SANITARY SURVEYS OF WHITE DEER CREEK WITH SPECIAL EMPHASIS UPON THE EFFECT OF BEAVER ON THE QUALITY OF THE WATER

Thesis presented in partial fulfillment of the requirements
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by

ROBERT ANTHONY GARDNER

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PROFESSOR W.C. HOAD

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WHITE DEER WATER COMPANY

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THE SANITARY SURVEYS OF 1931, 1934, & 1936

The sanitary surveys of White Deer Creek were carried out in June of 1931, 1934, and 1936, on the following respective dates, 11-17, 13-20, and 10-16. The surveys were sponsored and financed by the Community Water Service, Inc., through its local subsidiary, The White Deer Water Company. The surveys were executed by Dr. John W. Rice, Professor of Bacteriology, Bucknell University, and the writer, assisted by 6 to 8 recently graduated pre-medical and engineering students. In addition, a local woodsman served as camp cook and guide.

The purpose of such surveys was to gather information of a sanitary engineering nature with accompanying recommendations, for presentation to the water company, improving the quality of the water. The survey results have been extensively used by the company for publicity in building up the "good will" of the patron communities. A few camps violating sanitary regulations have been reported to the district forester after each survey.

The most vigorous action taken by the White Deer Water Company followed the survey of 1931, which showed apparent pollution by beaver. The very definite indications of pollution in beaver infested areas were presented to the Board of Game Commissioners of the Commonwealth of Pennsylvania. The Commission had state trappers remove 65 beaver alive for restocking purposes elsewhere, and repealed the protective law of long standing to permit trapping beaver through out

the state in March, 1932. The trapping carried on by individuals through this open season was estimated by district foresters to have removed an additional 65 beaver, completely eliminating them from the watershed. The state men opened all beaver dams permitting the draining out of flooded areas, reducing the stagnant pools and ceasing the drowning of trees. The trapping, and opening of dams by the state, was carried out during July and August of 1931. Many dams were rebuilt that Fall by the remaining beaver. However these were opened by the water company at the end of theopen season in the Spring of 1932.

The survey of 1931 covered three major projects, namely; a bacteriological survey of all tributaries of the watershed, an inspection of all camps and parks, and the examination for identification of algal growths. The surveys of 1934 and 1936 continued these three features with improved methods of procedure, and added the gaging of the main stream, tributaries, and springs for definite quantitative information on the discharge of each.

The water company, the state foresters, and the camp inhabitants are definitely in favor of these surveys. The water company has borne the expense of the three previous surveys and expects to continue this practice in the future. The net effect of all concerned is a cleaner, more sanitary watershed, and a greater sense of reliability in the quality of water drawn for the Public or the private campers use.

THE WHITE DEER WATER COMPANY

The Company has always been owned by out of town interests. Originally owned by Drexel & Co. of Phila., numerous exchanges of ownership has finally resulted in its joining the chain of water companies owned and operated by The Community Water Service, Inc., which is in turn controlled by a holding company, The American Water Works Co.

The White Deer Water Company serves the towns of Milton, Lewisburg, Watsontown, White Deer, West Milton, Montanadon, Dewart, New Columbia, and also the North Eastern Federal Penitentiary, located 3 miles from Lewisburg. These towns are located in an area ten miles in length extending along the west branch of the Susquehanna River in central Pennsylvania. The aggregate population is 25,000. Milton with 10,000 population and Lewisburg with 4500 are the two largest towns.

Two watersheds are involved in supplying the water company. The White Deer watershed (area 37.83 sq. mi.) with a small reservoir at elevation 696, and the Spruce Run watershed (area 12.05 sq. mi.) with reservoir at elevation 671. Water is distributed by a gravity system entirely through out. The topography along the river including the built up areas is gently rolling with elevations varying from 460 to 570.

The demand for water is steady. The population does not fluccuate through out the year or during periods of business prosperity and depression. The population trend is a slow but steady increase as revealed by records from 1880 up to date. The single indication of a break

was caused by the establishment of the North Eastern Federal Penitentiary in this area in 1932, resulting in an influx of approximately 2000 inmates and federal employes. Since that period a slow steady growth has been restored.

The industrial demand for water, usually the variable component, has never been appreciable. Many manufacturing concerns, including the steel mills at Milton and the brick works at Watsontown, have their own supply systems. Small steel fabricating plants, furniture factories, silk and woolen mills, creameries, and ice cream plants draw water from the system. The consumption averages 100 gallons per capita per day, with the White Deer watershed furnishing 1.5 million gallons per day and the Spruce Run watershed 1.0 million. Under normal conditions of stream flow, either water shed will meet the whole demand. This permits flexibility in operation to meet an impaired quality of water on either watershed.

Storage is not appreciable at either the White Deer or the Spruce Run reservoirs. Storage is provided through out the system as follows,

Milton -----	open reservoir ---	1.0	M. gallons
Lewisburg ----	standpipe -----	1.0	" "
Watsontown ---	open reservoir ---	0.3	" "
N. E. Pen. ---	standpipe ------	1.0	" "
	elevated tank ----	0.5	" "

The general lay-out of the White Deer Water Company system is shown on the following print. The scale is that of the local U. S. G. S. maps, 1 : 62,500, or approximately 1 inch to the mile.

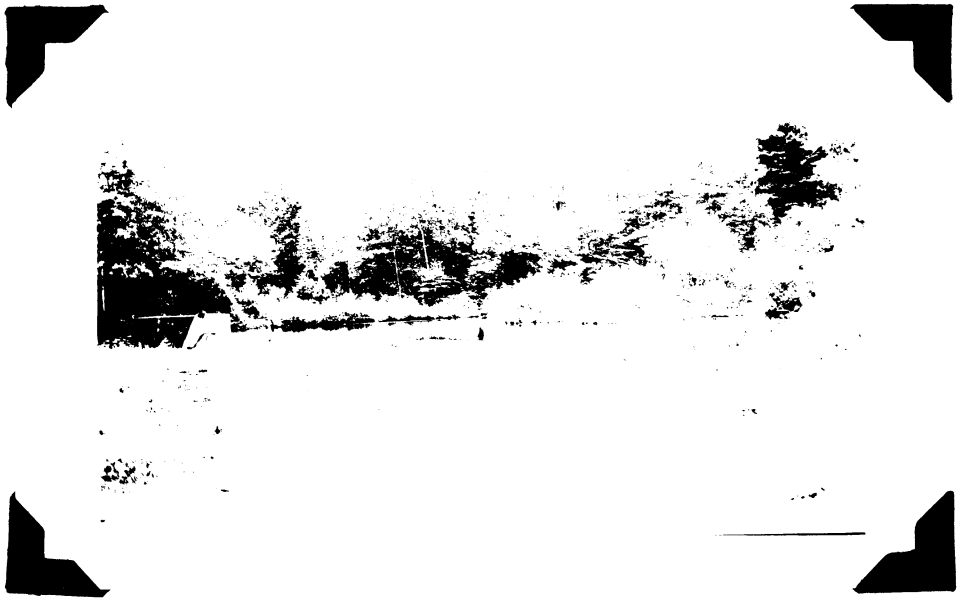
White Deer Reservoir

Water is collected in White Deer reservoir having very little storage capacity because of the low height earthen dam. The spillway (crest elevation 696) is a solid gravity design of concrete construction with ample wingwalls. Height of spillway crest above the stream bed is only 4 feet while the maximum height of the earthen embankment is 7 feet. Storage space has been furthur reduced by silting of the reservoir until channels remain open only through the center to the spillway and hence along the dam to the sedimentation channel. Water is wasted the year around in normal years. The only exceptions to this condition were the summers of 1931 and 1932. Seepage losses are very large as can readily be observed by examining the down stream side of the earthen dam.

The land in the vicinity of the reservoir on both sides of the stream is owned by the water company. Such ownership extends for 1 mile upstrem to join with state owned land. Residences for the reservoir caretaker and the assistant superintendent of the water company are down stream from the dam on opposite sides of the stream,

Sedimentation Channel

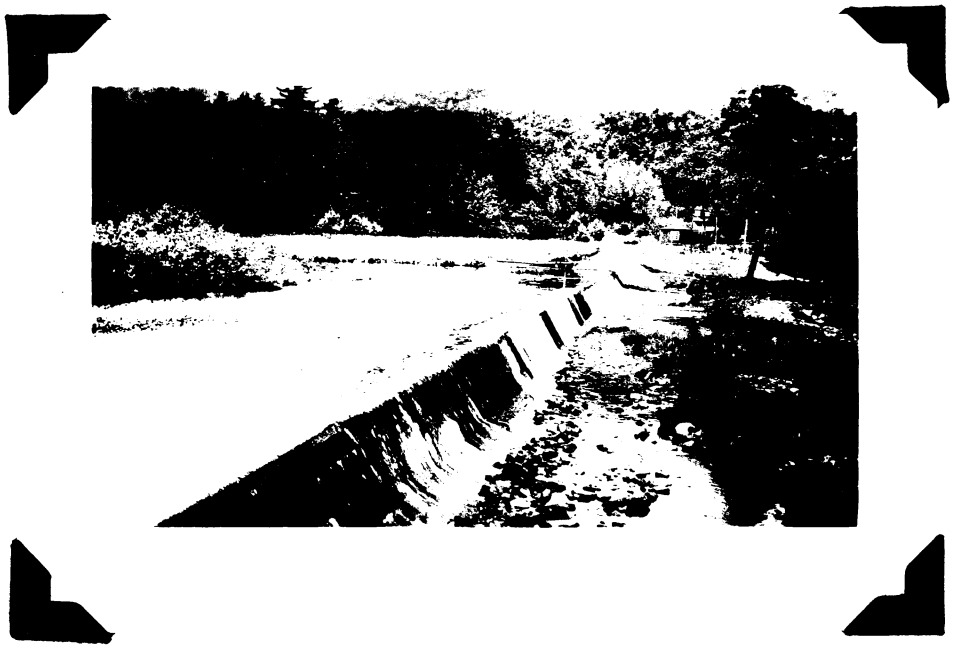
The sedimentation channel is 250 feet long, 20 feet wide and 3 feet deep extending parallel with and just back of the earthen dam. The channel is cut through marshy ground, carrying water from the vicinity of the spillway to the intake house set on the extreme North end of the dam. Fish are



SPILLWAY OF DAM AT THE RESERVOIR

(Looking South)

Note the small reservoir capacity



SPILLWAY, EARTHEN DAM, SEDIMENTATION CHANNEL, AND CHLORINATING HOUSE

(Looking North)

present in this channel as it is deeper and stores more water than the reservoir. Accumulated sediment is scraped out of the channel and over the dam to add to the height and also the down stream section. Such removal of sediment occurs about twice a year.

Sterilization Treatment

The chloramine process of sterilization is used. Water is admitted through 1/4 inch screens from the sedimentation channel to the intake house. Ammonium sulphate solution stored in a common wooden barrel is fed by a rubber suction line to the water as it passes the screens. Turbulence of the screens effects mixing. Liquid chlorine is fed from a Wallace & Tiernan chlorinator about 15 feet down the intake flume. Thorough mixing is accomplished by turbulence as the water passes through a submerged square edged entry to the 16 inch pipe line.

Operation Procedure

A test station for determining residual sterilizing agent is 300 feet down the pipeline. Samples are drawn and tested every two hours through the day and every four hours at night. The ortho-tolidine test is used with the usual color standards. Chlorine is adjusted to keep the residual, and the ammonium sulphate solution is varied in strength to keep a constant ratio between ammonia and chlorine.

A venturimeter near the test station is read at the same time the chlorine residual test sample is drawn. Records in an appropriate entry blank are kept of each observation by the caretaker.

WHITE DEER WATERSHED

The development of a large enough working map to orient our sampling parties at all times was imperative. Such a map was originally built up from the U.S.G.S. sheet covering the territory, and a watershed boundary survey by the water company. The map was corrected after each survey by field observations made by car speedometer measurements and pacing. The final corrected map after the 1936 survey is presented in this thesis and referred to as the WATERSHED MAP (Scale 1" equals 2,000'). This map, dated February 5, 1936, was revised after the 1936 survey by correcting the tracing as of October 20, 1936.

Corrections, involved after each survey, were location of newly discovered streams and springs, location of newly constructed camps, and location of newly constructed roads, trails, and bridges.

This WATERSHED MAP follows and is detachable for examination. The significance of symbols is indicated in the title block.

Terrain Conditions

White Deer Creek rises in Clinton County, and flows successively through sections of Center and Union Counties in central Pennsylvania, emptying into the west branch of the Susquehanna River at White Deer, Pa. In general, it follows a west to east direction. The slope of the stream bed varies from a maximum of 160 feet per mile to a minimum of 16, averaging 40 for the 19.25 miles above the water supply dam. The area comprising this watershed above the dam is 37.83 sq. mi. The terrain is rugged, possessing sharp topographical features; unglaciated, as the glacial morraine is 30 miles to the north. Valleys are generally narrow throughout the whole watershed. In places it is difficult to get a road through as the slopes rise at a steep grade from the streams edge, while in other places the valley widens to a maximum of 1000 feet.

The lowlands are predomomantly coarse grained soils; boulders, gravel, sand and silt, being present in abundance. Clay is found only in areas above old beaver or logging dams. The sides of the valley are covered with outcropping sandstone, dolomite, and boulders of dolomite. The ridge of mountains comprising the edge of the watershed are weather resisting sandstone.

Vegetation

The original stand of virgin timber was cut off in the decade previous to 1900. Forest fires have swept sections of the region until the effective functioning of the state foresters since 1915 reduced in number and localized such fires.

LOOKING UP THE WATERSHED

(Looking West from Buck Knob)

Sand Spring Run to the right. Main Creek passing to the left but winding back to be visible in the background at the left.

AN OPEN GLADE

Typical of the deer feeding areas which are plentiful on the watershed

MOUNTAIN LAUREL

These great banks of flowers attract many visitors in late June

MILE RUN

(Looking North from Buck Knob)

At the present time, vegetation of all kinds thrives in the valley. Second growth trees of many hardwoods, hemlocks, pines, and aspen, up to 1 foot in diameter, are prevalent. Occasionally is found a lone virgin pine or oak standing as a sentry from the previous era. Rhododendron and mountain laurel thickets are very common, and in places so dense as to make passage impossible. The growth of vegetation decreases in quantity with increase in elevation up the sides of the mountains until only scrub oak remains.

Wild Life

Animal life is abundant in this area. More so than in many other sections of the state land, because of the location of a large game reserve about 10 miles to the southwest. The usual kinds of small animals and birds are prevalent, with many unusual varieties found only in isolated areas present in considerable numbers. Deer , bear, beaver, wildcats, porcupines, wild turkeys, and whipper-wills, are an added inducement to attract hunters and vacationists to this area. White Deer and Sand Spring Run streams are natural trout habitats, having brook and brown trout as denizens of the deeper pools. In recent years these streams have been stocked by the Penna Dep't of Forests and Waters. Rattlesnakes and copperhead snakes infest many sections and demand the respect of the intruder.

Recreational Development of the Area

The watershed area attracts many hunting and fishing clubs with the result that sportsmans lodges are distributed throughout the accessible parts. With improved roads, as a result of civilian conservation corps activities, many of the

BLACK GAP

(Looking South)

View looking down from Eastville mountain road.

UP THE VALLEY

(Looking to West)

View from the same site.

SCRUB OAK

The usual tree growth on the higher ground.

wealthier residents of Sunbury, Lewisburg, Milton, Watsontown, and williamsport, have constructed cabins for weekend and vacation period occupation. Some camps are occupied throughout the week but this is the exception rather than the rule. Weekends and holidays from April to December, brings an influx of campers to tax the facilities of existing camps to the limit. New camps have been added annually and will continue to increase in number as long as the policy of the state remains to grant permits for such construction.

Picnic grounds, developed by the C. C. C. camp activities for public use, are prevalent in the McCalls Dam area. These grounds are equipped with outdoor stoves, tables, running water supply, and toilet facilities. Overnight and temporary camping occurs on the area but is not common.

Automobile travel has been greatly increased due to better roads, recreational facilities, and publicity of the area, all of which directly result from civilian conservation corps activities since 1933. The greatest automobile traffic occurs during the blossom season of the mountain laurel in mid-June.

Civilian Conservation Corps Activities

Two civilian conservation corps camps are located just off the watershed area. Tea Springs camp, to the north in Center County and just over the crest of the watershed on the road to Carrol, and Rapid Run camp, in the next valley to the south over Crabapple Mountain. Camp workers, under the guidance of a camp engineer co-operating with the Penna Dep't of Forest and Waters, have been engaged on the watershed in road and reforestation work.

STREAM FLOW ON THE WHITE DEER WATERSHED

Stream gaging was carried out only on the surveys of 1934 and 1936. Weather conditions were predominantly fair with rain during the latter part of the survey in these two years as well as in 1931. However, the volume of flow at this time of the year was not greatly increased as the interception, transpiration, and evaporation losses were at a maximum.

Measurements were made to determine the actual flow in cubic feet per second at the site, and to determine the percentage of the inflow to the reservoir contributed by each individual large tributary to the main creek.

