RICH DEPOSITS OF FUEL LIE NEGLECTED BENEATH OUR FEET

Dr. Frederick G. Cottrell, Newly Appointed Chief of the United States Bureau of Mines, Discusses Some of Our Undeveloped Sources of Power and Their Possibilities

BY RENE BACHE.

DR. FREDERICK G. COTTRELL, the newly appointed chief of the United States bureau of mines, is a tall, big-boned man with a genial grin. Smooth-shaved, he looks younger than his 43 years.

He was born in Oakland, Cal., and his first job was that of teacher of chemistry in the Oakland high school. Afterward he taught chemistry in the University of California, of which he was a graduate; and nine years ago he joined the staff of the bureau of mines in Washington as consulting chemist. He became chief chemist of the bureau and later on chief metallurgist.

Dr. Cottrell possesses the imagination which is a fundamental requisite to the successful investigator. He is an inventor, and in this line his first important achievement was the devising of means for getting rid of the objectionable smoke and fumes of smelting plants. Such plants for smelting ores of copper, zinc and lead have made themselves extremely obnoxious in parts of the west, especially to farmers. Cottrell cleared the fumes out of the air by passing currents of electricity through it, thus getting rid of sulphuric acid and poisonous arsenic, saving metal dust from going to waste and preventing injufy to orchards and crops. Not only that, but in certain cases he made the sulphuric acid commercially available as a by-product and recovered precious potash from cement-kiln smoke.

"I might tell you something about helium that would interest you," said Dr. Cottrell when I called on him the other day. "You probably know that the government just now is addressing earnest efforts to the production of that gas on a large scale in Texas. Natural gas in the neighborhood of Fort Worth contains nearly 1 per cent of helium, and the problem is to separate it out economically. It is wanted for filling balloons, having the great advantage of being incombustible. An incendiary bullet will set fire to a balloon filled with hydrogen, but would not do worse than make a tiny hole in a helium airship. The army and navy are now jointly establishing a plant designed to yield at least 50,000 cubic feet of helium per day at a cost not exceeding 10 cents a foot.

"At the time when the armistice was signed the United States had on the dock ready for shipment to France 147,000 cubic feet of helium, which was meant to fill balloons or airships for the use of our troops at the front. The gas had never been produced anywhere in quantity before; our efforts in this direction had been kept secret; and if peace had not arrived when it did there would have been a painful surprise for the kaiser."

Imagine it. Suppose that an American airship had paid a visit to Berlin with a heavy load of bombs. It would have been immediately attacked, of course, by a flock of airplanes. But the flaming bullets discharged from the flying machines would have had no effect upon the helium balloon, beyond a few punctures, while her crew, hovering at leisure over the city could have dropped their explosives exactly where they would do the most good, returning thereupon to their base unharmed. The Germans would have been paralyzed with astonishment and fright.

Later on, doubtless, big helium balloons would have visited German cities in squadrons. The huns would have had no means wherewith to oppose them effectively, while their own Zeppelins engaged in raiding operations would have continued to be shot down and destroyed. So frightful and mysterious an instrument of destruction possessed by one side only in the conflict might well have caused a collapse of the enemy.

But to get back to our conversation with Dr. Cottrell.

"At the time of our entrance into the war," he continued, "there was in the whole world probably not more than 100 cubic feet of helium. It was a mere curiosity of the laboratory, and was valued at about $1700 a cubic foot. We may get it down to a point much cheaper than ten cents; and, in fact, it is quite possible that, when we have fully worked out its industrial production, the by-products obtained along with it from the natural gas may actually pay more than the whole cost of separation. Many natural gases contain much gasoline, and the work for extraction of helium will stimulate the development of methods for getting gasoline and other light hydro-carbons from natural gas.

"Helium has more than nine-tenths of the 'ascensional power' of hydrogen, when used in balloons. In this respect, then, it is nearly equal to hydrogen, while in another very important respect it is far superior, its wastage through the balloon fabric being only about one-half as great. As regards the process by which it is obtained, a detailed description would be too technical. Suffice it to say that we get helium from natural gas by liquefying out all the other constituent gases."

I asked him to explain this for my lay readers, and he continued:

"Natural gas might be called the vapor phase of petroleum. The latter is an exceedingly complex mixture of substances which we call 'hydrocarbons.' If these were arranged in a column according to their densities we would have asphalt, the heaviest, at the bottom. Next would come lubricating oil, then kerosene, then gasoline and then certain gases the lightest of which is marsh gas—the vapor which, rising in marshy places, lends to Will-o'-the-Wisp his mysterious torches. Lighter than marsh gas, however, is helium, which, when reduced to a liquid, boils at a temperature more than 450 degrees below the zero of Fahrenheit—that is to say, within a few degrees of the 'absolute zero,' which is no temperature at all."

