

ance, but because their presence serves as an indication of sewage contamination, for pure waters are almost free from sodium chloride, whilst sewage is highly contaminated with it.

Exp. 12.—Half-fill a test-tube with water, acidulate with a few drops of nitric acid, and add silver nitrate solution. Four grains per gallon of sodium chloride give a turbidity; ten grains a slight precipitate; twenty grains a considerable precipitate soluble in ammonia. Good water should only yield a slight haziness.

(3) *Ammonia*.—The presence of free ammonia in considerable quantities in water points to sewage contamination. Good potable water should contain very little free ammonia. Its presence may be detected as follows:—

Exp. 13. To a test tube half full of well water add five or six drops of Nessler's Test (Art. 196). A yellow or brown color indicates sewage contamination.

Naturally Occurring Waters.

(1) *Rain Water*.—Although this is the purest form of natural water, still it contains certain impurities which are washed out by it from the atmosphere. It invariably contains ammoniacal salts, sodium chloride, and organic matter of various kinds.

(2) *Spring Water*.—The nature and amount of material in spring water depends on the nature of the strata through which it passes. The salts which most commonly occur are (1) the bicarbonates and carbonates of calcium and magnesium, (2) the sulphates of calcium and magnesium, (3) the alkaline carbonates, chlorides, sulphates, nitrates, or silicates. The gaseous constituents consist of oxygen, nitrogen, and carbon dioxide.

(3) *River Water*.—Although river water contains a smaller amount of salts, it is usually less fitted for drinking purposes than ordinary spring water, as it usually holds in solution a larger proportion of organic matter of vegetable origin, derived from the extensive surface of the country which has been drained by the stream.

(4) *Sea Water*.—This usually contains about 3½ per cent. by weight of substances in solution, the one which is present in by far the largest quantity being common salt, NaCl.

QUESTIONS AND EXERCISES ON WATER.

1. Water is said to be a compound of oxygen and hydrogen; describe experiments in proof of this view.

2. How is the composition of water ascertained by the eudiometer? After exploding a mixture of oxygen and hydrogen, .017 gram of water was obtained, and 11.5 c. c. of hydrogen remained. The temperature was 15°C. and the pressure 760 mm.; find the volume of the mixed gases.

3. Explain how the action of hydrogen on copper oxide may be used as a means of determining the composition of water.

Berzelius and Dulong heated 53.821 grams of copper oxide in contact with hydrogen. The residual copper weighed 42.989 grams, and 12.197 grams of water were obtained. Calculate from this data the percentage composition of water.

4. What are the characteristics of pure water, and how may water be obtained in a pure state? How may drinkable water be obtained from sea water?

5. At what temperature is water at its point of greatest density? How may this be shown experimentally?

What effect would continuous frosty weather have on lakes and rivers if water expanded and contracted according to the same rule as a piece of solid iron?

6. What is meant by the boiling point of water? How does the pressure of the atmosphere affect the temperature at which water boils?

Two thin flasks are filled with water and sealed up. One is placed in boiling water and the other in a freezing mixture. What occurs in each case?

7. What is meant by the term *hardness* as applied to water? Give the earthy impurities which are the frequent cause of hardness in water and of deposits in boilers, and state how they are removed. What is meant by saying that a given specimen of water is 10 degrees of hardness?

8. Some hard waters can be softened by boiling, whilst others cannot. Explain the cause of this, and describe any other methods for softening waters.

9. A sample of water contains in 100,000 parts, 16 parts of calcium carbonate, 5 parts of calcium sulphate, and 7 parts of common salt; what is its hardness, and how much will this hardness be reduced by boiling the water for half an hour?

10. Supposing a certain water contains 20 grams of calcium carbonate in the gallon, and that the following equation represents the action of a solution of soap on calcium carbonate, $2\text{NaC}_{18}\text{H}_{35}\text{O}_2 + \text{CaCO}_3 = \text{Ca}(\text{C}_{18}\text{H}_{35}\text{O}_2)_2 + \text{Na}_2\text{CO}_3$. What weight of soap must be added to the water before a permanent lather can be produced in one gallon of water?

11. How may the presence of lead in waters be accounted for, and how may its presence be detected?

12. How may the presence of organic matter in water be detected, and how would you distinguish organic matter of vegetable origin from that of animal origin?

NOTES ON ENTRANCE LITERATURE.

LESSON XII.—THE TRUANT.

This lesson consists of what is called an "allegory." An allegory is a tale or some other kind of representation in which the words used and the events narrated have a meaning different from that which appears upon the face of the writing. It is generally used to teach some lesson of experience or morality. One of the most beautiful of short allegories is to be found in the 80th Psalm, 8th and following verses. An allegory may be prolonged to any extent. The longest and best sustained allegory in the English, or, in fact, any language, is Bunyan's "Pilgrim's Progress."

Let the pupils study the lesson carefully, until they feel sure they understand not only its general drift, but the exact truth intended to be conveyed in each paragraph and incident. Then, as the lesson proceeds, let them be required to explain clearly in their own language the meaning of each part.

NOTE.—In the following the numbers refer to the paragraphs taken in order.

1. (a) *Daffdownilly*.—The name of a flower, the daffodil or daffadilly, a species of narcissus.

(b) *Flower*.—The author may have had in mind Matt. vi., 28.

(c) *Labor*.—Define. Why would doing only what is beautiful or agreeable not be labor?

(d) *Mother*.—If this word is to be allegorized, it must mean nature, or the arrangement of things as they are in the world. But this is probably carrying out the allegory more minutely than the author intended.

(e) *Toil* is represented as a schoolmaster, because of the valuable training it gives to mind and muscle.

2. (a) *Worthy character*.—Mention some of the ways in which toil does good to children and grown people.

(b) *Had dwelt*.—Explain the allusion.