natural waters are concerned, he found the giving-off of hydrogen to be an indication of the presence of microbes, and that the quantity in which the gas is given off appears to increase with the impurity of the water. Thus the waters on the uplands of Derbyshire give off less hydrogen when sugar is added than the same waters taken lower down in the valleys, where sewage enters the brooks. The addition of phosphate to the waters had a powerful stimulating influence; and as the examination of a soil for phosphate is a rather tedious process, and the condition of the phosphate a point difficult to examine, Dr. Smith suggests that his hydrogen process may prove useful in the discrimination of rich and poor soils; also it is a test of the influence of chemical conditions on soils and surfaces. And, obviously, if the giving-off of hydrogen is a test of microbe activity, the process applied to soils may afford a test of the miasmatic condition of particular localities. Indeed, Dr. Smith himself observes that the new light which the process promises to throw upon cases where there is microbe action suggests the examination of so many substances, that 'the end of the inquiry seems far away.' Having stated his results, and their probable immediate practical utility, Dr. Smith presents speculations bearing on ideas which are just now very prominent in the minds of microbiologists. He tells us that he hoped to examine the known microbes of zymotic diseases in order to see if they also produce hydrogen; and he evidently expected to establish a relation in this way between such microbes and the microbes of upland waters. "It is probable," he continues, "that in sewage we have, at some stage or another, the germs of every disease existing in the community, and perhaps, if intensified enough, the germs of every possible disease;" and later on he states the problem still more definitely. Is any germ of disease, he inquires, dangerous or otherwise, according to the conditions to which it is exposed? Is the activity of the microbes found in water diminished by aeration? Are microbes in water of value, and, as they assist in the production of hydrogen when sugar is present, do they assist in digestion, or are they obstacles to digestion? Do the microbes constitute some of the secret qualities of waters which have been found good or evil in the opinion of so many of mankind? In other words, is absolutely pure water wholesome? A curious speculation in which he indulges is, that, given the hydrogen test as a measure of the chemical activity of microbes, we have the basis for calculating the electrolytic power of the movements involved in the life of a single microbe, and thus for arriving at the mechanical equivalent of a disease-germ. In the second part of his water report, Dr. Smith has described additional experiments on the elimination of nitrogen during putrefaction in water, offering further evidence of what he calls the natural purification of waters (first by putrefaction, and then by oxidation) in continuation of the interesting exposition in the report for 1882.

In a third part, Dr. Smith gives the results of a long series of experiments by means of Dr. Koch's gelatine process on samples of water obtained from the most varied sources. The method consists in mixing a purified solution of gelatine with the water experimented upon. In very impure waters the gelatine is first rendered fluid at the surface; and this fluidity gradually increases until the whole becomes fluid. The fluid swarms with bacteria. The results are registered by photographing the test-tubes. It is significant that the results by the gelatine process correspond very fairly with the indications by the hydrogen process, approximate gradations of activity in the same waters being shown by both methods. The value of these investigations will easily be seen.

BARK-LOUSE SECRETION.

THE past summer has been remarkable all through the northern states for the great numbers of large scale or bark lice. These lice have seriously injured our maples, white ashes, hickories, sassafrases, tulips, and elms. The eggs of these coccids hatch in May and June. The young lice attach their force-pumps beneath the leaves, where they sap the vigor of the trees the summer through. As the drying-up of the leaves in autumn gives a prophecy of a weakening stem, and prospective fall of the leaves, the lice desert the leaves, and attach their suction-pumps to the under side of the twigs and branches. I found that I could, by plucking the branches, hasten the migration of these lice from leaves to stem. The premature drying of the leaves caused the premature emigration of the lice. In early spring the scales — for now the lice are plump, scale-like creatures — grow very fast; and so rapid is the nectar secretion which exudes from the lice, that the leaves twinkle and fairly drip with this bark-louse nectar. The grass and walks beneath the trees become sticky with the unctious sweet.

The species of coccid which infests the maples secretes a cotton-like, fibrous mass, in which the eggs to the number of seven hundred or eight hundred are placed. This cotton-like nidus pushes out from behind, and raises the scale from the branch. In other species the hundreds of white eggs are concealed beneath the brown scales.

The nectar from these bark-lice is dark in color, of rank odor, and bitter and unpleasantly pungent to the taste. Though the bees appropriate this secretion, they refuse it entirely when they can gather from flowers. In actions they say, 'Better this than none, but never this when other is possible.' The bees regard this questionable sweet just as they do grape-sugar, — only to be accepted in lieu of naught else. The odor of this nectar is so rank; that its presence on trees is often quickly detected when one passes by. In many sections the past season the bees gathered this liquid by tons. I know of cases where the odor in the apiary was so strong that the bee-keepers thought they were victims to that terrible fungoid malady, 'foul brood,' which bee-disease is indicated by a nauseating stench.

