLEY, ALL SET FOR THE FLOOD BUT NEVER ENTERED, AND THE DIVIDE AT THE HEAD WHICH BARRED OUT THE GLACIAL WATERS IS BETWEEN 1100 AND 1150. THE CREST OF THE FLOOD THEREFORE MAY BE SET AT 1100 HERE. AND ACROSS THE RIVER FROM BURR ARE TWO BASALT "PIMPLES", ONE OF THEM MARKED 1165, STANDING ON A SCRUBBED BASALT HILL RINGED BY THE 1100 FT CONTOUR. THESE SMALL CONICAL KNOBS CLEARLY HAVE BEEN STEEPENED BY THE SCABLAND FLOOD AND DEMAND A CURRENT ABOUT THEIR BASE, 1150, THO IT MAY NOT HAVE GONE OVER THEM. THEY ARE ONLY 6 MILES UPSTREAM FROM THE UNVIOLATED COL ABOVE DESCRIBED.

AS NOTEWORTHY A BAR AS IS TO BE SEEN ALONG THIS STRETCH OF THE SNAKE VALLEY IS IN SECTIONS 13 AND 24, T10N.,R32E., AND SECTIONS 18 AND 19, T 10N., R 33 E., IT OVERLIES IN PART AN EMINENCE OF BASALT WHICH HAS THE TYPICAL SCRUBBED SCABLAND ASPECT AND IN PART IT FILLS OR BLOCKS THE PRE-SPOKANE COURSE OF THE SNAKE AT THIS PLACE. PART OF THE OLD CHANNEL LIES ON THE SOUTH, SOUTHEAST AND EAST OF THE BAR. THE TIP OF THE ROCK KNOB REACHES 750 AND IS IDENTICAL WITH THOUSANDS OF SCABLAND BUTTES. THE BAR REACHES FROM 550 TO 650. ITS OUTLINES ARE UNMISTAKABLE.

APPARENTLY THE SNAKE HAS CUT A POST-SPOKANE GORGE TO THE NORTH AND WEST OF THE ROCK CORE OF THIS HILL. OR BETTER, THIS NEWER GORGE IS AN EROSIONAL PRODUCT OF THE GLACIAL FLOOD. IF IT IS SUCH, IT IS THE MOST PROMINENT FEATURE OF ITS KIND BELOW THE PLATEAU SCABLANDS.

THE ABANDONED VALLEY TO THE EAST AND SOUTH OF THE SCABLAND HILL AND BAR IN SECTION 35, IS PRE-SPOKANE. THE PRESENCE OF AN OLDER GRAVEL, EXPOSED JUST EAST OF THE FARM HOUSE IN ITS BOTTOM, ON SOUTH SIDE OF THE BAR, PROVES THIS. THE OLDER GRAVEL IS SOMEWHAT STAINED AND ITS MATRIX IS CONSIDERABLY DECOMPOSED. AND IT HAS NO MORE THAN 25% OF COLUMBIA BASALT PEBBLES. THE GRAVEL IS TYPICAL SNAKE RIVER DEBRIS.

near Page

WALLULA GATEWAY JULY 23 1924

THE SPOKANE FLOOD, OCEAN-BOUND, ACTUALLY OVERFLOWED THE GATEWAY AND SPREAD WESTWARD FOR A MILE AND EASTWARD FOR HALF A MILE. THE GREAT STREAM HERE WAS TWO AND A HALF MILES WIDE AND HAD A MAXIMUM DEPTH OF 700 FEET! DOES THIS SOUND PREPOSTEROUS? NOTE THE FIELD EVIDENCE.

THE TOP OF THE WESTERN BLUFF, FOR A MILE BACK FROM THE BRINK OF THE GATEWAY CLIFFS, IS SCORED AND CHANNELLED BY A PLEXUS OF BROAD RAVINES AND GULCHES, WHICH UNITE AND DIVIDE AND WHICH OPEN ON THE NORTH SIDE OF THE STRUCTURAL HILL THRU WHICH THE GATEWAY IS CUT AND OPEN OUT ON THE SOUTH SIDE OR OVER THE BRINK INTO THE GATEWAY. THE GRADIENTS ARE SLIGHT, YET THE EROSIVE ACTION HAS BEEN GREAT. GREAT VOLUME AT CONSIDERABLE VELOCITY IS RECORDED BY THE "HOLES" IN THE BOTTOMS OF THESE CHANNELS. AND THE WATER CAME INTO THEM FROM THE NORTH AT AN ALTITUDE OF 1000 TO 1050 AND LEFT THEM AT AN ALTITUDE OF 950 TO 1000 THIS WATER DID NOT COME DOWN FROM THE HIGHER LANDS TO THE WEST. IT CAME FROM A WATER SURFACE THAT COVERED THE KENNEWICK PASCO- WALLULA LOWLAND TO AN ALTITUDE OF 1000-1050 IT DID NOT FLOW DOWN TO THE COLUMBIA OR ANY LOWER LEVEL WHEN IT LEFT THEM. IT CEASED TO ERODE BELOW 900 AND MUST THEREFORE HAVE ENTERED A WATERBODY WHOSE SURFACE WAS ABOVE 950. THIS IS SCABLAND ON TOP THE WESTERN CLIFF OF THE GATEWAY. IT LACKS ONLY (1) THE BOUNDING BLUFFS OF LOESS, (2) THE GRAVEL DEPOSITS AND (3) TYPICAL 3/4 TALUS.

(1) IS ABSENT BECAUSE THE HIGHER LAND IS ALL BASALT. (2) IS NOT SHOWN BUT MAY BE PRESENT IN CERTAIN ROUNDED HILLOCKS AND SHOULDERS. (3) MOST OF THE TALUS IS HIGHER THAN 3/4, BUT SOME IS TYPICAL. THE BASALT AT THIS HORIZON BREAKS READILY INTO SMALL PIECES AND PERHAPS HAS DISINTEGRATED MORE RAPIDLY THAN THE AVERAGE.

THE EAST SIDE OF THE GATEWAY SHOWS SCABLAND UP TO THE SAME LEVEL, AND GENTLE, SOIL-COVERED SLOPES ABOVE. THE GUARDIANS (SENTINELS) AND THEIR ASSOCIATED HILLS AND CHANNELS COME OUT CLEARLY AS SCABLAND, WHEN VIEWED FROM A DISTANCE AND FROM A GREATER ALTITUDE. AND ALL THE PRE-SPOKANE DIVIDES BETWEEN GULCHES BELOW 1000 OF SO ARE SEVERELY SCORED TRANSVERSELY.

