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The University of Chicago

Department of Geology

Err.
DRIFTED ERRATICS IN COEUR D'ALENE LAKE VALLEY JULY 22 1925

TRAVERSE MADE FROM ROCKFORD TO HUNTER'S LANDING. LOESSIAL SOIL ALL THE WAY ACROSS TO THE BRINK OF THE VALLEY. BASALT BEneath. ALTITUDES ABOUT 2750. APPARENTLY THE BASALT FLOWS ENTERED CDA'LENE VALLEY MORE EXTENSIVELY BY THIS ROUTE THAN BY WAY OF SPOKANE RIVER VALLEY. MATURE TOPOGRAPHY ON THE DIVIDES IS NOT DEEPLY INCISED AND HILLS ARE FLATTISH ON TOP. NO TRACE OF ANY GLACIAL SPILL ACROSS. POSSIBLE THAT A ROUTE FARTHER EAST, EAST OF THE BIG, PRE-BASALT HILLS EXISTS. IT WOULD HAVE TO LEAD OUT OF THE ST. JOE RIVER VALLEYS AND WOULD HAVE TO KEEP EAST OF MOSCOW FOR THERE IS NO TRACE OF SUCH A SPILL BETWEEN MOSCOW AND SPOKANE.

DESCENT TO CDALENE LAKE IS ALMOST PRECIPITOUS. ONLY STEEP RAVINES LEAD DOWN. IN THE ONE FOLLOWED BY THE ROAD, NO ERRATIC MATERIAL ABOVE 2700. BUT BELOW THAT ALTITUDE, AT ABOUT 2550. WERE FOUND QTZITE, VEIN QTZ, VARIOUS GRANITOIDS AND COARSE GRAINED BASIC ROCK FRAGMENTS, MOST OF THEM AS WORN PEBBLES. THIS RECORDS THE SAME PONDED WATER THAT FILLED SPOKANE VALLEY EAST OF THE CITY OF SPOKANE.

ALTITUDE AT CLARKIA, ON MILWAUKEE BRANCH LINE, SOUTHEAST OF CDALENE LAKE, IS 2828 FT. A.T. AND THIS IS NEARLY TEN MILES NORTH OF THE BIVIDE BETWEEN THE ST. JOE AND THE DRAINAGE TO THE SNAKE,
and hence considerably lower. THIS IS THE ONLY POSSIBLE ROUTE OUT OF CDALENE VALLEY TO THE SOUTH AND OBVIOUSLY IS TOO HIGH.

THE SCABLAND FLOOD NEVER USED CDALENE LAKE AS A ROUTE.

See note on Lower Clearwater, July 6 1926

GRAND COULEE JULY 24 1925

THE WHITE SILTS OF UPPER GRAND COULEE NOWHERE CARRY GOOD TERRACE TOPS. THE DEPOSIT ALONG THE ALMIRA ROAD AT THE ANGLE BETWEEN THE COULEE AND THE COLUMBIA IS A TERRACE, LIKE THOSE SEEN IN THE DISTANCE DOWN THE COLUMBIA BUT ELSEWHERE IN THE COULEE ALL REMNANTS ARE CONSIDERABLY ERODED. PLENTY OF RAVINES AND VALLEYS IN THEM AND THE MAIN COULEE CHANNEL THRU THEM SO THAT THEY ARE BUT LATERAL OR MARGINAL REMNANTS OF WHAT MUST HAVE BEEN A CONTINUOUS FILL AT ONE TIME.

THE MAJOR PART OF THE DEPOSIT HAS BEEN TAKEN OUT BY A RIVER THRU GRAND COULEE. BOTH SIDES OF STEAMBOAT ROCK WERE CLEARED AND A LONG MEDIAN RIDGE OF THE MATERIAL HAS BEEN LEFT BELOW THE ROCK WHERE IT WAS PROTECTED FROM THE CURRENT FROM THE NORTH.

WHEN WAS THIS SILT DEPOSITED AND WHEN WAS IT ERODED? ITS EXISTENCE NORTH OF STEAMBOAT ROCK AND THE GRANITE KNOBS AND RIDGES SHOWS THAT IT IS POST- THE GLACIAL ICE WHICH OVERRODE ALL OF THEM (EXCEPT ON EXTREME EAST SIDE OF THE ~~VALLEYCOULEE~~). IF THE GLACIATION OF THESE KNOBS AND OF STEAMBOAT ROCK IS WISCONSIN, THEN THE FINAL CURRENT THRU THE COULEE MUST HAVE FOLLOWED A SLACK-WATER STAGE, ITSELF POST-WISCONSIN GLACIATION. AND THE FRESHNESS AND STRENGTH OF DEVELOPMENT OF THE MORAINE ON STEAMBOAT ROCK SEEKS TO ADMIT OF ONLY ONE INTERPRETATION AS TO AGE— THAT IT IS WISCONSIN.

A SPLENDID BAR, APPARENTLY WISCONSIN IN AGE, LIES IN AN ALCOVE IN THE COULEE'S EAST WALL, JUST SOUTH OF THE FAIRLY CONTINUOUS GRANITE RIDGE NEAR OSCAR OSBORNE'S RANCH. THIS IS THE NORTHERN OF THE TWO RIDGES WHICH TRANSECT THE UPPER COULEE. IT IS ABOUT 150 FEET ABOVE THE COULEE FLOOR

HERE AND PERHAPS 50 FEET ABOVE THE ABOVE FLOOR BACK OF THE BAR. ITS SHAPE IS VERY GOOD, THOUGH DRAINAGE FROM THE ALCOVE BASIN HAS CUT AWAY ONE SIDE SOMEWHAT. IT CANNOT BE ANYTHING BUT A BAR. IT IS COMPOSED OF OPEN GRAVEL. ON ITS SURFACE ARE NUMEROUS GRANITIC FRAGMENTS, LARGE AND ANGULAR, DERIVED FROM THE RIDGE ON WHICH IT RESTS IN PART.

FINE GRAVEL BARS WERE BUILT ON THE COULEE FLOOR JUST NORTH OF THIS RIDGE. THEY TERMINATE A FEW HUNDRED FEET FROM THE RIDGE AND LEAVE A FOSSE BETWEEN THEM AND THE HIGHER GRANITE. THO THE RIDGE IS DEEPLY CUT BY SEVERAL NARROW NOTCHES (THE EASTERNMOST BEING ESPECIALLY NARROW) THE WISCONSIN WATERS MUST HAVE OVERRUN THE VERY TOP IN LARGE PART AND THESE BARS THEREFORE RECORD IMPINGEMENT OF THE CURRENT AGAINST THE SUB-FLUVIAL BARRIER, AND THE PRODUCTION OF AN EDDY AT THE BASE.

A GLIMPSE ONLY WAS POSSIBLE FROM THE DRIVER'S SEAT OF THE CAR, BUT IT SEEMED THAT THERE WERE HILLS OF THE SILT DEPOSIT LYING BETWEEN THE GRANITE RIDGE AND THE GRAVEL BAR. IF THIS BE SO, IT HAS CONSIDERABLE SIGNIFICANCE IN DATING THE SILTY SILT.

THE UNDERCUT ~~END~~ SIDES OF A POTHOLE 40 FEET ACROSS AND PERHAPS 10 FEET IN MAX. PRESENT DEPTH - LOCATED RIGHT ON THE BRINK OF CASTLE LAKE FALLS, IS SMOOTH AND WORN. THE ONLY KNOWN EXAMPLE OF THESE POTHOLES WHICH STILL CARRIES A PART OF ITS ORIGINAL WORN SURFACE.

MOSES COULEE JULY 26 1925

THE COULEE WAS CROSSED ON THE SUNSET HIGHWAY. ON THE WEST SIDE, THIS HIWAY CLIMBS ON THE GREAT WASTE DEPOSIT WHICH PUZZLED ME IN 1922. NO ERRATIC~~S~~ MATERIAL WAS FOUND IN IT THEN (NOR THIS TIME) ONE-HALF TALUS STANDS ON THE CLIFF BACK OF IT. IT IS SOMETHING LIKE 200 FT. ABOVE THE VALLEY FLOOR. ITS FORM, AS THEN SEEN, RESEMBLED A BAR BUT IT WAS POSSIBLE THEN TO CONSIDER IT AN ALLUVIAL FAN FROM THE BIG GULLY TO THE WEST.

THIS YEAR'S TRAVERSE SHOW THAT THE ~~MOUTH~~ MOUTH OF THE BIG GULLY TO THE WEST IS COMPLETELY BLOCKED BY IT, DAMMED BY IT, A LARGE UNDRAINED BASIN 40 FEET OR MORE IN DEPTH EXISTING BETWEEN IT AND THE GULLY WALLS. THE BACK SLOPE FROM THE DEPOSIT TOWARD THE BASIN IS ROUNDED IN PROFILE EXACTLY AS ARE THE SCABLAND BARS.

THE DEPOSIT IS UNDOUBTEDLY A BAR. IT HEIGHT AND LENGTH INDICATE IT TO BE A SPOKANE BAR FOR IT IS HIGH ABOVE THE WISC. VALLEY TRAIN. IF NO ERROR HAS BEEN MADE IN THE INTERPRETATION WHICH CALLS FOR LARGE EVAPORATION AND LITTLE MELTING OF THE WISC. OKANOGAN LOBE, THEN THE BAR MUST BE SPOKANE.

BUT IF SPOKANE, THE TALUS CRITERION FALLS DOWN FOR THERE ARE NO REASONS WHY THIS BLUFF OF HORIZONTAL FLOWS SHOULD NOT DEVELOP A 3/4 TALUS. THE ADJUSTMENT OF FEATURES AT THIS LOCALITY MUST WAIT MORE DETAILED AND MORE CAREFUL STUDY. IT IS A CHALLENGE THAT MUST BE ANSWERED!

WENATCHEE TO CHELAN JULY 26 LIGHT-COLORED SILT WITH VARVES, INTERBEDDED WITH DARKER SAND, AND CONTAINING BLDRS AND COBBLES AND PEBBLES, OCCUR AT SEVERAL PLACES ALONG THE HIWAY BETWEEN THESE TWO POINTS. ESPECIALLY WELL SHOWN NORTH OF KNAPP COULEE. THEY HAVE BEEN DEFORMED CONSIDERABLY BY SLIDING ON THE STEEP ROCK SLOPES OF CHELAN VALLEY. TERRACES IN MOUTH OF KNAPP COULEE AT SAME LEVEL AS THE BIG TERRACE ACROSS THE RIVER HERE; APPROXIMATELY 1000 FT. A.T. LATER DATE — ARE NOT THE STRIKING TERRACES ON THE E. SIDE OF LAKE CHELAN NEAR THE LOWER END OF THE SAME CHARACTER AS THOSE IN OKANOGAN VALLEY AND THE VALLEYS AS FAR EAST AS CLARK'S FORK?

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OKANOGAN TO CONCONULLY TO LOOMIS TO TONASKET TO OMAK

TOPOGRAPHY ON OKANOGAN, CHOPAKA AND OSOYOOS SHEETS. TWO PROMINENT N-S VALLEYS HERE, THE TOATS COULEE AND PALMER LAKE VALLEY, AND THE OKANOGAN VALLEY. THE FORMER IS THE DEEPER AND NARROWER THO IT CARRIES ONLY AN INCONSIDERABLE STREAM (SINLAHEKIN CREEK). THIS STREAM FLOWS N. TO JOIN THE SIMILKAMEEN WHICH HAS A VERY GORGE-LIKE VALLEY ACROSS FROM THE WESTERN TO THE EASTERN VALLEY. AT THE SOUTH END OF TOATS COULEE IS CONCONULLY LAKE VALLEY, VERY NARROW, VERY STEEP-SIDED, VERY DEEP. ITS FLOOR IS ABOUT 500 FEET ABOVE FISH LAKE AT THE HEAD OF TOATS COULEE. RISH LAKE ITSELF DRAINS TO ~~SALMON~~^{JOHNSON} CREEK, AND NOT TO TOATS COULEE, THO THE COULEE TO THE NORTH IS BROADLY OPEN EXCEPT FOR MORAINIC MATERIAL ON THE BOTTOM. NOR DOES CONCONULLY DRAIN NORTHWARD. ITS DISCHARGE IS SOUTHWARD INTO SALMON CREEK.

THE DISCHARGE OF CONCONULLY LAKE PASSES A BROAD, SOUTHEASTWARD-TRENDING VALLEY ON ITS LEFT — GRAVEYARD FLAT — A GRAVEL FILL, WHOSE ALTITUDE IS 2300, TO ENTER A NARROW GORGE CUT ACROSS AN EASTERN SPUR OF PEACOCK MTN. THE ORIGINAL ALT. ACROSS THIS SPUR COULD HARDLY HAVE BEEN LESS THAN 3100 (ORIGINAL=BEFORE THE NARROW NOTCH WAS CUT). JUST EAST OF THIS GORGE OF SALMON CREEK IN THE SPUR IS A DEFINITE NORTH-SOUTH NOTCH CONTAINING AN ELONGATED LAKE BASIN AT 2400. IT LEADS OUT OF GRAVEYARD FLAT THO^s THE DRAINAGE OF THE FLAT ^{does not use it but} DISCHARGES TO THE WIDE OPEN SCOTCH CREEK VALLEY TO THE SOUTHEAST.

THESE PECULIAR RELATIONS ARE CHARACTERISTIC OF MOST OF THE DRAINAGE WAYS AND VALLEYS OF THE EASTERN HALF OF THE CHOPAKA QUAD. AN EXAMINATION OF THE MAP SHOWS THE FEATURES BETTER THAN A WRITTEN DESCRIPTION. THAT THEY ARE NOT DUE TO NORMAL STREAM EROSION IS PERFECTLY CLEAR. THAT THEY ARE GLACIAL DERANGEMENTS IS OBVIOUS WHEN THE EXTENSIVE IRREGULAR TILL DEPOSITS OF THE VALLEYS AND HILLSIDES AND EVEN MOUNTAIN SLOPES ARE CONSIDERED. BUT THEY ARE NOT DUE TO BLOCKING OF THE OLD VALLEYS BY DRIFT FOR THE DRIFT FILLINGS IN MANY CASES ARE MUCH LOWER THAN THE ROCK HILLS AND SPURS WHICH HAVE BEEN SO SHARPLY TRENCHED. TO CAUSE THE DIVERSIONS REQUIRES THE PRESENCE OF GLACIAL ICE. AND GLACIAL ICE OF GREATER EXTENT AND OF GREATER DURABILITY THAN REMNANTS OF A WASTING GLACIER OR ICE SHEET WOULD PROVIDE. IT SEEMS THAT STREAMS FLOWING FROM THE EDGE OF THE ICE WOULD BE UTTERLY UNABLE TO CAUSE THE DIVERSIONS AND THAT THE DRAINAGE MUST HAVE BEEN SUBGLACIAL.

