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MILITARY AND STRATEGICAL VALUE OF OIL FUEL.

It is for very weighty reasons that the United States navy has been engaged in a most searching investigation of the question of oil fuel for the navy. Although it is true that the whole industrial world will be benefited by the voluminous data of the most reliable character that will be available, it was, primarily, to learn the exact value to the navy as regards the efficiency of its ships, both individually, considered as fighting units, and collectively, in respect of their strategical efficiency in relation to the fleets and fortifications of friend and foe, that this investigation was begun some two years ago.

The superior advantages of oil fuel over coal as affecting the design of warships and their subsequent handling are well known. In the first place, oil, because of its superior heating qualities, weighs less and occupies less bulk, compared on a basis of total thermal value, than coal. Therefore, the difference in weight and bulk in a ship designed to use oil fuel represents so much weight that may be worked into that ship to improve her qualities, either by building her stronger in the hull, or by making a proportionate increase in the weight of her armor or in the number of her guns, or by providing her with a larger fuel supply.

Oil fuel has, moreover, the valuable quality that it can be stowed in the water-tight compartments of the double bottom of the ship, thereby permitting the very considerable space which is taken up by coal bunkers to be utilized by the naval constructor for other purposes, if he so desires. The effect of the substitution of oil fuel on the personnel of the ship would be to make a great reduction in the fire-room staff, the crowd of stokers being replaced by a few men with some slight engineering knowledge, who would be easily able to look after all the necessary pipe connections and burners for carrying the oil to the boilers and properly burning it in the furnaces. Furthermore, much of the delay, and all of the dirt and inconveniences, which make the work of coaling a ship the *bête noir* of the naval man, would be removed; since the oil could be piped by gravity from the tanks of the fuel supply station, or pumped from the fuel supply ship, directly into the tanks of the warship. Finally, there is the welcome riddance of ashes, with their necessary installment of ash hoists and chutes, to say nothing of the labor involved in their removal.

The question of the extensive use of oil fuel in the navy has a special strategical importance for the United States, and this for the reason that we are next to the largest, if not the largest, producers of oil fuel in the world. Comparing our position with regard to this question with that of other great naval powers, it may truly be said the oil fuel question is paramount, no other leading naval power being able to tap its supply of oil directly from so many widely-scattered centers. Thus, the great oil fields of Louisiana and Texas lie within pipe-line distance of the Gulf of Mexico, the value of the naval control of which by the United States is universally admitted, particularly with reference to its relation to the Panama Canal. The oil fields of Pennsylvania are connected by pipe line with the three great ports of Baltimore, Philadelphia, and New York, thereby serving the ships of the North Atlantic station at three different points; while on the Pacific coast, the port of San Francisco is similarly connected with the oil fields of California; and, from this last source, it would be possible to keep supplied the storage tanks of fuel stations at three widely distributed points, namely, the Hawaiian Islands, the Philippines, and the Aleutian Islands. Of course, it must be recognized that the storage of fuel at various stations answering to coaling stations would require special provisions as compared with the storage of coal, since the oil must necessarily be placed beyond the reach of shell-fire from a hostile fleet. To this, however, oil fuel would lend itself admirably, since the tanks could be placed inland, beyond the range of hostile fire, and the oil piped from these tanks to the docks. A further valuable advantage of the use of oil would be that the most important problem of coaling at sea would be simplified; since it would be sufficient to connect the tanks of the fuel supply ship by flexible hose with the fuel tanks of the warship, and pipe the oil from one to the other while the supply ship was in tow.

SURFACE INDICATIONS OF OIL.

The discovery of new oil fields in Kentucky, and the bringing in of gushers from time to time in fields hitherto unsuspected of being oil-bearing, has served to create great excitement in a part of the public mind. Prospectors study the trend of the land, and owners of real estate easily become convinced that their holdings will produce oil in vast quantities, if only some company could be persuaded to drill. It is a fact that large oil producers do not prospect; they leave that dangerous business to the professional "wildcatter," and when he has located a new, rich territory, they buy him out.

The greater part of the facts with which geologists have to deal possess for the general public a recondite character. They concern things which are not within the limits of familiar experience, and are usually treated in such a manner as to befuddle the understanding of the unschooled in geological lore. Perhaps no question pertaining to geology has been so earnestly and so often asked as, "What are the signs that reveal the presence of oil?" But the Sphinx of geology remains silent, notwithstanding wealth beyond the dreams of avarice waits upon him who, judging from surface indications, might infallibly point out the presence of oil beneath. So eager are men to have the question answered, that they strain the facts that are well known to exist, and persuade themselves that they have discovered the secret sign which nature has set upon her treasure house. When this thirst for wealth takes hold of one, nothing will quench its fire but actual experiment.

