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IN VAL FUEL RESERVES

by

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## LECTURE

### "NAVAL FUEL RESERVES"

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Before The Army Industrial College

As a background for the discussion of my subject it will be well to sketch briefly the developments that led to the necessity for the reserves.

Our Navy became seriously interested in oil fuel in 1903. Then a series of tests were conducted under a naval boiler by the Navy Liquid Fuel Board at the foot of Seventh Street, Southwest, in this City, by the crew of the torpedo boat RODGERS. At that time, it was interesting to note, Professor Langley was about ready to test his flying machine, and his houseboat with a catapult on top, from which the flying machine was subsequently launched, was tied up to the dock on which the liquid fuel tests were conducted. An Army sergeant who was custodian of the Langley equipment messed with the crew of the RODGERS. Thus oil as a fuel for naval vessels is contemporary with the development of aviation.

These liquid fuel tests extended over a period of a year and thoroughly explored the field of burners in which steam or compressed air is used to atomize the oil. In these tests oil was first burned successfully under a marine boiler in this country. Until then it had not been demonstrated that a marine boiler burning oil could make as much steam as with coal.

As a result of these tests the monitor CHEYENNE and a small torpedo boat were converted to oil burning.

The Standard Oil Company, from which we procured the fuel for these tests, was not inclined to encourage the extensive use of fuel oil because of the uncertainty of the supply.

The atomizing of oil by steam by compressed air had marked disadvantages, - in the one case there was a serious loss of fresh water amounting to about five per cent of the steam generated inasmuch as the steam used in spraying the oil escaped up the smoke pipe, and in the other method a cumbersome installation of air compressors was involved.

Fortunately, within the next few years Schutte Koerting, in Germany, developed a method of spraying the oil which had neither of these disadvantages. This mechanical method, which is the present almost universal method in marine engineering, is simple and efficient. The oil, heated to fluidity, is fed under pressure to the burner and there released through orifices in the burner tip in a tangential whirl, issuing from the burner in a cone of finely divided spray about like that of exhaust steam.

This method was used in our destroyers of that period and by 1911 the technique of oil burning and the problems associated with the safe storage and handling of fuel oil on board ship had been solved. In that year we were laying down the design of the battleships NEVADA and OKLAHOMA. Prior to this all of our battleships had been coal burners, although some of them were fitted to carry a small amount of oil with equipment for spraying it on top of the coal fires.

In the case of the NEVADA and OKLAHOMA a study was made in the Navy Department of an oil burning design. It was found that an improvement over the last coal burning battleship (the DELAWARE) could be realized to the extent indicated in the following table

	DELAWARE (coal)	NEVADA (oil)
Designed IHP	25,000	24,800
Number of boilers	14	12
Heating surface, square feet	61,943	48,000
Machinery weights in boiler compartments, smokepipes, and uptakes, tons	1,042	745
Length of fireroom space	128	66
Breadth of fireroom space	42'8"	75'6"
Area of fireroom space, sq. ft.	5,461	4,983
Smokepipes	2,- 13'	1-16' & 1 - 10'
Total weight in boiler compartments, smokepipes, uptakes and fuel	4,110	2,745
Complement of firemen and coal passers	212	141

Coal has to be carried in bunkers adjacent to boilers. Oil can be in tanks remote from the firerooms. By spreading the firerooms into space formerly given over to bunkers, the length of the ship required for boiler compartments could be reduced to about one-half, the boilers grouped under one smokepipe, and a very valuable section of the ship released. It would appear that the change from coal to oil in battleships was clearly indicated.

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There were, however, two disturbing factors. The cost of oil in the Atlantic was about three times that of coal. This was not of great amount because the military advantages that would result from the use of oil were considered to outweigh the difference in costs.

A much more serious condition - one that was a real deterrent - was the uncertainty of the future supply of petroleum

Of this we were warned by the United States Geological Survey, a group of men intelligent, competent and devoted to the interests of the nation to a degree that is unusual. They informed us that while there was practically an unlimited supply of coal available, there were, in the United States oil fields enough to last only about 30 years. It would have been unwise, therefore, to have laid down battleships burning oil, without some means of ensuring a future supply of the fuel, at least throughout the probable life of the ships.

Fortunately, this condition had been foreseen by President Roosevelt. He, having in mind the future requirements of the Navy, directed the Geological Survey to locate on the public domain areas believed to be rich in petroleum. In 1900 and 1910, upon the completion of the survey thus ordered, President Taft ordered withdrawn from all forms of entry areas from which the naval reserves were subsequently selected. This withholding of public lands by the President was specifically authorized by Congress. Later the Supreme Court decided that the authorization by Congress was not necessary.

Cognizant of this situation the Secretary of the Navy, in June 1912, addressed the following letter to the Secretary of the Interior

"There exists a situation seriously affecting this Department's future policy in the powering of naval vessels, and in which the cooperation of the Department of the Interior is required.

"Since the beginning of the American Navy our vessels, ship for ship, have been superior to those of our enemies. For this, largely, our uniform success in naval warfare has been due. Naval ordnance, engineering and construction have now become so standardized throughout the world, however, that it is difficult to maintain this superiority.