"What are some of the other problems you are facing?" I asked.

"The exhaustion of our petroleum wells looms ahead of us as a not distant prospect," Dr. Cottrell replied. "Gasoline is likely to become steadily more expensive, and with increasing scarcity its use will be restricted more and more to special purposes. More and more shall we become dependent upon foreign countries for oil supplies. Fortunately, we still have for oil production a vast and as yet untouched resource in the 'oil shale' which extend in beds over immense areas in the Rocky mountain states, much of these black rocks being capable of yielding a ton, something like forty gallons of oil, 3000 cubic feet of gas and seventeen pounds of ammonium sulphate—the last highly valuable for fertilizer. The oil shales of Colorado alone underlie 1400 square miles, with an average thickness of 53 feet.

"According to the estimate of the United States geological survey, these shales are capable of yielding a quantity of hydrocarbons many times greater than all the oil fields of the world have produced up to date. As yet, however, their development in this country is only in earliest infancy. It has not passed beyond the experimental stage, though in Scotland the industry has been well established for years."

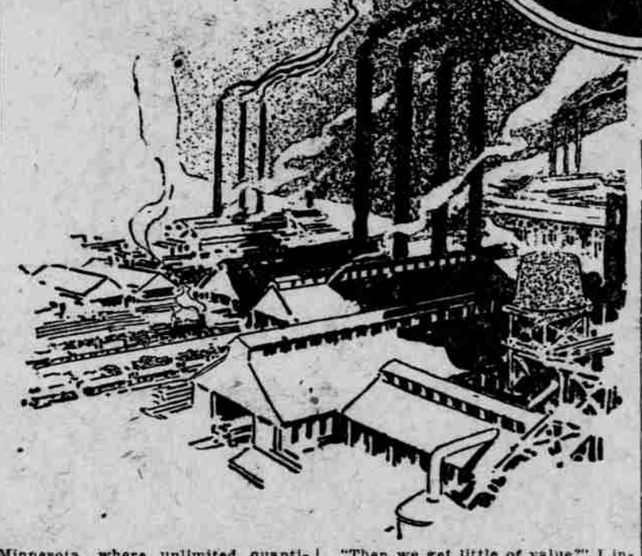
"How do they get the oil out of the shale?" was the natural question.

"They are mined like coal," he answered. "The material taken out goes to breakers and then into retorts for distillation, the oil being obtained by heating the rock in the absence of air. This process breaks up the complex organic compounds, probably of vegetable origin, contained in the shale, and yields hydrocarbon oils and gases. Among the ultimate products are motor gasoline, illuminating oils, fuel oils, lubricating oils and paraffin."

"Are there no other sources of fuel oils?" I wanted to know, and Dr. Cottrell went on:

"Virtually untouched as yet is our 'lignite,' which represents not less than one-third of the entire fuel resources of the United States. It is a fuel fully equal to much of what European countries depend on for industrial purposes; but we have such quantities of anthracite and bituminous that this low-grade kind of coal has been neglected. Indeed, millions of tons of bituminous coal and anthracite are annually shipped from the East into regions such as western

Dr. Frederick G. Cottrell, director of the U. S. bureau of mines.



Minnesota, where unlimited quantities of lignite are available near at hand.

There are vast beds of lignite in North Dakota, Texas and other western states. It is brown in color, woody in texture and contains about 30 per cent of water—this last, by the way, rather poor stuff on which to pay freight or to put into the furnace. In warm weather it falls to dust, owing to evaporation of the water. It takes fire readily by spontaneous combustion and so cannot be safely stored in quantity."

"Then we get little of value?" I interrupted.

"Oh, yes!" he responded. "Dried and powdered lignite is mighty good fuel under locomotive boilers, in cement kilns and in large furnaces. A mixture of 33 per cent of it with oil can be advantageously used as a liquid fuel; and if this expedient were widely adopted it would tend importantly to conserve our petroleum resources and effect a great saving in the cost of raising steam.

"Experiments have proved that dried lignite made into briquets with a suitable 'binder' is equal to some bituminous coal when used in heating plants and factory furnaces. In this shape, of course, it is easy for the fireman's shovel to handle. And the same material 'carbonized' affords, in the form of briquets, an ideal smokeless domestic fuel for stoves, fireplaces and ranges. By merely heating the lignite sufficiently to drive off the moisture and part of the volatile matter a 'char' is obtained that, when briqueted, is hardly inferior for such purposes to anthracite.