Correcting Gagings for Rainfall Effect

In computing the percentage of the total inflow to the reservoir contributed by each individual stream, allowance was made for the effect of rain on the gagings taken after such rain had increased the runoff. The flow at McCalls Dam, previous to the rain, divided by the flow at the same site, on the day gaging measurements were made upstream, was used as a factor by which upstream gaging results were multiplied. The resulting flow is entered in the summary sheets for the stream flow records of 1934 and 1936 as "Corrected Flow". This corrected flow is then used as the flow contributed by a stream in computing the percentage of total inflow to the reservoir. This method I consider to give a fair degree of comparison between gaging results irrespective of interfering weather conditions.

Selection of Gaging Sites

Terrain conditions were far from ideal for gaging the streams. A confined channel with clay bottom could occasionally be located on the main stream, but all tributary streams had steep slopes and rarely afforded a desirable gaging site. Many streams tumbled down the hill through a rocky bed of sandstone boulders. Fills for the old tramroad and old beaver dam sites were used as the most satisfactory sites.

Effect of March, 1936, Flood on Gaging Sites.

Several sites used on the 1934 survey had to be discarded in 1936 because of the errosive action of the unprecedented flood of March, 1936. This was the condition on the main stream as well as the tributaries. Clay or fine sand sites, (rare on this watershed) were usually widened or divided into two or more small channels, or as in two instances, an entirely new stream bed had been cut through. Kettle Hole Run and Black Gap Run had worked large boulders and accompanying sand into the 1934 sites. In general, it was much more difficult to gage the tributaries in 1936 than in 1934.

Mechanics and Procedure of Gaging

Equipment:- A Price Improved Gurley current meter was used for all measurements. It was mounted as a wading meter with parafined wire connections long enough to carry the battery in the hip pocket an allow free movement of the supporting rod while the ear phones were in place. In all measurements the rotating vanes were supported on the pivot bearing.

Equipment was carried to the site by placing the dismounted

GAGING SITE JUST ABOVE RESERVOIR INLET

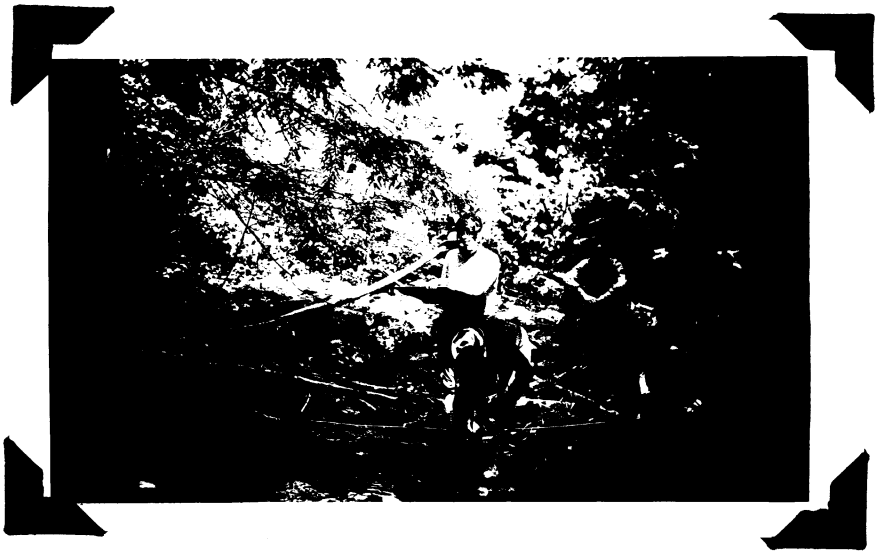
16 cubic feet per second flowing

GAGING SITE AT McCALLS DAM

Confined flow through an old beaver dam.

GAGING SITE ABOVE WOODEN BRIDGE

Just below Camp Recreation. Flow - 8 cfs.



THE BEST AVAILABLE

Gaging a tributary under very undesirable conditions.

vanes, with pivot bearing lowered, in a box containing a supporting cradle. Sections of the supporting rod, wire connections, battery, earphones, and other essentials were carried in a cloth satchel along with the tape and notebook.

Technical Method:- The two-tenths and eight-tenths depth method was used to determine average velocities in a vertical where ever possible. Vertical measurements were taken every two feet or closer where the bottom cross-section was irregular.

In shallow water, the six-tenth depth method or surface velocity method were resorted to in securing average velocities in the vertical. In all cases due allowance was made for the vanes being 0.40 feet above the zero position on the rod.

Observations and Computations:- Observations were recorded and computations carried out on standard U. S. Geological Survey, Water Resources Branch, form sheets. Notes were appended to each set of data describing the gaging site and giving an estimate of the probable accuracy of the results.

Summary of Gaging Results

The venturi meter reading on the pipeline indicated a flow of 1,471,000 gallons per day, or 2.27 cubic feet per second, out of the reservoir in 1934. In 1936 the demand was 1,320,000 gallons per day or 2.04 cubic feet per second.

Considerable water was wasting over the spillway at all times. Unfortunately, the spillway crest was not level and could not be used as a weir with any approximate degree of accuragy. A gaging station just above the reservoir indicated the inflow as 16.22 c. f. s. in 1934, and 13.30 in 1936.

SUMMARY OF STREAM GAGING ON WHITE DEER CREEK AND TRIBUTARIES
DURING THE SANITARY SURVEY OF 1934.

STREAM	GAGING SITE	DATE	MEASURED C. F. S.	CORRECTED C. F. S.	% OF INFLOW TO RESERVOIR
Pipe line	Venturi Meter	6/13/34	2.27		14.0
White Deer Creek	Inlet to Reservoir	6/13/34	16.22		100.0
Kettle Hole Run	Old Farm Road	6/16/34	0.56		3.6
Lymans Gap Run	1/4 mile above outlet	6/16/34	0.74		4.6
Lick Run	1/8 mile above outlet	6/13/34	1.04		6.4
Mile Run	Plank Walk	6/13/34	0.76		4.8
Sand Spring Run	Bridge on Creek Road	6/14/34	2.49		15.1
White Deer Creek	Wooden Bridge(below Recreation Camp)	6/14/34	8.45		52.1
Crabapple Run	Shakespere Camp	6/18/34	1.06		6.5
McCalls Branch	Camp Lucky	6/18/34	0.60		3.7

SUMMARY OF STREAM GAGING ON WHITE DEER CREEK AND TRIBUTARIES DURING THE SANITARY SURVEY OF 1934.

STREAM	GAGING SITE	DATE	MEASURED C. F. S.	CORRECTED C. F. S.	% OF INFLOW TO RESERVOIR
White Deer Creek	Old Beaver Dam	6/18/34	3.23		
	At McCalls Dam	6/20/34	5.34	3.23	19.9
Black Lap Run	Log Cabin	6/20/34	0.86	0.52	3.2
White Deer Creek	Below junction of Hall and Tunnis Branches	6/20/34	2.18	1.32	8.1
Tunnis Branch	Stone Camp	6/20/34	1.12	0.68	4.2
Halls Branch	(By difference)			0.64	3.9

SUMMARY OF STREAM GAGING ON WHITE DEER CREEK AND TRIBUTARIES
DURING THE SANITARY SURVEY OF 1936.

STREAM	GAGING SITE	DATE	MEASURED C.F.S.	CORRECTED C.F.S.	% OF INFLOW TO RESERVOIR
Pipe Line	Venturi Meter	6/10/36	2.04		15.3
White Deer Creek	Inlet to Reservoir	6/10/36	13.30		100.0
Kettle Hole Run	A. C. and F. Camp	6/10/36	0.65		4.9
Lyman's Gap Run	Oak Den Camp	6/10/36	0.71		5.3
Lick Run	1/8 mile above outlet	6/11/36	0.73		5.5
Mile Run	Camp Goodlander	6/11/36	0.61		4.6
Sand Spring Run	Creek Road Bridge	6/11/36	3.02		22.7
White Deer Creek	Bridge below Camp Recreation	6/11/36	7.93		59.6
Crabapple Run	Shakespere Camp	6/13/36	0.92		6.9
McCall's Branch	Camp Lucky	6/13/36	0.61		4.6
White Deer Creek	Old Beaver Dam	6/13/36	3.19		
	at McCall's Dam	6/15/36	4.00	3.19	24.0

STREAM	GAGING SITE	DATE	MEASURED C.F.S.	CORRECTED C.F.S.	% OF INFLOW TO RESERVOIR
Black Gap Run	Below Cabin	6/15/36	0.50	0.33	2.5
White Deer Creek	Below junction of Hall and Tunnis Branches	6/15/36	2.29	1.52	11.4
Tunnis Branch	At Stone Camp	6/15/36	1.22	0.81	6.1
Hall's Branch	(By differences)			0.71	5.3

DISCUSSION OF STREAM GAGING RESULTS

Only 45% of the flow in White Deer Creek was contributed by the main tributaries gaged. The largest tributaries not gaged were Buck Knob Run, Fredricks Gap Run, Cow Bell Hollow Run, Pot Pie Hollow Run, Frying Pan Run, and the streams coming from the series of gaps on the north side between Cow Bell Hollow and McCalls Dam. Gaging any of these is out of the question. Installation of a weir is likewise impractical because of the coarse grained soil conditions, and the tendency to spread out in to two or more surface or subterranean channels. Evidence of this tendency is furnished by the Third Gap Run with three definite surface channels, and the Fourth Gap Run with two definite surface channels.

However, the flow of each of these ungaged tributaries was small and collectively would not account for more than 15% of the flow as pro-rated by area. Thus, we conclude that 40% of the main stream flow is due to direct spring and underground seepage.

Penns Creek watershed(area 301 sq. mi.) lies to the south west and is the nearest as well as the most comparable in size of the states regularly operated gaging stations. The runoff of 0.48 and 0.39 inches for 1934 and 1936, is comparable with the Department of Forests and Waters published results of 0.66 and 0.49 for June on the Penns Creek watershed.

Sand Spring Flow Exceeds Draft of Water Company

The gaging results for both years showed Sand Spring Run contributing enough water to meet the demands of the White Deer Water Company. This statement gives an idea of the adequateness of the supply. However, it does not mean that a reservoir constructed on Sand Spring Run would meet the demands of the water company. Reservoir evaporation losses, seepage, and riparian rights alotments would reduce the available draft below the present demands. Furthermore, this was not the most critical period of low flows. Results throughout the state in 1930-31 changed the dependable low flow criterion suggested by the Dep't of Forests and Waters from 0.10 cfs. to 0.05 cfs. Applying this criterion Sand Spring Run could be depended upon for only one-tenth as much water as determined on these surveys.

Comparison of Ground Water Flow in 1934 & 1936

A comparison of the results on the 1934 and 1936 surveys gives an idea of the relative amounts of spring and surface flow.

Previous Rainfall Conditions in 1934 and 1936:- The summer of 1934 was at the end of a pronounced drought cycle effective since 1930. The result was a depressed ground water level, and a drying up or diminishing flow from springs. This was true even though precipitation for the Spring of 1934 was near normal, up to and including June, the month of the survey.

The situation in 1936 was decidedly different. The late Summer and Fall of 1934 produced very severe drought conditions throughout the entire United States. This was relieved during the Winter and following Spring with exceptionally heavy precipitation. Continued heavy rainfall and flood conditions in March,

1936, greatly augmented the ground water supply. However, the rainfall for April, May, and June, of this year is considerably below normal. A deficiency of nearly 2 inches occuring in May alone. Thus, surface drainage and shallow springs are producing a decreased flow as compared with 1934, while deep seated and larger springs are flowing more freely.

Williams port is located about 12 miles north of McCalls Dam. The rainfall record for that weather station follows,

Rainfall Record, U. S. Weather Bureau Station, Williamsport, Pa.

	Precipitation inches	Departure from the normal in inches
1934		
April	3.06	-0.36
May	3.06	-0.88
June	3.64	-0.54
1936		
April	3.01	-0.41
May	2.09	-1.85
June	3.80	-0.38

Surface Fed Streams on the Watershed:- The inflow to the reservoir is only 13.30 cfs. in 1936 as compared with 16.22 in 1934. The larger surface tributaries show this same tendency as is evident from the comparison below.

Stream	1934	1936
Lick Run	1.04	0.73
Mile Run	0.78	0.61
Lymans Gap Run	0.74	0.71
Crabapple Run	1.06	0.92
Black Gap Run	0.52	0.33

McCalls Branch is a long surface stream draining a narrow valley and has many small springs. The flow is very similar in the two years, 0.61 and 0.60 cfs., respectively.

Spring Fed Streams on the Watershed:- On the otherhand, the streams which are very definitely spring fed, and particularly those on the head waters, show the effect of a better ground water supply in 1936. Sand Spring Run is the largest tributary to White Deer Creek, draining an area of 5.00 sq. mi., but is predominantly a spring fed stream. Sampling results show 12 very sizable springs along the 5 1/2 miles of stream channel. In addition, the 8 other flowing streams sampled undoubtedly had one or more springs at their source.

The following streams are predominantly spring fed,

Stream	1934	1936
Kettle Hole Run	0.58	0.65
Sand Spring Run	2.45	3.02
Tunnis Branch	0.68	0.81
Halls Branch	0.64	0.71

Individual Spring Gagings:- In furthur support of the better conditions of spring flow in 1936, gagings on the two largest springs on the watershed definitely show them to be flowing in larger quantity. Sand Spring on Sand Spring Run, and Millmont Spring on Tunnis Branch had confined outlets permitting the measurement of flow. These results follow,

Spring	1934	1936
Sand Spring	0.13	0.17
Tunnis Branch Spring	0.14	0.22

Immediately following is a summary of the flow, during 1934 and 1936, with respect to area for White Deer Creek, Sand Spring Run, and the upper section of the main creek.

On the following pages are summarized the gaging results on the main stream and main tributaries for the two surveys. The flow at each of these sites is also expressed as a percentage of the total inflow to the reservoir.

Summary of Flow with Respect to Area

	Flow c.f.s.	Area sq. mi.	C.F.S. per sq. mile	Eq. Runoff inches per mo.
1934				
White Deer Creek	16.22	37.83	0.43	0.48
Sand Spring Run	2.45	5.00	0.49	0.55
White Deer Creek (above McCalls Dam)	3.23	6.85	0.47	0.52
1936				
White Deer Creek	13.30	37.83	0.35	0.39
Sand Spring Run	3.02	5.00	0.60	0.67
White Deer Creek (above McCalls Dam)	3.19	6.85	0.47	0.52

INSPECTION OF CAMPS

The Pennsylvania State Legislature, by an act of March 27, 1913, authorized the department of forestry to lease parcels of the state forest land for periods not exceeding ten years, for healthful, educational, or recreational purposes. Three camps on the watershed own their site and an appreciable amount of surrounding land, having clear titles from individual owners before the State became interested in buying forest land. By the privilege of the above act interested individuals or groups of individuals have constructed camps in such numbers that they totaled (34) in 1931, (41) in 1934, and (42) in 1936. Indications are they will continue to grow in number with returning prosperous years unless the policy of the State is altered.

A lease is granted for a term of years, not exceeding ten, with the privelege of renewal. Only citizens of Pennsylvania may hold leases or interests in leases. A lease obtained under false pretense by a citizen or association for the use of non-citizens of the state is justifiable cause for cancellation of the lease. All leases provide that a building must be erected on the site within two years of the granting date. This period of time may be extended upon the recommendation of the district forester who is acquainted with the circumstances.

Temporary Camping

Camping overnight in tents or bivouac does not require securing permission. Occupation of the site for more than 48 hours requires the securing of signed permits from the District

Forester. These permits are granted for a maximum period of three weeks. Temporary camping of this nature is resorted to by a small number of hunting and fishing parties.

Securing of Camp Site Leases

Application for a camp site lease in the state forests must be made on a special form, 59-A, to the district forester or the Harrisburg office. Form 59-A requires the names and addresses of the applicants, the signature of all persons having a financial interest in the camp, a description of the desired site, and the estimated cost of the proposed building. A sketch or plan of the building, together with the building specifications, should be placed on the reverse side of the application.

If a lease is granted to an unchartered club or to a group of people, it must be executed by an individual who will serve as trustee for the group. The leasee is held responsible for carrying out the provisions of the lease, and must necessarily enforce its provisions upon the other members and guests.

Clubs usually secure a charter. The lease is then executed by the officers of the club. A charter is obtained by making application to the County Court of Common Pleas, under the act of April 29, 1874. After the application has been duly advertised, the charter is granted by the court. Such a procedure involves a nominal cost.

Location of Camp Sites

Applicants usually have a definite site for their proposed camp in mind. The District Forester accompanys the applicant and passes judgement on the feasibility and desirability of using

that site. The District Forester, a state employee and subject to politics, is usually anxious to gain popular favor and oblige in every possible way. After a particular site has been chosen it is given a definite number which signifys the particular one of the 21 state forest districts of the camp location, and also the number of the camp in that district. Thus, 7C-150 indicates camp #150 in the 7th district. Adjacent camps have similar but not necessarily consecutive numbers.