AND OF GREAT VOLUME AND IMMENSE EROSIVE ABILITY. IT SEEMS THAT IT MUST HAVE BEEN UNDER ENORMOUS HYDROSTATIC PRESSURE AND THAT IT MUST HAVE COME FROM SUBGLACIAL MELTING. THIS IDEA, OF COURSE, SPRINGS FROM THE FAVORED HYPOTHESIS OF SUBGLACIAL VULCANISM TO ACCOUNT FOR THE SCABLAND FLOOD AND WOULD REQUIRE THAT THESE GREAT NARROW VALLEYS WHICH CUT ACROSS ~~NARROW~~^{PREGLACIAL} DIVIDES AND HILLS BE OF SPOKANE ORIGIN, NOT WISCONSIN. WISCONSIN MELTING, BY THIS EXPLANATION, SIMPLY CLEANED THEM OR KEPT THEM CLEAN FROM WISCONSIN DRIFT, THE ONLY DRIFT RECOGNIZED IN THE REGION.

THE GREAT TERRACE DEPOSITS OF THE OKANOGAN VALLEY AND ITS RIBUTARIES, AT LEAST FROM THE TOWN OF OKANOGAN NORTH, DO NOT SEEM TO BE REMNANTS OF COMPLETE VALLEY FILLS. NEGATIVE AND POSITIVE EVIDENCE EXISTS THAT THEY WERE BUILT ALONG THE EDGES OF WANING TONGUES OF ICE LEFT AS THE WISC. ICESHEET WASTED OFF THE HIGHER LANDS. NEGATIVE EVIDENCE EXISTS IN THE FACT THAT THE TERRACES ARE NOT CONSISTENT WITH EACH OTHER IN ALTITUDE ON OPPOSITE SIDES OF THE SAME VALLEY. THERE ARE

→ → → SOME NOTEWORTHY CASES WHERE ONE VALLEY WALL HAS A SET CONSIDERABLY LOWER THAN THE SET ON THE OPPOSITE SIDE. ALSO IN THE FACT THAT MANY TERRACES MARGIN CLOSED DEPRESSION VALLEYS, IN WHICH THERE HAS BEEN NO EROSION, BUT RATHER DEPOSITION, SINCE THE ICE MELTED AWAY. IT IS NOT THAT KETTLE HOLES EXIST IN THE TERRACES BUT THAT MOST OF A VALLEY, LIKE WAGONROAD COULEE, AND BIG GOOSE LAKE, IS A DEPRESSION AND THE TERRACES OCCUR BUT A SMALL PART OF THE WHOLE ROCK VALLEY.

POSITIVE EVIDENCE IS SEEN IN THE AMOUNT OF TILL IN THESE TERRACES. E. OF OKANOGAN TOWN ALL BUT THE LOWEST ARE OF TILL. ALSO IN THE IRREGULAR SCARPS OF SOME WHICH ARE TAKEN TO BE ICE-CONTACT SLOPES. ALSO THE KETTLES AND KNOBS AND GENERAL MORAINIC ASPECT OF MANY. ALSO IN THE FACT THAT TYPICAL KNOB-AND-KETTLE TOPOGRAPHY EXISTS IN THE VALLEYS BELOW THE LEVEL OF IMMEDIATELY ADJACENT TERRACES. THIS REQUIRES THE PRESENCE OF ICE OVER THE K-AND-K WHEN THE FLAT-TOPT TERRACE WAS BUILT. THEY ARE CONTEMPORANEUS, AND THE TERRACES ARE REALLY REMARKABLY SMOOTH KAME TERRACES.

WAGONROAD COULEE IS THE PREGLACIAL COURSE OF OKANOGAN RIVER. THE POST-GLACIAL COURSE LIES EAST OF WR COULEE. SINCE WR COULEE FLOOR, AS AGGRADED AT PRESENT, IS ABOUT 1000 FT AND THE HILL TOP BETWEEN IT AND THE PRESENT COURSE IS 500 TO ~~1000~~ FEET HIGHER, IT SEEMS THAT THIS DIVERSION, LIKE CONCONULLY LAKE, HESS LAKE VALLEY, BROWN AND GREEN LAKES VALLEY, ETC., MUST HAVE BEEN MADE UNDER THE ICE.

Omak Lake and Goose Lake and Nespelem JULY 29 1925

BOOT MTN. STANDS IN THE MIDDLE OF THE GREAT VALLEY IN WHICH THESE TWO LAKES LIE. NOWHERE WERE PRECIPITOUS SLOPES, LIKE THOSE OF CONCONULLY AND ITS CLASS. THE VALLEY APPARENTLY IS NOT OF THE SAME GENUS, BUT ^{ITS} CAUSE IS DIFFICULT TO CONCIEVE OF.

THERE IS BUT ONE STEEP-WALLED VALLEY OF THE CONCONULLY GENUS ALONG THE OKANOGAN-NESPELEM-GOOSE LAKE ROAD. THAT IS NEAR THE HEAD OF THE DESCENT ~~TO~~ NESPELEM. THE ABSENCE OF A TOPOGR. MAP AND LACK OF ADEQUATE FIELD EXAMINATION LEAVES THE MATTER IN DOUBT BUT THE VALLEY WAS CERTAINLY FORMED UNDER GLACIAL DRAINAGE CONDITIONS.

NESPELEM FLAT ^{IS} HELD UP TO ITS ALTITUDE OF 800 OR 850 ABOVE THE COLUMBIA BECAUSE THE NESPELEM RIVER HAS ENCOUNTERED A SHOULDER OF A PREGLACIAL GRANITE HILL AT ITS MOUTH. SECTION ALONG ROAD PARALLELING RIVER IS POOR BUT ONLY SAND AND GRAVEL WERE APPARENT ANYWHERE. ACROSS THE COLUMBIA HOWEVER, ARE SOME FRESHLY CUT SCARPS WHICH SHOW PALE SILTS WHICH RESEMBLE THE WENATCHE, CHELAN AND GRAND COULEE VARVE CLAYS.

IT IS CERTAINLY CURIOUS THAT THIS WIDE TRACT BETWEEN OKANOGAN AND NESPELEM RIVERS CARRIES NO SUCH DRAINAGE MODIFICATIONS AS THOSE BETWEEN OKANOGAN AND TOATS VALLEYS. IT MAY BE DUE TO THE PREGLACIAL VALLEYS OF OKANOGAN AND TOATS INVITING THE SUPPOSED SUBGLACIAL DRAINAGE AND THE HIGH MTS. NORTH OF THIS TRAVERSE OF TODAY PREVENTING SUCH DRAINAGE ACROSS THEM, EVEN THOUGH THEY WERE BURIED IN THE ICE.

NESPELEM VALLEY JUST NORTH OF THE TOWN CONTAINS A FRONTAL MORaine OF THE TONGUE WHICH OCCUPIED IT DURING THE LATEST STAGES OF THE WISCONSIN GLACIATION. IT IS NOT STRIKINGLY HUMMOCKY BUT IT CONSTITUTES A BELT OF DRIFT 50 FEET OR MORE THICK, ACROSS WHICH THE STREAM HAS CUT A NARROW VALLEY.

~~IT~~ IS THE NESPELEM FLAT AND ABOVE ~~WHICH~~ IS AN EXTENSIVE FLAT, EITHER OF LAKE OR OF RIVER AGGRADATION. WISCONSIN DRIFT MANTLES THE LOWER AND MIDDLE SLOPES OF THE ROCK HILLS WHICH ENCLOSE THE MOUTH OF THE VALLEY SOUTH OF AND MUCH ABOVE THIS MORAINE. THE TOPOGRAPHY IS SUGGESTIVE OF TERRACES BUT IS ALSO MORAINIC.

NESPELEM TO DISAULEL TO OKANOGAN JULY 30 1925

A VERY DEEP AND VERY NARROW AND VERY STEEP-SIDED CANYON, ORIENTED ~~NE~~, CROSSSES THE DIVIDE BETWEEN THE HEAD OF OMAK CREEK AND COYOTE CREEK. IT IS CUT IN GRANITE AND IS VERY SPECTACULAR AS SEEN FROM ABOVE. THE ROAD SKIRTS ALONG THE BRINK OF A PART OF THE EAST WALL. ITS DEPTH MUST BE 300 OR 400 OR POSSIBLY 500 FEET. ALL LOGIC CALLS FOR THE PLACING OF THE ROAD ACROSS THE DIVIDE THRU IT AND THE ONLY REASON THIS WAS NOT DONE MUST BE THAT THE EXTREME NARROWNESS CAUSES TALUS TO COVER THE FLOOR. THE TALUS MATERIAL IS LARGE AND ANGULAR. THIS NOTCH IS WHOLLY OUT OF HARMONY WITH THE REST OF THE TOPOGRAPHY AND DEMANDS SPECIAL CONDITIONS. THE STEEP UNGLACIATED WALLS INDICATE THAT THE LAST STREAM THRU IT (FOR IT MUST BE STREAM-CUT) WAS DURING WISCONSIN RETREAT. BUT IT SEEMS VERY UNLIKELY THAT WISCONSIN WATERS EVER FORMED IT. SUBGLACIAL DRAINAGE OF LARGE VOLUME WILL EXPLAIN IT. AND THIS IS A SPOKANE FEATURE, IF HYPOTHESIS BE ON THE RIGHT TRACK.

OMAK LAKE WAS SEEN AT THE NORTH END ONLY. WALLED IN BY VERY HIGH, PRECIPITOUS AND HEAVILY GLACIATED GRANITE HILL SLOPES. THE BASIN APPARENTLY IN ROCK. A LARGE SPUR OF HIGH GRANITE HILLS CONSTITUTES THE PENINSULA AT THE NORTH END OF THE LAKE. PERHAPS WISCONSIN ICE DEEPENED THIS, PERHAPS IT MADE IT ENTOTED. BUT IT IS QUITE UNLIKE OTHER TOPOGRAPHIC FEATURES PRODUCED BY A CONTINENTAL ICESHEET OVER SUBDUED MOUNTAINOUS TOPOGRAPHY, SO FAR AS I AM AWARE. A PROFITABLE STUDY WOULD BE THE EXAMINATION OF ALL TOPOGRAPHIC MAPS OF SIMILAR AREAS SIMILARLY Affected, FOR SIMILAR FEATURES. NE YORK, NEW ENGLAND, MARITIME CANADA, BRITISH COLUMBIA, NORWAY, SWEDEN, ETC.

VICINITY OF WANNACUT LAKE, CHOPAKA QUAD. JULY 31 1925

PRECIPITOUSLY-WALLED NARROW NOTCHES OR GORGES CUT ACROSS DIVIDES AND EVEN ISOLATED ROCK HILLS ARE CONSPICUOUS HERE. TWO AT SOUTH END OF THE LAKE BASIN, ELLEMahan DRAW, AND AN UNNAMED FEATURE OF SIMILAR CHARACTER IN ALIGNMENT WITH IT AT THE NORTH OF THE LAKE. THE UNNAMED FEATURE APPARENTLY INEXPLICABLE EXCEPT BY SUBGLACIAL DRAINAGE OF LARGE VOLUME AND VELOCITY. AND NORTH OF ELLEMahan DRAW ABOUT TWO MILES IS ANOTHER NOTCH, NOT SO STRIKINGLY DEVELOPED, LEADING SOUTHWARD OUT OF THE SIMILKAMEEN GORGE. ELLEMahan ITSELF IS CUT ACROSS THE SPUR OF A PREGlACIAL HILL WITH WHAT IS APPARENTLY A PREGlACIAL VALLEY NOT HALF A MILE DISTANT AND ORIENTED THE SAME WAY.

OROVILLE WASH TO ARMSTRONG, B.C. AND RETURN AUG. 1 AND 2 1925

THAT THE PREGlACIAL OKANOGAN LAKE RIVER FLOWED NORTHWARD TO THE THOMPSON SEEMS PERFECTLY CLEAR, FROM THE REGION A FEW MILES NORTH OF TONASKET, WHERE THE VALLEY IS UNUSUALLY NARROW, TO ARMSTRONG, WHERE THE PRESENT DIVIDE IS LOCATED, THE VALLEY BECOMES WIDER AND MORE CAPACIOUS ALL THE WAY. PART OF THIS IS SHOWN ON THE CHOPAKA SHEET BUT MOST OF IT IS IN UNMAPPED CANADIAN TERRITORY. THE LAKE ITSELF MUST BE ABOUT 100 MI LONG (?) ITS VALLEY BECOMES SO OPEN TO THE NORTH THAT ADJACENT VALLEYS ARE VIRTUALLY A PART OF IT, AND THE DIVIDES AMONG THEM ARE ISOLATED HILL GROUPS OR MTS. THE COUNTRY IS MOUNTAINOUS BACK ON EITHER SIDE BUT THE INTERVALLEY HILLS ARE SCARCELY MOUNTAINS FOR THIS REGION (SEE 1926 NOTES FOR A DIFFERENT IMPRESSION)

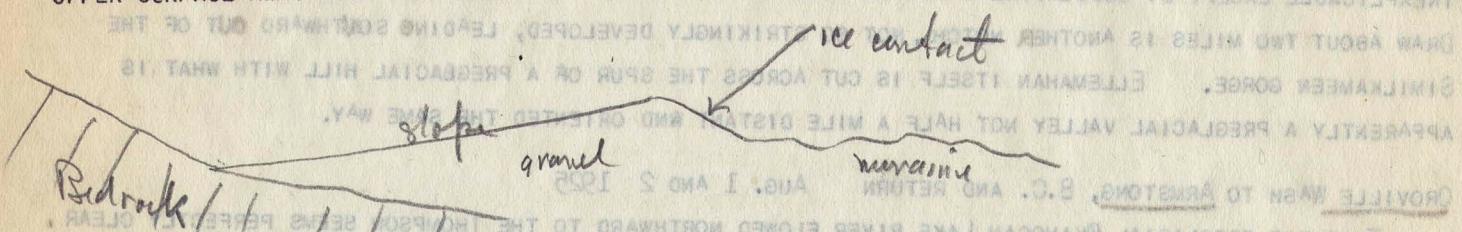
THE DIVIDE IS ABOUT A MILE NORTH OF ARMSTRONG. HERE DEEP CREEK ON THE WEST SIDE OF THE VALLEY FLOWS SOUTH AND ANOTHER CREEK ON THE EAST SIDE, FLOWS PARALLEL TO IT FOR A SHORT DISTANCE BUT IN THE OPPOSITE DIRECTION, NORTH, TO THE THOMPSON RIVER, INSTEAD OF TO OKANOGAN LAKE AND COLUMBIA RIVER. THE DIVIDE HERE IS ONLY A DRIFT FILL IN A VALLEY WHICH IS 2 OR 3 MILES WIDE AT THE BOTTOM. THE ALTITUDE OF ARMSTRONG MUST BE SECURED. IT IS HARDLY 200 FT ABOVE OKANOGAN LAKE, ITSELF REPORTED TO BE 1200 FT. A.T.