HERE THEN THE ENTIRE SPOKANE FLOOD WAS FINALLY CONVERGED TO MAKE THE PRODIGIOUS RIVER WHICH FILLED AND OVERFLOWED THE GATEWAY, TWO AND A HALF MILES WIDE, AND FOR HALF A MILE, 700 FT DEEP. THE GREAT CLIFFS WHERE SPRING GULCH ENTERS THE COLUMBIA PROBABLY WERE ALL CLEANED OF TALUS AT THIS TIME. THEY NOW HAVE 2/3 TO 3/4 TALUS, A GOOD SPOKANE RATIO, CONSIDERING THAT POST-SPOKANE RIVER WORK HAS PROBABLY CARRIED AWAY SOME MATERIAL.

SCABLAND ON THE VERTICAL BASALT ON THE NORTH SIDE OF THE UPLIFT IS VERY WELL DEVELOPED BUT NOT MORE THAN 750 AT. MAP DOESNT SHOW THIS WELL, INDEED, THE MAP DOESNT SHOW MUCH DETAIL IN THE SCABLAND AT 1000.

THE ANTICLINAL PUCKERS BETWEEN KIONA AND KENNEWICK JULY 24 1924

NO TRUE SCABLAND GRAVEL, LIKE THAT IN SNAKE RIVER VALLEY. GRAVEL UP TO 700 ON EAST FLANK OF NORTHERN PUCKER BUT PLENTY OF ROUNDED QTZITE, GRANITE AND VARIOUS PORPHYRITIC LAVAS. JUDGED FROM SURFACE PEBBLES. NO SECTIONS. ON SW SIDE, GRAVEL EXPOSED ON NPRR ABOUT 2 MILES EAST OF KIONA. NOT 50% BASALTIC MATERIAL. ALL WELL WORN. FORESET BEDDING WHICH DIPS DOWN THE VALLEY (ABANDONED VALLEY) I.E. EASTWARD. THE VALLEY ITSELF IS WALLED IN WITH BASALT. IT MAY BE STRUCTURAL, OR IN PART, EROSIONAL. BUT IT DOUBTLESS ANTEDATES THE SPOKANE EPOCH. NO SUGGESTION OF SCABLAND TYPE OR SCOURING OF BASALT. NEAR VISTA, THE FLAT IS UNDERLAIN BY STRATIFIED SILT AND SAND, THE SILT LIGHTER IN COLOR THAN THE SAND BUT NOT AS YELLOW AS THAT ASSOCIATED WITH GRAVELS IN SNAKE RIVER VALLEY ABOVE RIPARIA. NEARER KENNEWICK, THIS MATERIAL IS A COARSE, WELL-ROLLED, WELL-STRATIFIED RIVER GRAVEL. ALTITUDE HERE ABOUT 500 NOT TO EXCEED 50% BASALT.

IF THIS BROAD KENNEWICK REGION CONTAINS SPOKANE GRAVEL, ITS LOW ALTITUDE AND ITS HIGH PERCENTAGE OF NON-BASALT MUST BE EXPLAINED. THE ALTITUDE INDICATES THAT IT MUST BE A DEPOSIT AT THE BOTTOM OF THE GLACIAL RIVER OR PONDING. THIS REQUIRES AN ADEQUATE CURRENT ACROSS THE BROAD TRACT ABOVE THE WALLULA GATEWAY, A THING WHICH SEEMS DIFFICULT TO HAVE AT THE MAXIMUM OF THE FLOODING. IT MAY HAVE EXISTED EARLIER OR LATER IN THE FLOODING, HOWEVER.

THE HIGH PERCENTAGE OF NON-BASALT MAY BE EXPLAINED AS THE RESULT OF

1- CONTRIBUTION FROM COLUMBIA, INSTEAD OF SNAKE.

A- THE NON-BASALT DERIVED FROM OLDER GRAVEL DEPOSITS, REWORKED AT THIS TIME,

B- THE LACK OF DOMINANCE OF BASALT DUE TO SETTLING OUT IN HARTLINE AND QUINCY BASINS. IN SUCH CASE, ONLY MOSES COULEE AND KOONTZ COULEE WOULD CONTRIBUTE GREAT QUANTITIES OF 99% BASALT GRAVEL.

ERRATIC BLDRS OF GRANITE AT 1100, WEST SIDE, NORTHERN ANTICLINAL PUCKER.

VICINITY OF LYLE JULY 24 1924

SPOKANE GRAVEL (OLD PD GRAVEL) ALONG EVERGREEN HIWAY NORTHWEST OF LYLE, ON "LYLE GRADE" REACHES 390 FT ABOVE LYLE STATION (104 A.T.) IT IS VERY WELL EXPOSED IN GRAVEL PITS ALONG THE HIWAY AND AS NOTED IN PREVIOUS VISITS, THE FORESET BEDDING IS VERY STRIKINLY DEVELOPED AND IS ORIENTED AWAY FROM THE COLUMBIA. IT DIPS UP A TRIB. CANYON, NOT THE KLICKITAT CANYON PROPER ITS SUMMIT CONSTITUTES A DISSECTED TERRACE. IN IT ARE LARGE ANGULAR FRAGMENTS OF BASALT WHICH HAVE BEEN RIVER OFF NEAR-BY CLIFFS. NOT ONE PEBBLE IN A THOUSAND IS OF NON-BASALTIC MATERIAL. THE GRAVEL DESCENDS 130 FEET TO THE HIWAY AND PROBABLY HAS A TOTAL THICKNESS OF 200 FT.

THE STREAM, OR DISTRIBUTARY, OR BRAID, WHICH DEPOSITED THIS DELTA-LIKE TERRACE, CONTINUED WESTWARD HERE AND THE CHANNEL IS WELL MARKED ALONG THE EVERGREEN HIWAY JUST WEST OF THE TOP OF THE "GRADE". THE CHANNEL HERE IS CUT IN THE SATSOP FORMATION AND SOUTH OF IT THE GRAVEL EXPOSED IN THE CULTIVATED FLOOR OF A LARGE ORCHARD, CONTAINS GRANITE AND QUARTZITE. THE SATSOP IS VERY DISTINCTLY DIFFERENT FROM THE SPOKANE FLOOD GRAVEL. THE TOP OF ITS TERRACE IS 430 FT ABOVE LYLE STATION AND APPARENTLY THE SPOKANE FLOOD NEVER ALTERED IT, IF INDEED, IT EVEN REACHED IT. AT ANY RATE THE FIGURE OF 430 FEET ABOVE LYLE IS APPROXIMATELY THE UPPER LIMIT OF THE SPOKANE FLOOD AT THIS PLACE.

SEEN FROM THE "RIM ROCK" SOUTH OF THE ORCHARD ON THE SATSOP TERRACE, THE ROWENA MESA-TERRACE

IS PROBABLY LARGELY A SCABLAND AFFAIR. IT SURELY IS STRIKINGLY CANYONED AND ALCOVED AND TERRACED AND IT LIES BELOW THE UPPER LIMIT OF THE SPOKANE FLOOD. A GRAVEL DEPOSIT ON ITS LOWER WESTERN SLOPE WAS OPENED WHEN THE HIWAY WAS BUILT. THIS DEPOSIT IS DESCRIBED IN EARLIER NOTES.