The District Forester submits a survey of the chosen site with his report to the Harrisburg office.

Size of Camp Sites

The three privately owned camps have appreciable areas with them. However, the leased camp sites vary from two acres down to 1/10 th acre. In the early years of the campsite program it was not uncommon for the land granted under an individual lease to cover from 1 to 2 acres. The increasing demand for sites has reduced the size granted, so that now individual sites range from 1/10 th to 1/4 th of an acre. Leases upon expiring, and which originally included 1 to 2 acres, are renewed for much smaller areas but which are still large enough to include all permanent buildings.

Rental Cost of Camp Sites

Camp site rentals are vary moderate and vary according to the location and size of site. Annual rentals range from $7 to $15 per individual site. The money received for the camp leases is, according to law, paid into the state school fund for the maintenance of the poorer school districts of the Commonwealth.

Camp Site Building Requirements

The following requirements are quoted from Circular 34 of the Penna State Dep't. of Forests and Waters, "The department requires that all buildings meet with certain approved standards, though it does not require that buildings erected on state forest camp sites be distinctive or uniform in character. The standards set by the department vary with locations and conditions, but in general the buildings should be presentable in appearance. The type of building to be erected should conform in appearance to those in the immediate locality. The use of galvanized sheet steel, corrugated iron, tin, boards or roofing paper as building siding has been found by experience to be unsatisfactory, and is therefore disapproved. All exposed woodwork should be painted a color in keeping with the forest background.

It is required that all buildings shall be kept in a good condition of repair and presentable in appearance. The grounds around the building shall be clean and sanitary, and from time to time the building should be painted."

Sanitary Provisions

Sanitary rules and regulations of the Department of Health are printed on the back of the camp site leases. They are subject to enforcement by the police powers of the state. However, the police power has to be motivated by complaints of adjacent camps or the White Deer Water Company.

All camps and buildings must be situated on comparatively level ground, at a distance of at least 50 feet from any stream or spring and 20 feet from any road or trail, and so located that the direct drainage will be away from rather than toward the stream or

spring.

Latrine and garbage pits must be provided. They should be made at a distance of 100 feet from any stream or spring, unless a watertight pit of concrete or stone masonry is provided, in which case the distance must be a minimum of 50 feet. Latrines should be kept in a sanitary condition at all times. The minimum depth of latrine pits is 5 feet below the surface of the ground.

Kitchen and wash water must not be thrown into a spring or stream, or upon the ground in the immediate neighborhood of any such watercourse.

Coffee grounds and sawdust must be kept out of all watercourses as a protection to the fish life.

Failure to observe sanitary regulations will be cause for ordering the vacating of the camp and revocation of the lease or permit.

Fuel

The privilege of using dead or down wood can be obtained from the state district forester gratis or at a very nominal cost. Usually no charge is made.

Camp Inspection

Human habitation is a threat to the quality of water in White Deer Creek. To protect itself, the Water Company has had occasion to initiate police action against camps violating sanitary requirements. An essential part of the sanitary surveys of this watershed was the close inspection of each camp site.

Dr. Rice personally inspected each of the 34 camps in 1931 and likewise each of the 41 camps in 1934. He personally inspected or carefully supervised the inspection of the 42 camps and 2

park areas in 1936. These inspections covered the watersupply, provisions for and methods of disposal of human excrement, and method of disposal of garbage and rubbish.

Watersupply inspection consisted in tracing down the camp source of water. Usually a spring, but in other cases a mountain surface stream was utilized. Samples were taken for bacteriological analysis and included in the report for the watershed as a whole. Camps using water showing possible pollution were advised of this fact with suggestions of available sources in the vicinity which tested satisfactory. Check samples were run on any camp supply sources testing to show B. Coli. content.

Toilet facilities, and use and maintenance of such facilities were carefully checked. Inspection was carried out with the idea they should be enclosed, tight, scavanger animal proof, rodent proof, and fly proof. Garbage and refuse disposal was checked to see whether it was properly covered in pits, thrown into streams, or scattered on the ground.

Sanitary Survey of Camps in 1936

I am omitting the camp by camp inspections of 1931 and 1934 because they would not add anything to the 1936 report. These camps are located and symbolized on the WATERSHED MAP by small triangles. Individual camps are designated by the camp name or the state forest number. The complete summarized account of all camps on the watershed is taken from the 1936 report by Dr. John Rice to the White Deer Water Company. This summarized report is presented on the following pages.

TABLE IV

SUMMARY OF SANITARY INSPECTIONS OF CAMPS ON WHITE DEER CREEK

June 10-16, 1936.

CAMP IDENTIFICATION		TOILET FACILITIES					GARBAGE & REFUSE		GENERAL
Name	State Forest Number	Pit Construction	Present Condition of Pit	Lime on Hand	State of Repairs	Cleanliness and Odors	In Pit Covered with Soil	Scattered on Surface of Ground	Condition About Camp
1- Maple Spring		Earth and stone	1/4 full of water	None	Fair	Fair	Partially covered	Some	Fair
2-Wertz's Camp-burned		Loose stone	Partially filled	None	Very poor	Poor	No Pit	Some refuse about place	Fair
3- A.C. & F. Camp	7C-176	Earth and stone	Slightly filled	None	Good	Fair	Partially covered	Some	Fair
4-	7C-178	Earth and stone	Partially filled	A Little	Poor	Fair	Covered	Old junk all around	Poor
5- Oak Den	7C-177	Earth and stone	(Door padlocked)	-	Good	Good No Odors	Covered	Premises clean	Very good
6- (1) Camp Tamaqua		Earth and stone	Partially filled	None	Good	Fair	Covered	Premises clean	Fair
7- (2) Wait-A-Minute	7C-181	Cement and stone	Partially filled	None	Good	Fair	None	Very much so	Poor
8- Limburger	7C-183	Earth and stone	Partially filled	None	Good	Fair	Covered	None	Good
9- Fern Spring	7C-182	Earth and stone	1/2 full of water	None	Good	Good	Covered	Refuse from carbide tank only	Good
10- (3) "Our Camp"	7C-184	Cement and stone	Partially filled	None	Good	Fair	Uncovered	Bottles all over place	Fair
11- Goodlander	7C-185	Earth and stone	Partially filled	None	Fair	Fair	Covered but dug open by animals	Bottles & tin cans near creek	Fair
12- Buffalo	7C-165	Concrete	Partially filled	None	Good	Fair	Under	Cans and paper s scattered about	Fair

TABLE IV (Cont.)

Camp Identification		Toilet Facilities				Garbage and Refuse		General
Name	State Forest Number	Pit Construction	Present Condition of Pit	Lime on Hand	State of Repair	Cleanliness and Odors	In Pit Covered with Soil	Scattered on Surface of Ground	Condition About Camp
13- Kurtz's Gap	7C-163	Concrete	Partially filled	None	Good	Fair	Covered	None	Good
14- John Bobb		Cement and stone	Partially filled	None	Good	Good	Covered	None	Very Good
15- (4) Kahatango Pillow	7C-169	Cement & stone	Partially filled	None	Good	Good	No pit	Thrown near into stream	Good and Verypoor
16- Cooper Mill	7C-160	Cement & stone	Partially filled	Yes	Good	Good	Pit but uncovered	Tin cans, etc	Fair
17- Buck Horn		Concrete	Partially filled	None	Good	Good	Pit but uncovered	None	Good
18- T-Spring Lodge		Cow dung and human faces in meadow near stream. Inside toilet, etc., at Lodge O. K.							
19- Keystone	7C-168	Cement & stone	Partially filled	None	Fair	Good	Some in pit covered.	In crate & low place by camp	Fair
20- Recreation	7C-174	Earth & stone	Partially filled	None	Poor	Fair	None	Fireplace back of camp	Fair
20- Wagner's		Cement & stone	Practically empty	None	Excellent	Very good	None	In low place rear of camp	Good
22- Oak Grove	7C-171	Concrete	Partially filled	Yes	Excellent	Good	Covered	Clean as a pin.	Excellent.
23- Shamokin Dam Club	7C-156	Earth & stone	Partially filled	Yes	Good	Good	Covered	None	Good
24- Burned 1935 Crooked Corners		Loose plank	Partially filled	None	Fair	Poor	None	Old junk everywhere	Poor
25- Danville	7C-157	Loose stone	1/2 full of water	None	Poor	Fair	None	Old junk all around	Poor
26-	7C-155	Earth & stone	Partially filled	Yes	Leaky roof	Fair	None	Tin cans refuse	Poor
27- Blue Eagle	7C-145	Earth & stone	Partially filled	None	Leaky roof	Poor	None	Bottles & tin cans	Poor

TABLE IV (contd.)

CAMP IDENTIFICATION		TOILET FACILITIES					GARBAGE AND REFUSE		General Condition about Camp
Name	State Forest Number	Pit Construction	Present Condition of Pit	Lime on Hand	State of Repair	Cleanliness and Odors	In Pit Covered with Soil	Scattered on Surface of Ground	
28- Garnet Spring	7C-141	Earth and stone	Partially filled	Yes	Fair	Fair	None	Tin cans and refuse in gully	Poor
29- (4) Shakespere	7C-152	Earth and stone	Quite full	None	Fair	Fair	None	Ashes, cans, etc, in low pl.	Fair
30- Danber	7C-147	Earth and stone	Partially filled	None	Roof Leaks	Fair	Covered	None	Good
31- (6) Rocky Corners	7C-151	Loose Rocks	Almost empty	None	Fair	Poor	Covered	None	Fair
32- Spyker's	7C-122	Concrete base	Partially filled	None	Good	Good	Covered	None	Excellent
33- Lucky	7C-150	Loose stone	Almost full	None	Fair	Fair	Covered	Some	Fair
34- Twin Point		Loose rocks	Partially filled	None	Good	Fair	None	Cans, bottles refuse	Fair
35- First Gap	7C-153	Plank and earth	Partially filled	None	Good	Good	None	Garbage, refuse and clam shells toward run	Fair
36- Log Cabin	7C-149	Earth and stone	Almost filled	None	Good	Fair	Covered with ashes.	None	Fair
37- Black Cap	7C-143	Loose rocks	Partially filled	Yes	Good	Fair	None	Tin cans and refuse	Poor
38- Frederick Gap	7C-144	Earth and stone	Partially filled	Thrown backof toilet	Good	Good	None	Melon rinds, cans and bottles	Fair
39- Mt. Vernon		Earth	Open to rear	(Padlocked	Good	?	None	On heap near of toilet	Fair
40- Stone Camp "Old Birch Still"		Loose stone	Partially filled	None	Good	Fair	None	Scattered behind toilet	Poor
42- Center-Union		Loose stone	Allows free surface drainage	None	Bad	Poor	None	In ditch behind camp	Very poor

STATE FOREST PICNIC GROUNDS OR PARKS.

CAMP IDENTIFICATION		TOILET FACILITIES					GARBAGE AND REFUSE		GENERAL
NAME	State Forest Number	Pit Construction	Present Condition of Pit	Lime on Hand	State of Repair	Cleanliness and Odors	In Pit Covered with Soil	Scattered on surface of Ground	CONDITION about Camp
Sand Spring Run at McKeen's Spring		No toilets erected					Incinerator near stream	Organic matter unburned	Poor
McCall's Dam		Earth and stone	Caved in at rear	None	Good	Fair	Pit across road not used	In low area 50 ft. to WDC	Poor

Conclusions from the Inspection of Camps

Enforcement of the sanitary measures by some vigilant policing authority is necessary to maintain sanitary conditions about all camps.

The standard of living as well as the sense of responsibility varies between camps. The majority of camps will not need periodic visits but a few of the shiftless, careless camps should be inspected at regular intervals throughout the season from April to December.

The power of enforcing health regulations rests with the District Forester, the representative of the state and the custodian of the state property. He has the power to enforce all regulations, even to the extent of terminating the camp lease.

Detected causes of pollution or threats of pollution around camp areas are listed as follows,

(a) Establishment of "deer licks" by putting salt out to attract deer to the vicinity in hopes of improving the hunting. The 1931 survey disclosed a salt lick on the bank of Sand Spring Run with a resulting barn yard condition.

(b) Throwing kitchen wastes or discharging sink drainage directly into a watercourse. Sink wastes and wash water is not specifically covered in the health regulation, and many camps have taken advantage of this omission to drain the sinks directly into the streams.

(c) Porcupine frequenters dragging buried garbage or contents of toilet pits to adjacent streams. Numerous instances were observed where these animals had burrowed into the ground or gnawed through wood to gain entrance.

(d) Instance of poor housekeeping resulting in garbage and rubbish of all kinds being littered about the camp area.

Only 6 camps were considered as a threat to the sanitary standard of the watershed in 1931. The 1934 survey showed this number reduced to 4, while the 1936 survey indicated a relapse in sanitary conscientiousness throughout the watershed resulting in 12 camps being considered as definitely unsanitary.

BACTERIOLOGICAL SURVEY

The bacteriological analysis of collected samples was taken as indication of purity or contamination. Such analyses were carried out in accordance with the accepted procedure as prescribed in "Standard Methods of Water Analysis" published by the American Public Health Association. Such procedure involving "presumptive tests" and "confirmatory tests". Presumptive tests were completed at our field camp and transportable cultures made of plates giving positive presumptive results and requiring confirmation.

The cultures were transferred to the bacteriology laboratory of Bucknell University and the confirmatory tests carried out in the accepted manner. Therefore, the unique features of the analysis procedure on this survey are limited to the collection of samples and execution of the presumptive tests, and this part of the survey will be covered in detail in this discussion.

From personal knowledge and the perusal of the literature on sanitary surveys, this is the first instance to my knowledge where temporary facilities for incubation of collected samples in the field has ever been used.

Preliminary Arrangement and Supply

The preliminary arrangements for this survey was a very important part of the project. The most serious question involved was that of providing incubation for the plates in the field. This problem was solved by using a common egg incubator, such as is used in poultry farming. Such an incubator burned kerosene and maintained a temperature within the necessary limits of 37.5 degrees Centigrade. The results were satisfactory even when loaded to capacity with plates. For transporting this incubator into the field, the legs were detached and the oil lamp removed, to be packed and carried separately. The incubator was mounted on the rear carrier of a Marmon sedan and transported, after which it was quickly assembled for use.

Glassware and Media:- A great amount of glassware was involved. Every sample taken requires a sterile tube, two tubes of plain agar, one tube of litmus lactose agar, and three sterile petri dishes. In addition extras were needed for correcting mistakes, checking questionable counts, transfering cultures back to the University laboratory for confirmatory tests, and allowing for contaminants. The sampling tubes and petri dishes were all sterilized at the University laboratory and packed in tin can containers, the sampling tubes being plugged with sterile cotton and petri dishes being packed with covers in place. These tin cans, of one quart size and larger, were closed with tin covers held in place with adhesive tape. Plain and purple agar was poured into sterile tubes, stoppered with cotton, and packed as the sterile tubes after cooling.

The 1936 survey involved the sampling of 134 sources. For this survey the following quota of materials was taken to our field camps,

190 sterile sampling tubes
500 petri dishes
350 tubes of plain agar

500 sterile pipettes
175 tubes of purple lactose agar
50 slants for culturing

In addition to these basic materials, the following were used in the technical work involved,

Red & blue soft wax pencils
Tabulating pads
Alcohol lamp and platinum wires
Level, for leveling tables in pouring
Low power magnifying glass
2 common double boilers for liquifying agar
2 direction compasses
2- one-gallon thermos jugs

The WATERSHED MAP, enclosed in this report and discussed under the section describing the White Deer watershed, was developed and very essential for assisting the sampling parties. This map follows page

Considerable numbers of white pasteboard placards were cut for use in placarding points along the stream, and thus assist the sampling parties to orient themselves. Compasses and watches were necessary for each sampling crew.

Because of the rugged nature of the country, infested with snakes, medical aid kits were absolutely essential.

Sampling Procedure

The location and identification of such location of sampling sites was a major problem on this survey. The WATERSHED MAP (scale 1" equal 2000') is indespensible to locating in the field any sites sampled on previous surveys, and likewise necessary for correctly locating any newly discovered tributaries. All definite fixed observable features adjacent to the creek are located on the map.

Placarding Crews:- These features are placarded by separate placarding crews who work in from the road, which runs parallel and follows the same valley. Features placarded are trails, camps, brid-

TRANSPORTING EQUIPMENT

Common poultry incubator carried on the rear of car. Additional supplies unloaded at left.

STARTING THE DAYS WORK

Sampling crews leaving the cars for the days work. Note the maps and thermos jugs.

ges, main tributaries and springs. The placards are white pasteboard 15" X 4", lettered in pencil and posted by thumb tacks. They are mounted facing downstream and on trees at the very edge of the creek. Locating them to face an open area naturally makes a more conspicuous symbol to the sampling crews.

The placarding crew consists of two men, who usually use a car for traveling along the road. Judicious selection of objects to placard naturally reduces their work. In 1934 and 1936, each mile point along the creek was placarded and kept the sampling crews oriented as well as providing a definite site to lift the mile interval samples. These milepoints were also located on the WATERSHED MAP.

