a considerable longitudinal extension, and passes into the Steward mine property, formerly owned in this city.

At the latter mine, and at various other localities in this region, similar ores have been found, but the war has stopped all operations, and it will require capital and skill to develop this highly important mining district.

Galenite and zinc blende occur at several other mines, associated with gold ores, as at the Kings mountain, the Cansler and Shuford, and the Long Creek mines in Gaston county, etc. At Cedar Cove, McDowell county, in the limestones of the so-called taconic slates, at the Dobson mine, there is found an accumulation of yellow and yellowish brown zinc-blende mixed with lime. I have not, however, seen anything from there which looks encouraging.

Galenite and zinc-blende is associated with the gold ores at Murphy, Cherokee county. Highly argentiferous galenite occurs at several localities on Beech mountain, Watauga; argentiferous and auriferous galenite have been discovered at Flint Knob in Wilkes County, and I have seen specimens of it from Marshall, Madison County, Clayton, Johnson County, and Elkin Creek, Surry County, and also in several of the copper mines throughout the State, but I have no knowledge of any deposit of sufficient magnitude to be worked advantageously.

Tin.—No tin ore has been found in North Carolina as yet. Traces of this metal have been found in the tungstates of Cabarrus County, and in a micaceous slate in Gaston County, associated with garnet and columnar topaz (pycnite).

ON THE ABSORPTION OF GASES BY WATER, AND ON THE ORGANIC MATTERS CONTAINED THEREIN.

BY G. W. BAIRD, U. S. N.

Our attention was called to this subject a few years ago by some attempts made to aerate water on board ship. We had been suffering from the flat oleaginous and insipid taste of the freshly distilled water, and in our endeavors to render it potable within a reasonable length of time, it was found that the subject was one of no small importance, and attended with many difficulties.

By exposure to the air from four to five days the water became sweet and potable, and by exposure to the foul gases of the bilge it also became potable and sharp.

By delivering the water warm into the ship tanks it became potable much sooner than when delivered cold, though it was a well established fact that gases are less soluble in warm than in cold liquid. The water as delivered appeared as clear as crystal, yet there was always a mass of filth deposited on the bottom and sides of the tank after the lapse of a few months.

ABSORPTION OF AIR.

By subsequent investigations it has been proven that the "sharpness" of the water is due entirely to the amount of gas held in solution, and the oleaginous and insipid taste are due to the essential oils and organic matters brought over by the steam.

Our first attempt to purify the water was by forcing a blast of cold air through perforated pipes, situated in the bottom of a tank of known capacity, and a set of experiments conducted but with very unsatisfactory results. The bubbles of air rise very rapidly to the surface of the water and in right lines, without seeming to agitate the water at all. Experiments of ten hours durations were made, with the temperatures varying from 75° to 120° Fahr., and the water compressed in a small cylinder (Fig. 2) the measurements being made on the scale (b), and each set compared with the standard tension. The standard tension was obtained by subjecting water of fifteen days exposure to the air to a given pressure in the same instrument, and the deflection of the lever registered at one (1). The others were, consequently, in fractions of this unit.

Table A is the result of this set of experiments.

TABLE A.

By a blast of air directed through the water.

Temperature of water, Fahr.	75	80	85	90	95	100	105	110	115	120
Temperature of air.	68.43	68.104	67.98	68.112	68.181	67.875	68.17	68.645	68.	68.3
Compression of water compar'd with that of saturated water.	0.5625	0.4820	0.470	0.375	0.315	0.2812	0.2105	0.190	0.1555	0.0927

From these experiments it is evident that the nearer the temperatures of the air and water approach each other, the more readily they combine. It is equally evident that, with such apparatus, it is impossible to retain them at the same temperature long enough to determine the time required for saturation.

A fountain (fig. 5) was then constructed which injected the water in a spray, the pressure inside being kept up by means of a pump. Much time was consumed in making a proper nozzle, and it was demonstrated at the very first trial that the firmer the spray be divided the more rapid would be the absorption of gas.

Fig. 3 represents an enlarged view of the nozzle adopted, and one with which the following experiments were made: The water passes through the nozzle *a*, inducing a current of air or other gas through the openings *bb'*, issuing through the opening *c* in a beautiful spray, approaching, in fineness, a mist.

The saturated water was removed from the fountain by being displaced by mercury, it was then collected in a florence flask, the gases expelled by heat and collected in the metric glass, Fig. 4.

The gases were conveyed through the pipe *a* into the glass metric tube *b*, the weight of which was balanced by the cord running over the pulley *p* to the conical pulley *c*, and to the weight *w*. The object of this system of weights and pulleys was to maintain a pressure inside the tube, equal always to that of the external atmosphere, to eliminate, as far as possible, the errors that creep into calculations from experiments made under constantly varying pressures and temperatures.