THE BIG GRAVEL PIT EAST OF MOSIER, ON OLD HIWAY, IS A MOST LOGICAL RESULT OF THE SCABLAND FLOOD'S TRAVERSE OF THIS MESA-TERRACE. IT IS JUST WHERE THE FLOOD WOULD ENTER MOSIER CREEK VALLEY FROM THE EAST SIDE THRU A NOTCH BETWEEN HIGHER HILLS.

THE LYLE BAR IS BEAUTIFULLY SITUATED IN THE LEE OF A RIGOROUSLY SCROBBED CLIFF OF BASALT SO CLEAR IS THE FORM OF THIS DEPOSIT AND ITS SETTING THAT HE WHO RUNS MAY READ, AND HE WHO DOUBTS MUST CONFESS. THE BAR HAS AN UPSTREAM EDDY TERMINUS AND HERE A LARGE PIT SHOWS UPSTREAM FORESET BEDS. IT ALSO HAS A DOWNSTREAM SLOPING TERMINUS, REACHING OUT INTO THE KLICKITAT VALLEY BEYOND THE BASALT CLIFFS. IT IS A BAR LYING BROADSIDE ON THE SLOPE, NOT A DEPENDENCY FROM A ROCKY SALIENT. THOUGH THE HIGHER LEDGES IN THE SALIENT (TUNNEL POINT EAST OF LYLE) CONTINUE WESTWARD BACK OF AND ABOVE THE BAR, THEY ARE ALMOST COMPLETELY MASKED BY SLOPE WASTE NORTH OF THE BAR, IN STRIKING CONTRAST WITH THE CLIFFED SALIENT ITSELF. THE ALTITUDE OF THE CREST OF THE BAR IS, ACCORDING TO EARLIER MEASUREMENTS, 350 FT. A.T. IT IS CONSIDERABLY LOWER THAN THE TERRACE ON THE LYLE GRADE. BUT LACK OF HARMONY IN SUMMIT ALTITUDES OF BARS IS JUST WHAT IS TO BE EXPECTED. THE LYLE BAR HAS SUFFERED ALMOST NO EROSION.

THE PROBLEM OF THE UPSTREAM FORESET BEDDING IN SNAKE RIVER VALLEY ABOVE RIPARIA.

ALL SECTION SEEN IN COLUMBIA VALLEY BELOW WALLULA THIS PM (JULY 24) THAT SHOW FORESET BEDDING ALSO SHOW DOWNSTREAM DIP. THE SITUATION IN SNAKE RIVER VALLEY IS ABNORMAL, CLEARLY. THE BEST WORKING HYPOTHESIS, IN THE ABSENCE OF MORE EVIDENCE, IS THAT THE SNAKE, FLOODED UNTIL ITS WATERS STOOD 1100 ABOVE TIDE AND THEREFORE 400 FT DEEP AT LEWISTON, SUCCEEDED IN SPILLING A PORTION OF ITS WATERS ACORSS SOME DIVIDE IN ASOTIN OR GARFIELD COUNTY, OR IN OREGON SOUTH OF THESE COUNTIES, TO ENTER UMATILLA RIVER. UMATILLA RIVER IS SELECTED BECAUSE ANY STREAM LIKE THE TUCANNON OR WALLA WALLA WOULD ONLY LEAD SUCH WATER BACK TO THE ORIGINAL POND. THE WAY THE UPPER LIMIT OF THE SCABLAND ALONG THE SNAKE REMAINS CLOSE TO 1000, 1050 AND 1100 SUGGESTS THAT THE WALLULA GATEWAY HELD BACK THE FLOOD RATHER NOTABLY. BELOW THIS GATEWAY, THE SURFACE OF THE SPOKANE FLOOD SEEMS TO DROP RAPIDLY. 1050 AT WALLULA GATEWAY AND ABOUT 500 AT LYEE.

ALL BARS HAVE BEDDING PARALLEL TO SURFACE SLOPES, SAVE WHERE ALTERED BY SUBSEQUENT EROSION OR ADDED TO BY EOLIAN SAND.

COOKS JULY 25 1924

GRAVEL DEPOSIT ALONG HIWAY EAST OF TOWN HAS A TERRACE-LIKE TOP 210 FT ABOVE THE STATION (A.T.) AT THE TOP THE GRAVEL IS 75 TO 90% COLUMBIA BASALT. AT THE PIT ALONG THE HIWAY, A LITTLE LOWER, PERHAPS 80% COLUMBIA BASALT WITH UNDERWOOD LAVA RANKING NEXT IN ABUNDANCE.

FORESET BEDS DIP TOWARD, AND DOWNSTREAM ALONG, THE BASALT CLIFFS HERE. THE WHOLE DEPOSIT LIES ON AND TO THE LEE OF SCABL KNOBS OF COLUMBIA BASALT. ITS SUMMIT SLOPES DOWN TOWARD THE CANYON WALL OF THE COLUMBIA, THE SAME AS ITS BEDDING DIPS BUT NOT NEARLY SO STEEPLY. LARGE IRREGULAR BLOX OF COLUMBIA BASALT LIES IN THE DEPOSIT JUST AS THEY WERE DROPPED OR ROLLED WHEN THE SPOKANE FLOOD TORE THEM LOOSE FROM THE ADJACENT KNOBS. ROLLED PEBBLES AND SMALL COBBLES,

UP TO 6 INCHES IN DIAMETER, OCCUR IN THE GRAVEL, THO MOST OF IT IS LIKE THE LYLE GRAVEL, FINE ENOUGH TO PUT DIRECTLY ON THE HIWAY AFTER ONE SIEVING TO CATCH THE COARSER FRAGMENTS. THESE LARGE ROLLED PEBBLES, SOME OF UNDERWOOD LAVA, LIE IN THE RIVERWARD TRUNCATED EDGE OF THE DEPOSIT WHERE THE BEDS DIP BACK INTO THE DEPOSIT. THEY MUST HAVE BEEN ROLLED UP SOMETHING LIKE 200 FT OF A VERY STEEP SLOPE TO COME TO THIS POSITION, OR ELSE THE LITTLE WHITE SALMON WAS COMPLETELY BLOCKED BY A LATERAL BAR from upstream AND THIS IS ALL THAT REMAINS OF IT.