Sampling Crews:- The sampling crews worked in groups of three, a party of three being on each side of the stream and attempting to keep opposite each other on their respective banks. Impassably dense laurel and under brush along the creek bottom lands often made this impossible and forced the groups up on to higher ground for short distances. Each crew carried a WATERSHED MAP and had discussed the previous night all available information on sites sampled in the previous surveys along that stretch of the creek. Each crew carried a folding notebook to record information pertaining to the sampled site. This information covered the size of flow, apparently surface or subsurface, whether the drainage area was swampy or upland territory, apparent sources of contamination, whether a source of watersupply to camps, and information referencing the site to permanent topographical features. Features used for referencing included camps, mountain knobs, trails, rock ledges, prominent individual trees, clumps of trees, and abrupt bends, pools, and rapids of the main stream.

The notebooks from previous surveys were carried by these crews and afforded assistance in finding sites previously sampled as well as helping us in 1936 to correlate the few uncorrelated sites of the previous two surveys. Correlation was accomplished by checking the descriptive notes of each site until all doubt was satisfied of a satisfactory comparison.

In addition to the material mentioned previously, the time of sampling a source was also included. This had a very useful purpose in assisting to check the distance between sampling sites. To make it effective, each crew was instructed to enter in the notes at a particular site,the definite amount of time used in rest or lunch stops since the last entry. The crews averaged one-half to three-fourths of a mile per hour, and usually approximated the three-fourths.

Each sample collected was labeled according to a definite system resulting in a fraction for all tributary samples. All main creek samples at mile intervals were labeled as 1-mile, 2-mile, etc. The site information entry in the record book as well as the sample test tube received this designation, and were known thereafter by the designating fraction. The numerator was the day of the survey referenced to the first day as one. The denominator was the number of the site sampled on that particular day and also signified which side of the stream the tributary drained. The sites sampled consecutively on the right side facing upstream were given a series of odd numbers, while the sites on the left were given even numbers. Thus, 2/3 sample was the second lifted on the right side of the stream on the second day of the survey. Sample 3/2 was the first lifted from the left side of the stream on the third day of the survey. Sites missed and picked up later were given designations as 3/2A, etc.

B and C being used for a second and third sample which should be collected between the 3/2 and 3/4 sites. This designation furnished all information necessary in locating the sample and facilitated the analysis and incubation procedure by permitting the use of this very simple label entirely throughout.

Examples of entries in the sampling crew note books follow, as taken from the 1931 survey.

3/2 8:20 a. m. Small sluggish stream from alder and hemlock swamp emerges from a loose rock shelf and flows 50 yards to White Deer Creek. Quite large clearing on other side of the creek a few yards downstream.

3/4 8:40 a. m. Large cinnamon fern area around spring which drains into creek by a stream about as large as your two fists. Small beaver dam visible downstream which is only about 18 inches high. Considerable cutting of aspen in the area, the first observed since leaving Spruce Run road.

3/6 9:08 a. m. Small stream from open area below a 4 foot beaver dam on the main creek. Stream flows in a confined channel. Beaver active on this small stream, which has water black as coffee.. Tracing it up we found a small beaver dam on this stream, stagnant water with no overflow.

3/8 9:15 a. m. Oak Grove camp on opposite side of stream along the creek road. Well defined stream from low lying area enter creek about 200 yards below a big beaver dam. A small beaver dam just downstream. No signs of beaver in this stream itself.

3/10 9:25 a. m. A quite large stream, appearance of a mountain stream, flowing into White Deer Creek at right angles. Several large white pine logs indicate recent logging operations by foresters. Only old beaver cuttings in this area.

Handling Samples

A gallon thermos jug, burlap covered and supported by shoulder straps on the back of an individual, was carried successively by the three members of the sampling crew. Sterile tubes and collected samples were kept there in at the temperature of the stream. The jug carrier followed the other two and was assisted in every way to keep from falling as a spill would upset the tubes supported by a wire frame inside the jug.

Samples were collected from flowing tributaries by carefully removing the cotton plug, collecting the sample and replacing the plug without contamination to the plug or tube, and without in any way disturbing the sampled source previous to lifting the sample. The tubes were immediately labeled by use of a colored wax pencil, and the entry completed in the notebook.

Algae were collected and carried in an identical manner. In all cases being taken after the sample for bacteriological analysis.

The sampling crews were transported by car as nearly as possible to the initial starting point and were usually on the job by 7:00 a. m. A days sampling assignment covered from 3 to 5 miles and would be completed between noon and 2:00 p. m. The placarding crew moved the cars to the nearest accessible point where the sampling crews picked them up and proceeded to camp. A lunch of sandwiches and fruit was supplied each member going out in the morning and a hot meal was in readiness by the camp cook as soon as all crews were in from their sampling assignment.

Analysis Technique

All members of the party were in the field during the morning, and everyone needed a change of clothing upon returning to camp. While changing clothing and eating dinner, the sterile plain and purple agar tubes were put in double boilers and warmed over a slow fire. Thus, the agar could be liquified very quickly when needed.

Petri dishes were spread on a previously leveled flat top table and the liquified agar poured on top of the one c.c. sample which had been placed there in by a sterile pipette tube. The petri dish was rolled very gently at a slight angle to effect thorough mixing, after which it was permitted to set and solidify.

Plain agar plates were made only of undiluted and of 9 to 1 dilution. Purple agar plates were made only of undiluted samples. Thus, each sample collected resulted in three plates requiring incubation. The plates were transferred to the incubator as soon as the agar had solidified. Plates completing incubation having previously been removed. The samples collected in the morning and up until 2 p.m. entered the incubator between 2 and 4 o'clock that afternoon. In the meantime they were stored in thermos jugs at a temperature similar to that of their source.

The capacity of the incubator limited the number of plates; and thus, the number of samples that could be collected during any two-day interval.

The samples completing incubation were read within an hour after removal from the incubator. Colonies appearing with the characteristic "blue metallic" appearance, due to fermenting the lactose in the purple lactose agar, were cultured on slants for transferring to the Bucknell University bacteriological laboratory.

PLATING OUT

Working on the porch at Camp Goodlander.

SAME PROCEDURE

An afternoons work carried out indoors at Camp Recreation.

Here, the confirmatory tests were carried out.

Counts on the plain agar were made by counting both the 1 c.c. and the 0.1 c.c. indicated colonies and reporting the average of the two after multiplying the one by 10. The result closely approximates, but is not the "Total Count" of the standard methods analysis. Due to the availability of only one incubator, these plates were incubated at 37.5 degrees rather than the 20 degrees for the standard procedure. B. Coli counts were made from the single plate containing 1 c.c. Counts were tabulated in colored pencil by writing in large sized figures on the sample site description in the sampling crew notebooks. 40-2 would indicate a plain agar count of 40 and a confirmed B.Coli count of 2. B. Coli counts were recorded from the purple agar counts and crossed off if not confirmed. Having these results tabulated in the field books made them available to the sampling crews on the following years and consequently called their attention to polluted sources at the time they sampled them.

Confirmatory Tests

Cultures from positive presumptive tests were made on Russells double sugar lead acetate medium to serve as partial confirmation. Positive controls were set up in the form of known laboratory cultures of Escherichia Coli and Aerobacter Aerogenes in the same medium. When the cultures were found to be identical with the laboratory strain for E. Coli, it was considered to be evidence for declaring the organism E. Coli.

Survey Results of 1931, 1934, and 1936

The results of each survey follows immediately.

SUMMARY OF BACTERIAL COUNTS OF STREAMS ON THE WHITE DEER SURVEY

June 11 - 17, 1931

Stream Designation		Bact. Cols per cc	E. coli per cc	Remarks
Test Station below Intake		26	0	Chlorinated
Intake		45	2	
Dam		65	0	
1/1		90	0	
1/3		35	0	
1/5		73	0	
1/7		70	4	Crosses road
1/9		60	1 (?)	
1/2		22	0	E. of Smith's Clearing
1/4		75	0	W. of Smith's Clearing
1/11		120	2	Just below Cold Harbor Trail
1/13	Maple Spring	40	Spreader	Below Wert's Shack
1/6		7	0	Across from Wert's Shack
1/8		40	0	Flat across from Wert's Shack
1/15		80	1	Just above Wert's Shack
1/17		45	0	Spring at high wall
1/19		75	1	Just below Rock Oak Trail
1/21	Rock Oak Spring	360	0	Subsurface 1/8 mile(deer and grouse)
1/10		32	1	Flat across from Rock Oak Sp.
1/23		160	2	Crosses road
1/25		60	0	Three Sisters Trail
1/27		34	0	Spring opposite Kettle Hole
1/12	Kettle Hole Run	20	0	
	Beaver Dam	90	1	Small dam north of distributary of White Deer Cr.
1/29	Marshel Spring(Beaver Spring)	50	0	Stream crosses road
1/31		185	1	Stream crosses road
1/14	Lyman's Gap Run	22	1	Deer and Grouse
1/33	Lick Run	41	1	Camp Tamaqua and 7C181
1/16		60	0	Marsh opp. Reish's spring

Stream Designation		Bact. Cols per cc	E. coli per cc.	Remarks
1/35	Reish's Spring	6	0	Camp 7C185
1/37	Mile Run	40	1	Camps 7C184 and 7C185
1/18		50	3	Swamp opposite 7C185
1/39	(or 2/13) Hedden's Spring	80	0	Deer and Grouse
		SAND SPRING BRANCH		
3/9	Sand Spring Run	30	0	Below a small beaver dam
2/11	Stony Hollow Run	60	0	Just above bridge over Sandy Spring Run.
2/16	McKean's Spring	10	0	Road-side spring
2/9	Kurtz's Gap Run	100	1 (?)	Oil pipe line
2/7	Shingle Hollow(?) Run	90	0	
2/14	Sand Spring	40	10	Trout kept in spring
2/13		10	0	Just above Sand Spring-full of spirogyra.
2/10	"Spring"	10	0	Marker on "Narrows Road"
2/5		45	0	
2/8	Cooper's Mill Spring	50	0	
2/6		140	0	Spring near old Zimmerman Road
2/4		60	2	" " " " "
2/3		90	3	Fern Marsh
2/2		140	1	
2/1		5,080	100 +	(Deer lick on pine stump over spring)
2/	Tea Spring Lodge Meadow	210	3	Cattle grazing, etc.
3/18	Buck Knob Run	25	0	On Running Gap Trail
3/16	Recreation Camp Spring	20	1 (?)	
3/7	Cow Bell Hollow Run	42	0	
3/14		60	0	Stream above Dog Town

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Stream Designation		Bact. Cols per cc.	B. coli per cc	Remarks
3/5		45	0	Stream from 7th Notch
3/12		20	0	Below Straub's Dam
B. D.		140	(?)	Beaver dam above Straub's Dam
3/10		18	1 (?)	
3/3		60	1	Stream from 6th Notch-Camp Oak Grove.
3/6		28	0	
3/6		110	4	Small stream used as runway to beaver dam.
3/4		60	1	
3/2		40	0	
3/1	Cooper's Mill Trail Run	9	0	Rapid mountain stream
5/2		40	0	At Spruce Run Trail
5/4	Pot Pie Hollow Run	150	1	Traversed by Spruce Run Trail
5/6		12	0	
5/1		100	2	Swamp land worked by beaver
5/3		60	3	
5/8		40	0	
5/5	North Gap Trail Run	80	0	Mountain stream from 4th Gap
5/7		30	0	
5/10		32	0	
5/12		26	2 (?)	
5/9	Cracker Bridge Trail Run	75	2	Beaver dam just above
5/11	" " " "	190	0	Lateral stream from beaver dam
5/14		30	0	Below big beaver dam
5/14A		34	1 (?)	" " " "
5/13	Frying Pan Trail (opposite)	120	1	Camp 70155
5/16	Frying Pan Trail Run	14	0	Mountain stream
5/15		34	0	
5/18		15	1 (?)	
5/20		200	1	Marsh drainage

	Stream Designation	Bact. Cols. per cc.	E. coli. per cc.	Remarks
5/17	Garden Hollow Trail Run	110	0	Drains 4th Gap
5/22	Crabapple Branch	95	1	Camps 7C152 (Rocky Corner) 7C147 and 7C122.
5/19		200	1	Public toilet at McCall's Dam - swamp area below dam.
5/21	McCall's Branch	210	0	Camp Lucky, 7C150, 7C153.
6/27		630	11	Grass flats above McCall's Dam - beaver dam.
6/24		98	2	
6/25		180	1	
6/23		880	3	
6/21		140	2	Hemlock marsh below Black Gap Road.
6/22	Black Gap Run	210	0	Camps 7C147, 7C148 - deer and beavers.
6/20		130	1	Beavers
6/18		48	0	
6/16		350	1	Below a large beaver dam
6/19	Creek Trail Spring	60	1	
6/14		150	1	1/2 mile below Frederick's Gap.
6/17		75	2	Lower end of Camp 7C144- great swamp.
6/12	Frederick's Gap Run	130	Spreader	Two beaver dams on this stream.
6/15		520	"	Near big beaver dam
6/13		210	8	" " " "
6/11		650	3	" " " "
6/9		200	15	" " " "
6/7		70	2	Small mt. stream below small beaver dam.
6/5		100	6	Deer meadow just below a small beaver dam.

Stream Designation	Bact. Cols. per cc.	B. coli. per cc.	Remarks
6/3	26	0	Mt. Vernon Camp.
6/10	1,260	100 +	Near old beaver dam above Frederick's Gap.
6/8	530	Spreader	Opposite upper limit of beaver dams.
6/1	190	4	Near Tunnis Road Bridge
2/6/6	190	0	Drains marsh - deer
2/6/4	26	0	
2/6/2 Tunnis Spring	160	0	Clogged with algae
2/6/1	23	0	
Mill's Branch	300	6	Dense alder, fern, rhododendrons, deer.

Spreader - Colon count impossible because of spreading colonies.

SUMMARY OF BACTERIAL COUNTS OF STREAMS ON THE WHITE DEER SURVEY

June 13 - 20, 1934.

Designation and Location	Bact. Cols. per cc.	B. coli. per cc	Remarks
Test Station	10	0	Samples at approximately mile intervals mid-stream
Intake	140	0	Intake-140 bact.cols. per cc. 0. B. coli,per cc.
Dam			
1/1	80	0	0 miles
1/3	750	0	
1/5	380	0	
1/7	105	0	
1/9	74	0	
1/9A	250	6	
1/2 Smith's Clearing	200	15	
1/4	60	0	Trail to Smith's Clearing 1 mile 42-0
1/11 Just below Cold Harbor Trail	123	1	
1/6	150	0	
1/13 Maple Spring (Deer Lick)	90	6	
1/8 Below Rock Oak Spring	130	15	
1/15 Above Wolde's Camp	27	0	
1/17 Below Rock Oak Spring	228	0	
1/19 Below Rock Oak Spring	55	6	
1/21 Rock Oak Spring	230	10	
1/23 1/8 mile above Rock Oak Spring	300	0	Rock Oak Spring 260-0 2 miles
1/25 300 yds. above Three Sisters Trail	144	0	
1/27 Spring at Kettle Hole Trail	117	6	
1/12 Kettle Hole Run	48	0	
	98	0	Kettle Hole A.C.& F. Camp

Designation and Location		Bact. Cols per cc.	E. coli per cc	Remarks	
1/29	Marchel Spring	24-	0	3 miles	100-0
1/31	Watering Trough	170	6		
1/14	Spring-Camp 7C178 below Lyman's Gap	54	0		
1/14A	Lyman's Gap Run	86	0	Lyman's Gap Trail	250-4
1/33	Lick Run	180	16	4 miles	
1/16	Marsh Opposite Goodlander's	66	0		
1/35	Reishel's Spring	2	0		
1/37	Mile Run	280	16	Mile Run	30-0
				5 miles	
	SAND BRIDGE RUN				
2/13A	A new spring below Hedden's	18	0	Sand Bridge Run	34-0
2/13	Hedden's Spring	16	0	(4.75 miles long)	
2/11A	Stream under narrow gauge	43	0		
2/11	Stony Gap Run	260	5		
2/16	McKean's Spring	19	0		
2/9	Kurtz's Gap Run	172	'11		
2/7	Shingle Hollow Run	32	0		
2/14A	Camp Buffalo "Spring"	63	1		
2/14	Between Sand Spring and Run	9	0		
2/12	Sand Spring	11	0		
2/5	"Rock heap" drainage	230	4		
2/1	Lahatongo Camp Spring("Spring"1931)	30	0		
2/6	Cooper's Hill Spring	9	0		
2/8A	Buck Horn Camp Spring	830	30		
2/6B	Swamp drainage	25	0		
2/6A	Spring (hemlocks)	7	2		

