CHEMISTRY

Riches From the Sea

Gold in the Sea, Although Real Enough, Will Not Yield Wealth, But Extraction of Bromine is Practical Pursuit

By DR. FRANK THONE

See Front Cover

GOLD! That word of more-than-magic excitation has lured men by the millions, to frozen Klondikes, across burning deserts to Californias, over stormy seas to Australias and Transvaals, through countless ages to countless Eldorados and Golcondas. Not without cause did the Romans depict the goddess Fortuna with long locks of golden hair.

So when the American public got itself all excited over the announcement, at the recent meeting of the American Chemical Society in Florida, that the old hope of getting gold out of sea water had been made new again, it was only reacting in an entirely human and normal fashion. Golden pavements for all North America, golden dollars like seashore sands—it sounded like an apocalyptic dream of the New Jerusalem. Bankers might be worried if such a dream were in immediate prospect of coming true; there can be such a thing as too much gold—a permanent inflation on a gold basis. Just what *would* happen to the world's markets if gold became as common as copper? H. G. Wells please answer: here's a theme for a novel quite to your liking!

But one shouldn't become too excited over the prospect of practically unlimited gold squeezed out of the waters of the sea. There's no immediate promise of its becoming a fact, alluring or alarming though the dream may be. And in the meantime, the ocean really is yielding treasure of far more immediate importance in our daily lives and labors and enjoyments than anything the Forty-Niners or Klondikers or other treasure seekers as far back as Jason ever dreamed about.

From Ocean to Auto

If your car started without too much fuss during the cold weather of the end of this past winter, if it purrs along without knocking now that spring beckons to the country highways, credit that to a few drops of Extract of Ocean that have been mixed with the gasoline in your fuel tank. That is, you may do so if you use any of the numerous brands of ethyl gasoline, which almost everybody does nowadays.

When we speak of the tetra-ethyl-lead in modern motor fuel, with a sense of satisfaction of having mastered at least one of those many-jointed tough chemical terms, we are even at that omitting to give due credit to one important element, bromine, for its part in the chemical magic that makes the motor go—something much more important than the much-quoted money that makes the mare go. (Who drives a mare any more nowadays, anyway?) In the making of tetra-ethyl-lead, one of the indispensable ingredients is ethylene dibromide; and it is bromine for the making of this compound that men are now actually extracting from the sea, whereas they are only beginning to think seriously about trying to get sea-gold.

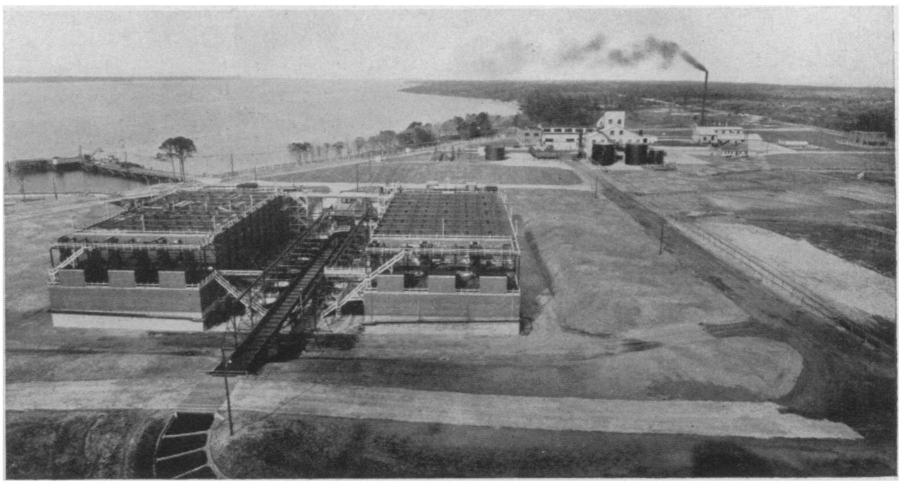
Adventuring in the Laboratory

The extraction of bromine from sea water is easily as romantic a tale as any romance that was ever woven about the Argosy of pre-history's dim mists or the Alaska of our hard-sinewed fathers' time. The adventurers were of the same breed of keen, audacious Americans, though their adventuring was done in the chemical laboratory and the engineers' construction shack rather than on the high seas or across frozen mountains. And their adventuring, moreover, had the sharper salt of the heroic in it, in that it was forefigured and sharply aimed at the aversion of a rapidly looming famine in one needed commodity, whose lack would have lamed cars and trucks and all other automotive traffic everywhere.