THE EVENTS WHICH PRODUCED THIS GREAT REVERSAL OF DRAINAGE MIGHT WELL HAVE BEEN DISTRIBUTED ALL THRU THE PLEISTOCENE GLACIATIONS. NO EVIDENCE SEEMS AVAILABLE TO PROVE THIS OR TO SHOW THAT IT WAS WHOLLY A WISCONSIN AFFAIR OR THAT IT ORIGINATED IN THE SPOKANE EPOCH. IT CAN HARDLY BE USED AS AN ARGUMENT FOR THE SPOKANE FLOOD THO IT MAY HAVE THEN BEEN FORMED. THE NARROW PLACE NORTH OF TONAWA IS NOT OF THE NOTCH-LIKE OR GASH-LIKE CHARACTER OF THE MANY SUCH THAT HAVE BEEN FOUND THIS SUMMER. BUT IT SHOULD NOT BE FOR IT CARRIED DRAINAGE FROM A LARGE AREA TO THE NORTH THEN (IF THE FLOOD OCCURRED HERE) AS WELL AS NOW. AND DURING ALL LATER TIME THAN THE FLOOD.

WHITE OR LIGHT-COLORED SILTS OCCUR IN LARGE TERRACES ALMOST ALL ALONG THE SHORES OF OKANOGAN LAKE AS FAR NORTH AS KELOWNA. HEIGHT OF CLIFFS FROM 100 TO 150 FEET. THE SILT RESTS ON TILL OR ON GLACIATED BEDROCK. THEY HAVE THE VARVE BEDDING. THEY ALSO HAVE GRAVEL LAYERS IN PLACES. THEY SEEM BEST EXPLAINED AS DEPOSITED IN WATERS PONDED ALONG THE EDGES OF A WANING TONGUE OF ICE IN THE OKANOGAN LAKE VALLEY. IF DEPOSITED IN A BODY OF WATER FILLING THE WHOLE VALLEY, THE REMOVAL OF MOST OF THE MATERIAL IS IMPOSSIBLE TO EXPLAIN. AND THE LAKE IS DEEP. NO DEFINITE FIGURES OBTAINED. WRITE TO THE CANADIAN SURVEY. MY PRESENT OPINION IS THAT THE NESPELEM FORMATION IN THE COLUMBIA VALLEY BEYOND THE WISCONSIN MORaine AND FOR SOME DISTANCE BACK OF IT IS A VALLEY TRAIN IN LARGE PART AND THAT THE NESPELEM AND DAWSON'S WHITE SILTS FARTHER NORTH IN THESE MT. VALLEYS IS A CONGREGATION OF LOCAL DEPOSITS MADE IN THE PRESENCE OF TONGUES OF ICE.

ANOTHER POINT OF IMPORTANCE IS THAT THE OKANOGAN VALLEY IN WASHINGTON CONTAINS BUT LITTLE OF THE WHITE SILTS. MOST OF IT IS GRAVEL. THIS IS BECAUSE THERE WAS A GRADIENT HERE WHILE ALONG THE LENGTH OF THE LAKE-FILLED VALLEY, THERE WAS LITTLE, IF ANY, GRADIENT, AND THE MARGINAL WATERS WERE LARGE PONDS, NOT STREAMS.

SEVERAL GOOD ICE-CONTACT SLOPES OF GRAVEL TERRACES IN OSOYOOS VALLEY. THE PROFILE INCLUDES MORAINIC KNOBS AND RIDGES, A STEEP BUT SOMEWHAT IRREGULAR SCARP AND A LONG, GENTLE GRADIENT OF THE UPPER SURFACE AWAY FROM THE SCARP AND TOWARD THE SIDE OF THE VALLEY.



ALL THIS WOULD BE PERFECTLY NORMAL IF ON A DRIFT PLAIN WITHOUT NEARBY ROCK WALLS. BUT IN A ROCK-BOUND VALLEY, ONE EXPECTS THE TERRACES TO BE REMNANTS LEFT BY EROSION OF A FORMER COMPLETE FILL. THESE ICE-CONTACT SLOPES AND MORAINE HILLS PROVE WITHOUT DOUBT THAT THEY ARE CONSTRUCTED FEATURES, AND NOT LEFT BY EROSION OF A FORMER COMPLETE FILL.

A BIG MORAINE OCCUPIES THE VALLEY BETWEEN VASEAUX LAKE AND SKAHA LAKE. IT MUST BE 300 FEET HIGH. HIWAY CLIMBS OVER IT, THE RIVER CUTS THRU IT.

~~SPRINGTIME LIKE SEASIDE TIDES TAKE PROPER LOCATION FOR THE PREGLACIAL DIVIDE. THE VALLEY IS~~

VASEAUX LAKE APPEARS TO BE THE LOGICAL PLACE FOR THE PREGLACIAL DIVIDE. THE VALLEY IS NARROWEST HERE AND THE SIDES ARE STEEPEST. GREAT VERTICAL WALLS RISE ON BOTH SIDES AND THERE SEEMS TO BE NO PLACE EITHER NORTH OR SOUTH FOR A DRIFT-FILLED PREGLACIAL ROUTE AROUND THIS PLACE. RE-EXAMINATION OF THE NARROW PLACE NORTH OF TONASKET SHOWS IT TO BE WIDER THAN THE VASEAUX NARROWS AND TO HAVE LOWER BOUNDING HILLS.

WHY SHOULD NOT THE VASEAUX LAKE CANYON WITH ITS STRIKING WALLS BE A SPOKANE SUBGLACIAL NOTCH?

TONASKET TO WAUCONDA AUG. 3 1925

BONAPARTE CREEK, WHICH ENTERS THE OKANOGAN NEAR TONASKET BY DESCENDING SEVERAL HUNDRED FEET OVER LEDGES OF GNEISS BURIED UNDER DRIFT TERRACES, SEEMS TO HAVE FORMERLY DISCHARGED FROM BONAPARTE MEADOWS, BINGHAM FLAT AND THE OTHER BROAD MATURE UPLAND VALLEYS OF ITS DRAINAGE BY WAY OF AENEAS VALLEY. THE OKANOGAN CANYONED VALLEY THEN COULD NOT HAVE BEEN AS DEEP AS NOW, BY FAR. THE DEEPENING OF OKANOGAN VALLEY SEEMS CLEARLY TO BE A PLEISTOCENE AFFAIR. HORSE SPRINGS COULEE IS ANOTHER UPLAND VALLEY OF THE PREGLACIAL DRAINAGE PATTERN.

DRIFT IN RUDE TERRACES OCCURS ALL THRU THESE UPPER REACHES OF BONAPARTE DRAINAGE. LOWER TERRACES ARE OF GRAVEL AND SILT AND ARE MORE NEARLY CONTINUOUS AND HAVE SMOOTHER SURFACES. SILT OF THE NESPELEM TYPE OCCURS UP TO 3300 IN THESE VALLEYS. IT CAN BE ONLY LOCALLY DEPOSITED MATERIAL, THO IT HAS THE SAME CHARACTERISTICS AS THE NESPELEM SILT IN THE OKANOGAN VALLEY.

REPUBLIC TO KELLER AUG. 3 AND 4 1925

VICINITY OF REPUBLIC HAS SOME REMARKABLE DRAINAGE FEATURES. THE MOST STRIKING IS THE GREAT PASS BY WAY OF CURLEW LAKE FROM KETTLE RIVER TO THE HEAD OF THE SAN POIL. SAN POIL LAKE LIES ON THE DIVIDE AND DISCHARGES BOTH WAYS. ANOTHER IS THE DEER CREEK-N. FORK GRANITE CREEK VALLEY PAST TOM THUMB MIN. ANOTHER IS BY WAY OF COPPER LAKES AND COPPER CREEK. THERE ARE A DOZEN OR SO SHORTER ONES, MOSTLY AT HIGHER ALTITUDES, ACROSS DIVIDES. SOME ARE MERELY NOTCHES, SOME ARE A MILE OR MORE IN LENGTH AND SEVERAL HUNDRED FEET DEEP. VIRTUALLY ALL ARE ORIENTED N-S. BEAVER CREEK AND BEAVER LAKE ARE EXCEPTIONAL IN THAT THEIR VALLEY BETWEEN TORODA CREEK AND MYERS CREEK IS AN E-W AFFAIR.

ARE THESE THINGS (SEE REPUBLIC SHEET FOR DETAILS) EXPLICABLE AS AFFAIRS OF NORMAL STREAM EROSION? DO THEY BELONG TO THE DRAINAGE PATTERN DEVELOPED IN PREGLACIAL TIME? THE ANSWER IS NO.

ARE THEY THE RESULT OF DIVERSION OF DRAINAGE FROM THE MELTING ICESHEET OR SHEETS? THE AMOUNT OF CUTTING IN THEM SEEMS ALMOST TOO MUCH TO ASK FOR. AENEAS VALLEY AND BONAPARTE MEADOWS VALLEY, BOTH OF WHICH ARE WIDE, PROBABLY ARE PREGLACIAL, BUT THE OTHERS FIND THEIR BEST EXPLANATION IN THE HYPOTHESIS OF SPOKANE SUBGLACIAL DRAINAGE, DUE TO EXCESSIVE RAPID MELTING FROM SUBGLACIAL VULCANISM. BUT THE SITE OF SUCH VULCANISM MUST BE PLACED FAR NORTH OF THE BOUNDARY.

PARDEE DESCRIBES A REVERSAL OF DRAINAGE IN THE HEADWATERS OF THE SAN POIL, THE FORMER DIVIDE EXISTING AT THE DEVILS ELBOW CLOSE TO THE SOUTHERN EDGE OF THE REPUBLIC SHEET. HERE THE VALLEY IS HALF A MILE WIDE AT THE TOP AND ABOUT 1000 FEET DEEP. ITS WALLS ARE GREAT PRECIPICES. NORTH OF IT FOR TEN MILES THE SAN POIL DESCENDS TOWARD IT ONLY 150 FEET. SOUTH OF IT THE STREAM DESCENDS 150 FEET IN ABOUT THREE MILES.

PARDEE'S ARGUMENT IS BASED ON THE ORIENTATION OF TRIBUTARIES. A STRONGER ARGUMENT CAN BE MADE FROM THE DATA ABOVE NOTED. PARDEE ADVANCES NO REASON FOR THE REVERSAL. IT DOES NOT SEEM PROBABLE THAT SHIFTING OF THE DIVIDE NORTHWARD BY HEADWARD EROSION OF THE SAN POIL CAN EXPLAIN

IT FOR THE FORMER DIVIDE AND ITS STEEP SOUTHWARD GRADIENT ~~THEN~~ WOULD LOSE THEIR CHARACTER. THE VERY BROAD CHARACTER OF THE VALLEY AT THE PRESENT DIVIDE AND THE FLAT BOTTOM WITH SAN POIL-CURLEW LAKES IS OPPOSED TO THIS EXPLANATION. FURTHERMORE, FROM THE DEVILS ELBOW NORTH TO REPUBLIC, THE VALLEY GRADUALLY BECOMES WIDER.

M THE ALTERNATIVE EXPLANATION IS THAT OF GLACIAL STREAM WORK, AND AGAIN ONLY GREAT SUBGLACIAL STREAM ACTION SEEMS ADEQUATE.

THE WISCONSIN T.M. LIES IN THE SAN POIL VALLEY ABOUT ~~HALF~~ WAY BETWEEN REPUBLIC AND KELLER. SOUTH OF IT ARE REMNANTS OF GRAVEL TERRACES ALL THE WAY TO THE COLUMBIA, APPARENTLY THE RELICS OF A V.T. WHOSE LOWER PORTION MERGED WITH THE BIG TERRACES OF THE COLUMBIA, CALLED THE NESPELEM FORMATION BY PARDEE.

THE NESPELEM FORMATION AT THE MOUTH OF THE SAN POIL IS COMPOSED OF SAND, GRAVEL AND COBBLES, NO SILT SEEN IN ANY OF THE SECTIONS. ITS UPPER LIMIT HERE IS ABOUT 1650 AND THE RIVER IS ABOUT 1033, ASSUMED AS HIGH WATER LEVEL. THE TERRACES ARE CLEARLY REMNANTS OF A FORMER COMPLETE VALLEY FILL, BOTH IN THE SAN POIL AND THE COLUMBIA.

NO SPOKANE DRIFT FOUND ON EITHER SIDE OF THE MOUTH OF THE RIVER. TRAVERSE MADE TO THE SUMMIT ON THE EAST, ON THE GEROME ROAD, ALTITUDE 3125. IS IT POSSIBLE THAT THE SPOKANE ICE DID NOT CROSS THE RIVER HERE? THAT A RE-ENTRANT OF UNGLACIATED COUNTRY EXISTS BETWEEN THE DOUGLAS CO. LOBE OF SPOKANE ICE, AND THE LOBE WHICH CROSSED FARTHER EAST? IT SEEMS THAT EVEN IF SO, THERE MUST HAVE BEEN PONDED WATER HERE UP TO 2300 OR SO AND DRIFTED ERRATICS SHOULD EXIST.