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Designation and Location	Bact. Cols per cc	E. coli per cc	Remarks
2/6 Spring 30 ft. north of stone pile	16	0	
2/4 Spring 200 yds. below Pipe Line Road	4	0	
2/3 Spring 100 yds. " " " "	66	0	
2/2 Spring 1/8 mile above " " "	17	0	
2/1 "Deer Lick"	270	1	
2/1A Spring in meadow	7	0	
2/2B T-Spring Lodge pond	620	[illegible]	
2/2A Johnson's spring house	61	1	
3/9 Sand Spring Run	34	0	
3/18 Buck Knob Run	22	0	1st Bridge Creek Rd. 20-0
3/16 Recreation Spring	8	0	6 miles
3/14 Opposite Wagner's Camp	7	0	West of Wagner's Camp21-0
3/7A Behind Wagner's Camp	66	0	7 miles
3/12A Spring .2 mile below oil pipe line at road	10	0	
3/7 Cowbell Hollow Run	90	0	
3/5A New Triple Spring	87	0	145 mile above 2nd Bridge Creek Road 20-0
3/5 Seventh Notch Run	10	1	8 miles
3/3A Spring at road-Straub's Dam	8	0	Straub's Dam
3/10 Above Straub's Dam	29	0	9 miles
3/3 Sixth Notch Run	29	0	
3/1B	13	0	
3/8 Opposite below trail from Oak Grove	11	0	
3/6 " above " " " "	18	0	
3/4A	5	0	
3/4 350 yds. below new road	8	0	New Road to Sugar Valley
3/2 300 yds. " " "	25	0	Narrows 15-0

Designation and Location		Bact. Cols per cc.	E. coli per cc	Remarks	
3/2A	Between Shamokin Camp and new road	28	0	10 miles	
3/1A	Spring 200 ft. east of Buffalo Path	20	0		
3/1	5th Notch-Buffalo Path Run	28	0		
5/1A	200 yds. above Shamokin Dam Camp	35	0		
5/2		40	0		
5/1B	.7 mile west of Buffalo Path	55	0		
5/4	Pot Pie Hollow Run	60	0		
5/1	150 yds. east of 4th Gap Trail	8	0		
5/6		14	0		
5/8	East of 4th Gap Run (opp. side)	20	0		
5/3	4th Gap Run (11.25 miles from Dam)	47	0	4th Gap	17-0
5/3A	Spring 100 ft. west of Danville Camp	16	0	11 miles	
5/10	Spring 50 yds. west of Danville Camp (opposite dide)	10	0		
5/12	(Rhododendron) subsurface drainage within 10 ft. of creek	15	1		
5/9	Broad flat between 4th and 3rd notches	57	0		
5/14	West of Cracker Bridge Trail	19	0		
5/14A	Drains grass flat just below Frying Pan Trail	70	0		
5/13	3rd Gap Run	90	0		
5/16	Frying Pan Hollow Run	36	0	Frying Pan Trail	19-0
5/16A	West of Frying Pan Hollow Run (rhododendrons)	40	0		
5/15	East of New Garden Hollow Road	30	0		
5/17	2nd Gap or Garden Hollow Run	10	0		
5/16B	Crabapple Branch	9	0		
5/19	Barnet Camp Spring	15	0		
5/10A	Spring at Forest Camp west of McCall's Dam	53	0	McCall's Dam	27-2
5/21	1st Gap or McCall's Branch	37	0	13 miles	

Designation and Location	Bact. Cols. per cc.	E. coli. per cc	Remarks
6/24 Rhododendron thicket W. of McCall's Dam.	30	0	
6/24A	70	1	
6/27 Dry			1.5 miles U.S.G.S.
6/25	400	0	
6/23	164	0	
6/21A	70	0	
6/21	210	0	
6/22 Black Gap Run	30	0	Black Gap 20-0
6/18 1/4 mile west of Black Gap Run	8	0	14 miles
6/16	9	0	
6/11 Large grass flat west of Black Gap Rd.	33	0	1.75 miles U.S.G.S. and speedometer readings.
6/7	20	0	
6/5 Large swampy flat	20	0	
6/14 Broad swampy flat	133	0	
6/3 100 yds. east of log drag from Frederick's Gap	18	0	
6/12 Frederick's Gap Run	21	0	Frederick's Gap 16-0
6/1 300 yds. east of Tunnis Bridge	11	0	15 miles
H/6/4 Big spring Hall's Branch	32	0	
H/6/2 Little spring Hall's Branch	9	0	
H/6/1 Hall's Spring	15	0	Hall's Branch 5-0 (2 miles long)
T/6/6	82	0	
T/6/4 (Center Union Camp)	20	1	
T/6/2 Tunnis Spring	30	0	
T/6/1 Right branch of Tunnis Run	18	0	Tunnis Branch 9-0 (1.75 miles long)

' - Cultures lost in subculturing

SUMMARY OF BACTERIAL COUNTS ON STREAMS ON THE
WHITE DEER SURVEY
June 10-16,1936

Designation and Location		Bact. Cols per cc.	E. coli per cc	Remarks
Sampling Station		8	0	Chlorinated
Intake		330	2	Sedimented only
Dam		89	0	Overflow of W.D.C.
1/1	Old Potato Patch			(Dry 1936)
1/3	East of Trail to Smith's Clearing.			(Dry 1936)
1/5	Swamp drainage, opposite Smith's Clearing.	160	7	
1/2	Spring on East Boundry of Smith's Clearing.	28	7	
1/4	Spring on West Boundry of Smith's Clearing.	3	0	
1/7	Approx. 200 yds. west of (1/5) Formerly swamp drainage			(Dry 1936)
1/9	Approx. 300 yds. west of (1/7) Formerly subsurface drainage			(Dry 1936)
1/6	Cold Harbor Run	35	0	
5/11	Swamp drainage just east of Cold Harbor Trail.	280	6	
1/13	Drains the flat east of the old Wertz camp.	490	0	
1/15	Source in Maple Spring. Sample collected in swamp area at Wertz Camp.	130	3	
1/8	Stream drains lower flat opposite Maple Spring.	150	3	
1/17	Stream 100 yds. west of trail in to old Wertz Camp.			(Dry 1936)
1/19	Stream 40 yds. east of Rock Oak Trail Bridge.			(Dry 1936)
1/21	Rock Oak "Spring".	310	1	Stream travels 1/8 mile sub-surface rocky terrain.

Designation and Location		Bact. Cols per cc.	E. coli. per cc.	Remarks
1/10	Stream drains upper flat (1/8) west of Rock Oak Spring on opp. side.	110	2	
1/23	Small rapid stream 200 yds. east of Three Sisters Trail	140	1	
1/25	Swamp and road drainage at Three Sisters Trail	730	2	
1/25A	Small rapid stream 100 yds. west of Three Sisters Trail	220	4	
1/27A	Swamp drainage, Small stream about 1/2 mile west of Three Sisters Tr.	450	0	
1/12	Kettle Hole Run	82	1	
1/27	"Spring" at entrance to A. C. & F. Camp.	58	0	Stream underpasses the road.
1/29	Underpasses road. Swamp area at Creek Marchel (Beaver) Spring	210	3	
1/31	Watering Trough			(Stream dry 1936)
1/14A	"Spring" for Camp 7C178 east of Lyman's Gap.	370	0	Really swamp drainage
1/14	Lyman's Gap Run	37	0	
1/33	Lick Run	80	3	
1/36	Reishes Spring. Camp Limburger 7X183	16	0	
1/16	Marsh drainage opp. mouth of Mile Run	420	0	
1/37	Mile Run at Camp Goodlander	145	5	
1/18	Marsh drainage at big bend in creek opp. to and west of Camp Goodlander.	430	0	
1/39A	Spring and sluggish stream 1/10 mile west of Mile Run	370	0	
1/39	Hedden's Spring. 2 miles west of Mile Run.	23	0	
3/9	Mouth of Sand Spring Run	100	0	
2/11A	Rapid stream through rock embankment of old tram road 100 yds. east of Bridge	50	0	

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Designation and Location		Bact. Cols per cc.	E. coli per cc.	Remarks
2/11	Stony Hollow Run	150	0	
2/16	McKeen's Spring	20	0	
2/14A	Marshy spring across from Buffalo Camp 7C165	87	0	
2/9	Kurtz's Gap Run	60	0	Oil pipe line
2/7	Shingle Hollow Run			Very low 1936
2/14	Sand Spring at Camp John Bobb	95	0	
2/12	Spring 100 ft. west of Sand Spring	8	0	
2/5	Drainage from large area of loose rocks opposite Camp 7C169	50	4	
2/10	Spring at Mahantango Camp 7C169	8	0	
2/8	Spring at Cooper Mill Camp 7C160	85	0	
2/8A	Spring at Buckhorn Camp	13	0	Very low
2/6B	Slow flowing swamp drainage on T-Spring Lodge Road	530	0	
2/6A	Drainage from low rocky flat 50 yds. north of 2/6B	30	0	
2/6	Not located 1936			
2/3	Spring in fern swamp 100 yds. south pf New Pine Flat Forest Road	54	0	
2/4	Swamp and road drainage stream 100 yds. north of junction of Pine Flat Road with T-Spring Road	1150	6	
2/1	South of High Fence T-Spring Lodge Formerly designated "Deer Lick"			Dry 1936
2/2	Spring underpasses road below gate to T-Spring Lodge.	135	0	
2/1A	Strong spring lower meadow T-Spring Lodge.	10	0	
2/2B	T-Spring Lodge ice and swimming pond	1480	14	
2/2A	Spring House - T-Spring Lodge	21	0	
3/18	Buck Knob Run	180	0	
3/16	Recreation Camp "Spring" Fern marsh drainage	103	3	

Designation	and Location	Bact. Cols per cc	E. coli per cc	Remarks
3/14A	Stream from Fern marsh midway between Recreation and Wagner's Camp.	59	0	
3/14	Stream from Fern marsh opposite Wagner's Camp	115	0	
3/7A	Small sluggish stream from spring between Cow Bell Hollow Run and Wagner's Camp	380	0	
3/7	Cow Bell Hollow Run	120	0	
3/12A	New walled-up spring at Creek Road east of Oil Pipe Line	10	0	
3/5A	Rapid stream at sharp bend in Creek Road from small depression east of 7th Notch.	18	0	
3/12	Small stream from swampy area about 1/2 mile east of Straub's Dam	100	2	
3/5	7th Notch Run	73	3	
3/3A	"Spring" and swamp drainage north of Creek Road-	1520	0	Slow flowing
	Old Beaver dam in creek about 1/4 mile west of Straub's Dam	220	0	
3/10	Green Gap Run	135	0	
3/3	6th Notch Run just west of Clark's Trail to Sugar Valley Narrows	250	0	
3/8	Well defined stream 100 yds west of Green Gap Run	145	2	
3/1B	Swamp drainage west of Oak Grove Camp trail to the creek	120	0	
3/6	Small sluggish stream opp. and west of Oak Grove trail to the creek	200	0	
3/4A	Spring and swamp drainage	360	0	

Designation and Location		Bact. Cols per cc.	E. coli per cc	Remarks
3/4	350 yds. east of Buffalo Path Road	45	0	
3/2	Swamp drainage 300 yds. east of Buffalo Path Road	240	3	
3/1A	Small, strong spring just east of Buffalo Path Road 75 ft. from creek	130	0	
3/2A	Sluggish stream 100 yds east of Buffalo Path Run on opp. side of creek.	220	0	
3/1	5th Notch (Buffalo Path Run) also Cooper Mill Trail Run	104	8	
5/2	Swamp drainage just west of old Pot Pie Hollow Trail	460	0	
5/1A	Small rapid stream from swamp just west of Shamokin Dam Camp	1310	0	
5/4	Pot Pie Hollow Run	280	0	
5/1	Swamp drainage opp. Pot Pie Hollow Run	240	0	
5/6	Swamp drainage half way between Pot Pie Hollow Run and North Gap Run; opp. side.	920	0	
5/1B	Swamp drainage just east of North Gap Run.	1180	0	
5/8	Swamp drainage 25 yds. west of (5/6)	540	1	
5/3A	Rapid stream then thru swamp east of North Gap run.	330	0	
5/3	Small rapid stream just east of camp 7C157-Danville Camp	280	0	
5/10	Subsurface drainage through grassy area east of North Gap Trail	122	0	
5/5	North Gap Run	170	0	
5/12	Small stream opposite North Gap Run	280	0	

Designation and Location		Bact. Cols per cc.	B. coli per cc.	Remarks
5/7	Swamp drainage	650	0	
5/9	Swamp drainage	200	0	
5/14	Fair sized mountain stream east Frying Pan Trail	120	0	
5/11	Swamp drainage	730	0	
5/14A	Halfway between Frying Pan Run and 5/14.	470	0	Drains grassy area
5/16	Frying Pan Run	160	0	
5/13	3rd Notch Run	200	0	
5/16A	About 1/4 mile west of Frying Pan Run.	470	0	Drains rhododendron, fern and grass flats.
5/15	Swamp drainage just east of Garden Hollow Road	340	0	
5/18	About a mile west of Frying Pan Run.	730	1	Swamp drainage
5/17	Garden Hollow Run	115	0	
5/20	Swamp drainage opposite the old Garden Hollow Trail	580	2	
5/19	Barnet-Spring Camp 7C141;	220	0	Somewhat stannant
5/19B	Small rapid stream 85 yds. west of Barrnet Spring	17	0	Underpasses creek road
5/22	Crabapple Branch	140	0	
5/19A	"Spring" at McCall's State Forest Park.	1400	0	Really swamp drainage
5/21	McCalls Branch	107	0	
6/24	Small stream from grass flats west of McCall's Dam	620	6	
6/27	Swamp drainage west of grass flats above McCall's Dam	760	4	
6/24A	Small stream from laurel grove 3/4 distance from Black Gap to McCall's Dam.	96	0	

Designation and Location		Bact. Cols per cc.	E. coli per cc	Remarks
6/25	Stony terrain drained by small stream about 2/3 distance from Black Gap to Camp Lucky.	150	0	
6/23	At the 14 mile level of the creek			Too dry to sample
6/22A	Swamp drainage 1/4 mile east of Black Gap Run	350	0	
6/22	Black Gap Run	210	0	
6/21	Spring at bend of Black Gap Road	170	0	
6/20	Deep channelled stream thru fern and hemlock grove west of Black Gap.	110	4	
6/19B	Swamp and grass area drainage near junction of Eastville Road	200	8	
6/18	Swamp drainage opposite Eastville road junction.	91	0	
6/19A	Rather rapid stream from swamp area just west of Eastville road junction	570	1	
6/16	Small sluggish stream from pine flat half way between Frederick's and Black Gap.	500	0	
6/19	Swamp drainage about 250 yds. east of Frederick's Gap Camp	270	0	
6/14	Grassy flat clearing about 100 yds. east of Frederick's Gap Camp on opposite side.	400	0	
6/17	Spring at Frederick's Gap Camp	104	0	
6/15	Between Frederick's Gap Camp and Frederick's Gap Trail			Dry in 1936
6/13	Ditto			
6/11	Ditto			
6/9	Ditto			
6/7	Ditto			
6/12	Frederick's Gap Run	150	0	
6/6	Spring at Mt. Vernon Camp.			Too low to sample
6/3	Stream through grassy area just west of Mt. Vernon Camp	155	0	
6/10	Small stream east end of natural clearing about halfway between Frederick's Gap and Tunnis Road	100	3	

Designation	and Location	Bact. Cols per cc	E. coli per cc	Remarks
6/8	Small stream out of western end of natural clearing (6/10)	130	0	
6/1	Swamp drainage short distance east of Bridge at Tunnis Gap Road	168	0	
	Junction Hall's Branch	60	0	
H6/4	Big Spring - Hall's Branch	50	0	
H6/2	Little Spring - Hall's Brnach	41	0	
H6/1	Hall's Spring	18	1	
T6/6	Tunnis Branch at junction	120	0	
T6/4	South branch of Tunnis Run at Center Union Camp	40	0	
T6/4A	Spring; source of T6/4 100 yds. south of Center Union Camp	26	0	
T6/2	Tunnis Spring	45	0	
T6/1	Tunnis North Branch runs for 3/4 mile north of Millmont Camp.			Dense Hemlock copses

DISCUSSION OF BACTERIOLOGICAL RESULTS

In analyzing the factors contributing to pollution on this watershed, we must appreciate the area was passing through a period of transition from 1931 to 1936. Transition from a wilderness country with poor roads and inhabitants only during the hunting season to a year around occupied area with a vastly increased number of visitors. Thus, we can consider this study as representing a decreasing effect of wild life and an increasing effect of civilization. During these five years beaver were entirely removed, game and fish decreased in abundance because of the intensive hunting and fishing during the depression years, and city dwellers occupied all available camps to eliminate paying rent. Added to this is the effect of two civilian conservation corps camps directing 400 irresponsible boys in road work and forest maintenance.

Correlation of Samples from Each Survey

The first step in the analysis of the collected data is correlating the samples from each survey for one particular sampling site. Such correlation was accomplished by refering to the records in the sampling crew notebooks. The sampling sites are numbered consecutively upstream,and individual survey samples are assigned to the correct site. This survey correlation was carried out by painstaking comparison of the notebook descriptions, and checked in the survey of 1936. The value of any resulting conclusions is dependent upon correctly comparing the bacterial counts of the same tributary in the three different years.