A Revolution

The invention of ethyl gasoline and its rapid adoption by the driving public wrought a veritable revolution in one American chemical industry. In 1924 the production of free and chemically combined bromine in this country amounted to approximately two million pounds. In 1931 this quantity had risen to about nine million pounds, all of which was being produced from natural brines and from seawater concentrated by evaporation. The demand for bromine was becoming so great that it had become perfectly evident that the sources then in use could not possibly keep it supplied. New sources simply had to be found.

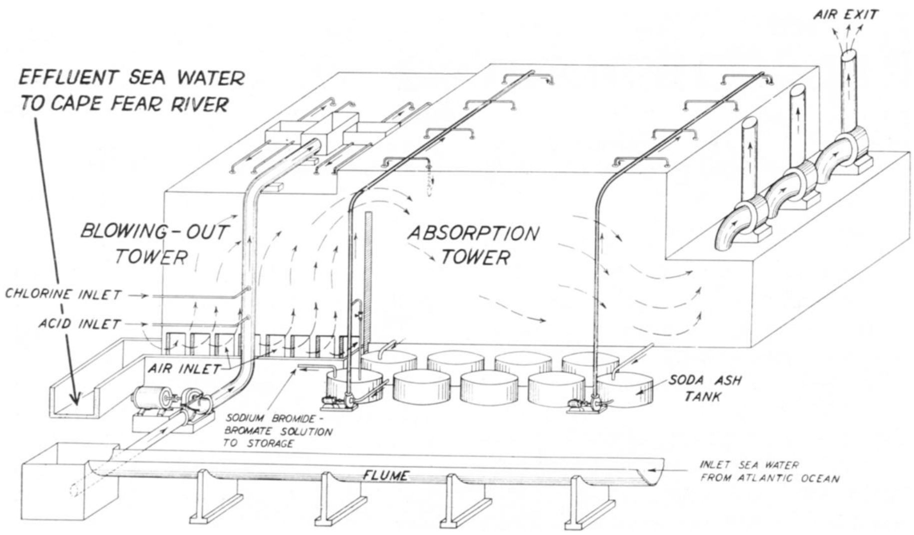
Chemists knew there was bromine in the sea. But it was there in exceedingly thin solution—in a million pounds of sea water less than 70 pounds of bro-



FROM ABOVE

General view of the first industrial plant built to rob the sea of its mineral wealth.

The illustration on the cover of this week's SCIENCE NEWS LETTER shows the inlet where the water pours in to the bromine plant.



HOW THE PLANT WORKS

The diagram gives an idea of the steps through which the water goes while it is being robbed of its bromine, and what happens to the bromine afterwards.

mine. No method known a few years ago could get it out cheaply enough to make it pay. Several pioneer efforts, one of them made in a ship that was a floating factory, failed to find a really satisfactory answer to the challenge of the bromine-hoarding sea.

Yet the challenge of Old Ocean could not be ignored. He had so much of this absolutely necessary element in his clutching wet fingers! How could he be forced to loose his hold?

The Secret Found

One of the most successful of American chemical manufacturing firms, the Dow Chemical Company, turned the batteries of its research chemists' wits on the problem. The secret was at last found: sea water hangs onto bromine because it is slightly alkaline. Make it acid, and it is willing to let go. The actual letting go is accomplished by adding to the acidified sea water a little chlorine—one part of chlorine for every part of bromine present. Chlorine, a chemical first cousin of bromine, is a "stronger" element: it can pry bromine loose from almost any combination in which it is a part, taking its place in the combination and letting the bromine drift out as a free gas.