WHITE SALMON JULY 25 1924

ALMOST THE WHOLE TOWN IS BUILT ON THE ORIGINAL SLOPING SURFACE OF THE GREAT EDDY BAR HERE. THE SUMMIT IS AT THE SCHOOLHOUSE, ON THE EVERGREEN HIWAY, 670 FT AT. HERE, AS IN MANY PLACES, THE STRUCTURE AND COMPOSITON ARE VERY WELLSHOWN. 90-95% BASALT. THE MATERIAL IS ALL FINE ENOUGH TO PUT DIRECTLY ON ROADS. NO SCREENING NECESSARY. HERE AND THERE ARE ANGULAR FRAGMENTS OF BASALT. FORESET BEDDING AND FORESET LAMINAE IN HORIZONTAL OR GENTLY INCLINED STRATA SHOW IN EVERY CUT. AND, WITHOUT AN EXCEPTION, ALL EXPOSURES SHOW A DIP UP THE COLUMBIA OR BACK INTO THE LOCAL VALLEY HERE, OR SOME COMPONENT OF THE TWO. THE GREAT EDDY BAR DEPENDS UPSTREAM FROM WHITE SALMON BUTTE. ITS LOWER LIMIT ON THE EAST IS ABOUT 330 FT A.T. BUT IT DOUBTLESS LIES ON A SLOPING ROCK SURFACE AND NO VERTICAL SECTION WOULD SHOW A THICKNESS EQUAL TO THE DIFFERENCE IN ALTITUDE BETWEEN THE UPPER AND LOWER LIMITS.

SUCH AN ALTITUDE FOR A TYPICAL SPOKANE FLOOD DEPOSIT WILL BRING PRACTICALLY ALL ROCKY LEDGES OF THIS PART OF THE COLUMBIA GORGE BELOW THE FLOOD LEVEL. AT LEAST, THE BASES OF THEIR CLIFFS WILL BE BELOW. ALL THE ROCK TERRACES AND FIELDS OF GREAT BOULDERS ON THE HOOD RIVER FLAT, FACING THE COLUMBIA, WILL COME UNDER THE SPOKANE FLOOD LEVEL. 3/4 TALUS SHOULD BE COMMON WHERE THE POST-SPOKANE COLUMBIA HAS NOT WORKED, PROVIDING ROCK IS COLUMNAR-JOINTED, HORIZONTALLY-PLACED LAVA FLOWS.

WHITE SALMON BAR SEEMS TO BE COMPOUND. THE BUSINES STREET LIES ON THE SUMMIT OF, AND THE ROAD UP FROM BINGEN TRAVERSES THE LOWER EDGE OF, A BAR WHOSE SUMMIT ALTITUDE IS NEARLY 600 A.T. (586 ON P.O. SIGN POST IS TOO LOW) AND WHICH LIES IN FRONT OF (ON RIVER SIDE OF) THE HIGHER BAR (670 FT. A.T.) THE LOWER BAR IS THE LONGER ONE AND ORIGINALLY BLOCKED THE CANYON JUST EAST OF WHITE SALMON TOWN. ITS STRUCTURE AND COMPOSITION AND TEXTURE ARE IDENTICAL WITH THE HIGHER PORTION. 95% OR MORE OF THE GRAVEL CAME FROM EROSION OF COLUMBIA BASALT. THE ENSEMBLE OF THE WHITE SALMON BAR DEPOSIT RESEMBLES A GREAT WEDGE IN GROUND PLAN, THE CREST DESCENDING AND THE WIDTH DECREASING WITH INCREASING DISTANCE EASTWARD, UP THE COLUMBIA.

IN TWO PITS ALONG THE RAVINE, CUT THRU THE LOWER TIP OF THE BAR BY POST-SPOKANE DRAINAGE FROM THE BLOCKED CANYON, THE FORESET BEDDING IS VERY WELL SHOWN INDEED. IT DIPS BACK ACROSS THE WIDTH OF THE BAR, TOWARD THE HILLSIDE, AND NOT ALONG THE LENGTH OF THE BAR. FURTHER, ONLY THE LEE SLOPE CONFORMS TO THE SLOPE OF THE BEDDING. THE TOP TRUNCATES IT AND THE SOUTH SLOPE, (COLUMBIA VALLEY SLOPE), THO NOT WELL SHOWN IN SECTIONS, ALSO APPARENTLY TRUNCATES IT. THE BEDDING IS TYPICAL DELTA FORESET; THERE ARE NO HORIZONTAL STRATA WITH FORESET LAMINAE. DEPTH OF EXPOSURE IN LARGE PIT IS ABOUT 40 FEET.

BARS MAY BE RECOGNIZED EAST OF WHITE SALMON VERY EASILY BECAUSE OF THE SPARSITY OR TOTAL TOTAL ABSENCE OF TREES. THUS A TRAIN TRIP MAY YIELD A LARGE AMOUNT OF RELIABLE DATA RELATIVE TO FORMS AND SIZES AND LOCATIONS.

KENNEWICK TO LYLE VIA SP AND S RR JULY 24 1924

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INHERITANCE/ OF CAST-OFF CLOTHING TOO LARGE FOR THE RIVER OF TODAY, THO THEY MAY HAVE BEEN INITIATED DURING THE SPOKANE EPOCH. THEIR ANCESTRAL PROTOTYPES STAND ON THE BLUFFS ABOVE, OVERLOOKING THE SCENE OF THEIR OWN DEVELOPMENT.

AT FALLBRIDGE IS A PROMINENT ROCK TERRACE 100 FT ± ABOVE THE RR WHICH BEARS SCABLAND HERE AND DOWNSTREAM FROM THE STATION. ON SOUTH SIDE HERE SCABLAND IS WELL SHOWN DOWNSTREAM FROM MOUTH OF JOHN DAY CANYON BUT UP FROM FALLBRIDGE.

BELOW CELILO FALLS, NORTH SIDE OF RIVER, A GRAVEL BAR 50 FT ABOVE RR IS CUT IN SECTION. FORESET BEDS IN IT DIP DOWNSTREAM.

IN THE HIGHWATER CHANNELS OF THE COLUMBIA IN "THE DALLES" THERE IS MUCH GRAVEL IN BARS.

BLUFFS OF THE DALLES FORMATION, ON THE TOP OF THE COLUMBIA BASALT, SOUTH OF "THE DALLES" ARE VERY MUCH LIKE STEEPENED LOESSIAL BLUFFS. ONE SUCH HILL ON SOUTH SIDE OF RIVER IS NEARLY ISOLATED, AS IS COMMONLY THE CASE IN THE LOESS OF THE PLATEAU.

A GREAT ISOLATED CRAG OF BASALT, 100 FT + ABOVE RIVER, NORTH SIDE, AT HEAD OF 5 MILE RAPIDS.

SCABLAND AND FINE BARS ALL OVER THE ROCK FLAT NORTH OF GRAND DALLES. HOW DID I EVER MISS IT BEFORE? THE CORRUGATED BASALT FLAT ON SOUTH SIDE HERE IS CONSIDERABLY LOWER THAN THAT ON THE NORTH.