Classification of Sampling Sites

The analysis is carried out by classifying the sampling sites according to the following described groups. Allotment to a group is based upon apparent surrounding physical conditions as recorded in the sampling crews notebook. This classification and correlation is made on the same set of tabulated form sheets. The classification symbol is recorded in the classification column of the composite summary to indicate the factors affecting the site and thus its grouping. It will be noted that some sites are classified into two or more groups. However, this is not common.

The groups and their description is as follows,

BEAVER (b) - Definite presence in the sampled source in 1931. Many samples taken from flow below the dams. No effect of these animals in the last two surveys as they were all removed in 1931 and 1932.

DEER (d) - Definite presence in the watercourse due to salt licks, runways, and deer droppings.

ROADS (r) - Roads adjacent to the sampling site or on the area a short distance upstream. Increased in number greatly due to C. C. C. activities as old as well as new roads were being worked.

CAMPS (c) - Camps near the spring or close to flowing stream. Small number so classified because of definite restrictions imposed upon the location of camps. (See camp inspection)

MARSHY STREAMS AND SPRINGS (M.S.) - Terrain features swampy and marshy. Springs in marshy areas included.

CLEAR STREAMS ----------Free flowing, clear, and free from vegetation. Most sources fell into this classification or that of the marshy terrain. Standards were interpreted very rigidly for this classification. Many streams falling on the border between C.S. and M.S. were put in the M.S. classification.

SPRINGS (S.)----------Definite clear springs, usually with sandy bottoms and free from vegetation except algal growths. Many springs showing marshy surroundings were shifted to the M.S. classification.

CORRELATION AND CLASSIFICATION SUMMARY

The sampling sites are classified and bacterial counts correlated on the following classification summary sheets.

To aid in analyzing the data, sampling sites are located on the WATERSHED MAP. Each site is numbered and carries a key indicating in which years samples were collected. To further aid the analysis, the "Total" and B.Coli counts are graphically plotted and hereafter referred to as the SURVEY RESULTS PLOTTING. Additional information on this plotting is the stream bed gradient and the estimated distribution of beaver in the 1931 survey. The MAP and the PLOTTING are both detachable and can be removed for studying together.

BACTERIACOLOGICAL RESULTS OF THE SANITARY SURVEYS OF 1931, 1934, and 1936.

Sampling site number	Location and Description of Sampling Site	Classification	1931			1934			1936		
			Sample	Total Count	E coli	Sample	Total count	E coli	Sample	Total count	E coli
1	Test Station after chlorination			26	0		10	0		8	0
2	Intake to chlorination house			45	2		140	0		330	2
3	Dam - overflow			65	0		80	0		89	0
4	Old potatoe patch trail	M.S. r	1/1	90	0	1/1	750	0	Dry		
5	Spring, East of Smiths clearing	S	1/2	22	0	1/2	60	0	1/2	28	7
6	East of Smiths trail	M.S. r	1/3	35	0	1/3	380	0	Dry		
7	Spring, West boundary of Smiths clearing	S	1/4	75	0	1/4	123	1	1/4	3	0
8	Swamp drainage, opposite Smiths clearing	M.S. r	1/5	73	0	1/5	105	0	1/5	160	7
9	Small stream, crosses road	C.S. r	1/7	70	4	1/7	74	0	Dry		
10	Cold Harbor Run	C.S.	1/6	7	0	1/6	90	6	1/6	35	0
11	Swamp drainage, East of Cold Harbor trail	M.S.	1/11	120	2	1/11	150	0	1/11	280	6

BACTERIAOLOGICAL RESULTS OF THE SANITARY SURVEYS OF 1931, 1934, and 1936.

Sampling site number	Location and Description of Sampling Site	Classification	1931			1934			1936		
			Sample	Total Count	E coli	Sample	Total count	E coli	Sample	Total count	E coli
12	Subsurface drainage, 300 yds. West of 1/7	M.S. r	1/9	60	1	1/9	250	6	Dry		
13	Swamp drainage, opposite Maple Spring Camp	M.S.	1/8	40	0	1/8	27	0	1/8	150	3
14	Maple Spring, Deer lick in 1934.	S	1/13	40	?	1/13	130	15	1/15	130	3
15	Swamp, drainage, East of Wertz's Camp.	M.S. r-c				1/9A	200	15	1/13	490	0
16	Surface drainage above Wolf Camp	M.S. r	1/15	80	1	1/15	228	0	Dry		
17	Spring at high wall	S	1/17	45	0	1/17	55	6	Destroyed by road work		
18	Swamp drainage, below Rock Oak trail.	M.S.	1/19	75	1	1/19	230	10	Dry		
19	Rock Oak Spring	S d	1/21	360	0	1/21	300	0	1/21	310	1
20	Marsh drainage, opposite Rock Oak Spring.	M.S.	1/10	32	1						
21	Small rapid stream, 200 yds. East of three sisters trail	C.S. r	1/23	160	2	1/23	144	0	1/23	140	1

BACTERIAOLOGICAL RESULTS OF THE SANITARY
SURVEYS OF 1931, 1934, and 1936.

Sampling site number	Location and Description of Sampling Site	Classification	1931			1934			1936		
			Sample	Total Count	E coli	Sample	Total count	E coli	Sample	Total count	E coli
22	Swamp and road drainage at Three sister's trail	M.S. r	1/25	60	0				1/25	730	2
23	Small rapid stream above Three sister's trail	C.S.				1/25	117	6	1/25A	220	4
24	Swamp drainage, 1/2 mile above Three sister's trail	M.S. r							1/27A	450	0
25	Spring, entrance to A. C. & F. Camp.	S	1/27	34	0	1/27	46	0	1/27	58	0
26	Kettle Hole Run	C.S.	1/12	20	0	1/12	98	0	1/12	82	1
27	Small beaver dam on branch of of creek.	C.S. b	B.D.	90	1						
28	Marchel Spring - Swamp area at the creek.	S 6-d	1/29	50	0	1/29	24	0	1/29	210	3
29	Watering trough overflow crosses the road	C.S. r	1/31	185	1	1/31	170	6	1/31	185	1
30	Spring at camp 7C 178 including swamp drainage	M.S. C				1/14	54	0	1/14A	370	0
31	Lymans Gap Run	C.S.	1/14	22	1	1/14A	86	0	1/14	37	0

BACTERIACLOGICAL RESULTS OF THE SANITARY SURVEYS OF 1931, 1934, and 1936.

Sampling site number	Location and Description of Sampling Site	Classification	1931			1934			1936		
			Sample	Total Count	E coli	Sample	Total count	E coli	Sample	Total count	E coli
32	Lick Run	C.S. r	1/33	41	1	1/33	180	16	1/33	80	3
33	Reishs Spring	S	1/35	6	0	1/35	2	0	1/35	16	0
34	Marsh drainage, opposite mouth of mile run.	M.S.	1/16	60	0				1/16	420	0
35	Mile Run	C.S. r	1/37	40	1	1/37	280	16	1/37	145	5
36	Marsh opposite Goodlander	M.S.	1/18	50	3	1/16	66	0	1/18	430	0
37	Spring, West of mile run	S				2/13A	18	0	1/39A	370	0
38	Heddins Spring	S	1/39	80	0	2/13	16	0	1/39	23	0
		SAND SPRING RUN									
39	Sand Spring Run	C.S. r-c	3/9	30	0	3/9	34	0	3/9	100	0
40	Rapid stream under old tram road.	C.S.				2/11A	43	0	2/11A	50	0
41	Stony Hollow Run	C.S.	2/11	60	0	2/11	260	5	2/11	150	0

BACTERIAOLOGICAL RESULTS OF THE SANITARY SURVEYS OF 1931, 1934, and 1936.

Sampling site number	Location and Description of Sampling Site	Classification	1931			1934			1936		
			Sample	Total Count	E coli	Sample	Total count	E coli	Sample	Total count	E coli
42	McKeens Spring	S	2/16	10	0	2/16	19	0	2/16	20	0
43	Marshy spring, Camp 7C165	S				2/14A	63	1	2/14A	87	0
44	Kurtz Gap Run	C.S.	2/9	100	1	2/9	172	11	2/9	60	0
45	Shingle Hollow Run	C.S.	2/7	90	0	2/7	32	0	2/7	10	0
46	Sand Spring - Trout present	S	2/14	40	10	2/12	11	0	2/14	95	0
47	Spring, just above Sand Spring	S	2/12	10	0	2/14	9	0	2/12	8	0
48	Roch heap drainage	L.S.	2/5	45	0	2/5	230	4	2/5	50	4
49	Spring, Camp 7C169	S	2/10	10	0	2/10	30	0	2/10	8	0
50	Spring, Camp 7C160	S	2/8	50	0	2/8	9	0	2/8	85	0
51	Spring, Camp Buckhorn	S				2/8A	830	30	2/8A	13	0
52	Swamp drainage on Tea Spring road.	M.S. r				2/6B	25	0	2/6B	530	0
53	Rocky Spring, 80 yds. North of of 2/6B	S				2/6A	7	0	2/6A	30	0
54	Spring, near stone pile	S	2/6	140	0	2/6	16	0			

BACTERIAOLOGICAL RESULTS OF THE SANITARY SURVEYS OF 1931, 1934, and 1936.

Sampling site number	Location and Description of Sampling Site	Classification	1931			1934			1936		
			Sample	Total Count	E coli	Sample	Total count	E coli	Sample	Total count	E coli
55	Spring, 100 yds. South of New Pine Flat Road	S	2/3	90	3	2/13	66	0	2/3	54	0
56	Spring and road drainage, 100 North of new road	M.S.r	2/4	60	0	2/4	4	0	2/4	1150	6
57	Spring, Deer Lick in 1931	Sd	2/1	5080	100+	2/1	270	0	Dry		
58	Spring, near gate to Tea Spring Lodge.	S	2/2	140	1	2/2	17	0	2/2	135	0
59	Spring, lower meadow	S				2/1A	7	0	2/1A	10	0
60	Tea Springs lodge pond, cattle etc.	S.P.d	2/1A	210	3	2/2B	620	?	2/2B	1480	14
61	Spring house	S				2/2A	61	1	2/2A	21	0
	WHITE DEER CREEK ABOVE SAND SPRING RUN.										
62	Buck Knob Run	C.S.	3/18	25	0	3/18	22	0	3/18	180	0
63	Recreation Spring	S	3/16	20	1	3/16	8	0	3/16	103	3
64	Fern marsh drainage above Recreation Camp.	M.S.							3/14A	59	0

BACTERIAOLOGICAL RESULTS OF THE SANITARY SURVEYS OF 1931, 1934, and 1936.

Sampling site number	Location and Description of Sampling Site	Classification	1931			1934			1936		
			Sample	Total Count	E coli	Sample	Total count	E coli	Sample	Total count	E coli
65	Fern Marsh drainage opposite Wagners Camp	M.S.	3/14	60	0	3/14	7	0	3/14	115	0
66	Spring, above Wagners Camp	S				3/7A	66	0	3/7A	380	0
67	Cow Bell Hollow Run	C.S.	3/7	42	0	3/7	90	0	3/7	120	0
68	Walled up spring, East of pipe line	S				3/12A	10	0	3/12A	10	0
69	Small stream, 3 branches East of 7th Notch	C.S.				3/5A	87	0	3/5A	18	0
70	Seventh Notch Run	C.S.	3/5	45	0	3/5	10	1	3/5	73	3
71	Swamp drainage below Straubs Dam.	M.S.	3/12	20	0				3/12	100	2
72	Swamp drainage, Straubs Dam	M.S.				3/3A	8	0	3/3A	1520	0
73	Beaver Dam above Straubs Dam	M.S. b	B.D.	140	?				B.D.	220	0
74	Green Gap Run	C.S.	3/10	18	1	3/10	29	0	3/10	135	0
75	Sixth Notch Run	C.S.	3/3	60	1	3/3	29	0	3/3	250	0
76	Well defined stream, 100 yds above Green Gap Run.	C.S.	3/8	28	0	3/8	11	0	3/8	145	2

BACTERIAOLOGICAL RESULTS OF THE SANITARY SURVEYS OF 1931, 1934, and 1936.

Sampling site number	Location and Description of Sampling Site	Classification	1931			1934			1936		
			Sample	Total Count	E coli	Sample	Total count	E coli	Sample	Total count	E coli
77	Swamp drainage, West of Oak Grove Camp.	M.S.				3/1B	13	0	3/1B	120	0
78	Small definite stream, beaver in 1931.	C.S. b	3/6	110	4	3/6	18	0	3/6	200	0
79	Spring and Swamp drainage	M.S.				3/4A	5	0	3/4A	360	0
80	Spring, East of Buffalo Path	S	3/4	60	1	3/4	8	0	3/4	45	0
81	Swamp drainage, 300 yds. East of Buffalo Path	M.S.				3/2	25	0	3/2	240	3
82	Sluggish stream, East of Path	M.S.	3/2	40	0	3/2A	26	0	3/2A	220	0
83	Spring, East of Buffalo Path	S				3/1/A	20	0	3/1A	130	0
84	Cooper Mill Trail Run	C.S.	3/1	9	0	3/1	28	0	3/1	104	8
85	Swamp drainage, West of trail	M.S.	5/2	40	0	5/2	40	0	5/2	460	0
86	Swamp drainage, West of Shamokin Damp.	M.S. r				5/1A	35	0	5/1A	1310	0
87	Pot Pie Hollow Run	C.S.	5/4	150	1	5/4	60	0	5/4	280	0
88	Swamp drainage opposite Run - Beaver 1931	M.S. b	5/1	100	2	5/1	8	0	5/1	240	0

BACTERIAOLOGICAL RESULTS OF THE SANITARY SURVEYS OF 1931, 1934, and 1936.

Sampling site number	Location and Description of Sampling Site	Classification	1931			1934			1936		
			Sample	Total Count	E coli	Sample	Total count	E coli	Sample	Total count	E coli
89	Swamp drainage, between gaps	M.S.	5/6	12	0	5/6	14	0	5/6	920	0
90	Swamp drainage, 25 yds. West of 5/6	M.S.	5/8	40	0	5/8	20	0	5/8	540	1
91	Swamp drainage, East of North Gap Run	M.S.				5/13	55	0	5/13	1180	0
92	Spring, East of Danville Camp	S							5/3	280	0
93	Part of Run, West of Camp	C.S. r	5/3	60	3	5/3A	16	0	5/3A	330	0
94	Subsurface drainage, across from the Run	M.S.	5/10	32	0	5/10	10	0	5/10	122	0
95	North Gap Run	C.S.	5/5	80	0	5/3	47	0	5/5	170	0
96	Small stream opposite North Gap Run.	C.S.	5/12	26	2	5/12	15	1	5/12	280	0
97	Swamp drainage, above trail	M.S. r	5/7	30	0				5/7	650	0
98	Fair sized stream, beaver	C.S. b	5/14	30	0	5/14	17	0	5/14	120	0
99	Swamp drainage above trail, beaver.	M.S. b	5/9	75	2	5/9	57	0	5/9	200	0

BACTERIAOLOGICAL RESULTS OF THE SANITARY SURVEYS OF 1931, 1934, and 1936.

Sampling site number	Location and Description of Sampling Site	Classification	1931			1934			1936		
			Sample	Total Count	E coli	Sample	Total count	E coli	Sample	Total count	E coli
100	Swamp drainage between Gaps	M.S. r	5/11	190	0				5/11	730	0
101	Grassy plot, East of Frying Pan Run	M.S. b	5/14A	34	1	5/14A	70	0	5/14A	470	0
102	Frying Pan Run	C.S.	5/16	14	0	5/16	36	0	5/16	160	0
103	Third Notch Run	C.S.	5/13	120	1	5/13	90	0	5/13	200	0
104	Swamp drainage, West of Frying Pan Run	M.S.				5/16A	40	0	5/16A	470	0
105	Swamp drainage, East of Garden Hollow Road	M.S.	5/15	34	0	5/15	30	0	5/15	340	0
106	Swamp drainage, mile West of Frying Pan Run	M.S. b-d	5/18	15	1				5/18	730	1
107	Second Notch Run	C.S.	5/17	110	0	5/17	10	0	5/17	115	0
108	Swamp drainage across from trail.	M.S.	5/20	200	1				5/20	580	2
109	Barnet Spring Camp 70-141	S				5/19	15	0	5/19	220	0
110	Small rapid stream, West of 70-141	C.S.	5/19	200	1				5/19B	17	0
111	Crabapple Run	C.S. r-c	5/22	95	1	5/16B	9	0	5/22	140	0

BACTERIACOLOGICAL RESULTS OF THE SANITARY SURVEYS OF 1931, 1934, and 1936.