SAN POIL VALLEY SEEMS TO BE ENTIRELY CANYONED. IT AND THE OKANOGAN AND OTHER DRAINAGE LINES INCLUDING THE COLUMBIA, APPEAR TO DATE FROM THE PLATEAU-MAKING WHILE AENEAS VALLEY, BONAPARTE MEADOWS, BINGHAM FLAT, HORSE SPRINGS COULEE FLAT, ETC., APPEAR TO BE THE OLD LANDS OF A FORMER LOW-LAND CYCLE.

VICINITY OF CURLEW LAKE AUGUST 5 1925

CUREW LAKE AND SAN POIL LAKE LIE IN A DEPRESSION IN EXCEPTIONALLY WELL-EXPRESSED MORAINIC TOPOGRAPHY. THE MORaine TOPOG. IS CLOSE TO THE LAKES IN GENERAL; AND BACK OF IT, HIGHER AND CLOSER TO THE HIGH ROCKY WALLS OF THE VALLEY, ARE FINE GRAVEL TERRACES. THERE ARE RECOGNIZABLE THREE TERRACE LEVELS, EACH OF WHICH HAS VALLEYWARD ICE CONTACT SLOPES. THE EVIDENCE HERE IS PERFECTLY CLEAR THAT THE TERRACES WERE AGGRADED ALONG BOTH SIDE OF AN ICE TONGUE WHICH OCCUPIED THE MEDIAL DEPRESSION WHERE THE LAKES NOW LIE.

THIS IS ALL AT THE DIVIDE IN THE VALLEY, THO NO DIVIDE IS RECOGNIZABLE UNTIL THE STREAM COURSES ARE EXAMINED. IT PROVES THAT THE VALLEY AS SUCH WAS HERE WHEN THE WISCONSIN ICE WAS RETREATING AND THAT ~~THE~~ ONLY AGGRADED WAS DONE BY THE ICE AND THE WATER THEN. NO GREAT VOLUME OF WATER ESCAPED SOUTHWARD, NO GREAT STREAM EROSION WAS PERFORMED BY THESE WATERS. THE REVERSAL OF DRAINAGE AND THE CUTTING OF THE THRU VALLEY IS PRE-WISCONSIN. THERE CAN BE NO QUESTION OF THIS.

REPUBLIC TO AENEAS VALLEY TO TORODA TO CURLEW AUG. 7

THE PREGLACIAL DRAINAGE OF AENEAS VALLEY APPEARS TO HAVE BEEN NORTHWESTWARD TO BONAPARTE CR. THIS IS A REVISION OF A FORMER OPINION. BUT WHERE BONAPARTE CREEK ENTERED THE OKANOGAN, UNLESS BY A HANGING VALLEY, IS A PUZZLE. IT LOOKS AS THO THE CANYONING WAS SO LATE THAT BONAPARTE DRAINAGE WAS SENSIBLY LEFT HANGING.

THE SOUTHEAST END OF AENEAS VALLEY, (OR THE HEAD WATERS OF THE WEST FORK OF SAN POIL RIVER,) HAS BEEN GREATLY ERODED BY GLACIAL ICE. DEEPENING HAS BEEN CONSIDERABLE, PERHAPS SEVERAL 100 FEET. SEVERELY ERODED LEDGES, ROUNDED TOPS AND SLOPES, SHOW EVERYWHERE. THE BREAKING DOWN OF THE DIVIDE AT THE SOUTHEAST END OF AENEAS VALLEY, BETWEEN IT AND THE SAN POIL, MAY HAVE BEEN A LITTLE WISCONSIN EVENT, BUT IT MORE PROBABLY IS A SPOKANE AFFAIR, IF NOT STILL OLDER. THAT AENEAS VALLEY CARRIED THE POSTULATED SPOKANE SUBGLACIAL DRAINAGE IS CLEAR FORM THE FACT THAT BONAPARTE LAKE VALLEY IS IN ONE OF THE GREAT LONG NOTCHES ACROSS A MAJOR DIVIDE AND THE WATERS ENTERING HERE WERE IN PART THROWN ACROSS THE NW FLANK OF MT. ANNIE. TWO SPLENDID GASHES CROSS THIS FLANK. THE THREE HILLS THUS ISOLATED CARRY THE LONG GENTLER SLOPE OF THE MOUNTAIN SPUR TO THE VALLEY BOTTOM, TO THE WEST. THE GASHES ARE WELL SHOWN ON THE TOPOGRAPHIC MAP. WISCONSIN DRIFT TERRACES PARTIALLY CLOSE THEM ON THE NORTH (NOT SO FOUND IN 1926).

ANOTHER SPOKANE SUBGLACIAL STREAM COURSE LIES IN THE EXTREME SE CORNER OF THE OSOYOOS SHEET, ON THE SOUTH SIDE OF LOST CREEK. IT CUTS ACROSS TO THE SAN POIL SOUTH OF THE COURSE OF LOST CR. AND WEST FORK.

ANOTHER SUCH SUBGLACIAL COURSE IS THAT OF MUD LAKE N. OF REPUBLIC, TO COPPER LAKE AND FERRY LAKE AND THENCE TO THE SAN POIL. THIS COURSE IS REMARKABLE IN CROSSING THE COURSE OF GRANITE CREEK.

TERRACES IN KETTLE RIVER VALLEY BETWEEN LYNCH AND CURLEW HAVE THE FLUVIAL GRADED SURFACES AND THE KETTLE VALLEYWARD SCARPS THAT ARE FOUND SO ABUNDANTLY IN THIS REGION. ICE CERTAINLY LAY IN THE VALLEY WHEN THEY WERE BUILT. BUT THEIR ALTITUDE IS NOT 2100. AND THE ALTITUDE OF THE LOWER TERRACES OF THE SAME GENESIS WHICH FLANK CURLEW LAKE ARE MORE THAN 2500. SINCE CURLEW LAKE ITSELF IS 2347, IT IS OLEAR THAT THE STREAMS WHICH AGGRADED THESE 2000-2100 TERRACES ON KETTLE RIVER DID NOT DISCHARGE THRU CURLEW VALLEY TO THE SAN POIL. THE ONLY OTHER ROUTE POSSIBLY OPEN IS THAT OF KETTLE RIVER ITSELF TO THE COLUMBIA AND THIS IS SOME DISTANCE NORTH IN CANADA. THE CONTINENTAL SHEET THEREFORE HAD WITHDRAWN THAT FAR WHILE STAGNANT ICE STILL LINGERED IN THE BOTTOM OF KETTLE RIVER VALLEY BETWEEN LYNCH AND CURLEW. THUS THESE ICETONGUES ARE NOT TO BE CONSIDERED AS LIVE FINGERS OF THE SHEET.

A SPLENDID LATERAL MORaine ON THE WEST SIDE OF CURLEW VALLEY SOUTH OF THE TOWN OF CURLEW. CAUGHT BY THE CONTOURS ON THE REPUBLIC SHEET. ALSO A BIG PILE OF MORaine ON THE EAST SIDE. IMMEDIATELY SOUTH IN THE VALLEY LIES ST. PETER FLATS, A GREAT TERRACE FILLED WITH VERY GOOD ICE CONTACT SCARPS 400 FEET HIGH. SURFACE OF ST. PETER FLATS SLOPES SOUTHWARD TO BECOME THE TERRACE SURFACES BORDERING CURLEW LAKE. TOP OF THE FLATS NOT SEEN BUT AT CURLEW LAKE THESE TOP SURFACES ARE STRIKINGLY KETTLE. SOME KETTLES ARE MERE SHALLOW SAUCERS, OTHERS ARE MORE THAN 100 FEET DEEP. MORAINIC KNOBS OR KAMES STAND UP ABOVE THE TERRACES IN PLACES. THE TERM "KAME TERRACES" SEEMS TO BE THE BEST ONE TO APPLY TO THESE TERRACES OF FLUVIOGLACIAL MATERIAL BUILT BETWEEN ICE TONGUES AND VALLEY WALLS IN THESE MT. VALLEYS OF NORTHERN WASHINGTON. BUT THE KAME CHARACTER ISN'T VERY PRONOUNCED.

AENEAS VALLEY SEEKS FROM MAP STUDY TO BE PERFECTLY PLANE- A LACSTRAL FLAT. DRAINAGE IS OUT AT BOTH ENDS AND SEVERAL UNCONNECTED LAKELETS LIE IN MIDLENGTH. BUT WHEN SEEN IN THE FIELD THE VALLEY TURNS OUT TO BE LIKE ALL THE OTHERS. IT HAS FLAT BORDERING TERRACES, MANY KETTLES AND SOME KNOBS ON THEM, AND A SERIES OF DISCONTINUOUS LARGER BASINS IN THE MIDDLE. THE ARGUMENT THAT THE BORDERING TERRACES NEVER WERE CONNECTED ACROSS THE MIDDLE IS UNANSWERABLE. NO AGENT OF EROSION HAS MADE THE CENTRAL DEPRESSIONS; THEY SIMPLY MARK THE LOC OF ICE BLOCKS OR A DISCONTINUOUS ICE TONGUE.

THE QUESTION OF THE SOURCE OF THE GRAVEL IN THE TERRACES IS A BIT PUZZLING. IT DOES NOT SEEM PROBABLE THAT THE MELTING OF THE WANING STAGNANT TONGUES COULD YIELD ALL THE DEBRIS, YET A COMMON FEATURE IS THE GENTLE SLOPE OF A TERRACE SURFACE FROM THE VALLEYWARD SCARP TOWARD THE ADJACENT ROCK WALL. AND MOST KAMEY PILES OR KNOBS ARE ON OR NEAR THE VALLEYWARD SCARP. IS IT NOT LIKELY THAT MUCH OF THE DRIFT WHICH WAS IN THE ICE DIRECTLY ABOVE, THE ICE WHICH MELTED OFF TO LEAVE THESE LINGERING TONGUES,^{WAS} CONTRIBUTED ~~TO DRIFT~~, SO THAT THE TERRACES REPRESENT WHAT THE BASAL ICE (THE TONGUE) CONTAINED ORIGINALLY, PLUS ALL OR NEARLY ALL THAT THE SUPERJACENT ICE CONTAINED?

SECTIONS THRUOUT THE REGION SHOW ALMOST NO SYSTEM OR ORDER IN THE DISTRIBUTION OF TILL, GRAVEL AND VARVE SILT IN THE TERRACES. TILL ABOVE SILT HAS NOT BEEN SEEN, BUT EVERY OTHER COMBINATION OF THE THREE HAS BEEN. IN GENERAL, THE LOWEST TERRACES ARE LIKELY TO BE OF SILT, IF SILT IS PRESENT IN THE VALLEY, OR OF GRAVEL IF NO SILT EXISTS AT THAT PLACE. AND UPPER TERRACES ARE MORE LIKELY TO BE OF TILL THO THEY MAY HAVE A PLANE GRAVELLY TERRACE TOP. IS IT NOT LIKELY THAT MOST TERRACES ARE BUT BURIED LATERAL MORAINES, WITH SILT AND GRAVEL ABOVE TO SMOOTH OUT THE IRREGULARITIES?

CHESAW TRIP AUG. 8 1925
ANOTHER SUCH DRIFLAGITAL COURSE IS THAT OF LAKE N. OF REPUBLIC TO COPPER LAKE AND FERRY

VALLEY OF ANTOINE CR. AND REGION SW OF CHESAW TOWARD TONASKET DOES NOT SHOW MORAINIC TERRACES OR GRAVEL TERRACES ~~AT ALL~~ WELL. REASON NOT CLEAR. CHESAW VALLEY HAS THEM VERY WELL DEVELOPED. BEAVER LAKE PASS IS CUT IN (OR LEFT UNFILLED IN) THE TERRACE DEPOSITS.

EDEN VALLEY AND BONAPARTE LAKE VALLEY BOTH ARE LONG, FLAT-FLOORED VALLEYS CUT IN ROCK ACROSS PREGLACIAL DIVIDES. WESTWARD SLOPE OF BONAPARTE MTS. HAS A NOTCH LIKE THAT IN THE CORRESPONDING SLOPE OF MT. ANNIE.

REPUBLIC TO GRAND FORKS TO KETTLE FALLS TO COLVILLE. SUNDAY AUGUST 9 1925

VERY SMOKY AND LITTLE INTERPRETATION OF THE PHYSIOGRAPHY POSSIBLE. GRAND FORKS LIES IN A BROAD VALLEY, QUITE UNLIKE THE KETTLE RIVER VALLEY IN WASHINGTON. LARGE DEPOSITS OF SPLENDIDLY VARVE-BEDDED SILTS IN KETTLE VALLEY SOUTH OF LAURIER. VARVES 6 INCHES TO A FOOT IN THICKNESS. GRAVEL ABOVE THE SILT IN MOST PLACES. VERY STRIKINGLY GLACIATED AMPHIBOLE GNEISS AT KETTLE FALLS. A GREAT SILT PLAIN FROM KETTLE FALLS TO COLVILLE. DELTA-BEDDED GRAVELS IN SCARP ABOVE THE SILT PLAIN A MILE OR TWO EAST OF COLVILLE. ALT. 1850, 250 FT. ABOVE THE COLVILLE PLAIN.

COLVILLE TO BOUNDARY TO NORTHPORT TO ECHO TO COLVILLE AUGUST 10 1925

A GRAVEL TERRACE FLAT EAST OF COLVILLE AT 1850, 250 FT. ABOVE THE SILT PLAIN, WHICH CONSTITUTES THE VALLEY FLOOR. FORESET BEDS WELL DEVELOPED, DIPPING TOWARD THE VALLEY. FARTHER NE., TOWARD THREE FORKS, THIS GRAVELLY PLAIN RISES GRADUALLY UP THE VALLEY OF MILL CREEK IN THE HILLS. APPARENTLY THIS IS A DEPOSIT OF GLACIAL WATERS ESCAPING FROM THE NORTH AND ENTERING THE COLVILLE LAKE. THE SILT PLAIN VARIES SOMEWHAT IN ALTITUDE BUT IS ABOUT 1600 HERE. HOWEVER, RECORD THE ALTITUDE OF THE SURFACE OF THE LAKE. THE DELTA PLAIN SHOULD RECORD THIS.