AT SOME PLACES IN "THE DALLES" THERE ARE POTHOLES DRILLED INTO THE BASALT, EXPOSED AT LOWWATR

THE GENTLE SLOPES OF THE RINGEN ANTICLINE, NORTH SIDE OF RIVER, ARE VERY SCABBY. THESE SCABBY SURFACES EXTEND UP ABOUT 300 FT ABOVE THE RR TRAX. ABOVE THIS ALTITUDE, THE SLOPES ALL HAVE ABOUT THE SAME GRADIENT BUT ARE ALL SOIL-COVERED AND GRASSED.

HOOD STATION——— THE COLUMBIA BASALT KNOBS AND LEDGES WHICH OUTCROP HERE BELOW THE UNDERWOOD LAVA ARE GOOD SCABLAND FEATURES.

THE PORTLAND DELTA SUNDAY JULY 27 1924

THE PORTLAND DELTA IS A SUBAQUEOUS DEPOSIT, AN AFFAIR OF RIVER-BOTTOM DEPOSITION, AND IS NOT A DELTA PLAIN. INSTEAD OF DISTRIBUTARIES WHICH ERODED INTO THE PLAIN WHEN THE BASE-LEVEL WAS LOWERED DURING THE DELTA GROWTH (AS MY EARLIER INTERPRETATIONS HAD IT), THESE BROAD WATER-WAYS OF THE COLUMBIA ARE CHANNELS HELD OPEN WHILE THE HIGHER PARTS WHICH SEPARATE THEM WERE AGGRADED AS GREAT BARS.

THE EVIDENCE FOR THE ABOVE STATEMENT IS FOUND IN

1- THE CHARACTER OF THE BARS

2- THE SITUATION AT ROCKY BUTTE

3- THE DEMANDS OF THE SPOKANE BARS AND SCABLAND DOWN THE COLUMBIA BELOW WALLULA.

(1) THERE ARE TWO FAIRLY CONSISTENT LEVELS IN THE PORTLAND DELTA; THE HIGHEST IS 300 FT., THE LOWEST IS 200 FEET. AT THE 300-FOOT LEVEL OCCUR BROAD FLATS AND NARROW ELONGATE RIDGES, AT THE 200-FOOT LEVEL OCCUR BROAD FLATS AND FAIRLY RESTRICTED CHANNELS. THE TWO LEVELS OF FLATS LED TO THE ORIGINAL INTERPRETATION OF DISSECTION OF AN ORIGINALLY CONTINUOUS 300-FOOT LEVEL. BUT IF THIS WERE CORRECT, THE NARROW RIDGES STANDING APPROXIMATELY ON THE 200-FOOT LEVEL AND RISING CONSISTENTLY TO THE 300-FOOT LEVEL MUST BE REMNANTS LEFT BY EROSION. AS TO WHETHER THEY ARE SUCH, THE REGION OF HIDDEN, THREE MILES NORTHEAST OF VANCOUVER, SUPPLIES THE FIELD DATA.

(A) THE RIDGES ARE LONG AND NARROW. THE MOST STRIKING ONE, 1/2 MILES SOUTH OF HIDDEN, IS 1 1/2 MILES LONG AND ABOUT 300 FEET WIDE ON TOP. AND WHERE THE PORTLAND QUADRANGLE SEEMS TO SHOW A GREATER WIDTH TO SOME, FIELD INSPECTION SHOWS THAT TO BE DUE TO CLOSE POSITION AND PARTIAL COALESCENCE OF TWO OR THREE PARALLEL RIDGES.

(B) THE RIDGES ARE COMPOSED OF FORESET-BEDDED SAND AND BB-SHOT-SIZED GRAVEL. NOT MANY SECTIONS AVAILABLE BUT THESE SHOWED THE DIP TO BE DOWN THE NORTH SLOPE, IN PARALLELISM WITH THAT SLOPE, AND TO BE TRUNCATED BY THE TOP AND SOUTH SLOPE. FURTHER, THE DIP SLOPE IS THE STEEPER SLOPE.

(C) BB GRAVEL, BY COUNT, IS 7% NON-BASALT.

(D) VALLEYS BETWEEN RIDGES CONTAIN PONDS, SWAMPS AND LAKES—— NOT STREAMS.

(E) RIDGES ARE GROUPED ABOUT THE EDGE OF THE 200-FOOT LEVEL, NEAR HIDDEN, AND POINT ARE ORIENTED AT RIGHT ANGLES TO THE EDGE OF THE DEPOSIT. THE MOST DISTANT OF IS THE GROUP OF THREE IN CENTRAL PART OF SECTION 33, R1E.,T1N. NO GRAVEL IN THIS IS SHOWN— ALL SAND.

THESE RIDGES ARE THEREFORE HELD TO BE RIVER BARS, ABOUT 100 FEET HIGH ABOVE THE MAIN CHANNEL FLOORS AND 50-75 FEET HIGH ABOVE IMMEDIATE SURROUNDINGS.

(2) ROCKY BUTTE IS CLIFFED ABOUT THE LOWER SLOPES ON THE EAST SIDE AND NORTH END. AN ELONGATED DEPRESSED AREA LIES CLOSE TO THE BASE OF THE EAST SIDE AND SOUTH END AND ANOTHER TRAILS OFF TO THE WEST, DEPENDENT FROM THE SOUTH END. DIRECTLY WEST OF THE BUTTE IS A GRAVEL DEPOSIT 75 FT + ABOVE THE ELONGATED DEPRESSIONS AND ITSELF ELONGATED EAST-WEST. THE ENSEMBLE IS NOW CLEARLY SEEN AS THE PHENOMENON OF A PRONOUNCED ISOLATED OBSTRUCTION IN THE PATH OF A GRAVEL-CARRYING STREAM. THE CURRENT IS DEFLECTED downward FROM THE UPSTREAM SIDE AND KEEPS A NARROW EDDY DEPRESSION UNFILLED. IT ALSO IS DEFLECTED AROUND THE ENDS AND CARRIES THE DEPRESSION DOWNSTREAM FOR A MILE IN THIS CASE. THE IMPINGING CURRENT ERODED THE UPSTREAM SIDE AND PRODUCED THE LOWER CLIFFS WHICH ON THE NORTH SIDE ARE SHARPLY CUT IN ORIGINALLY GENTLER SLOPES AND DO NOT RISE ABOVE 300 FT A.T. THE DEPOSIT OF GRAVEL ON THE WEST OF THE BUTTE IS THE CONSEQUENCE OF CURRENT

CHECKING ON THE ~~LOWER~~ DOWN-STREAM SIDE. THE ENSEMBLE IS IN PERFECT HARMONY, BUT A STREAM WHOSE UPPER SURFACE WAS AT LEAST 300 FT A.T. AND WHOSE DEPTH ABOUT THE BUTTE WAS 100 FEET IS REQUIRED.

