

other compounds of the aromatic series and intend soon to describe the action of N_2O_3 in CS_2 solution upon the aldehydes, acids and amido derivatives of the same.

College of the City of New York, January 3d, 1890.

ON THE ALLEGED STERILIZATION OF RIVER WATER BY MINE WATER.

BY A. A. BRENEMAN.

During an epidemic of typhoid fever which occurred in the city of Wilkesbarre, Pa., in the Summer of 1889, questions arose as to the purity of the different sources of water supply upon which the city depended, and the writer was called upon to make an examination of the waters in question. The water of the Susquehanna River is one of these and is the only one concerned in the present discussion. The history of the epidemic and its causes is not at present to the purpose.

It was found that the river water was preferred by the public and by local physicians to water from adjacent mountain streams in spite of the fact that it receives above Wilkesbarre the sewage of nearly 100,000 people in the course of ten miles, the city of Scranton, which discharges its sewage into the Susquehanna through a tributary, the Lackawanna, and of Pittston, which is directly on the river, being the principal sources of contamination.

This peculiar faith in the purity of a river so open to defilement is traceable in part to the general indifference to filth that is known to be largely diluted, but much more to the influence of certain articles published in the local papers with the stamp of official commendation and the authority of scientific or *quasi* scientific opinion.

It was believed by the people of Wilkesbarre that the river water was peculiarly free from possibility of transmitting infectious diseases because of the considerable quantities of mine water

which it receives, the mine water being supposed to exert a sterilizing effect through its well known constituents, free sulphuric acid and sulphates of iron.

As it seemed that this belief, which was supposed to rest upon a scientific basis, could best be upset by direct scientific tests, the writer proceeded to make the following examinations :

Samples of water were taken,

1. From the Susquehanna River at the intake of the Wilkesbarre Water Co.
2. From the mouth of the shaft of the Hollenbach coal mine, the drainage from which runs into the river above Wilkesbarre.
3. (For comparison only) From Mine No. 3 of A. Pardee & Co. (coal operators at Hazleton, Pa.), at a depth of 300 feet from the surface.

The above samples were examined chemically and biologically with the results given below.

CHEMICAL EXAMINATION.

	GRAINS PER U. S. GALLON.					
	Total Acid (SO ₃).	Free Sulphuric Acid H ₂ SO ₄	Ferric Oxide, Fe ₂ O ₃ .	Lime.	Magnesia.	Silica.
River.....	1.00	.00	.71	1.88*	.46†	----
Hol. Mine...	51.16	15.59	12.23	8.21	4.09	2.50
Haz. Mine...	127.30	20.85	65.40	2.55	4.27	2.70

The iron present in the mine waters was entirely peroxidized when received, and as it was contained in well corked bottles with very small vacant spaces above the liquid it had probably had little chance to change after bottling.

The river water was alkaline in reaction and contained no iron in solution; the portion present being suspended ferric oxide.

These qualitative data alone dispel the idea that the river water can retain at Wilkesbarre any of the germicidal power that may be possible to salts of iron or free sulphuric acid.

* Equivalent to 2.1 grains calcium carbonate or 1.7 grains calcium sulphate.

† Equivalent to 0.96 grains magnesium carbonate.

The mine waters are quite acid and the quantity of free acid irrespective of the ferric sulphate in solution (calculated from the ferric oxide present, although a portion of this had been precipitated when received), was sufficient to permit of some germicidal effect.

As the total sulphuric acid in the river water (all of which is combined) is only one grain per gallon, it is not possible to admit that any quantity of this acid that is relatively important can reach the river throughout its entire course of more than a hundred miles above Wilkesbarre, and as all of this acid, which has once entered the river, must remain in the water as soluble sulphates the inflow of the mine water must be quantitatively insignificant.

Bacteriological Examinations.

In view of the important part played by bacteriological evidence in such discussions as this, it seemed well to examine the above waters also for bacteria, and as a crucial test, to attempt the cultivation of the specific bacillus of typhoid fever in the water of the river after it had been sterilized by heat.

To this end new samples of the waters 1 and 2 were taken in sterilized bottles, with the necessary precautions, and submitted to Dr. Hermann Biggs, of Bellevue College Hospital, a well known specialist in bacteriology, for the necessary bacteriological examination.

The results of Dr. Biggs' examination showed that the sample of river water contained from 400 to 500 germs per c. c. of at least fourteen different species, six of these being of species that signify gelatine (putrefactive bacteria). When samples of this water was sterilized by discontinuous heating, inoculated with pure cultures of typhoid bacillus, allowed to stand for forty hours and then put into an incubator, the typhoid bacillus was found to be active at the end of forty-eight hours and apparently to have increased in numbers. The sole purpose of this experiment was to demonstrate, that there is not present in the river water any inorganic substance that can exert an inhibitive action upon the life or growth of the typhoid bacillus.

Further experiments showed also that the mine waters contained yeast and mould fungi, but no bacteria, although bacteria could

be developed in both by inoculation with appropriate cultures after sterilization, provided a small quantity of nutritive gelatine were added. As to the typhoid bacillus it was found that its growth (after treatment as in the case of mine water alone) was possible in No. 2 (Hollenbach mine water) but not in No. 3. As the proportion of free sulphuric acid is very slightly higher in No. 3 than in No. 2, the difference must apparently be ascribed to the much larger proportion of ferric salts in the Hazleton mine water.

In conclusion, it is evident that no effective sterilization of the water of any large stream can result from the small and varying contributions made to its volume by mine drainage since surface waters are certain to overpower any specific effect which the former might be capable of exerting, and the results of the foregoing examination render it unlikely that even mine waters of such strength as are commonly met with could, even undiluted, be of certain effect with germs having the high resisting power that the typhoid bacillus is known to possess.

It is certain, moreover, that a water rich enough in sulphuric acid or iron salts to act as a disinfectant would be entirely unsuited for drinking.

ABSTRACTS.

GENERAL CHEMISTRY.

Analysis of the Seed of *Calycanthus Glauca*. H. M. WILEY.*

The above plant is a shrub growing in the mountains of the Southern States from North Carolina to Georgia. The berries, known locally as "bubby" berries, are violently poisonous, and

* See also a paper by L. E. Sterns on the Fruit of the *Calycanthus* (Bulletin of the Torrey Botanical Club, August, 1888,) and by R. G. Eccles, in *Western Druggist*, Jan., 1889, p. 15, and in *Druggists' Circular*, March 1889, p. 65.