"Before very long the demand for carbonized lignite, which is, in effect, a dense charcoal, will be large, and will grow apace. It will place the lignite regions in possession of a fuel virtually equal to anthracite. Meanwhile, in those regions, neglect to utilize the lignite makes high prices for fuel, retards industrial development, and is a cause of other economic losses.

"The gas yield of lignite is upward of 10,000 cubic feet a ton. It may be used for coking, for illumination, for furnace fuel or for power for gas engines. Perhaps we may see the day when the farmers of North Dakota and Texas will employ gas-producer tractors. To till the soil by power derived from fuel mined beneath the ground will be a performance not altogether lacking in picturesqueness.

"Other by-products of oil shale distillation are ammonia, oil and tar. From the tar may be derived carbolic acid, dyes, medicinal drugs, perfumes, benzol, toluol—which last, when treated with nitric acid, yields TNT—and a great variety of other things, including pitch, which may be used in the binder for the carbolized lignite briquets. Indeed, the by-products should, with a developed industry, pay the cost of carbonization."

And here I turned the conversation to coal, so much in our mind today, Dr. Cottrell declaring:

"It would be appropriate for me to say that before long undoubtedly we shall make much wiser and better use of our coal than hitherto. We shall save and utilize its valuable by-products which we have been accustomed to throw away. More of our coal will be used in the shape of powder, blown into furnaces like oil—a method which of late has been widely adopted in metallurgical furnaces." And in the next breath he astonished me with this prediction:

"One thing we want is cheap oxygen for industrial purposes, and we are soon going to have it. Today bottled oxygen in steel cylinders costs $200 or more a ton. We shall get it down to $2 or $3 a ton or possibly even less. How, you ask? Simply by reducing air to a liquid and distilling it. Then, instead of being sold in steel bottles, it will be piped direct from the separating plant to the furnaces.

"Our coal, before it comes to market, is carefully cleaned, to get rid of slate and other incombustible refuse. We throw a few shovelfuls of it, say, into the family furnace; but, in order that it may burn, we must also pour into the furnace a large quantity of air to furnish oxygen. The air is only one-fifth oxygen, the balance being nitrogen, an inert gas—so much refuse, in other words.

"What is the result? A lean vigorous fire. Much refuse puts fire out, whether it be slate or ashes or nitrogen. We are obliged, incidentally, to heat the nitrogen uselessly, and that heat passes out and away; it is just so much clear loss. The same proposition applies, of course, to industrial furnaces.

"Ores, before they go into the smelting furnace, are 'concentrated' to the utmost—meaning by this term that all waste is eliminated so far as possible. But, in thus dealing with iron, copper or lead the weight of air that goes into the furnace is as great or greater than that of all the solid materials. Four pounds of waste in the form of nitrogen go in for every pound of oxygen. It means a throwing away of much valuable fuel efficiency.

"We must separate the oxygen from the air and use it for the fire in more concentrated form than at present. That, when oxygen is cheap, as I am sure it will be before long, will mean economy of fuel and a correspondingly less cost of production. With more concentrated oxygen we can utilize poorer and cheaper coals, because when the nitrogen is cut out the fire will stand more of other things that will not burn."

Next I wanted to know about the business of getting rid of smoke and fumes.

"Well," the chief replied, "the beginning of that was fifteen years ago, in California. A smelter near Benicia got into trouble because of alleged fume nuisance and damage, of which residents of the town and farmers of the surrounding country complained. Its plant was near one of the railroad tunnels and when the wind blew just right fumes of sulphuric acid from the silver-dissolving house would fill the tunnel with choking gas. A large traveling public was thus rather forcibly impressed with the apparent justice of the complaints, and general public opinion correspondingly influenced in the controversy.

"It was, of course, a very serious matter, and finally legal proceedings were started to compel the closing of the smelter plant. Laboratory work of mine relating to smoke and fumes excited the smelting company's attention, and soon a small electrical equipment installed on the dissolving-house flue cured the trouble.

"The principle on which the process was based was that of passing electric currents through the flue gases before they left the smokestacks of the works, thereby causing precipitation of the objectionable matter from the gases. That little contrivance is still in operation and is yielding sulphuric acid as a by-product of commercial value.

"If it had not been for legal proceedings against other smelting concerns, what is known today as the precipitation process for getting rid of objectionable fumes and smoke might not be available today to industry and the public generally. But when it came to be understood that means were available for mitigating nuisances of the kind, as well as recovering in many cases considerable values from the waste gases, smelters all over the west began to investigate the subject carefully—which has led to adoption of the method by many plants, partly as a matter of better metallurgical efficiency and partly because courts and juries have inclined to the view that farmers were not demanding of the smelters anything unreasonable when they insisted upon thoroughly up-to-date equipment for fume control.