(3) RELATIONS TO THE SPOKANE GRAVEL AND SCABLANDS UP THE COLUMBIA. IN PERFECT ACCORD WITH THE DEMANDS FOR A HUGE VOLUME OF WATER OVER THE PORTLAND DELTA. ONLY PUZZLING THING ABOUT IT IS THE UPPER LIMIT OF THIS STREAM. FROM THE FACT THAT THE UPPER FLATS ARE 300 FT + A.T. AND MOST OF THE BARS RISE TO 300+, ONLY TWO OF THEM EXCEEDING 325 (THE HIGHEST IS 350+), AND FROM THE UPPER LIMIT OF THE CLIFFS ALONG NORTH SIDE OF ROCKY BUTTE, IT SEEMS OBVIOUS THAT THE SPOKANE FLOOD NEVER REACHED MUCH ABOVE 300 HERE, NOT TO EXCEED 350. (PERHAPS THE EXTRA 25 FT ON THE 350-FOOT KNOB IS A DUNE). YET IF THE FLOOD WAS NOT ABOVE 350 FT A.T. AT PTLD. AND YET REACHED 670 FT AT WHITE SALMON, THE SLOPE OF THE SURFACE OF THIS RIVER WAS INCONCEIVABLY STEEP FOR SO GREAT A STREAM. EITHER THE FLOOD WAS DEEPER AT PORTLAND, OR THERE HAS BEEN SOME DIFFERENTIAL MOVEMENT, SINCE THE BARS WERE DEPOSITED. THE ONLY ALTERNATIVE IS TO ACCEPT A GRADE OF 6 FEET TO THE MILE FOR THE SURFACE OF THE SPOKANE COLUMBIA THRU THE GORGE.

COMMENTS ON PORTLAND DELTA JANUARY 1927

STUDY OF THE PTLD SHEET SHOWS THAT THE BAR DOWNSTREAM FROM ROCKY BUTTE HAS A LONG GENTLE SLOPE ON THE NORTHEN SIDE AND A STEEP SCARP ON THE SOUTH, ENDING IN THE E-W DEPRESSION THERE. AFTER SEEING THIS TRACT AGAIN IN THE FIELD, OR THINKING OVER THE VISUAL IMPRESSIONS GAINED IN 1924 BUT NOT RECORDED, I HAVE THIS TO ADD.

THERE ARE FORESET STRATA IN THE HIGHWAY CUT THAT CROSSES THIS SCARP WEST OF RKY BUTTE. THEY DIP WITH THE SCARP SLOPE, SOUTHWARD. THERE ARE MINOR FLUTINGS AND BARLIKE FORMS ON THE GENTLE NORTHERN SLOPE OF THIS BAR JUST LIKE THOSE ON THE NORTHERN SLOPE OF THE 300 FT TERRACE EAST OF THE EDDY FOSSE. SEEN IN THE FIELD, THEY LOOK MUCH MORE LIKE ACCRETIONAL FORMS THAN LIKE EROSIONAL RESULTS. IT IS IMPOSSIBLE TO ACCOUNT READILY FOR THEM AS EROSIONAL FORMS. THEREFORE, THE NORTHERN SLOPE OF BOTH BARS, THAT EAST AND THAT WEST OF THE BUTTE, IS THE ORIGINAL SLOPE AS LEFT BY THE GREAT STREAM. THE FORESET BEDS DIPPING SOUTHWARD AROUND THE WEST END OF RKY BUTTE RECORD THE GROWING FACE OF THE BAR THAT WAS BUILT BY THE SOUTHWARD SURGE WHEN THE WATERS ~~WERE~~ HAD PASSED THE BUTTE. THE DELTA THEREFORE ISNT A DISSECTED FORM IN ANY SENSE (EXCEPT AS SMALL GULLIES EXIST). THE CENTRAL CHANNEL OF THE COLUMBIA WAS WHERE IT NOW IS, AND ABOUT AS DEEP AS IT NOW IS. THE STREAM CHANNEL ACROSS THE DELTA WAS PERHAPS 300 FEET DEEP. THE FLUTINGS, WHICH CAN BEE SEEN ON THE MAP, ARE ORIGINAL FORMS.

COLUMBIA GORGE HOTEL AND ENVIRONS. JULY 29 1924

SURFACE OF HERMAN CREEK LAVA WHICH HERE CONSTITUTES THE BLUFFS HAS A TYPICAL SCABLAND EXPRESSION OF KNOBS AND CHANNELS, and IN ADDITION, HAS A FEATURE NEVER FOUND IN COLUMBIA BASAKT SCABLAND—— POTHOLES !! THEY ARE NOT TYPICAL IN OUTLINE AND RECORD THE ONWARD SWEEP OF RIVER-BORNE DEBRIS RATHER THAN THE WHIRLING IN MINOR EDDIES. BUT THESE SURFACES ARE UNDENIABLY WATERWORN AND OCCUR RIGHT ON THE BRINK OF THE PRESENT CLIFF, 200 FT OR SO ABOVE THE COLUMBIA.

HOOD RIVER JULY 30 1924

GRAVEL TERRACE IN SW PART OF THIS CITY IS 500 FT AT, OPENED BY BREAT GRAVEL PIT AT ABOUT 450 A.T. FORESET LAMINAE, ORDINARY CURRENT TYPE, IN HORIZONTAL STRATA. NO LONG DELTA FORESETS. UP TO ABOUT SAME LEVEL FROM HOOD RIVER WEST TO RUTHTON GRADE, THE SLOPES BEAR QUANTITIES OF LARGE ROLLED BOULDERS OF THE UNDERLYING HERMAN CREEK LAVA. ABOVE THIS LEVEL, THE ORCHARD LAND IS SOIL-COVERED, UNTERRACED, UNBROKEN BY OUTCROPS OF ROCK AND WITHOUT ANY BOULDERS. IF IT WERE NOT FOR THE WHITE SALMON BAR AT 670 FT. A.T., THIS WOULD DO NICELY FOR THE UPPER LIMIT OF THE SPOKANE FLOOD.

BINGEN ANTICLINE JULY 30 1924

ALONG HIGHWAY ON SOUTH SIDE, BETWEEN HOOD RIVER AND MOSIER, THERE ARE CASTELLATED CRAGS WITH LINEAR CHANNELS SEPARATING THEM FROM THE MAIN HILLSIDE UP AT LEAST TO 400 FT A.T. (AS HIGH AS THE HIWAY GOES HERE). THESE CRAGS ARE AS SEVERELY ERODED ON THE SIDE TOWARD THE HILL AS THEY ARE ON THE COLUMBIA SIDE. THE CLIFFS BEAR TALUS ABOUT 3/4 UP.

THESE CRAGS AND CHANNELS ARE AS CLEARLY A RECORD OF THE SPOKANE FLOOD AS ANYTHING IN THE GORGE.