All this the chemists learned in the laboratory, first with synthetic sea water which they mixed up themselves, then with tank carloads which they had shipped in from the Atlantic Ocean. They found also that the free bromine could be blown out of the water simply by shooting a strong stream of air through it. The bromine could be recaptured from its mixture in the air by passing it through a strongly alkaline solution of soda ash, and then released again by acidifying that solution and warming it. The finally freed bromine could then be captured as the pure element.

All this was demonstrated in the laboratory. When the company sought for a site where it could be put into profitable operation on a large scale, they combed both coasts of the country. The right place had to be as remote as possible from the outlets of large rivers that would dilute the incoming supply of sea water. It had to be free from sewage and industrial pollution. It had to provide some means of disposing of the vast quantity of waste water after the bromine had been removed. Preferably, it should be in a warm-water region, because warm water will give up its bromine more readily than cold.

River Takes the Waste

All these requirements were met finally on a narrow peninsula a little above the mouth of the Cape Fear river, a few miles below Wilmington, N. C. By cutting a canal across the peninsula, the pure sea water could be brought to the plant on one side, and the spent water discharged into the river on the other, with no danger of mixing with the supply.

Having decided on their site, the company moved decisively and fast. On July 27, 1933, they began clearing the land. On August 14 the first working drawing was completed, and on the next day the first building operations were begun. On January 10, 1934, the production of ethylene dibromide was under way; the plant, with a rated capacity of 15,000 pounds of bromine a day, is now working at 101 per cent. of that capacity—actually making more bromine than it is supposed to be able to make! The whole is a monument to the drive and energy of one industrial firm during times when many businessmen are still sitting on the dustheap of depression and wringing their hands over the hopelessness of the times. Incidentally, the undertaking "made jobs," too, at a time when jobs were needed: at one period they had 1500 men at work, and the whole task absorbed 90,000 man-days of labor.

Plant Simple

The working of the plant is practically as simple as that of its small laboratory prototype, but on an enormously greater scale. The machinery is titanic, for it must handle a veritable river of sea water, kept flowing all the time by a pair of gigantic pumps with a combined capacity of 56,000 gallons a minute, driven by a pair of 300-horsepower motors. These suck in the water from an inlet protected by a pair of piling-strengthened dikes, and hurl it over a concrete dam into the canal that carries it across the peninsula. In summer it is permitted to linger in a broad pond where it is still further warmed by the sun; in winter it gets no such basking period. The engineers have cleverly taken advantage of labor done before them: in one place utilizing an old Civil War trench, in another using as a kind of settling basin one of the strange elliptical depressions common in the Carolinas and believed to have been left ages ago by the impact of a shower of huge meteorites.

In the extraction plant, the water is thrown vertically upward through a great rubber-lined pipe 42 inches in diameter. Part way up, sulphuric acid is injected into it, and a little above this point, the chlorine that dislodges the bromine. Then the water, with its bromine all loose and ready to come out, encounters the counter-current of air. Out comes the bromine, and away it sails in the air. This carries it through a long series of soda-ash brine tanks, where it is recaptured. The bromine is released again by acidification and warming and now condensed in its pure state.

In the meantime, in a separate establishment, pure alcohol is being evaporated and passed over a very fine porcelain clay known as kaolin. This breaks it up into ethylene gas, and this gas is mixed with the bromine to form pure ethylene dibromide. This final product of the treasure-from-seawater factory is packed in steel drums and loaded into the company's boat, the Ethyl Dow, for its short voyage up river to Wilmington and thence out to the wide world's highways and their endless appetite for ethyl gasoline.

The company's chemists and officers have made man's first direct profits out of sea water. They are as yet extracting only one of the many things it contains; for there are in sea water, besides bromine, such elements as gold, silver, copper, nickel, cobalt, lead, strontium, tin, phosphorus and many others, including even radium. All of these, some in known quantities, some in unknown, are daily pumped into the company's plant and allowed to flow back into the sea, simply because nobody has any idea how to extract them. It is like standing on the bank of a river crowded with all kinds of good fish, equipped with a net that will catch only herring. Herring are good—but it's a shame to see all the others getting away, since we have the river anyway, all bought and paid for. The Dow chemists feel that if even a very small quantity of any of these valuable elements could be extracted from the same water as a by-product, it would be just that much "velvet."