"Perhaps one of the best illustrations of the great expansion of the utilization of the process from its small beginnings is a recent installation at a copper mine in Montana. There one sees a stack thirty feet higher than the Washington monument and eighty-six feet in diameter, containing the equivalent of 6,672,214 bricks, built expressly for the installation of the process. The smoke, conducted through a vast flue system from the furnace, is passed into chambers wherein hang 111 miles of chains electrified by a high-tension current. Its solid particles are repelled by the chains and adhere to large plates between which the chains are suspended. When the plates have become thickly coated, the current is shut off and the accumulated material falls into hoppers. By this means the gases that go through the stack are 'swept' before joining the outer atmosphere and several hundred tons of dust and fume are collected each day, having a value that runs into the thousands of dollars."

And Doctor Cottrell closed the interview with these startling statements, adding:

"It was this work—dealing with smoke and fumes as a business of national interest, inasmuch as an adjustment between farmers and smelters in many parts of the country was involved—that originally led to my joining the Bureau of Mines in Washington."

"MARSE HENRY" WATTERSON AT 80 OPTIMISTIC ON FUTURE

"Don't Worry, Even if Atlas Should Stumble and Drop the World," He Advises. The Best Way to the Editorial Chair Is Through the Ranks

BY CHARLES W. DUKE.

IS AMERICA going down hill? Have we climbed to the zenith of human endeavor in this modern civilization and started down the other side?

"For 2000 years we have been building the world's most perfect civilization," said Colonel "Marse" Henry Watterson, who has been called "The Greatest Editor the South Ever Produced."

"If history is to repeat itself," he added, "then we have attained the pinnacle and are now bound the other way."

Eighty years ago, his hair and whiskers snow white, a falter in his step, but that hair-trigger brain of his still functioning as of old, this patriarch of American journalism was taking it easy in a soft-cushioned chair in the foyer of a big New York hotel, a picture of comfort, when the writer "bumped" into him. "Marse" Henry had just dropped in from the Manhattan club, his favorite New York nook, to meet Mrs. Watterson in time for lunch.

The question of the alleged impending decline of American civilization was one of his own propounding. It had been arrived at after a few dissertations on world events, the high cost of living, the political situation and the league of nations. Colonel Watterson dismissed bolshevism, socialism and the democratic party with one sweep of the hand.

"I'm getting too old to meddle in such perplexing things any more," he said. "But ours is somewhat of a difficult situation today. It is not a political situation, but rather a condition growing out of the war. It will take us some time to untangle and get back to normal."

It was then he raised the question of possible decadence after 2000 years of Christian civilization—more particularly, after 300 years' construction of the North American republic, known as the U. S. A.

"Well, what do you say?" was asked in turn. "Do you think the world is so topsy-turvy that it is headed down hill instead of upward?"

Colonel "Marse" parried. "Study history," he counseled. "Look at the Egyptian decline. Take up the Grecian civilization; then the Roman. In each case they builded what was considered a perfect civilization. Each in turn represented something bigger and better than the world ever before had known. Then they crumpled and fell.

"Now we have been building our own for 2000 years. If history may be taken as a criterion, then we are bound for a tumble.

"Will it happen? How do I know? How does any one know? Time alone will answer. Wait and see; but in the meantime it might be a good thing to study the underlying reasons for the decay of other civilizations and take care lest we go the way of the rest of them. History, I tell you; study it. You can learn a whole lot from it."

In the meantime, "The gentleman from Kentucky" is not worrying a whole lot about the future.

"It would be a terrible thing if we all knew just what was going to happen," he added. "Just think what a fearful thing it would be if we all knew when we were going to die.

"Don't worry—that's my motto," he remarked. "I guess you might sum up my whole philosophy of life in that way. Worry won't get you anywhere. Just go along naturally and take things easy. I have worked hard in my time, but I never let work throw me."

The colonel was reminded he was looking exceedingly well on his 80th birthday.

"Looks are deceiving," he countered. "Don't you hear me puffing? I've just come over from the club—and in a taxi, too—but I'm blowing like a bellows. Can't stand much any more."

The Wattersons were about to "take off" from Manhattan for their home in the south. The colonel explained he now sees little of his native heath out Kentucky way. Only a small portion of the year is spent there. Their time is divided between New York and their winter home in Florida.

No matter if Atlas stumble and fall, permitting the world to come crashing down, there is one virtue amid all the vices of today, according to Colonel "Marse." It is the modern newspaper. True to his old love, he maintains, with Talcott Williams, that, "taken as a whole, the newspaper was never better written and never did its work better in any of its fields than it is doing today."