BETWEEN THREE FORKS AND ADDING IS A DEEP NOTCH, TWO OR THREE MILES LONG, ACROSS FROM MILL CREEK TO DEEP CREEK DRAINAGE. IT HAS A BREADTH OF PERHAPS 1/4 MILE FOR AN AVERAGE, AND IN ONLY ONE PLACE IS IT WITHOUT A BOTTOM FLAT. THIS IS WEST OF THE DIVIDE AND APPEARS TO BE A POST-

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WISCONSIN GORGE WITH WISCONSIN DRIFT FILLING IN THE ORIGINAL BROAD NOTCH JUST EAST OF THE V-NOTCH. IN OTHER WORDS, A ROCK SHOULDER ENTRENCHED WITH STREAM SUPERPOSED. ALTITUDE AT THE DIVIDE IN THE BIG NOTCH IS ABOUT 2600. STREAM GRADIENTS BOTH NORTH AND SOUTH ARE GENTLER HERE THAN THEY ARE DOWNSTREAM IN EITHER DIRECTION. THIS FACT AND THE BREADTH OF THE NOTCH INDICATE THAT THIS IS VERY PROBABLY ONE OF THE LARGE NUMBER OF N-S NOTCHES OR GORGES WHICH CROSS E-W DIVIDES DEEP LAKE AND ADA LAKE, 2250 AND 2325 RESPECTIVELY, LIE IN A REMARKABLE VALLEY ACROSS THE DIVIDE BETWEEN DEEP CREEK AND COLUMBIA RIVER. THE GREAT TROUGH IS HALF A MILE WIDE AND 6 MI. LONG AND HAS A VERY SLIGHT GRADE NORTH TO CEDAR (ADA?) LAKE AND SOUTH TO DEEP LAKE. DIVERSION OF A LARGE STREAM ACROSS THE HILLS HERE IS CLEARLY RECORDED. WISCONSIN DIVERSION OF THE COLUMBIA LOWER WATERS IS NOT TO BE CONSIDERED, FOR SUCH WATERS MUST EITHER RETURN VIA DEEP LAKE CREEK JUST A FEW MILES BELOW OR WOULD HAVE TO CROSS THRU THE ALADDIN NOTCH WHICH IS 300 FT. HIGHER. MUCH MORE PROBABLE IS THE CONCEPTION THAT BOTH NOTCHES ARE OF SPOKANE SUBGLACIAL STREAM ORIGIN.

COLUMBIA VALLEY SW OF NORTHPORT HAS MORaine TERRACES WITH GOOD KETTLES AND KNOBS. AN ICE TONGUE SURELY LAY IN THE VALLEY WHEN THESE WERE BUILT.

NO GOOD SPOKANE SUBGLACIAL TYPE OF NOTCH ALONG ROAD TO LAKE CITY AND ECHO. A DELTA-BEDDED TERRACE NTH OF ECHO. ALTITUDE 1770 LOCATION 7 MI. BY ROAD FROM COLVILLE. TOPSET AND FORESET BEDS SHOW ALONG ROAD GRADE. A DEFINITE SCARP FACING DOWN (SOUTH) THE TRIB. VALLEY. NO TRACE OF GRAVEL TERRACES FARTHER SOUTH.

CHEWELAH AUG. 11 1925

WISC. TM AT WAITS LAKE. SPOKANE DRIFT, REDDISH IN COLOR, UP THE CREEK VALLEY TOWARD RED MARBLE MTN AND KEYSTONE PROPERTIES. A FAIR TERRACE AT ABOUT 2200, SEVERAL MILES UP THE VALLEY, FROM THE MORaine. HIGHEST ERRATIC AT 2900, ABOVE THE END OF THE RR GRADE TO RED MARBLE QUARRY CLIMBED TO 4000, TOP OF RED MARBLE MTN., AND DOWN AGAIN BY ANOTHER ROUTE. GRADED TRAIL BOTH WAYS AND GOOD EXPOSURE OF SOIL. NOT A TRACE OF ERRATIC MATERIAL. IF SPOKANE ICESHEET GOT HIGHER ON THESE HILLS THAN 2900, IT HAS LEFT NO TRACE HERE. THIS ALT. OF 2900 WEST OF CHEWELAH COMPARED WITH THE ALT. OF SPOKANE DRIFT AT SPANGLE, AFFORDS A VERY PUZZLING SITUATION. NO ADEQUATE GRADIENT IS AVAILABLE ON WHICH TO PUT THE SPOKANE ICE ACROSS onto THE PLATEAU TO THE HEADS OF THE SCABLAND CHANNELS. THE ICE ACTUALLY REACHED THAT FAR— NO OTHER SITUATION WILL PUT WATER INTO THE DIFFERENT CHANNELLED ROUTES. THE ONLY EXPLANATION NOW APPLICABLE IS THAT THE SPOKANE DRIFT, ONCE HIGH ON THESE MT SLOPES, HAS BEEN SO LARGEY ERODED THAT NO TRACES HAVE BEEN FOUND IN THE FEW TRAVERSSES MADE.

ADDY TO HUNTERS TO SPRINGDALE AUG. 12 1925

WISC. DRIFT COMPLETELY OVER THE RANGE ALONG THE ROAD FROM ADDY TO MAUD. ALT. AT SUMMIT IS 3250. TILL ALMOST ON THE TOP, PLENTY OF ERRATICS ON THE TOP.

GIFFORD TO HUNTERS—HIGH MORAINIC TERRACE AT 2000 BETWEEN MAUD AND GIFFORD. SILT TERRACE AT 1700. THIS IS RECOGNIZABLE ALMOST ALL THE WAY TO HUNTERS. A LOWER TERRACE, ABT. 1350, OF GRAVEL, ALSO PROMINENT. WISC. TM. CROSSED BY ROAD NEAR CEDONIA, ALT. 1850. SILT TERRACE AS WELL SHOWN SOUTH OF THE MORaine AS NORTH OF IT.

MORAINES EAST OF HUNTERS IS EASILY RECOGNIZED. ITS ALTITUDE IS 2300 HERE. ABOVE IT, EAST ALONG THE ROAD TO SPRINGDALE, ARE SCATTERED ERRATICS UP TO 3200. A VERY GOOD TERRACE 9 MI. EAST OF HUNTERS BY ROAD AND 3050 A.T. IT IS OF WELL-SORTED GRAVEL, DISTINCTLY BROWNISH IN COLOR HORIZONTALLY BEDDED. MOST OF THE MATERIAL IS OF LOCAL SCHISTS AND SLATES BUT THERE ARE LARGE NUMBERS OF QTZITES, GRANITES OF VARIOUS SORTS, BASIC IGNEOUS ROCKS, ETC. IT CLEARLY IS A GLACIAL GRAVEL. ITS ALT. ABOVE, AND DISTANCE FROM, THE MORAINES (WISC. TM) AND ITS OXIDATION, SEEM CLEARLY TO MAKE IT PRE-WISC. TAKEN WITH THE ERRATIC COBBLES AND BOULDERS UP TO 3200 ALONG THIS ROAD, IT IS A GOOD RECORD OF THE SPOKANE DRIFT. ALTITUDE OF 3200 HELPS THE MATTER OF GRADIENTS FOR THE SPOKANE ICE. AND IT SEEMS CLEARER NOW THAT SPOKANE DRIFT IN THESE COLVILLE MTS. IS VERY FRAGMENTARY IN CHARACTER. TOO MUCH POST-SPOKANE EROSION ON THE STEEP SLOPES. NO SPOKANE DRIFT-- NO DRIFT OF ANY KIND-- ON THE SLOPE DOWN TOWARD SPRINGDALE UNTIL THE WISC. TM IS ENCOUNTERED AT 2200. ALT OF DIVIDE ON ROAD IS 3400.

PEND O'REILLE LAKES (THOMPSON-FRATER-LEE) AUG 14

THEY LIE ON THE SUMMIT OF THE MOUNTAINOUS DIVIDE BETWEEN COLVILLE VALLEY AND CLARKS FORK VALLEY ALT. ABT. 3100. BUT THE DIVIDE HERE IS A BROAD, DRIFT-COVERED TRACT, LOW AMONG THE ROCK HILLS TO THE N AND TO THE S. IT IS SIMPLY A LOW BROAD TRACT ON THE SUMMIT, MADE SO largely BY PREGLAC. EROSION, AND MODIFIED NOW BY THE WISCONSIN DRIFT DEPOSITS.. NO EVIDENCE TO TIE IT UP WITH THE SPOKANE SUBGL. NOTCHES.

BIG DRIFT TERRACES THENCE TO COLVILLE

COLVILLE VALLEY AUG. 14 1925

THIS VALLEY VARIES VERY MUCH IN WIDTH, IN SOME PLACES HAVING NO BOTTOM FLAT AT ALL. AND IT IS IRREGULAR IN OUTLINE AND ORIENTATION SO THAT ONE GET NO LONG VIEWS IN MANY PLACES. THE SILT WHICH FLOORS IT EXTENDS SOUTH ALMOST TO SPRINGDALE. IN MANY PLACES, IT OCCURS IN ROUNDED SPURS OR DISCONTINUOUS TERRACES 25 TO 50 FEET ABOVE THE VALLEY FLOOR. CUTS IN THESE SPURS COMMONLY SHOW THE SILT IN THEM TO BE HORIZONTALLY BEDDED, THE SLOPES BEARING NO RELATION TO THE ORIENTATION.

THIS THROWS OUT THE IDEA THAT THE SPURS ARE DEPOSITS ABOVE ROCK SHOULDERS NOW BURIED AND DEMANDS THE IDEA THAT THE PLAIN ITSELF IS AN EROSIONAL AFFAIR, MADE BY COLVILLE RIVER SINCE THE LAKE DIS-APPEARED, AND THAT THE SPURS ARE REMNANTS OF A FORMER COMPLETE FILLING. (SEE LATER IDEA) THE COLVILLE RIVER MUST BE LODGED ON A ROCK LEDGE AT ITS MOUTH OR IT WOULD HAVE A BIG TRENCH CUT BACK IN THE SILT. (Ascertain this definitely)

TWO POSSIBLE N-S SUBGL. STREAM CHANNELS IN ROCK IN THIS VALLEY. ONE AT ADDY, NOW OCCUPIED BY COLVILLE RIVER AND ONE ABOUT 2 MILES SOUTH OF CHEWELAH ON W. SIDE OF VALLEY, CROSSING THE SPUR OF ONE OF THE MTS. OF THE COLVILLE RANGE BUT CUT DOWN TO THE VALLEY BOTTOM. NEITHER ARE GOOD EXAMPLES AND BOTH MAY BE DUE TO NORMAL EROSION OR TO WISCONSIN GLACIAL AND STREAM EROSION. BUT BOTH HAVE STEEP WALLS, COMPARED WITH PROFILES OF ALL OTHER SLOPES NEAR THEM. (SEE PROOF OF PORTION OF CHEWELAH QUAD) (This fails to show the one near Chewelah)

LOON LAKE - SPRINGDALE - FORD - WELLPINIT AUG. 15 1925

TWO VT'S OUT AT SOUTHERN END OF COLVILLE VALLEY, ONE DOWN CHAMOKANE CREEK, AND ONE DOWN
ABOUT 400 FT. DIFFERENCE IN ELEVATION, CHAMOKANE BEING LOWER. BOTH LEAD TO SPOKANE VT.
SPOKANE VT. AT LONG LAKE (N. SIDE) HAS 1725 UPPER ALT AND 1525 ALT. OF LOWER MAIN
TERRACE. IMPRESSION GAINED THAT DISSECTION OF THE VT TO MAKE THESE TERRACES WAS BY GLACIAL
WATERS.

HIGH TERRACE AT SPRINGDALE, S OF TOWN AND ON E SIDE OF THE COL BETWEEN COLVILLE AND CHAMOKANE CREEKS. ALT. IS 2375, HEIGHT 285 FT. ABOVE RR STATION, ITSELF 2080. (2086?). COARSE GRAVEL, STRUCTURE NOT SHOWN, FROM BOTTOM TO TOP. A LIMITED AFFAIR, PROBABLY NOT MORE THAN ONE MILE IN LENGTH AND 1/4 MI WIDE. NONE OTHERS SEEN ANYWHERE IN THE CHAMOKANE VALLEY, THO IN THE LOON LAKE - DEER LAKE VT., THE ALTITUDE OF THE WHOLE VALLEY FILL IS 2400+ (2475 NEAR DEER LAKE, 2420 AT LOON LAKE STATION). GRAVEL IS APPARENTLY FRESH AND HAS AN ABUNDANCE OF QTZITE IN IT! IT SEEMS BEST EXPLAINED AS WISC. IN AGE AND PERHAPS DEPOSITED BETWEEN THE ICE AND THE HILL AT A TIME WHEN THE WISC. COLVILLE TONGUE REACHED ~~HALF~~ A MILE OR A MILE SOUTH OF THE MORaine AS IT NOW STANDS. MORaine MIGHT HAVE BEEN BLT. UNDER THE ICE SOMEWHAT, INSTEAD OF AT THE EDGE. ALL OTHER VT TERRACES IN CHAMOKANE VALLEY ARE LOW. 2100 FOR THE HIGHEST JUST SOUTH OF SPRINGDALE.

THE COL BETWEEN COLVILLE AND CHAMOKANE VALLEYS IS A MARKED FEATURE NEARLY HALF A MILE WIDE. CHAMOKANE CR. ENTERS IT FROM THE WEST AND TURNS AN ACUTE ANGLE TO FLOW SOUTH. COLVILLE CREEK ENTERS FROM THE EAST AND FLOWS NORTH. ALTITUDE OF THE MEADOW ON THE DIVIDE IS ABOUT 2000. THIS COL CARRIED THE LAKE WATERS OUT OF COLVILLE VALLEY DURING THE RETREAT OF THE ICEFRONT FROM SPRINGDALE TO COLVILLE, ABOUT 40 MILES, FARTHER NORTH. IT IS HIGH ENOUGH TO ACCOMMODATE ALL THE SILTS AND ALL THE DELTA GRAVELS FOUND. IT IS REALLY TOO HIGH FOR THE TWO DELTAS NEAR COLVILLE (1850 AND 1770), AND THEY MUST HAVE BEEN BUILT AFTER THE NORTH MOUTH OF COLVILLE VALLEY WAS CLEARED, AND SOMEWHAT LOWER WATER LEVELS PREVAILED, SUCH AS THOSE RECORDED BY THE 1700 FT SILT TERRACE BETWEEN GIFFORD AND HUNTERS.