ROWENA MESA JULY 30 1924

SCABLAND ALONG COLUMBIA RIVER HIWAY IS WELL-EXPRESSED UP TO 700 FT A.T. BUTTES OF THE DALLES FORMATION, DESCRIBED IN NOTES OF PREVIOUS FIELD SEASONS, ARE THE EROSIONAL PRODUCT OF THE SPOKANE FLOOD. IF THEY WERE NORMAL AFFAIRS OF SUBAERIAL DEGRADATION, THEY WOULD EXIST WELL DISTRIBUTED OVER THE AREA OF THE FORMATION, FOR SLOPES ELSEWHERE ARE ADEQUATELY STEEP. IF THEY WERE DUE TO SUPERIOR EROSION BY THE COLUMBIA DOWN IN THE GORGE HERE, ONLY THE RIVEDWARD SLOPES WOULD BEAR THE MESA CHARACTER. THIS 700-FT ALTITUDE AGREES WITH THE 670 FT WHITE SALMON BAR.

SEEN FROM THE ROWENA MESA AND THE HIWAY NEARER THE DALLES TOWN, THE ORTLEY ANTICLINE ON THE NORTH SIDE OF THE RIVER IS SEVERELY ERODED UP TO 500 FT OR SO ABOVE THE RIVER. BARE, BLACK ROCK AND EXCEEDINGLY ROUGH SURFACES BELOW THIS LEVEL ARE IN STRIKING CONTRAST WITH THE GRASSED SLOPES OF ABOUT THE SAME GRADIENT ABOVE THIS LEVEL.

THE RUGGED BASALT FLAT NORTH OF GRAND DALLES MIGHT BE TRANSPLANTED DIRECTLY FFOM THE SCABLANDS OF THE PLATEAU. IT IS IDENTICAL IN EVERY RESPECT ! A LONE ISOLATED HILL, PROBABLY OF DALLES BEDS, CERTAINLY WITH GENTLER SLOPES THAN BASALT WOULD HAVE, STANDS AT UPPER LIMIT OF THE BASALT FLAT, JUST SOUTH OF THE GREAT SHOULDER PREVIOUSLY DESCRIBED (FORMER YEARS) AS OF COLUMBIA BASALT. IT LOOKS JUST LIKE A RELICT HILL.

STACKER BUTTE JULY 30 1924

SEEN FROM THE OW RR AND N, THE GREAT TALUS OR WASTE SLOPE OF STACKER BUTTE, EAST OF THE "BLUE LAVA" FLOW FROM SUMMIT VOLCANO, IS SHARPLY TRUNCATED ALONG THE LOWER EDGE JUST ABOVE THE SCABLAND BASALT. AND GULLIES HAVE TRENCHED DEEPLY INTO IT AS A CONSEQUENCE OF THIS TRUNCATION. THIS CAN ONLY BE A CONSEQUENCE OF THE SPOKANE FLOOD. ALTITUDE OF THE SCARP A.T. UNKNOWN BUT APPROXIMATELY 500 FT ABOVE THE RIVER.

ROOSEVELT FLAT, JUST WEST OF JULY 30 1924

WHAT LOOKS LIKE A ONCE COMPLETE VALLEY BLOCKING OF THE FIRST PROMINENT TRIBUTARY BELOW ROOSEVELT FLAT IS VERY CONSPICUOUS FROM SOUTH SIDE. MAP STUDY TO ELUCIDATE AND GIVE ALTITUDES. (MAP DOESNT SHOW IT AS A BAR. ALTITUDE NOT TO EXCEED 400 A.T.)

O-W RR AND NØ CUT-OFF, MESSNER TO STANFIELD JULY 30 1924

THE ENTIRE ROUTE IS ALMOST FEATURELESS. A MANTLE OF COARSE SAND COVERS IT AND THE SLOPES ARE VERY GENTLE. ONLY THREE CUTS SHOW ANYTHING MORE THAN SAND AND ONLY ONE TOPOGRAPHIC FEATURE OF SIGNIFICANCE WAS SEEN. THE CUTS REFERRED TO EXPOSE GRAVEL. THIS GRAVEL IS COARSE AND CONTAINS AN ABUNDANCE OF LIGHT-COLORED MATERIAL. IT HARDLY SEEMS POSSIBLE TO MAKE IT SPOKANE GRAVEL. NOR DOES IT LOOK STAINED OR DISCOLORED, AS IS THE STANFIELD AND ECHO GRAVEL. NOR IS IT INDURATED, AS THAT IS. I DONT KNOW WHERE IT BELONGS UNLESS IT IS MATERIAL ALREADY ON THE GROUND, REWORKED BY THE SPOKANE FLOOD. HIGHEST ALTITUDE CROSSED WAS ABOUT 600.

THE TOPOGRAPHIC FEATURE OF INTEREST IS A SCARP, FACING WESTWARD FROM A GRAVEL FLAT 600/650 FEET IN ALTITUDE. THE SCARP IS ABOUT 50 FT HIGH. A RR CUT SHOWS THE GRAVEL BENEATH THE FLAT, THO THE RR SWINGS PRETTY WELL SOUTH OF THE FEATURE. IT LOOKS ~~L/K~~ AS THO IT MIGHT BE A DOWNSTREAM SCARP OF A HUGE BAR, BUILT BY WATERS OF THE SPOKANE FLOOD WHICH SWUNG WESTWARD ACROSS THE GREAT FLAT OF THIS PART OF THE BLALOCK LOWLAND. BUT THIS IS NOT A GOOD, CLEAR CASE AND SHOULD NOT BE USED IN BUILDING THE ARGUMENT FOR THE SPOKANE FLOOD.

UMATILLA, HERMISTON AND ~~AND/EMIGRANT~~ BUTTES ARE SEVERELY SCOURED, EMIGRANT BUTTE HAS ~~A~~ GENTLE GRADED SLOPES. THIS IS BECAUSE IT STOOD BACK FROM THE PATH OF THE SPOKANE FLOOD, AND PERHAPS ABOVE

VICINITY OF STANFIELD, COLD SPRINGS RESERVOIR AND HERMISTON

UMATILLA SHEET JULY 30 1924

AN INDURATED GRAVEL CONSTITUTES THE TERRACE JUST NORTH OF ECHO. THE SUMMIT OF THE TERRACE IS 800, THE GRAVEL IS EXPOSED AS LOW ALMOST AS THE RR GRADE. GRAVEL MUST BE 100 FT THICK HERE.

SAME GRAVEL NORTH OF STANFIELD (FOSTER), EXPOSED ALONG RR AND HIWAY. AS SHOWN BY TRAVERSE FROM STANFIELD TO C-S RESERVOIR, THE BROAD, ROLLING PLAIN AT 700-750 IS DOUBTLESS ALL UNDERLAIN BY THIS SAME GRAVEL. NO SCARS OR EXPOSURES ALONG THE TRAVERSE BUT PLENTY OF GRAVEL AND LIMY INTERSTITIAL MATERIAL ALONG THE ROAD AND AMONG THE SAGE. INCIDENTALLY, A LOT OF GRANITIC ERRATICS UP TO 750. Err.