The Absorption of Air was completed after three hours and a half, the water giving the same compression as water of fifteen days exposure. Experiments were then made with varying temperatures,

the time required to dissolve the gases increasing almost directly with the temperatures. Our attention was then directed to the

ABSORPTION OF OTHER GASES.

The glass shade over the fountain (fig. 5) was filled with the gas under investigation, the temperature and pressure being the same as that of the external atmosphere at the time the gases were withdrawn for measurement.

The same metric tube was used as before.

VOLUMES OF GASES DISSOLVED IN THE UNIT VOLUME OF WATER.

Carbonic Acid	Oxygen	Nitrogen	Sulphuretted Hydrogen	Carbonic Oxide	Marsh Gas	Nitrous Oxide
1.57	0.04692	.0255	3.1435	0.0327	.0543	1.3052

The above table gives the amount of gases soluble in pure water. Water, after dissolving four hundred times its volume of ammoniacal gas, seizes its normal volume of any other gas and absorbs it as readily as if not already impregnated. But the quantity of oxygen necessary to oxidize organic matter in water, is much greater when other gases are present.

RAIN WATER.

The quantity of gases dissolved in rain water was found, by Peligot, to be twenty-five cubic centimetres per litre, or 6.10699 cubic inches per 61.74 cubic inches = 2.47 per cent. of gas. The ratio of absorbed oxygen to nitrogen is greater by volume than in air, on account of the greater solubility of oxygen in water.

Peligot has given the following analysis, by measure :

Atmosphere.		Gases in Rain Water.	
Oxygen	20.81	Oxygen	31.20
Nitrogen	79.21	Nitrogen	66.40
	<hr/>	Carbonic anhydride	2.40
	100.02		<hr/>
			100.00

Rain water also contains nitric acid and ammonia, and sometimes nitrous acid.

Sulphurous acid is often found in the rain falling in or near manufacturing towns.

All liquids and solids absorb or condense on their surfaces, and in their pores, certain definite quantities of every gaseous body with which

they are placed in contact. The quantity of gases thus absorbed depends on the properties, both physical and chemical, of the bodies brought together, and on the temperature and pressure under which the absorption takes place. Charcoal is a powerful absorbant of oxygen, taking it freely from the atmosphere and liberating nearly all of the nitrogen, for which it has but little affinity.

ON THE ORGANIC MATTER CONTAINED IN WATER.

Surgeon Woods, U. S. N., of the Mare Island Hospital, kindly furnished us with five specimens of water, distilled at the Hospital, as follows:

- (1). Distilled, ærated and filtered through animal charcoal.
- (2). Distilled, ærated but not filtered.
- (3). Distilled, but neither ærated nor filtered.
- (4). Distilled, filtered but not ærated.
- (5). Salt water, used in the still.

The ærating apparatus was an air-injector, placed in and forming part of the steam pipe, connecting the boiler and condenser.

The filterer was a double return column, the water passing through both, but its velocity, depending on the difference of heights of water in the two columns, was very slow. By such a filterer water is much more effectively deprived of any solid matter held in suspension than by any other form.

The salt water, which was the first taken in consideration, is essentially a chlorinated alkaline mineral water. The saline contents were chiefly sodic, magnesian, potassic and calcic chlorides and sulphates. The organic constituents consisted of a number of very beautiful spores, which gradually develop and produce a very beautiful flower. These flowers are rich in color and luxurious in the quantity, and arrangement of their tints.

We are indebted to Dr. Burgess, of San Francisco, for the use of an admirable microscope of very high power and elegant construction, and for the assistance that gentleman afforded us in our microscopic investigations.

Each specimen was subjected to a careful examination under a quarter inch object glass, before and after exposure to the light, without any discovery in any of those specimens that had been either filtered or ærated. It is easily understood how spores may be removed by filtration, but it is difficult to believe that they could be completely oxidized by any process of æration.

Seven different specimens, treated with pure chrySTALLINE sugar, gelatin, creatin and gum arabic, developed no germs; while in those specimens which were unfiltered and unærated, a single day was sufficient to develop germs, when exposed to the light.

Having failed to develop either spores or animalculæ in the ærated or filtered water, our attention was given entirely to specimens Nos. 3 and 5, namely, the unfiltered and unærated distilled water, and the salt water from which specimen No. 3 was distilled.

After twenty-four hours exposure to light, (in a closed phial) No. 3 showed a small number of germs, scattered about, and of very different sizes and colors.

By treating with crystalline sugar they collected together like bunches of grapes, their colors gradually assuming the same shade. By further exposure to the light they developed into spores and gradually into beautiful flowers, exactly the same as those in the mother salt water, except that the tissue was more delicate and transparent. Finally the same stalks developed, put forth into tiny branches, produced the same flowers as in the sea water, but retained the delicate transparency which could not be found in any of the salt water tissue. Day after day a drop of each was examined under the microscope, and while the total quantity of matter in the salt water seemed to remain constant, that in the distilled specimen increased rapidly, until, after a few weeks, shreds and clusters of it could be seen with the naked eye in every part of the phial. A few grains of potassic permanganate was introduced into the water in this state, which rapidly oxidized the tissue and precipitated quantities of putrid fungi, which, when received under a quarter-inch object-glass, presented a jelly-like appearance.