It may be generally said upon the highest authority, and in the light of experience in every oil field in the world, that surface indications cannot be relied upon to reveal the presence of petroleum in the underlying strata. It would seem that nothing has been more positively and definitely settled than this; and yet with the spread of discoveries of new fields, also spreads the belief that such and such localities are situated over inexhaustible quantities of the fluid. Every day brings confirmation of this.

Now, in countless neighborhoods, and practically in every State in the Union, there are "signs" of oil that incite the finder to extravagant statements and rouse his wildest hopes. The spring that trickles from the rocks bears upon its clear water little globules of oil, apparently brought from the depths of the earth; the stagnant pond nestling among the little hills has an oily cast, and a smell of oil pervades the air about the place. These signs are taken to mean that there is an immense reservoir of oil, so full that it is fairly bursting, and some of the overflow has appeared upon the surface. No heed is given to the fact that in order to reach the surface those few drops of oil would have penetrated hundreds of feet of rock and shale which overtop the oil-bearing strata in every field and form an impervious cover to prevent the escape of oil. Those surface indications mentioned are common manifestations. They indicate the presence of decaying or decayed vegetable or animal matter in the depths from which they spring. A rotting carcass in the pond will create a gas, and ultimately globules of oil will float to the surface. In the absence of animal matter, then, the appearance of the oil signs may be accounted for by rotting vegetable matter, which has accumulated year after year, until the chemical change has been effected, and oil appears where once was vegetable life. In the case of the spring bursting from the depths of the earth bearing particles of oil upon its surface, it must be admitted that there are some very creditable and learned geologists and oil experts who insist that it is a "sign" of oil in immense quantities. It cannot be taken as an infallible sign, however, nor should any importance be given it at all. As has been said, though, so eager are persons to discover a deposit of oil in their land, that even slight indications produce a very great hope and incite to wildest speculation. The spring water in percolating through the rocks has come in contact with a slight deposit of decayed vegetable matter, which it has caught up and carried to the surface of the earth. Geologists' theories in some instances controvert this statement, and credit the presence of oil on the water of a spring to the fact, which is claimed to be self-evident, of the uprising of oil particles from a reservoir below. It seems altogether probable that the oil found in the rocks at various depths is of widely different ages, according to the location in which it is found. That which is observed to rise above the surface on the streams of springs may be but comparatively a few years old, while that found in the stratum underlying the shale and rock certainly is centuries old. There are Cambrian, Ordovician, Silurian, Devonian, Carboniferous, Triassic, Jurassic, Cretaceous, and Tertiary petroleums. Each of these varieties is found in a geological structure which is unlike any of the others in points of age and formation. Hence the position seems well taken that the surface oil appearing on streams of water may be of comparatively recent creation. The best authorities agree that the oil found in the reservoirs underlying the overtopping and impervious shales is not being added to, that its volume remains stationary, and when it is exhausted there will be no source from which the supply can be renewed.

The facts of geology seem to show, too, that it is exceedingly improbable that oil has been transferred in a large way from one formation to another in the geologic column. That there has been some transfer of oil in the rocks is beyond question. It is associated with water, and gravitation will always raise it to the highest point in the stratum in which it happens to be. As in the case of the spring, the water in rising to the surface caught up the particles of oil, and conducted them to the exit in its formation. Doubtless, or at least very probably, the oil had appeared in the stratum which contained the water from a substratum, from which it had escaped through some crack or orifice, and assisted thereto by a mounting stream of water or shale gas, which latter is to be found in almost every crack and crevice of stratified rock of a porous nature. If the reservoir in which the modicum of oil was contained were fractured at the summit of an arch, the oil, which is very mobile, will follow the lines of escape to the surface, and, as a matter of course, diffuse itself through any porous beds of stone or shale which the fracture crosses. With these escapes of oil we are very familiar. We call them surface indications, and some geologists aver that they may lead to the storehouse from which they escaped. This has never been proved, so far as known, and it is extremely doubtful if its truth can be demonstrated; for it would be a devious course to follow the track of a particle of oil through cracks in the rock so fine as to be all but imperceptible. A porous rock is often found stored with petroleum or its by-products, evidently derived from a stratum or bed directly underlying it. The most common form of such occurrence is a sandstone overlying a carbonaceous shale.

When such a series rises to the surface, the porous rock is often charged with maltha, resulting from the oxidation of the original petroleum. If this sandstone is used for building purposes, the tar is often seen exuding from it, even for a term of years. Tar springs, so called, have a like origin, the escaping water of the porous rock carrying out some of the inspissated petroleum.