DAM AT THE C-S RESERVOIR IS BUILT ON A BASALT FOUNDATION BUT IMMEDIATELY BELOW THE DAM, NO BASALT IS SEEN ANYWHERE IN THE GULCHES. THEY ARE ALL IN THIS GRAVEL FORMATION. KNOBS OF BASALT APPEAR IN HERMISTON BUTTE AND UMATILLA BUTTE, SEVEN AND EIGHT MILES TO THE WESTWARD, BUT ELSEWHERE IS THE GRAVEL PLAIN, SCORED BY EROSION BUT ESSENTIALLY INTACT AND CONTINUOUS. THIS PLAIN PROBABLY EXTENDS NORTHWARD NEARLY TO THE COLUMBIA BLUFFS, THEMSELVES OF BASALT. IN OTHER WORDS, THERE IS A BROAD LOW TRACT IN THE BASALT HERE, FILLED WITH GRAVEL, LYING ON AN ERODED SURFACE (WITNESS HERMISTON AND UMATILLA BUTTES)

THE BEST SECTION OF THE GRAVEL IS BELOW THE C-S DAM WHERE EXTENSIVE EXCAVATING WAS MADE WHEN THE DAM WAS CONSTRUCTED. THE GRAVEL IS FRESH, EXCEPT FOR LIMEY INCRUSTATIONS AND PARTIAL CEMENTATION. IT IS COMPOSED LARGELY OF BASALT. THERE IS SOME QTZITE IN IT! IF THE SECTION WERE SEEN IN THE GORGE, ITS COLOR, STRUCTURE AND COMPOSITON WOULD CONVINCE ONE THAT IT BELONGED TO THE PORTLAND DELTA. IT IS MORE INDURATED NEAR ECHO AND STANFIELD THAN THE PORTLAND DELTA BUT AT THE C-S RESERVOIR IT IS NOT INDURATED AT ALL. NOWHERE IS IT STAINED OR DECOMPOSED. NOWHERE DOES IT SHOW ANY DEFORMATION. NO ASH FOUND IN IT. IN ALL WAYS THESE IT RESEMBLES PD GRAVEL VERY CLOSELY. EXCEPT FOR ALTITUDES AND THE CEMENTATION NEAR ECHO AND STANFIELD, IT IS PD. AND THE ALTITUDE OF 750 MAY WELL FALL INTO THE ASCENDING GRADIENT OF THE PD ~~XØ~~ UPSTREAM. FURTHER, THE INDURATION IS NOT A FATAL OBJECTION.

THE PRESENCE OF QTZITES IS WHOLLY OUT OF HARMONY WITH THE SATSOP-DALLES-ARLINGTON DEPOSIT. IT HAS NONE OF THE CHARACTERS OF THAT DEPOSIT. IN THE LIGHT OF PRESENT KNOWLEDGE, IT IS PD, NOT SATSOP. IF FURTHER INVESTIGATION CAN BE MADE, THE DEPOSIT SHOULD BE TRACED EASTWARD. IF IT RISES ON THE SLOPE OF THE ANTICLINE (WALLULA GATEWAY FOLD) IT IS SATSOP. IF IT ABUTS AGAINST THE BASALT, AS IT APPEARS TO DO AT THE C-S DAM, IT IS PD.

THIS IS THE DEPOSIT WHICH YIELDED THE ELEPHAS COLUMBI TOOTH, REPORTED BY WHISTLER TO HAY, AND PROBABLY THE CAMEL VERTEBRA AS WELL. WHISTLER SAYS THE CAMEL VERTEBRA WAS FOUND ON BEDROCK AT LEAST 100 FT BELOW THE HIGHEST BASALT HERE. THIS CAN ONLY MEAN THAT THE GRAVEL LIES AGAINST A SLOPING SURFACE OF THE BASALT, AS ABOVE SUGGESTED.

HERMISTON AND UMATILLA BUTTES RISE 120 AND 175 FT RESPECTIVELY ABOVE THE RIVER FLOOD PLAIN. THEY ARE IRREGULAR KNOBS OF BASALT, LEFT BY THE EROSION OF THE COLUMBIA ACROSS THIS LOWLAND TRACT. THEY ARE IDENTICAL WITH ROCKY ISLANDS NOW IN THE COLUMBIA CHANNEL IN PLACES. THE COLUMBIA SWUNG ACROSS HERE, REMOVED FROM 100 TO 175 FT OF ROCK IN PLACES, THEN FILLED THE WHOLE WITH GRAVEL, AND LATER ASSISTED THE UMATILLA IN THE PARTIAL REMOVAL WHICH HAS OCCURRED SUBSEQUENTLY. ((INSERT SOME TIME LATER—— NO! THESE BUTTES ARE LOCAL UPWARPS))) FOUR MILE GAP IS AN OLD

CHANNEL OF THE COLUMBIA, SIMILAR TO THOSE SOUTH OF ARLINGTON. BUT NO DELTA HERE AS IN ALKALI CANYON.

SOMETHING IS WRONG IN THESE COMPARISONS !! THE GRAVEL DEPOSIT WITH CHANNELS OF THE COLUMBIA ACROSS IT AND A DELTA AT THEIR MOUTHS AT ARLINGTON IS A SATSOP DEPOSIT, AND THE CHANNELS AND DELTA ARE PD. SO SHOULD THE HERMISTON GRAVEL PLAIN WITH ITS CHANNELS BE SATSOP AND PD. BUT THE PRECEDING ARGUMENT IS THAT THE PLAIN IS PD AND THE CHANNELS STILL YOUNGER. YET THE PD AT PORTLAND HAS CHANNELS ACROSS IT !!

ANOTHER PUZZLE IS TO EXPLAIN THE DISCONTINUANCE OF THE PD TERRACES, 600 AT MARYHILL, 700 AT ARLINGTON, 750 AT STANFIELD (FOSTER) AND THE LOW TERRACES ABOVE THE WALLULA GATEWAY.

THE BROAD PLAIN WEST OF UMATILLA RIVER ON THE UMATILLA QUAD. IS DOUBTLESS THE SAME GRAVEL PLAIN. FROM THE LOOKS OF THE BLALOCK ISLAND MAP, THIS PLAIN IS CONTINUED WESTWARD TO THE ARLINGTON DEPOSIT. THEN ETTHER THE ARLINGTON-SATSOP AND THE HERMISTON-SUPPOSED-PD ARE THE SAME, OR TWO FORMATIONS UNDERLIE THE SAME PLAIN.