SPOKANE DRIFT COVERS THE TOP OF THE BASALT TABLELAND SOUTHWEST OF SPRINGDALE, AT LEAST SO FAR AS EXAMINED. TRAVERSE OF ABOUT FOUR MILES OUT ON THIS TABLELAND. DRIFT VERY ABUNDANT NEAR THE EDGE OF THE CHAMOKANE VALLEY. QTZITES PREVAILENT, MANY ROUNDED. PLANE OF EROTTIC COBBLES WITH GLACIAL STRIAE. THICKNESS ONLY A FEW FEET OR A FEW TENS OF FEET, BASE LT SHOWS HERE AND THERE THRU IT. A GENTLY ROLLING TOPOG. MARKS THE SURFACE OF THE BASALT TABLELAND. THIS THOT TO BE THE REMNANTS OF ORIGINAL MORAINIC EXPRESSION, SUBSEQUENTLY MODIFIED BY SLOPE WASH ONLY. NO STREAMS ACROSS, NO STREAM HEADS BACK IN THIS TRACT. ALT. OF THE PLATEAU HERE IS 2550 TO 2600.

PREGLACIAL DRAINAGE IN COLVILLE-CHAMOKANE VALLEY DID NOT HAVE A DIVIDE AT SPRINGDALE. THE VALLEY HERE IS TOO WIDE. CHAMOKANE CR. UP IN THE COLVILLE HILLS TRENDS NE BUT ON ENTERING THE MAIN VALLEY AT SPRINGDALE, IT TURNS SOUTHWARD TO ENTER THE SPOKANE. IT LOOKS AS THO IT SHOULD CONTINUE NORTHWARD AS A TRIB TO THE COLVILLE.

BUT THERE ARE ROCK HILLS IN THE COLVILLE VALLEY NORTH OF CHEWELAH WHICH NEARLY CLOSE THE VALLEY. THEY DO CLOSE OFF THE FLOODPLAIN. THIS PLACE MIGHT EQUALLY WELL BE SELECTED FOR THE PREGLACIAL DIVIDE, THO THE ARGUMENT DEPENDS ON DIFFERENT EVIDENCE AND THE TWO HYPOTHESES CANNOT BE ENTERTAINED TOGETHER. ONE DEMANDS A NORTHWARD FLOW FROM SPRINGDALE AND A NARROW PLACE SOUTH OF SPRINGDALE FOR THE PREGLACIAL DIVIDE. NO SUCH NARROW PLACE EXISTS. THE OTHER DEMANDS THAT THE ACUTE ANGLE IN CHAMOKANE CREEK BE IGNORED.

AS OF NO CONSEQUENCE/ SIGNIFICANCE.

SPOKANE DRIFT VERY SPARSE INDEED IN VICINITY OF WELLPINIT. TURTLE LAKE, 5 MI. WEST OF THE TOWN, HAS NO EXPLANATION FOR ITS EXISTENCE, UNLESS IT LIES IN MORAINIC TOPOGRAPHY. ITS NORTHERN AND SOUTHERN WALLS ARE OF ROCK BUT THE LAND AT THE E AND W ENDS IS VERY LOW AND MAY BE DRIFT. A MILE WEST OF THE LAKE IS A SECTION IN A GULLY AND NUMEROUS ERRATICS OF VARIOUS SORTS WERE FOUND THERE, UNDOUBTEDLY GLACIAL IN ORIGIN. HENCE SPOKANE. A SUBDUED IRREGULAR MORAINIC ASPECT TO THIS PARTICULAR PLACE.

SPOKANE DRIFT FAIRLY ABUNDANT ALONG THE ROAD WHICH CROSSES THE HILLS BETWEEN CHAMOKANE VALLEY AND TUM TUM, 7 MI. SOUTH OF SPRINGDALE. UP TO 2550. FOUND ALONG THE ROAD UP BOTH SIDES OF THE DIVIDE WHICH CROSSES THE HILLS. DRIFT CONSISTS ENTIRELY OF ROCK FRAGMENTS. NO TILL. A COARSE GRANITE SAND CONSTITUTES THE UNCONSOLIDATED MATERIAL OF THE REGION. BEDROCK ALL GRANITE. THE MT. TO THE NORTH OF THE PASS WAS CLIMBED TO THE SUMMIT, 3950. NOTHING ON IT BUT GRANITIC DEBRIS. APPARENTLY THESE STEEP SLOPES DO NOT RETAIN SPOKANE DRIFT. A GRANITE PINNACLE 8 FT. HIGH ON THE SLOPE CLIMBED. IT IS A MEASURE OF THE AMT. OF DECOMPOSITION AND EROSION WHICH HAS OCCURRED ON THE GENTLER OF THESE MT. SLOPES SINCE SPOKANE TIME AND SHOWS WHY ONLY THE VALLEYS NOW RETAIN THE OLDER DRIFT.

A BROAD TERRACE OF SPOKANE DRIFT ON THE EAST SIDE OF THESE MTS., ALT. 9 MI SOUTH OF LOON LAKE. MORAINIC TOPOGRAPHY FAINTLY SHOWING. PLENTY OF FOREIGN MATERIAL OF CONSIDERABLE VARIETY. ONE FRAGMENT WITH GLACIAL STRIAEE DISTINCT. THIS TERRACE IS 2350 AT. A MILE TO THE EAST IS THE BROAD FLAT OF DEER PARK REGION, PERSUMABLY UNDERLAIN BY COLUMBIA BASALT. ALT. ABOUT 2200-2250 HERE. THIS IS LOWER THAN THE BASALT TOP WEST OF SPRINGDALE AND SOUTH OF CHAMOKANE CR. HEADWATERS BY 350 FEET. THE BROAD FLAT ALSO CARRIES GLACIAL ERRATICS THO MOST OF THE MATERIAL SEEMS TO BE OF GRANITIC SAND. THESE ERRATICS MUST BE SPOKANE DRIFT.

LOON LAKE AND DEER LAKE BOTH DAMMED BY THE VT WHICH EXTENDS SOUTHEASTWARD TO DEER CREEK. ALT. OF THE VT AT LOON LAKE STA IS 2420. WEST OF LOON LAKE IT IS 2475

SILTS OF COLVILLE AND COLUMBIA VALLEYS ABOVE JCT OF SPOKANE RIVER.

THESE SILTS ARE DEEP AND FAIRLY FREE FROM GRAVEL LENSES AND STRATA, SO FAR AS SEEN. THEY ARE VARVE CLAYS, AS SHOWN IN INNUMERABLE SECTIONS. THEY WERE DEPOSITED IN A GLACIAL LAKE, OR TWO SEPARATE LAKES. THEIR ALTITUDE IN COLVILLE VALLEY IS NOT MUCH ABOVE 1650 ANYWHERE AND MOST OF THE PLAIN IS 1600 OR LOWER. IN COLUMBIA VALLEY THE READINGS OBTAINED WERE CLOSER TO 1700. A DAM FOR THESE GLACIAL WATERS IS NECESSARY. THAT DAM IS BELIEVED TO BE THE HEAVY VT WHICH CAME DOWN THE SPOKANE AND ENTERED THE COLUMBIA, EXTENDING THENCE DOWN THE MASTER STREAM. THIS VT IS ABOUT THE RIGHT ALTITUDE, 1775 AT LONG LAKE (CHECK WITH SPOKANE SHEET) NEAR THE MOUTH OF THE CHAMOKANE. 1700 SILT MEANS THAT THE LAKELIKE EXPANSION TO THE NORTH OF THE VT WAS SILTED UP until it had A RELATIVELY SHALLOW DEPTH. THE COLUMBIA ABOVE ENTRANCE OF THE SPOKANE RIVER VT WAS PONDED MUCH AS TRIBUTARY STREAMS FREQUENTLY ARE BY VTs IN THEIR MAINS.

BUT COLVILLE VALLEY HAD A DRIFT DAM, OR DRIFT AND ROCK PERHAPS, AT SPRINGDALE, WHILE THE COLVILLE LOBE WITHDREW TO COLVILLE. THIS DAM WAS 2000 FT. AT. AFTER THAT, THE WATERS IN BOTH VALLEYS MERGED INTO ONE, THE CONNECTION EXISTING AROUND THE NORTH END OF THE COLVILLE MTS., BETWEEN COLVILLE AND KETTLE FALLS.

CLARKS FORK VALLEY BETWEEN Z CANYON AND NEWPORT. AUG. 18 1925

THE PREGLACIAL VALLEY HERE HAD ITS HEAD IN THE VICINITY OF Z CANYON, 10 MI. BY ROAD NORTH OF METALINE FALLS. THIS VALLEY DRAINED EASTWARD FROM NEWPORT ACROSS THE RANGE TO THE PEND OREILLE LAKE VALLEY OR TO THE HOODOO VALLEY, THENCE TO THE PREGLACIAL COLUMBIA IN THE SPOKANE VALLEY. THE EVIDENCE FOR THE DIVIDE CONSISTS IN THE GENERAL HIGH ALTITUDE OF THE VICINITY AND THE REMARKABLE CANYON CUT IN ROCK. THE MTS OF THIS REGION ARE MORE LOFTY THAN ANY OTHERS ALONG THE ENTIRE DISTANCE UP FROM NEWPORT, AND THEY COME CLOSER TOGETHER. THE SITE IS ESSENTIALLY THAT OF A PREGLACIAL LOW SADDLE. ROCK HILLS, NOW IN PART BURIED IN WISCONSIN DRIFT, RISE AS MUCH AS 1000 FEET ABOVE THE RIVER. THE SITE OF THE Z HAS AN ALTITUDE OF ABOUT 2100 AT THE BRINK OF THE CANYON WHERE THE STREAM FIRST BEGAN TO TRENCH. THE DRIFT FILL TRAVESED BY THE ROAD ON THE WEST SIDE OF THE RIVER RISES TO 2600. THERE IS NO POSSIBILITY OF USING THE IDEA OF SUPERPOSITION OF THE STREAM ON A ROCK SHOULDER OF A FORMER THRU VALLEY HERE, WHICH BY HYPOTHESIS IS NOW BURIED IN DRIFT. THERE IS NO MAIN VALLEY HERE AND THERE NEVER HAS BEEN.

THE EVIDENCE FOR THE PREGLACIAL DISCHARGE FROM NEWPORT EASTWARD LIES IN

- (1) THE LONG, RELATIVELY GENTLE SLOPES FROM MT SUMMITS BOTH N AND S OF CLARKS FORK DOWN TO THE STREAM, JUST EAST OF NEWPORT,
 - (2) THE ABSENCE OF BEDROCK IN THE STREAM HERE AND
 - (3) THE IMPOSSIBILITY OF CARRYING THIS DRAINAGE NORTHWARD, AS SET FORTH ABOVE, OR SOUTHWARD BY WAY OF THE LITTLE SPOKANE.
- THE CHARACTER OF THE LITTLE SPOKANE VALLEY WILL BE DESCRIBED LATER.

THE PREGLACIAL COLUMBIA APPARENTLY NEVER CROSSED FROM THE PEND OREILLE TRENCH TO THE VALLEY IT NOW FOLLOWS FROM BOUNDARY AND NORTHPORT TO THE JCT WITH THE SPOKANE. JUST WHAT CONDITIONS CAUSED ITS TRANSFER TO THE PRESENT COURSE ARE UNKNOWN. THE NORTHPORT-TO-~~GEROME~~^{GEROME} VALLEY WAS ORIGINALLY A RELATIVELY SHORT SOUTH-FLOWING GRIBUTARY. ABOUT NORTHPORT AND BOUNDARY, THE COLUMBIA VALLEY IS VERY NARROW AND DEEP, SO NARROW THAT NO VT REMAINS IN IT.

THE SPOKANE HISTORY OF CLARKS FORK VALLEY NORTH OF NEWPORT IS POORLY RECORDED. THERE ARE ONLY TWO KNOWN PLACES FOR THE POSTULATED SUBGLACIAL STREAMS ACROSS ROCK RIDGES OR SHOULDERS. ONE IS NEAR METALINE; BETWEEN METALINE AND Z CANYON. THIS IS WHERE ONE SHOULD BE IF SPOKANE WATERS CAME DOWN IN ANY QUANTITY ALONG THIS ROUTE.

AND IF NOTCHES BE A CRITERION OF SUBGLACIAL STREAMS, CLARKS FORK VALLEY CARRIED SUCH STREAMS. THE REAL FEATURE ON WHICH THE ARGUMENT IS BASED IS A GROUP OF THREE NOTCHES CUT ACROSS TWO SPURS FROM THE EAST SIDE ^{INTO} OF THE VALLEY ABOUT THREE MILES NORTH OF NEWPORT. THESE ARE GASHES WHOLLY OUT OF HARMONY WITH ANY OTHER TOPOGRAPHIC FEATURES IN THE REGION. THEY ARE VERY NARROW AND STEEP-SIDED AND THEY CROSS THE SPURS PRETTY WELL OUT TOWARD THEIR VALLEYWARD TERMINI. NOTHING EVER PROPOSED IN PHYSIOGRAPHIC LITERATURE CAN EXPLAIN THEM. THEY ARE, BY THE FAVORED HYPOTHESIS THE PRODUCT OF SUBGLACIAL STREAMS UNDER GREAT HYDROSTATIC PRESSURE.

THE LARGEST AND MOST PROMINENT OF THESE NOTCHES IS VISIBLE FROM NEWPORT. ITS BOTTOM IS ABOUT THE LEVEL OF THE HIGHEST DRIFT TERRACE HERE BUT THIS IS A COINCIDENCE, ONLY. WISC. ICE APPARENTLY DID NOT REACH ANY OF THEM, SO THEY MUST BE OF SPOKANE AGE.

THE WISCONSIN HISTORY OF CLARKS FORK VALLEY NORTH OF NEWPORT IS PECULIAR TO THIS VALLEY. THE WISC TM APPARENTLY LIES A FEW MILES NORTH OF NEWPORT. IT IS RECORDED BY MORAINES DAMS FOR MARSHALL LAKE (ALT OF DAM 3000) AND BEAD LAKE (ALT OF DAM 2900. LAKE 2800), AND BY INFER-^{ANCE} THE OTHER TWO OR THREE SMALLER LAKES IN THIS REGION ARE OF THE SAME ORIGIN. GRAVEL TERRACES OF LIMITED EXTENT ARE ASSOCIATED WITH THIS MORAINES. THEIR ALTITUDES VARY. AS A MORAINE, THIS EASTERN PART IS POORLY EXPRESSED. AND THERE IS NOTHING IN THE MIDDLE OF THE VALLEY. ON THE WEST SIDE, 7 MILES OR SO NORTH OF NEWPORT BY ROAD, IS A LINE OF HILLS ALONG THE BASE OF THE MT. WALL; MORAINIC IN ASPECT, PROPERLY PLACED FOR MORAINE AND INEXPLICABLE UNLESS THEY ARE MORAINE. THEY WERE NOT EXAMINED, HOWEVER.