So much for the actual and visible presence of oil on the surface in relation to its value as an indication of the stored reservoirs of the fluid below. The usual forms of surface indications are as described, but there are others said to be vastly superior to the foregoing. To repeat the reported experience of Capt. Lucas, who discovered the great Beaumont, Texas, field, will sufficiently describe these "superior" indications. Capt. Lucas is said to have followed the surface indications from Louisiana to Beaumont. This was done with full knowledge that when the signs appeared for which he was looking, oil would be discovered in exhaustless quantities. The probability is that this story is not correctly stated. He is said to have followed the synclines, monoclines, and anticlines from Louisiana to Beaumont, in spite of the fact that those structures are far below the surface of the earth, the contour of which has never been known to have been revealed, or indicated, or suggested by the outlines of the earth's surface.

To repeat what has so often been said, if research in oil fields has proved anything, it is that surface indications do not indicate the presence of oil in reservoirs below.

FINE PERFORMANCE OF THE BATTLESHIP "KENTUCKY."

BY LIEUT. R. W. MCNEELY, U. S. N.

The U. S. S. "Kentucky," which has just returned from the Asiatic station, made some remarkable records at recent target practice with some of her guns, these results being largely due to new devices invented by her officers. In these improvements the question of sights for naval guns was the one that received most attention; for it was discovered that, when more care was taken to plot the exact spot of fall of shots, our sights were of too frail and obsolete design; for such close observation and good shooting cannot be accomplished unless one has good sights.

The custom formerly had been for each gun pointer to make his own allowance for speed, wind, etc., by aiming to the right or left of the target, as the case might require. This inexact method was entirely done away with during the recent four-year cruise of the "Kentucky," and mechanical means have been substituted, whereby the sights can be turned in azimuth, so that exact allowances can be made, while the gun pointer is always looking at the spot to be hit. In the 13-inch and 8-inch turret sights, this is accomplished by mounting the telescope on vertical trunnions, motion being given by a graduated sliding wedge, the telescope being held against the wedge by a heavy flat spring. The changes in elevation are made by a drum and screw, as in the older design of sights. All these parts are massive, and have large excesses of strength. The turrets are trained by one man, the trainer; and each gun is pointed by another man, the pointer, who fires the gun. These men are of necessity not stationed close together, and it is therefore obviously difficult to have all the sights of the turrets moved or "set" together, although that is greatly to be desired. Just here it may be mentioned that one of the disadvantages of the superimposed turret made itself evident when our navy began to take up the question of accurate shooting. It is obvious that the drift which is inherent in all rifled cannon, but different for each caliber, is not the same for the 13-inch as for the 8-inch guns; therefore, when the turret is trained exactly on the target for the 8-inch guns, the 13-inch is slightly off. This inaccuracy is of no importance as long as only one gun of the turret is firing, but when both sets of guns are firing, the error will be introduced.

The chance of premature explosion of a loading charge in the turret guns by burning particles and ignited fumes has long been recognized, and ingenious and effective means were used aboard the "Kentucky" on the Asiatic station, during the recent target practice, to drive these dangerous foes out of the gun on opening the breech. One of these was to make a "closed stokehole" of the turret, by introducing an atmospheric pressure in the turret chamber of about one-half inch. Another was to direct a compressed air jet on the breech during opening. Both these methods drove every particle of cinder, residue, or fume out of the muzzle, and left a clear chamber, so that it made no difference what had been the material of the powder-bag, or whether the fumes ignited or not. Many shots were fired with an interval between shots of 30 seconds; which is many times the speed originally thought possible with some of our 13-inch turret guns.