After a few days of additional exposure to the sun, spores again made their appearance, developed, ripened and produced the same flower as before, but this time darker and more dense even than those produced by the salt water.

The following is copied from the *British Chemical Journal*, Vol. XXI, being a lecture by Dr. Frankland, F. R. S., to the Association.

ON THE DETERMINATION OF THE AMOUNT OF OXYGEN NECESSARY TO
OXIDIZE THE ORGANIC MATTER IN WATER.

“By the addition of known weights of different organic substances to equal volumes of pure distilled water, the latter was artificially

contaminated with a known proportion of each kind of organic matter. Every sample of water so contaminated was made to contain three (3) parts of organic matter in 100,000. The amount of oxygen which this organic matter abstracted from potassic-permanganate was first carefully ascertained, and then the actual amount of organic matter in the water was calculated on the assumption that eight (8) parts by weight of organic matter consumed one (1) part by weight of the permanganate.

“The same test was also applied to another sample of distilled water, from which all organic matter was carefully excluded, but to each 100,000 parts of which three parts of sodic nitrate were added. The importance of this experiment will be evident when it is remembered how frequently nitrates are present in potable waters. The amount of oxygen consumed was determined for two different times, viz.: First, for a period, at the end of which the acidulated and contaminated water remained tainted with the permanganate for ten (10) minutes after the addition of the latter, and secondly, for a period of six hours, during the whole of which time the permanganate was present in excess. The results are contained in the following table, where they are compared with the known amounts of organic matter present, and the known amount of oxygen which that organic matter would require for its complete oxidation :

1	2	3	4	5	6	7
Name of substance, three parts of which were contained in 100,000 parts of water.	Oxygen absorbed in ten minutes	Oxygen absorbed in six hours.	Oxygen required to oxidize organic matter in water (calculated)	Amount of organic matter present (calculated from column 2.)	Amount of organic matter present (calculated from column 3.)	Amount of organic matter actually present
Gum arabic	0.0102	0.0350	3.55	0.082	0.280	3.
Sugar cane	.0064	.0152	3.37	.051	.111	3.
Starch	.0142	.0302	3.55	.114	.241	3.
Alcohol	0.0093	.0164	6.26	.074	.131	3.
Creatin	.0080	.0172	6.59	.064	.138	3.
Gelatin	0.0792	.0836	6.76	.634	1.469	3.
Urea	.0092	.0119	6.40	.074	.095	3.
Hippuric acid	.0328	.0600	5.90	.262	.480	3.
Oxalic acid (crystalized)	.3747	.375	0.38	2.998	3.000	3.
Sodic acid	.691	.6913	0.00	5.521	5.520	0.

From this table it is seen that of the nine kinds of organic material operated upon, only one was completely oxidized by potassic permanganate, even after the lapse of six hours; whilst it will be remarked that urea, hippuric acid and creatin—three organic sub-

stances likely be to present in water recently contaminated with sewage—suffer an oxidation which only reaches $\frac{1}{50}$ of complete oxidation; whilst if the attempt be made to calculate the amount of these substances present in the water, from the quantity of oxygen so absorbed, instead of finding three (3) parts in each 100,000 we obtain only 0.138 part of creatin, 0.095 part of urea and 0.480 of hippuric acid."

THEORETICAL VIEWS.

From the experiments of Dr. Frankland, and those made by ourselves, there is but little doubt that the unoxidized condition of the organic matter after the specified period of duration, was due to imperfect diffusion; the degree of the oxidation of most of the substances depending upon the time they remained in contact with the permanganate.

But in the sample of ærated water (No. 1) though it had not been filtered, there could not be found a trace of any organic matter. It is popularly believed that the organic matter brought over with the steam is thoroughly oxidized by its contact with the atmospheric air, which is mixed with the steam and has the same temperature. By such means there is probably a most perfect diffusion of all the gases of the atmosphere with the steam and with each other, and being assisted by temperature, little or nothing escapes oxidation.

Bibliographical Notices.

Half Hours with Modern Scientists. Charles C. Chatfield & Co., New Haven. 1871.

The publishers have very judiciously issued, in book form, the first five numbers of their "University Scientific Series," and will doubtless be amply repaid for their experiment. The volume contains lectures and essays from Huxley, Barker, Cope and Tyndall.

The matter of the discourses needs no comment. They have already received the heartiest tribute of praise which is their due. They have inaugurated almost a new era in the influence they have exerted upon popular thought. They have served the great purpose of breaking down the barrier of exclusiveness with which men of science had hedged themselves about. They have presented the aspirations and strivings of physical investigators in terms free from technicality and