

DEPARTMENT OF COMMERCE

UNITED STATES BUREAU OF MINES
SCOTT TURNER, DIRECTOR



REPORT OF INVESTIGATIONS

THE ACIDITY OF BLACK LICK, TWO LICK AND
YELLOW CREEKS, PENNSYLVANIA,
DURING LOW WATER IN 1930



BY

R. D. LEITCH

REPORT OF INVESTIGATIONS
DEPARTMENT OF COMMERCE - BUREAU OF MINES

THE ACIDITY OF BLACK LICK, TWO LICK AND
YELLOW CREEKS, PENNSYLVANIA,
DURING LOW WATER IN 1930 1/

By R. D. Leitch²

INTRODUCTION

This report is another of the series on the effect of drouth and low water on the pollution of streams by coal-mine drainage. A previous report³ dealt with work on Bennett Branch of Sinnemahoning Creek, Pa. This report deals with the results obtained during a similar study of Black Lick Creek, Two Lick Creek, and Yellow Creek. All of these belong to the same drainage system. Two Lick Creek is a tributary to Black Lick Creek, and in turn Yellow Creek is a tributary to Two Lick Creek, as shown in Figure 1.

Black Lick Creek was of such a volume that a seasonal investigation was not entirely feasible. Yellow Creek was found to have mines only near the mouth, except a few of status unknown to the writer at the extreme headwaters, and the stream was also more or less inaccessible for regular and frequent sampling. Two Lick Creek was found to be most suitable of the three.

ACKNOWLEDGMENTS

The work reported has been carried on under the direction and with the advice of Dr. R. R. Sayers, chief, health and safety branch, and W. P. Yant, supervising engineer, Pittsburgh Experiment Station.

DESCRIPTION OF STREAMS

The following description of the streams is taken mainly from a State report.⁴ Figure 1 is a map which shows the streams, mines, and most

-
- 1 - The Bureau of Mines will welcome reprinting of this paper, provided the following footnote acknowledgment is used: "Reprinted from U. S. Bureau of Mines Report of Investigations 3102."
 - 2 - Associate chemical engineer, U. S. Bureau of Mines, Pittsburgh Experiment Station, Pittsburgh, Pa.
 - 3 - Leitch, R. D., The Acidity of Bennett Branch of Sinnemahoning Creek, Pa.: Rept. of Investigations 3097, Bureau of Mines. In press.
 - 4 - Water Supply Commission of Pennsylvania, Water Resources Inventory Report, Part III: Gazetteer of Streams, 1917.

of the towns. The map has been prepared from Pennsylvania State Topographic maps and the mines spotted from locations given on a map of the Pennsylvania State Department of Mines, dated 1921.

As stated in the report on Bennett Branch, because of the probable indefinite period that the very low-water stages might continue and the desire to obtain as much general information as possible during that period, time was not taken to investigate tributary streams and the condition of most of the mines.

Black Lick Creek is formed by the junction of two branches on the Indiana-Cambria County boundary near Vintondale at an elevation of 1,378 feet. It flows in a general westerly direction for 29-1/2 miles to its mouth, about 2 miles west of Blairsville, where it empties into the Conemaugh River. The drainage area is 412 square miles in southeastern Indiana and western Cambria Counties, about 39 per cent of which is wooded, principally on the ridges and steep slopes. The topography is mountainous in the headwaters, flattening into broad, rolling tablelands in the northern portion of the basin. The channel is tortuous, with rocky bottom, and the rate of fall from source to mouth is 16.4 feet/mile. The rainfall is 40 to 50 inches per annum.

The seven towns in the basin, ranging in population from 550 to 5,600, contribute no industrial pollution other than coal-mine drainage.

Two Lick Creek is a tributary to Black Lick Creek. It is formed by junctions of its north and south branches in eastern Indiana County at an elevation of 1,290 feet. Its course is southwesterly to Black Lick Creek for a total distance of 26-1/2 miles. The drainage area is 190 square miles in eastern Indiana County. Only a small percentage of the basin is wooded. The topography is mountainous in the headwaters and the main valley is flanked by irregular and rounded hills almost bare of timber. The channel is tortuous and has a rate of fall of 12.4 feet per mile from source to mouth. The rainfall is 45 to 50 inches per annum. Industrial pollution is coal-mine drainage.

Yellow Creek is a tributary to Two Lick Creek. Its source is in Green Township, eastern Indiana County, at an elevation of 1,900 feet. Its course is southwesterly to Two Lick Creek at Homer City and total length is 25 miles. The drainage area is 67 square miles. The topography is rough and hilly with the main valley flanked by steep hills. The channel is tortuous through a broad alluvial flat in the middle basin and a gorge in the lower basin. The rate of fall from source to mouth is 36 feet per mile. Rainfall is 45 to 50 inches per annum. The industrial pollution is waste from coal mines.