With the 5-inch battery of the "Kentucky," some novel ideas were introduced for the first time, and it was with these guns that the most remarkable records were made. The original sights of these guns were not arranged so that the correction in azimuth (for speed, wind, etc.) could be given to both sights at once by the sight-setter, but this drawback was removed by introducing a heavy bar, which gave parallel motion to the two sights. Formerly, it had been the custom for the sight-setter to set one sight, then run around to the other side of the gun and set the other sight; but while he was doing this, the range having changed, large errors crept in. With the new sights, the sight-setter stands in a fixed position, and sets both the range and lateral correction at once for both sights. Longer and more powerful telescopes were used, and, in fact, the pointer could see the hole made in the target by his shot—a very pleasing sensation. In the Morris tube drill, as used in these guns, which has been described in the SCIENTIFIC AMERICAN, all the members of the crew were drilled except the sight-setter, who happens to be one of the most important men at the gun. A device was mounted on the larger guns which gave range and lateral movement to the Morris tube, while these movements were known to the officer. The Morris tube was set at various ranges, these ranges being given to the sight-setter, as at target practice, and unless he set his sights correspondingly, the Morris tube would miss the bull's eye. It must be remembered that the large gun was loaded with a dummy cartridge at the time of loading the Morris tube, so that every movement of firing was given to the crew except the actual shock and noise of discharge. Strange as it may seem, nothing but percussion primers, which many ordnance experts think obsolete, were used. The lanyard used to fire the gun was pulled by an electro-magnet, and the interval between the time the pointer "willed to fire" and the actual "discharge" was the same as in purely electric primer fire. The contact for the electro-magnetic circuit was led to a platform attached to the revolving part of the gun-carriage, on which the pointer stood. This platform allowed the pointer to stand in a fixed position while the gun was in motion, and also gave him the use of one free leg and foot with which to fire the gun by pressing the contact. The platform also gave the pointer the use of his right hand (which is generally exclusively used for firing) to assist his left hand in working the gun. It is not so remarkable, but rather natural, that the remarkable record of eleven hits in one minute was made under these favoring conditions.

It is the custom nowadays to have a practising device known as the "loading machine" on board each ship. This device is arranged so that the drill cartridges are the same shape, size, and weight as those used for actual firing, and each day the crews were drilled at this machine. This drill gives the crews fine physical exercise as well as team work. Since the renaissance of naval ordnance, about two years ago, improvements, discoveries, and changes are being made in drills as well as in material. Thus, nowadays, the drill officer has become a "coach," and the crew become a "team." It was by these means, coupled with the improved sights, that it became possible to fire twelve rounds in one minute with a 5-inch gun, and to make eleven hits, range 1,600 yards, speed 10 knots; something that nine months ago would have been thought impossible.

The smaller guns of the "Kentucky's" battery consist of 6-pounders, 1-pounder Hotchkiss R. F. guns, and 1-pounder Maxim-Nordenfelt automatics. The day of non-automatic guns below a 3-inch R. F. is past; and as the 6-pounder and 1-pounder R. F. guns did not develop any new ideas, they will not be described.

Happily, the extreme usefulness of the torpedo became evident to our navy before the Russo-Japan war brought that question before the world, and our navy will soon regain the time lost while the experts were fighting it out academically.

The question as to the ultimate age of naval guns, which is so often asked, is a question of the quality of the powder used in the gun. The English prefer a nitroglycerine compound, and as the temperature of combustion is very high—higher than the fusing point of steel—at each discharge a thin layer of the bore of the gun is fused or pitted, until the bore is eroded or worn out. In our navy, a pure nitro-cellulose powder is used, and its temperature of combustion is lower than the fusing point of steel. Therefore, on discharge, the bore is not fused or eroded, and the life of our guns is practically indefinite. The English are now adopting a nitro-cellulose powder.

The "Kentucky" class of ships has often been called "wet" because of their low freeboard forward. This is undoubtedly a disadvantageous feature, which in the newer ships is overcome by raising the freeboard; but it must be understood that the "Kentucky" could have fought all her main battery guns in any weather that she experienced during the last three years.

The electrical department of this ship is unusually complete, and not only are all of her turret motors electric, but the ammunition hoists, deck winches, and boat cranes are electric. Her bunker chutes load directly to her coal bunkers, and this feature, combined with fast electric deck winches, makes a rapid and easy ship to coal. Her crew in one working day put in over 1,100 tons of coal. These points all combine to make her, in spite of her age, a very valuable ship for our fleet.

The steam engineering department, which furnishes the propelling power, is the one which generally suffers the most deterioration in a three or four years' cruise; but this rule apparently does not apply to the "Kentucky." Since she left the United States in November, 1900, she has cruised 65,000 miles, and, if necessary, she could immediately repeat this excellent performance, although the ship has been kept on the go, and therefore away from dockyard repairs for over three years and a half. The following is a brief description of the steam engineering department. Steam is furnished at 180 pounds pressure in five Scotch boilers, three being double-enders and two being single-enders. The two main engines are direct-acting vertical triple-expansion. The propellers are three-bladed. The ship was designed for a forced-draft speed of 16 knots, or about 110 revolutions per minute of the main engines. Last year the Secretary of the Navy ordered the "Kearsarge," a sister ship, to make a natural-draft trip across the Atlantic Ocean. The "Kearsarge" was put in order for this trip, which was to be a record breaker. She did well, having covered 2,800 miles at an average speed of 13.4 knots per hour, or 87.5 revolutions per minute. No special orders were issued to the "Kentucky" on her homeward trip to break records; but nevertheless that was done, as she steamed 2,900 miles under natural draft, crossing the Atlantic at an average speed of 13.82 knots, or 91.1 revolutions per minute. The maximum speed of the engines on the trip was 98.8 turns per minute for four hours, or over 15 knots for the ship per hour. The consumption of coal per diem averaged about 135 tons, and enough coal for over three days' steaming at full speed was in her bunkers on arrival at Tompkinsville on May 21, 1904.