Naturally, their thoughts turn first to the gold, though that is present only in a few parts per billion, instead of about 70 per million, as the bromine is. Even if they got the gold, the bromine they are already sure of is worth twelve or fifteen times as much. Nevertheless, the age-old human hankering for the yellow metal asserts and reasserts itself.

And what though nobody has the least idea about how to go after it? Ten years ago nobody had much of an idea how to go after the bromine. Maybe, ten years hence—who knows?

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A Canadian scientist says: "In spite of the fact that weeds probably cost us more than plant diseases, animal diseases and insect pests combined, we left them to be the last of the pests of agriculture to occupy serious attention as a subject of scientific investigation."

MEDICINE

Reports Improved Tests For Diagnosing Tuberculosis

AN IMPROVED test for tuberculosis, discovery that the disease is less prevalent in the United States than generally supposed, improvement in taking X-ray pictures of tuberculosis patients—these are the major advances in the fight against the white plague discussed at the meeting of the National Tuberculosis Association.

The improved diagnostic aid is a new kind of tuberculin used to detect the presence of tuberculosis. One difficulty with tuberculin tests in the past has been the fact that a number of different kinds of tuberculin were used. Not all of them were reliable. Tested with one product, a person might be found free from tuberculosis whereas a test made with another tuberculin might show the presence of tubercle bacilli in his system.

The new tuberculin, prepared by Dr. Florence Seibert of the University of Pennsylvania and the Henry Phipps Institute, Philadelphia, was described at the meeting by Dr. Esmond R. Long of the same institution. This tuberculin is considered more accurate and otherwise superior to any of the products previously used.

The Medical Research Committee of the National Tuberculosis Association has persuaded two drug firms to manufacture this product and hopes to have it universally adopted for tests. This would make the diagnosis of tuberculosis more certain. It would also enable health officials to determine accurately the amount of tuberculosis throughout the country.

Tuberculin tests sift out the persons who have tuberculosis from those who have not. But after the disease has been diagnosed further examinations must be made to determine the extent of the disease and the kind of treatment needed.

Most important in this respect is the X-ray picture. Here again wide variations in the way the pictures were taken made it difficult for physicians to compare pictures and judge the extent of the disease. The Medical Research Committee, under the chairmanship of Dr. William Charles White of Washington, has sponsored research to improve X-ray picture taking and is trying to have the improved method here also made standard throughout the country.

Tuberculin tests are already being made on a large scale, Dr. Long reported. An entirely new view of the situation in the United States has appeared as a result.

Fewer persons are infected with the tubercle bacilli, with or without symptoms of actual disease, in the West than in the East. The number of persons so infected is steadily decreasing in both sections.

Contrary to general belief, very many adults are entirely free from tuberculous infection. It used to be thought that by the time a person had grown up, he had many tubercle bacilli or germs in his body, the result of picking up a few at a time from chance contact with tuberculosis patients. Because he got the germs in small, repeated doses, he developed a resistance to them which kept him from getting ill with tuberculosis. The tests now being made in schools and colleges all over the country indicate that adults generally are not infected with the tuberculosis germs.

Science News Letter, May 26, 1934

ASTRONOMY

MacDonald Observatory Disc Not Damaged

REPORTS that the glass disc of the mirror of the MacDonald Observatory has been damaged during manufacture at Corning, N. Y., are erroneous, Dr. Otto Struve, director of the MacDonald and Yerkes Observatories, has informed Science Service.

The incorrect report probably arose because it has been decided for greater safety to repeat the process of slow cooling or annealing, thus giving the glass the benefit of two annealings. The glass is of excellent mechanical quality, Dr. Struve said, and relatively free from bubbles and other defects.

The MacDonald Observatory is being erected in Texas by the University of Texas, and it will be operated jointly with Yerkes Observatory.

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