DISCUSSION OF RESULTS

The method of sampling and volume measurement have been described in a previous report on the Acidity of Bennett Branch. Table 1 gives results for Black Lick Creek, Table 2 for Two Lick Creek, and Table 3 for Yellow Creek.

Black Lick Creek

The south branch of Black Lick Creek is seen (fig. 1 and sample 20, Table 1) to be high in acidity even near the headwaters above Nantyglo due to mine drainage above. Mines at that town and below, at Twin Rocks and Vintondale, almost double the original acidity (samples 21 to 25, inclusive).

North Branch of Black Lick Creek is approximately the same size as South Branch at their junction at Vintondale (sample 23, Table 1), and is almost as badly polluted.

Additional drainage from mines along the stream and on tributaries to the stream between Wehrum and Dilltown do not significantly change the acidity (sample 26, Table 1). From Vintondale on, volume measurements were not made because methods ordinarily used by the writer are unsuited to streams of this size. For a distance of about 11 miles below sample 26 there is no road near the stream, so that it could not be sampled in the brief period of time available. Also, no topographic maps have been published covering this section of the stream, and it is therefore shown as a broken line in Figure 1.

There is no great change in free acidity from the maximum observed at Vintondale (sample 22) to the last one taken about 4 miles from the mouth, although the total acidity is only about two-thirds as great.

Between samples 26 and the last one taken (sample 27), Two Lick Creek enters. Near the mouth it had a volume of 11,250 gallons per minute and a total acidity of 324 parts per million. The free acidity was 149 parts per million (see sample 1, Table 2). The volume of Black Lick Creek at this point appeared to be at least three times as great as Two Lick Creek. Assuming these relative proportions, the volume and composition of Two Lick Creek is almost enough to account for the final acidity of Black Lick Creek. The result of mixing, according to this calculation, would be to reduce Black Lick Creek from 1,075 and 405 parts per million total and free acidity to 887 and 341 parts per million, respectively. By analysis, it was found to be actually 810 and 405 parts per million total and free acidity. If the difference between the two total acidity values (887-810) or 77 parts per million of iron sulphates be presumed to have hydrolyzed, the result would be 55 parts per million of free sulphuric acid to make a total of 396 parts as compared to 405 parts actually found. This is well within the limits of accuracy of the estimation of relative volumes. It may be assumed, therefore, that dilution and hydrolysis are the determining factors in a decrease of approximately one-third the total acidity observed at Vintondale to that near the mouth of Black Lick Creek. The same situation has been observed and commented on in the report on Bennett Branch.

Table 1.- Samples from Black Lick Creek
(Acidity in parts per million; volume in gallons per minute)

Location (fig. 1)	Total acidity	Free acidity	Volume
20) Near headwaters, South Branch	696	317	180
21) Near Twin Rocks	1100	710	12,500
22) Bridge at Vintondale	1265	480	-
23) North Branch at Vintondale	1115	493	12,000
24) Bridge at Wehrum	1150	405	¹ Not measured
25) Bridge at Dilltown	1210	430	do
26) Bridge at Route 56	1075	405	do
27) Near Black Lick and mouth	810	405	do

1 - From sample 24 on, the stream volume, even at low water, was too great for accurate measurement by method used.

Two Lick Creek

South Branch of Two Lick Creek apparently has no pollution near its source (Fig. 1 and sample 19, Table 2), though some pollution may enter between samples 19 and 10, as evidenced by a lowering of the alkalinity.

North Branch contains mine drainage from near its source. Drainage was observed to enter at the place marked (11) in Figure 1, also the sample taken at this place appeared to be acid, but it was unfortunately lost by spillage before analysis. About 1-1/2 miles below this point (sample 9) the values are 599 and 222 parts per million total and free acidity, respectively. Several small streams of both mine drainage and pure water (springs) entered during this distance but are not shown on map.

Continuing down-stream, a sample taken about a mile below the junction of the two branches (sample 18, Table 2) shows only a slight acidity, due to the original alkalinity and volume of South Branch (sample 10).

It will be observed that the sum of the volumes of North and South Branches (samples 9, 10, Table 2) should be about 1,925 gallons per minute. At sample 18, somewhat more than a mile below the junction of these two branches, the volume actually measured about 495 gallons. There is no reason to doubt the relative accuracy of volume measurements at any of these three locations, so the explanation of apparent discrepancy must be similar to that noted on West Creek⁵ and Bennett Branch.⁶ Here, relatively large volumes of water suddenly disappeared by sinking into loose rocky stream beds and this situation is not infrequently observed by geologists and others engaged in

5 - Leitch, R. D., The Comparative Acidity of Several Pennsylvania Streams During Low-Water Stages. Bureau of Mines Rept. of Investigations.