A scheme for an elevated reservoir at Tallah is now exercising the minds of the Calcutta Water Supply Commissioners. The reservoir is proposed to be of steel construction and will hold 5,000,000 gallons. It is to be elevated to a height of 85 feet by means of a series of braced steel pillars.

SCIENCE NOTES.

A very interesting discovery has been made in the Etruscan necropolis of Tarquinia. It consists of a coronet of modern shape, three thousand years old. Two hundred tombs containing helmets, a breastplate of gold, amulets, vases, etc., have been opened, showing that Etruscan civilization was far superior to that of the Romans. The collection will be offered for sale after the Italian government has appropriated one-fourth of it under the law.

In No. 7 of the Physikalische Zeitschrift (April 1, 1904) Prof. Wladimir de Nicolaïève arrives at the conclusion that electrostatics in its present form is a fiction. In order to agree with the experimental facts, this science should be transformed, and its formulæ should be made to include the electric conductivity in addition to the permeability; the formulæ of electrostatics, from which the forces acting on an isotropical dielectric substance are calculated, fail to be of any use when applied to some experiments described by the author.

Sir Norman Lockyer, the British astronomer, has advanced a remarkable new theory concerning the utility of sun spots. Our knowledge of sun spots is distinctly limited, and Sir Norman Lockyer contends that the discovery and understanding of these phenomena will prove one of the most beneficial additions to the world in general. He advances the theory that such knowledge may enable astronomers to convert the sun into an agent to enable us to cope with droughts and famines, and that the spots on the sun may render it possible to predict with practical certainty the coming of famine and the exact part of the world where it will take place.

A discovery of great archeological interest has been made at Cheddar, England. In the course of cutting a trench for drainage purpose through a bed of cave-earth, the skeleton of a man of great antiquity was excavated. Although the skull could only be removed in pieces, it was possible to determine that it was that of a man of a period intermediate between the paleolithic and neolithic ages. The bones of the leg exhibit the characteristic flattening peculiar to those of that period. The frontal bone of the skull is thicker than that of the present day, while over the eyes a decided boss of bone demonstrates that the brows were very prominent. Judging from the size of the skeleton, the height of the man was about 5 feet, 3 inches. In close proximity were found several flint flakes and knives.

In a paper published in No. 8 of the Physikalische Zeitschrift (April 15, 1904) Prof. F. Himstedt arrives at the conclusion that radio-active bodies giving off a gaseous emanation are widely diffused throughout the earth. These emanations are absorbed by water or by petroleum; and after having been conveyed along with the latter to the surface of the earth, will diffuse into the air. Because of the many analogies noted between these emanations and radium emanations, the author thinks it possible that both are identical. In this case the ores of uranium from which radium emanations are derived would either be widely diffused, or else there would be some further matters possessing, though to a lesser degree, the property of giving off emanations. Considering that the absorption coefficient of water as well as of petroleum with respect to this emanation is found to decrease for increasing temperatures, while hot fountains on the other hand show an especially high activity, the hypothesis is suggested that the amount of radio-active material is increasing for augmenting depths, and, according to Curie's observation as to the continual heat evolution from radium, the radio-active components of the earth should possibly have to be allowed for in accounting for the temperature of the earth.

Some interesting demonstrations have been carried out in London with a new photographic art material called "photolinol." This fabric is composed of linen, which is thoroughly permeated with the photograph, producing a high translucency. One very picturesque effect obtained by this means is that the picture, when colored and viewed with a reflected light, bears a very strong resemblance to an oil painting, the lines of the weaving of the linen appearing similar to the canvas in a painting. Photolinol is waterproof and indestructible, while the photograph does not fade in the sun, as it appears to be woven into the material. By its aid much greater enlargements than are now possible can be made with ease. The fabric can be made to any size, some of the enlargements shown being ten feet square. It is applicable to an extensive variety of purposes. As it is transparent, it can be adapted to lamp shades and other ramifications of photographic art for which transparencies are now employed. Novel results can be obtained with it, for the picture appears with equal distinctness on either side by either reflected or transmitted light. The process is a secret one, but its commercial utility and value are already asserted, since it can be employed for curtains, screens, or theatrical scenery. For the latter is is peculiarly adapted, and is both cheaper and more durable than hand-painted scenery.