Sampling site number	Location and Description of Sampling Site	Classification	1931			1934			1936		
			Sample	Total Count	E coli	Sample	Total count	E coli	Sample	Total count	E coli
112	Spring, State Forest Park	S				5/19A	53	0	5/19A	1400	0
113	McCall's Branch	C.S. r-c.	5/21	210	0	5/21	37	0	5/21	107	0
114	Swamp drainage, West of McCall's Dam	M.S. b-d	6/24	98	2	6/24	30	0	6/24	620	6
115	Swamp drainage, 1/2 mile above McCall's Dam	M.S. b-d	6/27	630	11	Dry			6/27	760	4
116	Small stream from Laurel grove	C.S.				6/24A	70	1	6/24A	96	0
117	Stony drained by small stream.	C.S.	6/25	180	1	6/25	400	0	6/25	150	0
118	Swamp drainage, beaver in 1931.	M.S. b.	6/23	880	3	6/23	164	0	Dry		
119	Swamp drainage 1/4 mile East of Black Gap	M.S.							6/22A	350	0
120	Black Gap Run	C.S. r-c	6/22	210	0	6/22	30	0	6/22	210	0
121	Spring, bend of Black Gap Road	S	6/21	140	2	6/21	210	0	6/21	170	0
122	Spring, Run above bridge	S				6/21/A	70	0			

BACTERIACOLOGICAL RESULTS OF THE SANITARY SURVEYS OF 1931, 1934, and 1936.

Sampling site number	Location and Description of Sampling Site	Classification	1931			1934			1936		
			Sample	Total Count	E coli	Sample	Total count	E coli	Sample	Total count	E coli
123	Stream from Hemlock Grove	C.S. d	6/20	130	1	6/18	8	0	6/20	110	4
124	Swamp drainage near road corners.	M.S.							6/19B	200	8
125	Swamp drainage opposite corners.		6/18	48	0				6/18	91	0
126	Swamp drainage, West of corners.								6/19A	570	0
127	Sluggish stream from Pine Flat	M.S. b	6/16	350	0	6/16	9	0	6/16	500	0
128	Swamp drainage, East of 7C-144	M.S.	6/19	60	1				6/19	270	0
129	Grassy Flat, East of 7C-144	M.S.	6/14	150	0	6/14	133	0	6/14	400	0
130	Spring at 7C-144	S	6/17	75	2				6/17	104	0
131	Beaver Pond	S.P. b	6/15	520	?						
132	" "	S.P. b	6/13	210	8						
133	" "	S.P. b	6/11	650	3						

BACTERIACOLOGICAL RESULTS OF THE SANITARY SURVEYS OF 1931, 1934, and 1936.

Sampling site number	Location and Description of Sampling Site	Classification	1931			1934			1936		
			Sample	Total Count	E coli	Sample	Total count	E coli	Sample	Total count	E coli
135	Fredericks Gap Run	C.S. b	6/12	130	?	6/12	21	0	6/12	150	0
136	Small mountain stream- beaver in 1931	C.S. b	6/7	78	2	6/7	20	0	Dry		
137	Spring, Mt. Vernon Camp	S b-d	6/5	100	6	6/5	20	0	Dry		
138	Stream, West of Camp	C.S.	6/3	26	0	6/3	18	0	6/3	155	0
139	Small stream at end of natural clearing	M.S. b	6/10	1260	100+				6/10	100	3
140	Small stream, other end of clearing	M.S. b	6/8	530	?				6/8	130	0
141	Swamp drainage, East of bridge	M.S.	6/1	190	4	6/1	11	0	6/1	168	0
142	Halls Branch at junction	C.S. b-d	H.B.	300	6				H.B.	60	0
143	Big Spring, Halls Branch	S				H 6/4	32	0	H6/4	50	0
144	Little Spring, Halls Branch	S				H 6/2	9	0	H6/2	41	0
145	Halls Spring	S				H 6/1	15	0	H6/1	18	1

BACTERIACOLOGICAL RESULTS OF THE SANITARY SURVEYS OF 1931, 1934, and 1936.

Sampling site number	Location and Description of Sampling Site	Classification	1931			1934			1936		
			Sample	Total Count	E coli	Sample	Total count	E coli	Sample	Total count	E coli
146	Tunnis Branch near junction	C.S.	T 6/6	190	0	T 6/6	82	0	T 6/6	120	0
					TUNNIS BRANCH						
147	East Branch at Center Union Camp.	C.S.	T 6/4	26	0	T 6/4	20	1	T 6/4	40	0
148	Spring at Center Union Camp	S							T 6/4A	26	0
149	Tunnis Spring	S	T 6/2	160	0	T 6/2	30	0	T 6/2	45	0
150	West Branch above camp	C.S.	T 6/1	23	0	T 6/1	18	0	T 6/1	185	0

Effect of Temperature and Rainfall

Daily temperature varied from 55 to 85 degrees Fahrenheit through out the periods of these surveys. Such temperatures are typical of June weather conditions in this area.

The steep stream bed gradient makes an estimated rate of flow of 3/4 mile per hour very conservative. Using this rate, the"time of concentration" for the area above the water dam is 24 hours. As sampling was carried out during the forenoon of a day, rainfall for a 24 hour period previous to 8:00 a. m. of that day is correlated with that days sampling results. This is clearly shown on the SURVEY RESULTS PLOTTING. Rainfall for a period of 24 hours terminating at 8 a. m. is plotted in red ink over the bacterial counts for samples collected from 7 a. m. through the forenoon of a day.

Heavy rainfall had a very definite effect resulting in high counts. No effort has been made to compare the effect on counts of rainfall terminating a dry spell as compared with rainfall in the middle of a rainy period.

The Weather Bureau Station at Williamsport, Pa., within 20 miles of all parts of the watershed furnished the following records for the periods of the three surveys.

WEATHER BUREAU STATION, WILLIAMSPORT, Pa.

Year	Month	Date	Temperature		Rainfall	
			Max	Min	inches	
1931	June	9	65	47	0	
		10	70	57	0.02	
		11	77	54	0	1 st day
		12	85	58	0	2nd day
		13	84	55	0	3rd "
		14	81	62	0	4th "
		15	75	66	0	5th "
		16	75	61	0.43	6th "
		17	82	52	0.54	7th "
1934	June	11	85	60	0.29	
		12	78	53	0	
		13	70	54	0.14	1st "
		14	84	54	0	2nd "
		15	87	50	0	3rd "
		16	89	56	0	4th "
		17	88	55	0	5th "
		18	81	63	0	6th "
		19	82	60	2.02	7th "
		20	85	55	0.02	8th "
1936	June	8	76	64	0.20	
		9	85	63	0.01	
		10	80	62	.00	1st "
		11	84	64	0.02	2nd "
		12	78	63	0.39	3rd "
		13	75	59	0	4th "

WEATHER BUREAU STATION, WILLIAMSPORT, Pa.

Year	Month	Date	Temperature		Rainfall	
			Max	Min		
1936	June	14	75	60	0.44	5th day
		15	83	55	0.00	6th "
		16	77	57	0.00	7th "

Temperatures - Max and Min for 24 hours ending 5:30 P. M.

Rainfall - For 24 hours ending 8:00 A. M.

Bacterial Results from Classified Sites

The bacterial counts for the classified sites are analyzed to determine any definite indications of a relative degree of purity of the source.

We must note the average counts for the watershed vary with the different surveys. 1936 had the highest total count average, 256 for the 131 samples collected. This high count is due to heavier rainfall previous and during the survey period. 256 compares very high with 120 for 1931,and 84 for 1934.

The average B. Coli count is 0.95 in 1936, 1.30 in 1934, and 2.07 in 1931. With beaver in the area in 1931, we have definite reasons why the B. Coli count should be appreciable. In 1934 the C. C. C. camp boys were more actively engaged in greater numbers on grubbing and new road work.

The conclusion of the highest total count and lowest B. Coli count in 1936 seems to be that rainfall does increase the total counts, and thus makes a very disturbing factor in comparing the classified site results.

Another conclusion from the low B. Coli count in 1936, is that the higher percentage of spring and grounwater flow of that year produced a purer water. (See discussion of stream gaging results).

A compensating fact exists to improve the reliability of comparing classified site results in spite of the disturbing factor of rainfall. Each survey, by chance, had a quite similar cycle of weather conditions. The fore part of the survey up to McCalls Dam had small rainfall interference, while the area above was subject to heavy rains.

Summary of Bacterial Results for Classified Sites on the White Deer Watershed.

	1931			1934			1936		
	N	T.C.	B.C.	N	T.C.	B.C.	N	T.C.	B.C.
White Deer Watershed	111	120	2.07	122	84.0	1.30	131	256	0.95
Springs	23	76.4	2.95	38	75.0	1.42	35	95.0	0.50
Clear Streams	43	84.6	0.86	43	71.8	1.63	43	133	0.75
Marshy Streams	41	150	3.31	35	102	1.00	48	440	1.20
Camp	4	138	0.25	7	60.0	2.10	7	403	0
Road	22	90.0	0.54	25	140	2.76	22	440	1.75
Deer	8	618	15.7	5	82.0	0	6	400	2.50
Beaver	22	297	7.6	11	39.6	0	14	322	1.00

N - Number of Samples

T.C. - Total Count (Average)

B.C. - B Coli (Average)

Spring Waters

23, 35, and 38 sites were classified thus in the three surveys. Only included definite clear cut springs without marsh drainage. Most of the sources of watersupply for camps are in this classification. Total counts were lowest in this grouping with values of 76.4, 75.0, and 95.0. The B. Coli counts were 2.95, 1.42, and 0.50. The 0.50 average B. Coli count establishes this classification as upholding the general opinion that "spring waters are the purest" for the survey of 1936. The average is rather high for 1931 and 1936 because 9 out of 23 samples and 6 out of 38 in the respective years, showing positive results, were of individually high count. Thus, we see that while a spring is most probably the safest source, it may very definitely not be so.

Clear Streams

43 tributaries were thus classified in each survey, including all the larger and freely flowing streams. Total counts were 84.6, 71.8, and 133. B. Coli counts were 0.86, 1.63, and 0.75. The conclusion is justified that these streams compared with the springs in the purity of the water.

Marshy Springs and Streams

Springs draining marshy ground or subjected to surface drainage were included in this classification along with sluggish streams draining swamps. The total counts were 150, 102, and 440. B. Coli counts were 3.31, 1.00, and 1.20.

It is evident the total count is relatively much higher

than the B. Coli count. Such results would be expected of waters retarded on the surface of the ground, in contact with saprophytic bacteria, and exposed to high temperatures favoring biological action.

The conclusion is inevitable, that such waters are impure when compared to springs or the freely flowing streams. However, the B. Coli counts are not exceptionally high except in 1931, which was probably due to beaver. 41, 35, and 48 samples were taken from these sites on the respective surveys, representing 40 % of the samples lifted on the watershed.

Effect of Camps

The small number of samples thus classified were 4, 7, and 7. This is too small a number to justify generalizing from the results. Such generalization from these results would lead to the conclusion that camps are beneficial for the sanitary quality of the watershed, and be contrary to known facts. The fact remains that a camp is a continual threat to develope sporadically into a serious source of contamination. (See camp inspection)

Effect of Roads

22, 25, and 22 sites were in this classification. Total counts were 90, 140, and 440, with B. Coli counts of 0.54, 2.76, and 1.75. The results indicate a definite correlation between roads and high bacterial counts. This is emphatically appreciated when we understand that 1931 was a period of limited road facilities; 1934, a period of extensive road construction by the C. C. C.; and 1936, a period of maintaining these roads and accomodating a greatly increased number of visitors. The conclusion is justified that roads decrease the purity of water from a water-

shed. Such a conclusion is probably most evident on this watershed, where a boulder strewn, snake infested, scrub oak covered, rough terrain was very effective in keeping out all but the most ardent of sportsmen.

Effect of Deer

This classification is based upon selecting sites where deer are known to frequent. The number of such sites, 8,5 , and 6 is too small a number for confidence in the results. These results do tend to prove that deer increase total and B. Coli counts.

A better idea of their effect can be obtained from the results of the 1931 sample collected at sampling site No. 57, and designated 2/1 of that survey. Such site was a spring with an over hanging stump serving as a salt lick. The ground around the spring represented a "barnyard condition". Bacterial counts were 5,680, and 100 plus. The deer lick was removed by the guilty persons upon complaint.

Another cause of objection to the presence of deer was apparent in the survey of 1936. The deep snow and exceptionally low temperatures during the 1935-36 winter was known to have reduced the deer herds. The White Deer Water Company removed 42 dead deer from the tributary areas in the early Spring of 1936. During the survey period, the sampling crews detected 8 putrefying carcasses close to the streams. Such dead deer are a definite contaminating influence and certainly offend the senses of the user of the water even though possible disease can not be traced directly to them .

BACTERIAL RESULTS OF MID-STREAM SAMPLES

Examination of the results of the 1931 survey suggested collecting one mile samples lifted from the freely flowing water at the center of White Deer Creek. If such samples had been taken in 1931, pollution effects of beaver at the upper end could have been traced downstream.

Such samples were collected on the surveys of 1934 and 1936. (See sampling procedure)

Results of these one mile samples are presented in tabular and graphical form.

Conclusions from the 1934 results, are that C. C. C. workers in the area around Mile Run did increase the count of samples downstream. Such increased count was undoubtedly due to loosening the biologically active humus layer in road and forest grubbing work, as well as direct contamination from the large body of workmen.

The 1936 results emphasize the effect of rain previous to sampling. In general, the effect was to multiply the total count by 10. Counts were still 2 to 3 times normal after 24 hours had elapsed following the end of the rain.

The 1936 total count average at mile mid-stream samples was 311 as against 60 for 1934. The concentration of bacteria being in the ratio of 5 to 1. This is in spite of the fact that the spring sources were contributing more water of low bacterial count. Rain producing surface wash is the largest single factor affecting bacterial results. The B. Coli count was not greatly affected.

BACTERIAL RESULTS OF WHITE DEER CREEK PROFILE AT MILE INTERVALS

SAMPLING SITE	LOCATION AND DESCRIPTION OF SAMPLING SITE	1934		1936	
		TOTAL COUNT	E. coli	TOTAL COUNT	E. coli
Dam	Crest of Spill Way	80	0	89	0
1 Mile	Smith's Clearing	42	0	220	0
2 Mile	East of Rock Oak Spring	260	0	190	0
3 Mile	West of Kettle Hole Trail	100	0	260	1
4 Mile	West of Lyman's Gap Run	250	4	100	0
5 Mile	East of Mile Run Outlet	30	0	165	1
6 Mile	Below First Creek Bridge	20	0	92	0
7 Mile	West of Cow Bell Hollow Run	21	0	140	2
8 Mile	East of Straub's Dam	20	0	75	3
9 Mile	Clark's Trail	29	0	160	0
10 Mile	Shamokin Dam Camp	15	0	110	0
11 Mile	Cracker Bridge Trail	17	0	1300[X]	0
12 Mile	Opposite New Garden Hollow Road	19	0	600[X]	0
13 Mile	McCall's Dam	27	2	880[X]	0

BACTERIAL RESULTS OF WHITE DEER PROPER AT MILE INTERVALS CONT'D.

SAMPLING SITE	LOCATION AND DESCRIPTION OF SAMPLING SITE	1934		1936	
		TOTAL COUNT	E. coli	TOTAL COUNT	E. coli
14 Mile	East of Black Gap	20	0	420xx	0
15 Mile	Opposite Eastville Road	Not	sampled	450xx	0
16 Mile	Frederick's Gap	16	0	240xx	0
17 Mile	Below Hall & Tunnis Junction	Not	sampled	100xx	0

x Heavy showers for previous 24 hours and rain still falling

xx 24 hours or more after rain had ceased

Note: In the 1934 survey, mile samples were not collected in any case within a period of 48 hours after heavy rain.

To aid in studying the self-purification of the stream and the effect of treatment, the following summary from the surveys of 1934 and 1936 was developed. Such summary shows only total count results as B. Coli counts were too small to study reduction effects.

TOTAL COUNT SUMMARY

	1934	1936
Average of tributaries	122	256
Average of mile samples	60	311
Spillway of dam	80	89
Intake to chlorination house at end of sedimentation channel.	140	330
Test station - chlorinated	10	8

Purification of the Main Stream

The tributary average was 122 in 1934 with a main stream average of 60. Such a relation indicating the ability of the stream to purify itself by mechanical agitation effects, aeration, and sunlight germicidal action, under clear weather conditions.

In the more rainy 1936 survey, the tributary average was 256 and the main stream average 311. An increas due to the decreased sunlight effect and increased surface wash.

Effect of Sedimentation Treatment

The sedimentation channel was effective in providing a settling period for the water. However, bacterial counts at the intake to the chlorination house showed much higher counts in

1934 and 1936 than the water flowing over the spillway. The sedimentation channel contained about one-sixth of a days demand. As we collected a sample about 7:00 a. m., we probably secured water which had been stored throughout the night period of low draft. The channel is shallow with a maximum depth of 3 feet and built through marshy ground. Surrounding conditions justify the suspicion aroused by the bacterial results, that the channel actually increases the bacterial count.

The 1931 results showed the channel as functioning to reduce the bacterial results.

Effect of Chlorination

All bacterial samples collected at the test station showed greatly reduced counts. B. Coli were absent and the total counts were 26, 10, and 8. These would be furthur reduced by the "chlorine residual" maintained in the operation procedure.