Some one complained recently that reporting appeared today to be a lost art. To this Colonel Watterson emphatically takes exception, declaring the newspaper of the moment cannot be excelled in the matter of collecting and presenting news.

"Where is there anything to compare with it?" he demanded. "Every morning at breakfast I read not only everything of importance that has happened in my own town, in my own state, in my own country, but throughout all the world. In what business field do they work faster and produce more substantial results than in the modern newspaper office?"

Take it from "Marse" Henry, the best way into the editorial chair is by way of the "local" room. The best editors are those who have come

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up from the ranks of "cub" reporters sparring for "scoops."

"Give me the 'cub' every time," he said, "rather than the long-haired intellectual when it comes to making editors. I'd much rather have the district reporter than the highbrow from college hill if I were molding an embryo editor."

Watterson came up from the local room. As a lad he was educated at the Episcopal academy in Philadelphia, where he gained his first editorial experience as editor of the school paper. They badly bent their bylaws to continue him in office.

After school, as a lad of 17 years, he went to MacMinnville, Tenn., and there started in journalism as founder, publisher and editor of a weekly newspaper. But he was not for small-town stuff, and at 18 years of age he sold his country newspaper and set forth for New York to embark upon the remarkable career that carried him to the editorship of the Louisville (Ky.) Courier-Journal and the title of "The Greatest Editor the South Ever Produced."

"I was born next door to a print shop and grew up in a newspaper office," is the colonel's proud boast. "First and last, I have filled every newspaper function, from galley boy to leader writer. I am proud of my calling and jealous of its good name."

"No game like it in all the world," he says. "A high calling—no man can attain a higher sphere of usefulness—but withal good sport, life, adventure, color, travel, temperament and all that.

"Some people think of it as a strenuous game in which a man wears out before his time. Well, I'm still here and 80 years old. Just got out of the saddle recently. On the point of longevity the newspaper man may live as long as any other, provided he takes care of himself."

Colonel Watterson complains they are not making great editors nowadays, like they used to. He says there are no Greeleys, no Danas, no Bowles, Medills and Halsteads, like there were in the old days when an editor could speak for a whole section of the country, and whose opinions could help shape party platforms. He deplores the passing of "individualism" in this respect.

While airing his own personal view in the matter the colonel took occasion to say that "If I had my way I would abolish the average editorial page, for it is nothing but flapdoodle." He says the people are thinking for themselves today.

But when it comes to the straight news the modern journal is a marvel of 20th century perfection. He thinks "You have to hand it to the boys, for they are getting out the news," which, from his point of view, is the prime function of a newspaper.

Scientist Explains Gravity's Hold on Atmosphere

Air, If It Could Be Seen, Would Resemble Swarm of Gnats.

SCIENTISTS say that to understand how the atmosphere is tied to the earth by gravitation, a mental picture of a gas, such as the air, must be formed.

Can you call to mind the appearance of a swarm of gnats dancing in a sunbeam and how they flit to and fro and up and down with irregular motion? If your powers of sight could be increased about 10,000,000 times the air might present to you an appearance not unlike that swarm of gnats. For the air consists of innumerable particles (molecules) of diminutive size, flitting about and jostling each other, now colliding like billiard balls, now flying apart, now hitting against the solid object of which the visible world is composed.

"Just as would be the case with a jumble of billiard balls rolled at random on the table, the individual molecules have all kinds of different speeds," explains Alfred J. Lotka in Popular Science Monthly. "But the average speed of a large number of them is definite, and depends on the temperature. At 60 degrees Farenheit the average speed of the molecules of the air is about 1500 feet, or something over one-fourth mile, per second.

"To shoot a body off the earth so that it will never return requires a velocity of about seven miles per second. You will therefore see that a molecule of the air, at the average speed of 60 degrees, can never leave the earth.

"The earth's gravitational pull falls off as the distance increases. A stone weighing one pound at the earth's surface, 4000 miles away from the center, will weigh only one-quarter of a pound if taken to a point out in space 4000 miles from the surface or 8000 miles from the center. This is the law discovered by Newton.

"But if, instead of going out into space, we make a deep bore-hole in the earth, how will gravity vary as we go down?

"If the earth were a uniform perfect sphere, gravity would decrease as you go down into it. But, as a matter of fact, the central portion of the earth is more than twice as dense as the crust, and for this reason the weight of a body increases as you go down; though, if you could go far enough, a point would undoubtedly be reached where gravity would begin to decrease, becoming zero at the earth's center."