In press.

6 - See footnote 3.

examining streams. One and one-half miles farther (sample 8) the volume was found to be only 675 gallons per minute, which is still far below the estimated sum of North and South Branches after their junction.

During the next 1-1/2 miles the acidity has increased (sample 8) as well as the volume. Although the latest map at hand showing location of mines does not indicate it, there must be a significant amount of mine drainage entering between these two points. The next sample (number 6, Table 2) shows an increased acidity and volume due to entry of two streams (fig. 1) and drainage from at least one mine and probably more.

Table 2.- Samples from Two Lick Creek
(Acidity in parts per million; volume in gallons per minute)

Location (fig. 1)	Total acidity	Free acidity	Volume
10 South Branch 0.5 mile above junction	20 alk.	92 alk.	1125
19 South Branch 2.0 miles above junction. Iron bridge	69 alk.	113 alk.	225
11 1.5 miles above junction, North Branch	Lost	sample	255
9 North Branch above junction	599	222	800
18 4.5 miles above Clymer. Covered bridge	18	8	495
8 3.0 miles above Clymer. Concrete bridge	271	119	675
6 South edge of Clymer. Concrete bridge	327	170	1900
17 Sample Run at mouth	172	76	30-40
16 Main stream between Penn and Sample Runs	310	159	—
5 4.0 miles from Indiana, U. S. 422	288	144	3750
15 3.0 miles from Indiana, U. S. 480	263	136	7600
7 McCartney Run below Indiana	60 alk.	104 alk.	450
4 About 2.0 miles below 7. Cliffside Park	277	132	—
3 Above junction Yellow Creek, Homer City	420	185	9300
2 Yellow Creek at mouth, Homer City	134	68	2350
1 Two Lick 4.0 miles below Yellow Creek	324	149	11250

During the remainder of its course to Homer City where Yellow Creek enters, both mine drainage and tributary streams of pure water were observed but not investigated individually.

Yellow Creek

Yellow Creek is the most important tributary of Two Lick Creek. A few samples were taken from it and are given in Table 3. Above Lucerne mine drainage the stream is definitely acid. Sample 2, Table 3, was taken one day and the other three samples in the table were taken the following day. The mine drainage enters this stream only during the hours of pumpage, and when sample 2 was taken this drainage was not entering the stream.

Table 3.- Samples from Yellow Creek
(Acidity in parts per million; volume in gallons per minute)

Location (fig. 1)	Total acidity	Free acidity	Volume
12 Yellow Creek above Lucerne drainage	129	43	40-50
13 Lucerne mine drainage	745	233	2400
14 Yellow Creek below mine drainage	475	228	---
2 Yellow Creek at mouth	134	68	---

Changes in Two Lick Creek

The result of these additions is a fluctuation in acidity values and, of course, an increase in volume of the main stream. The acidities at the mouth are fairly similar to those found in samples 17 miles above, although the volume has increased nearly six times. In other words, the quantity and quality of acid water flowing into the main stream during an approximate distance of 17 miles is almost enough to balance the addition of fresh water so as to hold the acidity fairly constant in spite of a large total volume increase. This situation may or may not exist under more normal conditions with respect to rainfall. As already stated in the report on Bennett Branch,⁷ while the streams were undoubtedly extremely low at this time, mine drainage may have been correspondingly low.

It will be noted from the tables of analyses that there is a fairly constant ratio between the total and free acidity in all three streams. For Black Lick Creek this ratio varied between 1.55 and 2.84:1. All but one sample were between 2.20 and 2.84. For Two Lick Creek the ratio was as 1.92 to 2.69:1; all but three samples were as 2.0 to 2.69:1. For Yellow Creek, although only a few samples were taken, the ratio was as 1.97 to 3.0:1. There were many samples quite constant in this relation that varied only between 2.0 and 2.3, and it suggests the possibility of an equilibrium between total and free acidity. This will be investigated further.

SUMMARY AND CONCLUSIONS

The acidity of Black Lick, Two Lick, and Yellow Creeks in Indiana and Cambria Counties, Pa., has been determined at various points and their volumes have been estimated during a period of unusually low water.

An equilibrium between total and free acidity in streams polluted by mine drainage seems to exist under certain conditions. The ratio of total to free acid under these conditions seems to be between 2.0 and 2.3 to 1.

7 - See footnote 3.

In addition to other streams investigated under the same conditions⁸ this investigation indicates that dilution and such neutralization as may result from entry of unpolluted streams, are the predominating if not the only significant factors that decrease the acidity of streams polluted by mine drainage.

⁸ - See footnotes 3 and 5.