ANOTHER PROJECTION OF THE CLARKS FORK VALLEY TO NGUE K OF ICE EXTENDED SOUTH FROM DALKENA TO THE MIDDLE OF THE TOWNSHIP IMMEDIATELY WEST OF THE ONE IN WHICH NEWPORT IS LOCATED. A GOOD HIGH MORAINE RIDGE EXISTS HERE WITH A BIG BASIN, NOW HOLDING A MEADOW, TO THE NORTH OF IT. DAVIS LAKE APPEARS TO LIE IN THIS MORAINE. NOT VISITED. SACHEEN LAKE LIES AMONG GRANITE HILLS TO THE S. APPARENTLY BLOCKED BY WISC. DRIFT, OUTWASH OR MORAINE. ALT. OF SUMMIT OF THIS MORAINE IS 2600 FT.

FAR EXCEEDING THE MORAINE OF CLARKS FORK VALLEY TONGUE IN PROMINENCE IS THE OUTWASH DEPOSIT AT NEWPORT. IT CONSTITUTES A GREAT GRAVEL FILL, NOW ONLY IN TERRACE REMNANTS, 2400 FT OR SO IN SUMMIT ALTITUDE. FROM MEMORY OF A TRIP TWO YEARS AGO FROM NEWPORT TO SAND POINT, THIS TERRACE TAKES ORIGIN JUST A FEW MILES EAST OF NEWPORT WHERE A LOBE OR TONGUE OF ICE FROM THE PEND OREILLE TRENCH PUSHED WESTWARD ALMOST ACROSS THE WASH. BDY LINE. SIMILARLY, THIS GREAT TERRACE EXTENDS BUT A SHORT DISTANCE NORTHWARD INTO THE CLARKS FORK VALLEY NW OF NEWPORT. IT SEEMS PROBABLE THAT TWO TONGUES OF ICE JUST FAILED TO MEET, ONE FROM THE NORTH, ONE FROM THE EAST. THAT PORTION OF THE VALLEY BETWEEN THEM WAS FILLED FULL OF GRAVEL AND DISCHARGE WAS SWWARD INTO THE LITTLE SPOKANE VALLEY.

THE LITTLE SPOKANE VT DESCENDS SOUTHWARD FOR A FEW MILES, THEN TOTALLY DISAPPEARS WHERE THE LITTLE SPOKANE CROSSES A HIGH RIDGE BETWEEN SCOTIA AND CAMDEN. STILL FARTHER SOUTH, ABOUT CHATTAROY, THE VT IS AGAIN IN PROMINENT DISPLAY, AND THE ONLY ROUTE FOR THE GRAVEL TO REACH CHATTAROY IS ~~THRU~~ THE REMARKABLY NARROW DEFILE THRU THE HIGH RIDGE NOW USED BY THE LITTLE SPOKANE AND THE G.N.R.R. NO VT WAS BUILT THERE APPARENTLY BECAUSE OF THE NARROWNESS AND BECAUSE OF DISCHARGE THRU THAT ROUTE AFTER THE AGGRADATION HAD CEASED. THIS DISCHARGE IS NOW TO BE DESCRIBED.

FOR 50 MILES OR MORE OF RETREAT OF THE CLARKS FORK TONGUE, ITS WATERS HAD TO FLOW SWARD ACROSS THE VT AT NEWPORT AND DOWN THE LITTLE SPOKANE. THESE WATERS CUT A CHANNEL 275 FEET DEEP AT NEWPORT IN THE GRAVEL DEPOSITED WHEN THE ICE STOOD AT THE MORAINES. THEY CLEANED OUT THE DEFILE ABOVE NOTED AND CUT IT TO ITS PRESENT DEPTH. WHILE THIS LAKE EXISTED ~~IN FRONT OF THE RIVER~~ TREATING CLARKS FORK TONGUE, SILTS WERE DEPOSITED. THESE SILTS APPEAR TO HAVE HAD A VERY VARIABLE UPPER LIMIT. AT METALINE, THEY CONSTITUTE A VERY PROMINENT HIGH TERRACE. IN OTHER PLACES, REMNANTS OF THEM WITHOUT GOOD TERRACE FORM LIE A FEW 100 FT UP ON THE VALLEY WALLS. BUT ABOUT USK AND CUSICK AND CALISPELL LAKE (ALL PART OF A VERY BROAD PLACE IN THE CLARKS FORK VALLEY) THE MT. WALLS HAVE NOT A TRACE OF THE SILTS OR OF ANY OTHER DRIFT DEPOSITS. INSTEAD, THE ROCKY SLOPES COME DOWN TO THE VALLEY FLAT WHICH A VERY PROMINENT FEATURE HERE. THIS FLAT CANNOT BE A TRUE FLOODPLAIN. THE RIVER NEVER COULD HAVE CLEANED OUT THIS BROAD PLACE SO COMPLETELY. HERE IT IS BELIEVED, THE TOP OF THE SILT FILLING IS THE BROAD LOW PLAIN. THE VALLEY ITSELF MUST BE STRUCTURAL.

NO GRAVEL TERRACES, EXCEPT LOCAL LOW ONES, SEEN NORTH OF THE MORaine. PONDED WATERS ALONE CAN WELL ACCOUNT FOR THIS, AND THEY ARE ADEQUATE.

A CURIOUS GRAVEL TERRACE 4 MILES NORTH OF NEWPORT ON THE WEST SIDE OF THE VALLEY. TRAVERSED BY THE HIGHWAY. ALTITUDE ABOUT 2400. IT IS A LARGE CURVED PROJECTION NORTHWARD ACROSS THE TRACE OF THE MORaine, AND FORESET BEDDING WHICH DIPS NORTHWESTWARD, UP CLARKS FORK VALLEY. ITS FAILURE TO LIE OUTSIDE THE COURSE OF THE MORaine AND ITS PROJECTION INTO THE OPEN VALLEY, WITH ITS STRUCTURE, LEAD ONE TO REGARD IT AS THE WESTERN PORTION OF A DELTA BUILT NORTHWESTWARD INTO CLARK FORK LAKE, WHILE GRAVEL WAS STILL COMING TO THE VT AT NEWPORT FROM THE TONGUE TO THE EAST.

LARGE'S POSTGLACIAL LAKE CLARKE MUST BE DISCARDED. THIS WAS A GLACIAL LAKE AS ITS CHARACTERISTIC PALE SITES SHOW WITH VARVE BEDDING SHOW. THE CUTTING OF Z CANYON BEGAN AS SOON AS THE HILLS NORTH OF Z CANYON WERE CLEARED SO THAT WATER COULD ESCAPE TO THE COLUMBIA. PERHAPS THIS PART OF THE COLUMBIA VALLEY, NOT NOW THOT TO BE PREGLACIAL, IS A PRODUCT OF THE SPOKANE SUBGL. STREAMS. ANYWAY, IT WAS THERE AND LAKE CLARK CHOSE TO FLOW OVER THE 2100 FT BARRIER HERE RATHER THAN TO CONTINUE TO DISCHARGE BY WAY OF THE COL TO THE LITTLE SPOKANE, WHOSE ALTITUDE IS ALMOST THE SAME (2115 AT NEWPORT G.N.R.R. STATION)

SPOKANE FEATURES IN LITTLE SPOKANE VALLEY.

Aug 19 1925

A PROMINENT PREGLACIAL DIVIDE CROSSES THE LITTLE SPOKANE VALLEY FROM THE MTS NORTH OF MT. SPOKANE TO THE MTS BETWEEN COLVILLE VALLEY AND CLARK FORK VALLEY. IT IS SEVERAL 100 FEET, PERHAPS MORE THAN 1000 FT. ABOVE THE COUNTRY TO THE N AND THE W. TWEEDIE AND SCOTIA LIE NORTH OF IT. DIAMOND LAKE IS N OF IT. IT IS CROSSED THRU A RATHER BROAD LOW SADDLE BY THE TR HIWAY BETWEEN NEWPORT AND SPOKANE. IT IS LOWEST TOWARD THE WEST, NEAR FAN, HORSESHOE AND TROUT LAKES, BUT THE NUMEROUS GRANITE HILLS HERE PRECLUDE ANY INTERPRETATION OF A PREGLACIAL VALLEY THRU HERE.

THE LITTLE SPOKANE CROSSES THIS FORMER DIVIDE IN THE DEFILE EARLIER NOTED, BETWEEN SCOTIA AND CAMDEN. THE GREAT CLEFT NEVER WAS INITIATED BY CONDITIONS OF THE WISCONSIN GLACIATION. THE VT PROFILE FAILS SOME 100 HUNDREDS OF FEET TOO LOW TO HAVE EVER SPILLED THE GLACIAL WATERS FROM NEWPORT OVER THIS WAY. AND IF THE VT EVER DID RISE HIGHER THAN ITS REMAINING TERRACES RECORD, THE ESCAPE WOULD HAVE BEEN THRU DIAMOND LAKE BY WAY OF THE SADDLE (2500) USED BY THE TR HIWAY. THIS SADDLE LOOKS PREGLACIAL AND ANY SURFACE DRAINAGE, OF WHATEVER CHARACTER OR ORIGIN, SHOULD HAVE TAKEN THIS ROUTE AT 2500.

INSTEAD, FOR SOME UNUSUAL REASON, THE NOTCH WAS CUT ACROSS A NOTABLY HIGH PLACE. AND FURTHERMORE, THERE ARE THREE OTHER NOTCHES IN THE PREGLACIAL DIVIDE RIDGE IN THIS VICINITY. THE ROAD FROM SCOTIA TO CAMDEN TRAVERSES ONE OF THESE NOTCHES. ALTITUDE AT THE DIVIDE IN THIS NOTCH IS . ANOTHER NOTCH IS BETWEEN THESE TWO AND THE FOURTH IS A MILE WEST OF THE ROAD CROSSING NOTED. THE ROAD NOTCH IS A GOOD VALLEY WITH STEEP SIDES, FLAT FLOOR FROM SIDE TO SIDE. A STEEP ASCENT FROM THE NORTH AND A LESS STEEP DESCENT TO THE SOUTH. IT IS 200 OR 300 FT DEEP AND AS UNLIKE A SADDLE BETWEEN HEADS OF STREAMS AS COULD WELL BE.

ALL FOUR OF THESE NOTCHES ARE PLACED IN THE CATEGORY OF THE SUBGLACIAL STREAM COURSES. THEY LIE BEYOND THE LIMITS OF WISCONSIN GLACIATION, HENCE IF DUE TO ANY GLACIAL CONDITIONS, MAY BE AScribed TO THE SPOKANE EPOCH. THEY ARE N-S NOTCHES ACROSS AN E-W DIVIDE, JUST AS THEY SHOULD BE. NOWHERE IN THE WHOLE AREA HAVE E-W NOTCHES BEEN FOUND ACROSS N-S RIDGES. BEEN FOUND

ANOTHER GROUP OF NOTCHES, VERY STRIKINGLY GASH-LIKE IN APPEARANCE. LIE ABOUT TWO MILES NORTH OF SACHEEN LAKE. THEY ARE IN PLAIN VIEW ~~FROM THE~~ JUST NORTH OF THE ROAD CORNER WHERE A NEWPORT ROAD LEADS EAST FROM THE USK ROAD. THE USK ROAD TRAVERSES ONE OF THESE NOTCHES. IT IS VERY NARROW AND WITH PRECIPITOUS WALLS. THE TALUS FROM THE TWO SIDES OVERLAPS. NO STREAM THRU IT NOW. ALL THREE ARE ESSENTIALLY N-S AND CUT A NEARLY E-W RIDGE OF GRANITE. THEY LIE SOUTH OF THE WISCONSIN MORaine. NOTHING TO EXPLAIN THEM EXCEPT THE PROPOSED SUBGLACIAL STREAM HYPOTHESIS! IT IS PARTICULARLY SIGNIFICANT THAT MOST OF THE NOTCHES FOUND THIS SEASON OCCUR IN GROUPS.

DIAMOND LAKE APPARENTLY DAMMED BY THE WISC VT. ITS ALT. IS 2350 BY ANEROID WHICH CHECKED AT BOTH ENDS OF A TWO HOUR TRIP. SIGN AT EAST END OF LAKE SAYS 2450, BUT MUST BE IN ERROR. IF 2350 ON HIGHWAY (PERHAPS 20 FT. ABOVE THE LAKE) THEN THE LAKE'S ALTITUDE IS RIGHT FOR ORIGIN BY A DAM OF THE LITTLE SPOKANE VT. ON THE OTHER HAND, IT MAY BE A LAKE IN THE SPOKANE DRIFT TOPOG., NOT YET FILLED. EXTENSIVE FLATS JUST ABOVE LAKE LEVEL, AT THE WEST END.

SPOKANE DRIFT COVERS THE DIAMOND LAKE REGION. ITS TOPOG. HAS LITTLE RELIEF. IT SLOPES GENTLY FROM ALL SIDES TOWARD THE LAKE. SOME OF IT IS A CLEAN FAIRLY FRESH GRAVEL BENEATH THREE FEET OF REDDISH GRAVEL AND LOAM. SOME IS TILL.

SOUTH OF THE PREGLACIAL DIVIDE CROSSED HERE BY THE HIWAY (THE DIVIDE WITH FOUR NOTCHES) THE REGION IS 200 FT OR MORE LOWER AND MUCH ROUGHER FOR A FEW MILES. MUCH ROCK IN EVIDENCE. APPARENTLY NOT SO GREAT A FILL OF SPOKANE DRIFT SOUTH OF THE RIDGE AS NORTH OF IT.

SPOKANE DRIFT ALL OVER THE COUNTRY UNDERLAIN BY THE BASALT. SOME OF IT LOOKS VERY MORAINY. HIWAY DESCENDS OVER ROUNDED TERRACES OF SPOKANE GRAVEL TO THE LEVEL OF THE LITTLE SPOKANE VT, A LITTLE WAY NORTH OF CHATTAROY. THESE GENTLE SLOPES ON THE SCARPS OF THE SPOKANE GRAVEL MEAN EITHER A MUCH GREATER AGE THAN THE STEEP SCARPS OF THE WISC. VT, OR ELSE THEY MEAN EXCEPTIONAL CONDITIONS OF DEPOSITION, THO JUST WHAT CONDITIONS IS NOT AT ALL CLEAR. PROBABLY THE IDEA OF GREATER AGE IS THE BETTER.