This bark-louse nectar presents a strong contrast to that of Aphides. It is dark, not light, in color; disagreeable, not pleasant, to the taste; distasteful to the bees, and not coveted by them; unwholesome for winter food for bees, and positively injurious to honey which is to be placed on the market.

Yet this bark-louse cloud has its silver lining. In early spring, before the flowers bloom, it stimulates the bees to their highest endeavor in breeding, so that well-stocked colonies greet the clover-bloom. The apiarist has only to extract this dark, ill-flavored honey at the dawn of the clover season, to convert a seeming ill into an unmixed blessing; especially as this coccid nectar is equally as good as honey for various manufacturing purposes, as the making of printers' rolls, the flavoring of cigars, and the manufacture of honey-cakes. Knowledge and caution on the part of the bee-keeper will keep this dark honey wholly separate from the other, and thus eliminate all harm, and make the former of no small advantage to him.

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ECONOMY OF FUEL.

How much can be accomplished in the way of economizing in fuel is shown by the results obtained lately on a trip of the Burgos, a freight-steamer built to carry cargo cheaply at a slow speed. Her engines are on the triple compound system, where the steam — in this case from a boiler-pressure of a hundred and sixty pounds per square inch — is expanded in three cylinders in succession. The average speed at sea, in all weathers, is very nearly ten miles per hour. In a voyage from Plymouth, Eng-, to Alexandria, on the way to China, with a cargo weighing 5,600,000 pounds, and in a distance of 3,380 miles, the consumption of coal was 126 tons (or 282,240 pounds), being at the rate of 83.5 pounds per mile, or .03 of a pound per ton of cargo per mile: in other words, half an ounce of coal propelled one ton of cargo one mile. The *Railroad gazette* very neatly says, "Assuming that paper is as efficient a fuel as coal, we have only to burn a letter on board this steamer to generate and utilize enough energy to transport one ton of freight one mile. It is difficult to realize that so trifling an act as burning a letter involves such a waste of useful energy, or can have any reference to the energy sufficient to perform a feat which, under less favorable circumstances, requires a couple of horses and a teamster for about half an hour."

We may contrast with her performance that of the steamship Oregon, of the Guion line, where every thing is sacrificed to speed. The Oregon has engines of 13,000-horse power, 12 boilers, 72 furnaces, a cargo capacity some seven or eight times that of the Burgos, but intended for passenger business largely, attains an average speed of 17.9 knots (or 20.5 miles) per hour, and burns 337 tons of coal per hour, combustion taking place at the rate of over 16 tons of coal for each mile traversed. The cost of her coal for the voyage is put at considerably over $18,000.

The best locomotive performance in this country of which there is authentic record gives a consumption of about two ounces of coal per ton of freight hauled one mile, at the rate of thirteen miles per hour including stoppages, and rising to five or more ounces per ton per mile on grades of from fifty to seventy feet.

EXPLOSIVES AND ARMOR-PLATE.

DURING the last session of congress the theory was advanced that the effect of a moderate weight of dynamite, exploded in contact with the plates of a modern armor-clad ship, would be disastrous to the vessel. The Naval bureau of ordnance has tested this by exploding charges of gun-cotton and dynamite varying in weight from five to one hundred pounds, against a vertical target composed of nine layers of one-inch wrought-iron plates, strongly backed with twenty inches of wood, and braced so as to represent, as well as possible, the stiffness of the sides of a ship. Though much more work was done than it is likely would ever be performed against the armored side of a ship, the target was not materially injured.

In the course of these experiments it was apparently shown that the point at which a charge of a high explosive is ignited has an important effect upon the work done, since the effects of these charges were readily increased or diminished very materially, according as they were ignited on the side away from or adjacent to the plate; and this, too, notwithstanding the distance between the points of ignition in the two cases was only a foot. It is claimed that this result shows that the charge of a high explosive cannot furnish any tamping effect, but that to produce the greatest effect the ignition must be at some interior point of the explosive, well toward the rear. It also appears that the effects do not increase proportionally to the increase of the charge when the ignition surface remains constant.

The gradual ignition of the charge, even in the case of so violent an explosive as gun-cotton, was strikingly illustrated by the fact that when twenty-six pounds of wet compressed disks of that material were piled upon an iron plate, and exploded from the top (without tamping or cover), accurate impressions of the lower disks in the pile were stamped upon the iron underneath them. In this case there did not seem to be the least doubt concerning the complete explosion of the charge.

Experiments were also successfully made in firing shells charged with gun-cotton from ordinary rifled cannon, twelve rounds being fired from the twelve-pound howitzer, and thirteen rounds from the eighty-pound breech-loading rifle, and the ordinary service charges of gunpowder being used in the gun. Three unfuzed shells, charged with gun-cotton, were fired from the eighty-pounder against the target used in the dynamite experiments. The shells exploded with great violence, on impact; but the damage to the target was very slight, as the explosion took place before any practical penetration was effected. In view of recent successful experiments with a fuze