Sanitary Significance of Beaver in White Deer Creek

Beaver life always appeals to the average person. In the field of commerce it has made a lasting impression upon the history of America. Beaver skins provided the basis of bargaining for the purchase of Manhattan Island from the Indians by the original Dutch settlers. This, the most valuable present day property in the world was evaluated in terms of the skin of this humble animal. The romantic tales of trappers pushing back the frontier throughout the United States and Canada, as far north as the Hudson Bay, have provided basic plots for novels and moving pictures.

Coupled with this actual part in history are the myths or legends of the unusual characteristics of beaver. Its industrious application to the pursuance of its normal life has earned for it a standard of measurement of industriousness as manifested by the popular term "working like a beaver." The idea of clan or family life in a mutually constructed house and living on a mutually gathered food supply appeals to the public's fancy. The popular conception of beaver mating is as a monagamist for life. The beaver is supposed to warn associates of approaching danger by slapping its paddle like tail. Additional conceptions of the use of its tail are for troweling clay in the dams and even to serve as a barge for transporting such clay over water to the dam site. The noted success of the beaver as a dam builder has been played up to the public by the designation of "dam engineer." Not only

is the beaver an engineer in dam building but also in falling trees. We hear of its ability to fall a tree in the exact direction of its choice.

The following summary of beaver life attempts to set forth the facts of value to our appraisal of the effect of beaver life on the sanitary quality of a water supply.

Life Characteristics

Beaver are commonly brown, and rarely black, furred animals of the family of rodents, or gnawers. Being the larger brother of the common muskrat. Definite characteristics are the flat scaley tail, large webbed hind feet, and large chisel shaped front teeth or incisors. The usual size of adults is 30 to 45 inches long, including a 12 to 15 inch tail, and weighing from 30 to 70 pounds. The young are born in litters of 2 to 5 during May and June, being fully furred, and develop very fast, attaining independence of existence in 3 to 6 weeks. Yearling beavers are practically full size and probably breed. The life span is logically dependent upon natural enemies and whether protected from trapping by law. Observations in protected areas indicate 10 to 15 years as the life cycle.

The most important factor of beaver life affecting streams is the building of stick and mud dams. Such dams vary in height from one to eight feet, usually being from two to four. The length may be several hundred feet. Usually the dam is constructed at a wide shallow crossing rather than a confined and free flowing site. The area flooded upstream varies from a fraction to several acres. Usually it includes a considerable

BEAVER DAM AND POND

Note the dam on the left, and the drowned trees fringing the pond. Photograph taken near McCall's Dam and is representative of beaver ponds in the area as occuring in 1931.

number of standing trees which are drowned, causing a serious objection to the presence of beaver. The dams are constructed adjacent to one another, backing water up to the upstream one or even flooding it out entirely. The construction is of green boughs, seasoned sticks, or water soaked sticks from the stream bottom, and varying up to six inches in diameter and five feet in length. These are laid in random directions and packed with mud, roots and plant stalks. The dam zigzags up or down the stream to include growing trees and bushes. As the water backs up behind it larger diameter poles may be cut and floated into position. The cross-section is widened as it rises higher. The job of building is never ended, and really merges into a continuous maintenance job. Every night additions are made to reduce seepage and close developing streamlets. These dams are very resistant to erosion. In flood times they are topped by a rising torrent, but erode very slightly. The matted mass of sticks and consolidated mud offers great resistance to the efforts of man or nature. The experience of the Penna. Dep't of Forests and Waters was that opening such dams was a laborious and expensive procedure. Being accomplished by doggedly digging and cutting out the mat of sticks. Explosives could not be used as White Deer Creek was a stocked trout stream.

The usual beaver lodge is constructed similarly to the common muskrat house. It is up of dome shaped construction from a deep section of the flooded area. It has a diameter of 10 to 20 feet, and is constructed of sticks and mud, and carried well above the usual water level to provide living

Remains of beaver dams near Straub's Dam (1934)

Old beaver dam in foreground with the formerly flooded area extending up stream. Frying Pan Run (1934)

Remains of old beaver dam near Tunnis Branch (1934)

Old Beaver Flow, Sand Spring Run (1934)

quarters above this water level. Entrance is below the water surface to provide protection from preying animals. Observation indicates there are usually more than one entrance. When sound stream banks are available, bank lodges are very common. Entrance is through a sub-surface opening to a passage running above the water level for 30 or 40 feet to the lodge proper. These living quarters, being a honey combed area, often cave during a wet spring and thus are detected from the stream bank above. A single beaver lodge accomodates from two to fifteen beaver. While it seems usual for the young beaver to move out upon mating, several observations have reported three generations living in a single house.

Beaver cut down select types of trees by a characteristic radial gnawing. Large chips are removed until the tree remains joined by the two cones, one of the trunk and the other of the stump, merging at a small section. The cut is made within two feet of the ground. Trees up to one foot in diameter have been felled. The preferred tree is aspen or poplar. Warren (p.18) shows the distribution of beaver and aspen trees in the U.S., attempting to show that beaver life depends upon aspen. It seems questionable that such a dependent relation exists. Certain it is, that beaver cut birch, hemlock, ash, buttonwood and poplar. Reports of cutting spruce and pine are rare. The main trunk and limbs are cut in lengths up to five feet. These are rolled, dragged, and floated into place at the dam or lodge. The chips, twigs, and leaves may be used in the building process. Either left in place or used in the structure, they add to the decaying

vegetable matter of the area.

Summary of Opinion as to the Value of Beaver

In summarizing the investigation of beaver in the Adirondacks, Mr. Charles E. Johnson weighs the advantages of wild life conservation and financial returns from beaver pelts against the loss of timber by flooding. His conclusions are expressed as follows, "Taking a broad view of the question, therefore, based in net returns that have been derived both in our own state and elsewhere, and on the inherent possibilities of beaver culture, it would seem that only the careless or prejudiced thinker is likely to contend that the introduction of beaver into the Adirondacks was an economic mistake."

Mr. Ivan E. Houk describing the Colorado practice in the Scientific American writes, "A plan has already been developed and put into practice in Colorado, whereby beavers are taken from one section of the state where they are plentiful, and transplanted as it were, to the other sections where their services are more essential. The animals are trapped in huge wire nets placed on the dam. The plan followed is to save the beaver storage until late in the summer, when water is scarce and crops are badly in need of moisture, then to cut the dams and allow the water to drain into the irrigation ditches. With 24 hours the beavers have the dam repaired so that they are again storing water for another emergency. Thus

the beaver storage can be utilized several times in one season if necessary."

Mr. Ernest D. Leet in presenting an argument against protecting beaver in New York State writes, "For a quarter of a century beavers had not been seen along the St. Lawrence until their presence was revealed last Spring (1922) by a number of fallen trees that had been gnawed through at the base. Whereas they are still protected by game laws on the New York side of the river, the owners of property on the Canadian side have engaged an experienced trapper for the season, with headquarters on Dillingham's Island, near Brockville, Ontario. Owners of islands in Canadian and United States waters have been given permission by the Dominion government to exterminate them on the Canadian side of the boundary."

Mr. J.C. Sayler reports as follows on the beaver-trout investigation in Michigan, "The beaver should not be permitted to continue occupying our trout streams without control. Unless a sound beaver-trout management program is adopted and carried out, a choice will need to be made between beaver and trout. Finally it may be pointed out that the urgency of the need for beaver trout management is evident from our estimate that 25% of the mileage of Michigan trout streams becomes the bottom of a beaver pond every ten years."

To attempt a summary of opinions in beaver culture is difficult. It seems there are advantages and disadvantages. The answer to the problem apparently is a control of the beaver numbers to attain a maximum advantage and a minimum of the undesirable effects. Beaver will develop into a serious nuisance in a watershed in about ten years of the time of original stocking. We may deduce that an open season would be required at least once every ten years.

The effect of beaver on the sanitary quality of water has not been discussed in any previous known investigation.

Propogation Period of Beaver in White Deer Creek

Beaver were native to Pennsylvania and undoubtedly were trapped by the Indians who frequented the Susquehanna Valley before the white man. The Indians living a migratory existence were not as destructive to beaver culture as the white man who followed a more settled life and concentrated his activities in a more restricted area. Trappers preceded the lumber camps and tanneries up the tributaries of the Susquehanna River. The few beaver escaping these outpost trappers in the early part of the 19th century fell prey to the trapping activities of the lumber camp inhabitants who swept over this area from the close of the Civil War until the close of the century. The destroying of natures beaver supply was even more complete than the wanton destruction of virgin timber.

By 1900 it is doubtful if any beaver life existed on the White Deer watershed. Individual mountain woodsmen argue they were always present but kept to small numbers by continual trapping. If present at all they were certainly scattered and in small numbers until 1915. With the active organization of the forestry department and the resulting "conservation consciousness," emphasis was laid on protecting and culturing wild life. Such protection was necessitated by the automobile making possible more concentrated forestry hunting and fishing by greater numbers of urban dwellers.

Beaver were stocked on the area by the state between 1915 and 1922. The exact date is not known. In 1922, fishermen reported beaver dams along the creek. Certain it seems, is the fact that protection by the law permitted the beaver to develop. Such protection covering beaver and beaver dams and houses was provided by the legislature in 1912, providing $100 fine and/or 60 days in jail for killing a beaver of damaging a beaver lodge or dam.

Distribution of Beaver

Beaver were concentrated on the upper head waters of the creek, from the oil pipe line crossing to Hall's Branch. The greatest concentration was in the vicinity of Frederick's Gap. Another concentration over a wider area was in the vicinity of Frying Pan Run. Two beaver dams and cutting were evident at Kettle Hole Run on the lower part of the main stream. Three dams with considerable cutting were found on Sand Spring Run. These facts are set forth by the beaver distribution graph on the SURVEY RESULTS PLOTTING.

Sanitary Survey Results of 1931

The average for the 111 samples lifted in 1931 gave a total count of 120 as compared with 89 and 256 in the other two years. The Coli average count was 2.07 as compared with 1.30 and 0.95. Here we have definite indication of greater pollution for the entire watershed while the beaver were present in 1931. The 22 samples definitely classified as coming from beaver frequented sampling sites gave a total count average of 297, a Coli count average of 7.60. These are in the ratio of $2\frac{1}{2}$ and $3\frac{1}{2}$ to the average for the whole watershed. The conclusion is justified that beaver greatly increase the counts with the greatest effect on the Coli count. This fact is most readily emphasized by examination of the SURVEY RESULTS

PLOTTING, following in the vertical to compare individual site results for the three years, and projecting up to the beaver graph to determine whether beaver were in the vicinity.

An additional observed undesirable effect was that of increasing the organic matter content of water stored by the dams. Many stagnant pools appeared as "coffee" colored due to the tannic acid content. PH measurements showed acidity as great as 6.6. The water does not freely overflow the dam but seeps through near the bottom. Thus, scum and floating debris collect in considerable quantity and decomposing adds to the putrifying load of the stream. Unfortunately, lack of equipment prevented the running of dissolved oxygen or B.O.D. tests.

Action of the State in Removing Beaver

Acting on the complaint of the White Deer Water Company following the survey of 1931, the State Game Commission suggested the removal of some beaver to protected game reserved and the declaring of an open season on the beaver for controlling their numbers. The Penna. Dep't of Forests and Waters removed 65 beaver alive by trapping in the Summer of 1931. These 65 beaver were trapped without serious injury to a single one and transported to game reserves. Many dams were opened and the flooded areas drained.

Traps employed in trapping beaver alive. Steel and aluminum frames with wire mesh. "Sets" were made on the dams.

Open season was declared on beaver in February and March of 1932. Trapping being permitted throughout the state except on game reserves. The district foresters estimated an additional 65 beaver were removed from the White Deer Watershed, completing their extermination from the area. Trappers realized 15 to 30 dollars per beaver pelt.

Statistics of Beaver Distribution

Our sampling crews estimated there were 125 beaver dams in the watershed. This estimate was made from a daily summarization of dam remains observed. On this area it would appear the ratio of beaver to dams was 1 to 1.

The beaver intensity for the whole area averaged about three per square mile. In the area above the oil pipe line crossing the average was about 10 per square mile, while considering the area north of Black Gap the intensity was 20 per square mile.

The SURVEY RESULTS PLOTTING shows the distribution of beaver per mile along the creek. The maximum intensity was 40 per mile in the vicinity of Frying Pan Run.

Estimating the intensity of beaver per unit of discharge gives 6 for the whole area. However, considering the concentrated beaver population west of McCall's Dam gives a ratio of 20 beaver per unit of discharge.

The apparent effect of beaver on the bacterial counts was a 250 per cent increase in total count, and a 350 per cent increase in Coli count.

The price of beaver pelts averaged between 15 and 30 dollars, with an average of 20 dollars. Thus, the private trappers realized an aggregate total of $1600 for the beaver trapped from White Deer Creek in 1932.

ALGÆ ON THE WHITE DEER WATER SHED.

The Spring fed cool waters of White Deer Creek offer an optimum habitat for many kinds of algal growths. The kinds and varieties are unlimited and the examination of a collected sample offers a real thrill because of the customary presence of an entirely new and picturesque genus or modification.

Millmont Spring

June, 1936.

CONTROL OF ALGAE IN THE RESERVOIR

Algae have never caused any odor or taste conditions for the water company. However, algae growths are often very much in evidence in the reservoir. At such times, an application of copper sulphate by the caretaker has always proved effective in checking and eliminating such growths.

EXAMINATION AND IDENTIFICATION OF COLLECTED SAMPLES

Samples were collected from all springs and flowing streams, showing an appreciable growth of algae, along with the samples for bacteriological analysis. Samples were taken in 1 inch tubes, corked and labeled with the same designating label as the bacteriological sample to identify the source. Collected samples were carried to camp in a thermos jug and identification made as soon as practical.

Identification was made under 50 to 100 magnification by use of a microscope set up at our camp. Identification was made by comparison with colored plates in Fresh Water Algae of the United States by Wolle, and Fresh Water Biology by Ward and Whipple.

RESULTS OF ALGAE IDENTIFICATION

In the 1931 survey, samples were taken and not identified as to source. The following algae, identified as to genus only, were detected throughout the water shed.

Algae samples from 1931:

Ulothrix

Spirogyra

Chain Desmids

Draperna1dia

Zygnemia

Palmella

Chara

Cylondrocarpa

The result of the 1934 and 1936 surveys follow, identified as to genus only, correlated with the sampling station number at the correct site on the water shed map.

ALGAE FROM WHITE DEER WATER SHED IN 1934 AND 1936.

Sampling site number	1934 Sample	1934 Algae	1936 Sample	1936 Algae
6	1/3	Chroolepus		
Main Creek (1 mile point)			1 mile	Conferva Chain Desmids Spirogyra
34			1/16	Spirogyra
35			1/37	Conferva Spirogyra
41			2/11	Palmella
42	2/16	Spirogyra Conferva Ulothrix	2/16	Conferva Chain Desmids
46	2/12	Spirogyra	2/14	Conferva Spirogyra

ALGAE FROM WHITE DEER WATER SHED IN 1934 AND 1936 CONTINUED

Sampling site number	1934 Sample	1934 Algae	1936 Sample	1936 Algae
47	2/14	Spirogyra Chain Desmids Ulothrix		
52	2/6 B	Diatoms Zygnema Palmella		
53	2/6 A	Ulothrix		
54	2/6	Ulothrix Conferva		
60	2/1 A	Spirogyra Drapernaldia		
62	2/2 A	Chain Desmids Conferva		
81			3/4 A	Palmella
83			3/2	Palmella Chain Desmids
103			5/14 A	Drapernaldia
110			5/20	Spirogyra Chain Desmids
111			5/19	Spirogyra
113			5/22	Stigleoclonium Conferva Zygnemia
130			6/19	Spirogyra
132			6/17	Closterium Giant Desmids
146			H 6/2	Chaetophora
149			T 6/4	Chain Desmids Conferva

ALGAE FROM WHITE DEER WATER SHED IN 1934 AND 1936 CONTINUED

Sampling site number	1934		1936	
	Sample	Algae	Sample	Algae
151	T 6/2	Palmella Conferva	T 6/2	Spirogyra Conferva
152	T 6/2	Spirogyra Conferva	T 6/4	Chain Desmids Conferva

DISCUSSION OF RESULTS

Spirogyra and Conferva, both in many different forms, were widely distributed throughout the water shed. Palmella, Ulothrix and Chain Desmids were likewise very common. These are common algae and occur very frequently in the waters of Pennsylvania.

Fortunately, none of the algae detected cause serious odor and taste in water supplies. The only possible danger is a too luxurious growth resulting in a choking action to water works appurtenances. This danger is of no consequence on the water shed.

Unfortunately the luxuriant growths did not occur at the same sites on the two different surveys. We note that only 4 sites were sampled on both surveys. These results suggest but are too limited to establish the fact, that the same predominating growths of algae remain from one year to the next at any one site.

Likewise, do the results suggest that adjacent springs are likely to have the same predominating algal growths.

The springs in open glades, exposed to direct sunlight produced the most prolific growths.

In conclusion I might state that this feature of the survey provided the writer with more enjoyment, than facts to establish any definite laws.

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