LAKE ELOIKA (BLAKE'S LAKE) LIES IN A VALLEY 250-300 FEET DEEP. FAN LAKE AND HORSESHOE LAKE ALSO LIE HERE. THE VALLEY AT WEST BRANCH APPEARS TO HAVE SPOKANE MORAINAL MATERIAL IN IT. THE VALLEY SEEMS TO HEAD IN THE MTS BETWEEN COLVILLE VALLEY AND NEWPORT, BUT THERE MAY BE A ROUTE ACROSS FROM SACHEEN LAKE. THE ELONGATION OF THE VALLEY IS VERY SUGGESTIVE OF STREAM ORIGIN. IT IS LOCATED ALONG THE CONTACT OF BASALT AND GRANITE, THE WEST WALL BEING THE BASALT ESCARPMENT. IT IS A SPOKANE FEATURE. THE LITTLE SPOKANE VT CANNOT CONSTITUTE A DAM FOR IT, AND THE WESTERN BULGE OF THE WISC. MORAINE IN CLARKS FORK VALLEY CANNOT BE CONCERNED IN BLOCKING THE VALLEY. IT IS POSSIBLE THAT IT REPRESENTS A DEEP-SET SUBGLACIAL STREAM OF THE SPOKANE FLOOD, BUT THIS CANNOT BE ARGUED UNTIL MORE DATA ARE AT HAND.

AT CHATTAROY, THE WISC. VT IS IN TWO TERRACES, THE UPPER ONE ABOUT 50 FEET HIGH, THE LOWER ONE FULLY 100. THE TRENCHING BY THE RIVER OUT OF CLARKS FORK VALLEY DOWN THE LITTLE SPOKANE SEEMS TO HAVE OCCURRED HERE ~~AS AT NEWPORT~~. THE UPPER TERRACE CUTTING CANNOT BE A CONSEQUENCE OF THE LITTLE SPOKANE'S POSTGLACIAL WORK.

THE LIDGERWOOD TERRACE MUST BE CONSIDERED AS PART OF THE WISC. VT. PRESUMABLY EDDIED BACK FROM THE MAIN GLACIAL RIVER FROM PEND OREILLE LOBE DOWN THE SPOKANE. THE SURFACE OF THIS TERRACE CERTAINLY DESCENDS NORTHWARD TOWARD THE LITTLE SPOKANE.

NOWHERE IN THE WHOLE AREA HAVE E-M NOTCHES BEEN FOUND SINCE 1948 RIDDERS. BEEN FOUND

SPOKANE TO BONNERS FERRY AUG. 20 1925

THE TM OF THE PEND OREILLE LOBE OF WISCONSIN ICE WAS CORRECTLY LOCATED IN 1923 NOT THE SLIGHTEST DOUBT OF IT, AFTER RE-EXAMINATION TODAY. NO LAKE SILTS SEEN SOUTH OF SAND POINT. MORAINES, GRAVEL AND ROCK KNOBS. THESE KNOBS STRONGLY GLACIATED.

BUT A GREAT SILT DEPOSIT EXTENDS NORTH FROM SAND POINT TO BONNERS FERRY. ITS ALT. IS BETWEEN 2100 AND 2200 IN THE VICINITY OF S.P. AND ABOUT 2300-2400 NEAR B.F. WHERE KOOTENAI RIVER HAS DISSECTED IT AND LEFT TERRACES WHOSE SCARPS ARE 200 TO 300 FT HIGH. SILT IS MORE YELLOWISH IN COLOR THAN THAT IN WASHINGTON BUT HAS VARVE BEDDING WELL DEVELOPED. NO GOOD EVIDENCE OF DEPOSITION ALONG EDGES OF AN ICE TONGUE, AS THERE IS IN OKANOGAN LAKE VALLEY. NOR ARE THERE ANY MORAINIC TERRACES ON THE MT. WALLS. PRIEST LAKE MAP SHOWS SILT FILLING WELL IN CLARKS FORK VALLEY EAST OF PODOREILLE LAKE AND IN KOOTENAI VALLEY NORTH OF B.FERRY.

NO NOTCHES OR GASHES SEEN. NONE SHOWN ON MAP. THIS IS IN HARMONY WITH THE EVIDENCE EAST OF SPOKANE THAT THE FLOOD DID NOT ENTER THE PLACID LAKE WATERS THERE. BUT WHY NOT?

STUDY OF DRAINAGE LINES AND MT. RANGES IN CANADA JUST NORTH OF THE BDRY LINE SHOULD LOCATE THE EASTERN POSSIBLE LIMITS OF THE SUBGLACIAL VULCANISM AND ITS FLOOD. ^{ICE DOUBTLESS DEEPER (SURFACE HIGHER) IN P.D.R. valley than farther west, because of higher mts for feeding grounds.}

SEE RATHDRUM SHEET FOR ALTITUDE OF NORTH EDGE OF SPOKANE VALLEY TRAIN.. THIS SHOULD BE HIGHER THAN THE CHANNEL AT NEWPORT TO THE LITTLE SPOKANE AND WOULD THUS ESTABLISH THE FACT OF DRAINAGE OF SAND POINT-PEND OREILLE-BONNERS FERRY LAKE TO THE LITTLE SPOKANE.

LATER— THE ALTITUDE OF THE TWO PLACES IS ALMOST EXACTLY THE SAME-2400.

BOTH DISCHARGEWAYS THUS FUNCTIONED DURING BLDG OF THE VT AND THERE HAS BEEN NO TILTING IN THE REGION SINCE.

THE SILT TERRACES ABOUT BONNERS FERRY CONTAIN TILL IN THE LOWER PART IN PLACES. THE LOWER TERRACES, THO LARGELY SILT, GENERALLY HAVE A GRAVEL COVER, THE DEPOSIT OF THE POSTGLACIAL RIVER WHICH CARVED THEM OUT OF THE ORIGINAL DEPOSIT. EXPOSURES FROM BONNERS FERRY TO TROY AND LIBBY ALONG THE HIWAY ARE FEW. AND FOREST OBSTRUCTS THE VIEW. SOME SECTIONS NEAR LIBBY SHOW SILT BUT THE HIGHEST TERRACE IS HEAVILY COVERED WITH GRAVEL, IF NOT ALL GRAVEL.

TOPOGR. MAP SHOWS THESE WIDE VALLEYS ON PRIEST LAKE SHEET TO BE SINGULARLY BACKING IN SPURS. SOME MT. FRONTS LOOK LIKE STRUCTURAL SLOPES.

THE SILTS OF BONNERS FERRY REGION IS FINE ENOUGH TO FORM MUD TRICKLES AND RIVULETS OVER THE FACE OF THE ROADSIDE CUTS, DURING RAINS THESE REMAIN DURING THE DRY SEASON. IN SOME SECTIONS HOWEVER, THE MATERIAL SEPARATES TO A FINE LOOSE SAND WHEN DRY, A SAND WHICH DRIFTS AND RIPPLES LIKE DUNE SAND. A GREAT DEAL OF WHITE SILT EXPOSED IN GNRR CUTS NEAR BONNERS FERRY. (WEST OF BF AND 10-15 MI AND LESS WELL SHOWN NEAR NORTHERN CROSSING OF GN OVER THE ?)

THE SILTS OF THESE VALLEYS BELONG TO THE CLASS OF DEPOSITS, GENETICALLY, AS THE NESPELEM ~~FORMATION~~ IN OKANOGAN VALLEY, COLVILLE VALLEY, COLUMBIA VALLEY, ABOUT CEDONIA, ETC. AND THEY ARE ALSO OF THE SAME AGE—NAMELY, LATE WISCONSIN.

GENESES OF SILTS.

LAKE SILTS OF OKANOGAN VALLEY ALMOST UNQUESTIONABLY WERE DEPOSITED ALONGSIDE A TONGUE OF ICE IN MIDVALLEY. SO WITH SILTS IN OKANOGAN RIVER VALLEY, GOOSE LAKE VALLEY AND MANY MINOR VALLEYS OF THIS REGION.

BUT LAKE SILTS OF THE COLUMBIA VALLEY BETWEEN BOUNDARY LINE AND SPOKANE RIVER, IN COLVILLE VALLEY, IN CLARKS FORK VALLEY NORTH OF NEWPORT, ABOUT BONNERS FERRY, ETC, WERE AS UNQUESTIONABLY

DEPOSITED IN LAKES WHICH FILLED THE ENTIRE VALLEYS, AT LEAST FROM SIDE TO SIDE. THESE LAKES
FOR ALL REQUIRE A DAM. IN EVERY CASE THE VALLEYS OPEN TO THE SOUTH. FOR COLVILLE VALLEY, THE MORaine
AND OUTWASH SOUTH OF SPRINGDALE CONSTITUTE A DAM, AT LEAST UNTIL THE ICE HAD RETREATED NORTH OF
COLVILLE. FOR COLUMBIA VALLEY NORTH OF SPOKANE RIVER JCT., THE SPOKANE VALLEY TRAIN MUST HAVE
BEEN THE DAM. FOR CLARKS FORK, PEND OREILLE LAKE AND BONNERS FERRY, ALL THESE VALLEYS BEING OPEN
INTO ONE ANOTHER, BELOW THE LEVEL OF THE SILTS, THE RATHDRUM PRAIRIE AND LITTLE SPOKANE VTS MUST
HAVE BEEN THE DAM. SILTS THEN WERE DEPOSITED IN THE DEPRESSIONS WHERE THE ICE LAY WHEN THE
MORAINE AND VTs WERE DEPOSITED, AND RETREAT FROM THESE DEPRESSIONS MUST HAVE BEEN VERY RAPID
TO AVOID THEIR FILLING WITH GRAVEL, OR THE SUPPLY OF GRAVEL MUST HAVE BEEN MUCH LESS DURING RETREAT
ALONG THESE STRETCHES.

TERRADES ON THE MT. MELT. RIBBED LAKE WAS SIMILARLY FILLING MELT IN CLARKS FORK

PEND OREILLE LAKE AND IN KOOSENAY VALLEY MOUTH OF S. FERRY.

NO HATCHES OR SASHES SEEN. NAME SHOWN ON MAP. THIS IS IN HARMONY WITH THE EVIDENCE

EAST OF SPOKANE THAT THE FLOOD DID NOT ENTER THE RAVOID LAKE WATER THERE. BUT MY NOTES

STUDY OF DRIVEWAY LINES AND MT. RANGES IN CANADA TELL NORTH OF THE BORROW LINE SHOULD LOCATE THE
EASTERN POSSIBLE LIMITS OF THE SUEDELOAF ALLOANISM AND ITS FLOOD. 1900' ALLOANISATION, 1900' SUEDELOAF,
SEE RATHDRUM SHEET FOR ALITUDE OF NORTHERN EDGE OF SPOKANE VALLEY TRAIN. THIS SHOULD BE
HIGHER THAN THE CHANNEL AT NEWPORT AS COMPARED TO THE LITTLE SPOKANE AND MELT THIS ESTABLISH THE FACT OF

DRAWING OF SAND POINT-PEND OREILLE-BONNERS FERRY LAKE TO THE LITTLE SPOKANE.
LATER. THE ALITUDE OF THE TWO PLACES IS ALMOST EXACTLY THE SAME-SAY 5000.

EDTH DISCHARGEWAYS SHOW FUNCTIONING DURING BLOC OF THE VT AND THERE HAS

BEEN NO LIFTING IN THE REGION SINCE.

THE SILT TERRACES AROUND BONNERS FERRY CONTAIN LIFT IN THE LOWER PART IN PLACES. THE LOWER

TERRADES, THE LARGEST SILT, GENERALLY HAVE A GRAVEL COAT, THE DEPOSITS OF THE POSTGLACIAL RIVER
WHICH DRAWS THEM OUT OF THE ORIGINAL DEPOSIT. EXPOSURES FROM BONNERS FERRY TO TROY AND LIBBY SHOW SILT
ALONG THE HIGHWAY ARE FREE. AND FOREST OVERGROWS THE AIRE. SOME SECTION NEAR LIBBY SHOW SILT

BUT THE HIGHEST TERRACE IS HEAVILY COVERED WITH GRAVEL, IF NOT ALL GRAVEL.
TOPOG. MAP SHOWS THESE MILD VALLEYS ON RIBBED LAKE SHEET TO BE SIMILARLY BACKED IN SPOTS

SOME MT. RIBBONS LOOK LIKE STRUCTURAL RIBBONS.
THE SILT OF BONNERS FERRY REGION IS FINE ENOUGH TO FORM MUD CRACKS AND RIBBONS OVER THE

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HOWEVER, THE MATERIAL SEPARATES TO A FINE LOOSE SAND WHEN DRY, A SAND WHICH SPLITS AND RIBBLES
LIKE DUNE SAND. A GREAT DEBT OF WHITE SILT EXPOSED IN GROUT CUTS NEAR BONNERS FERRY. (CUTS OF

50' WITH 10-12' MI AND LESS MELT SHOW NORTHERN DRASSING OF GLA OVER THE)
THE SILT OF THESE VALLEYS BELONGS TO THE CLASS OF DEPOSITS, GENERALITY, AS THE MELT

FORMATION IN OKANAGAN VALLEY, GORALLE VALLEY, GORALGY VALLEY AROUND CEDARVILLE, ETC. AND THEY

ARE ALSO OF THE SAME AGE- MELT. FILE MELTSONGIN.

GENERALITY OF SILTS.

LAKE SILTS OF OKANAGAN VALLEY ALMOST UNDISTINGUISHABLE HERE DEPOSITED ALONGSIDE A TONGUE OF
ICE IN MIDVALLEY. SO WITH SILTS IN OKANAGAN RIVER VALLEY, GOOSE LAKE VALLEY AND MANY MILES

VALLEYS OF THIS REGION.
SILT LAKE SILTS OF THE COLUMBIA AND SPOKANE RIVER AND SPOKANE RIVER, IN GORALLE

VALLEY, IN CREEKS FORK VALLEY NORTH OF NEWPORT, ABOUT BONNERS FERRY, ETC., MELT AS UNDISTINGUISHABLE