"It is now definitely determined as a result of years of investigation, experiment, and development, that the use of oil as a fuel will render our vessels distinctly superior to the coal burning vessels of other navies. ----

"Our position as an oil producing nation should permit us to adopt this simple means of maintaining a superior type of vessels which is denied to others, because no other important nation, except Russia, has an oil supply which is dependable in time of war.

"In order to profit fully from the advantages of the liquid fuel, bunker spaces adjacent to the firerooms are omitted in an oil burning vessel, the fuel being stowed in remote portions of the vessel which are unimportant for other uses. It is not practicable to convert such a vessel into a coal burner. It is manifest then that with our important naval vessels oil burners, a failure of the supply might constitute a national calamity.

"Therefore this Department is unable to profit from the use of fuel oil to the extent of definitely adopting it for capital vessels until the certainty of a dependable supply, sufficient for the possible demands of war, has been established. This is estimated to be 250,000,000 barrels.

"I am informed that there is in California, on public lands withdrawn from entry, oil estimated at four billion barrels. Were it definitely established that a sufficient quantity of this oil would remain in the ground, there would be no occasion for the present concern of this Department. It is understood, however, that until sufficient quantity of the oil has been definitely reserved for the Navy there will always be a possibility of legislation permitting the removal of this oil under leases.

"The demand for oil will, within the next few years, considerably increase. Already foreign nations are importing American oil for the purpose of building up artificial reserve supplies.

"This Department therefore earnestly requests the cooperation of the Department of the Interior to secure a definite reservation for the Navy by Executive Order, of oil bearing public lands in California sufficient in extent to insure a supply of 250,000,000 barrels."

As a result about 39,000 acres of land in the Elk Hills District of California were, on September 2, 1912, by order of the President, constituted as Naval Petroleum Reserve No. 1, "for the exclusive use or benefit of the United States Navy." There being some doubt as to the adequacy of the petroleum content of this Reserve, on December 13, 1912, some 29,000 acres in the Buena Vista Hills, California, were given to the Navy as its

Reserve No. 2. Furthermore, on April 30, 1915, 9481 acres in the Salt Creek District of Wyoming became Naval Petroleum Reserve No. 3. This is Teapot Dome

### THE STRUGGLE TO HOLD THEM

Thus the Navy came into the possession of very valuable properties. The petroleum content of the three Reserves was probably nearly 500,000,000 barrels. Its value above ground was greater than the cost of the Panama Canal. The Navy Department was justified in committing the nation to an oil burning Navy, and it became the patriotic duty of all officials of the Government to defend the Navy's title to these properties.

As is ever the case with possessions of great value, considerable effort was required to hold the reserves. The fact that they had been reserved for the Navy attracted attention to their value. Squatters came on the land and claimed title. Corporations sought to despoil them. Litigation ensued. Legislation designed to wrest the lands away from the Navy was attempted.

The extent to which these interests, hostile to the high national purpose of the Reserves, commanded support in the courts, the Congress, and the departments of the Government, was surprising. The Navy had, however, valiant assistance from the Department of Justice and from our friends in the Geological Survey, although the Department of the Interior was frequently on the other side. In 1916 the Naval Consulting Board, the Council of National Defense, the Franklin Institute, the Coast Guard Service and the Navy League, rallied to our assistance in opposition to a leasing bill, which would have destroyed the Navy's title to its reserves. By 1917, it appeared that the battle had been won. The Public Lands Committee of the Senate appreciated the importance of the oil lands to the national defense, and the threat of hostile legislation was gone. Litigation had, in general, resulted favorably to the Navy.

The situation was well in hand, and an organization for the administration of the reserves had been developed. There was an officer in the Navy Department charged with this duty, and one on the Reserves. These officers assembled information, coordinated the efforts of the various government offices, and by association with geologists, petroleum technologists and practical oil men, were qualified to advise the Department on all matters pertaining to the Reserves, a duty which they performed thoroughly and competently.

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Those of us who are familiar with the reserves were shocked when we heard of the disposition that had been made of them during the Harding Administration. That is of such recent occurrence that it is perhaps unnecessary for me to say much about it, for after all it is an unpleasant subject, and the Navy has no cause for pride for its part in the sordid affair. Suffice it to say that under an unhealthy condition of government and under circumstances which have resulted in the trial and conviction of an ex-Cabinet official for a criminal offense, the Reserves were taken from the Navy and disposed of to private interests through fraud and conspiracy. As a result of civil suits, successfully prosecuted by the Government, these properties have all been returned to the Navy without serious compromise, and in addition tanks at Pearl Harbor in the Hawaiian Islands and at Portsmouth, N.H. have come to the Navy. The Navy's profit from the transaction is forty-six million dollars.

In February, 1922, Naval Petroleum Reserve No. 4 on the north coast of Alaska, east of Point Barrow, was constituted. This is a reserve of tremendous area, 22,000,000 acres (35,000 square miles) and of doubtful value. It probably was given to the Navy to divert attention from the locating of our Continental Reserves. It is not known that there is oil in productive quantity there although there are seepages and the geological structure is reported to be favorable. If oil is there we do not see how it can be gotten out. The coast is shallow, a region of mud banks and sand bars, without harbors, and open to navigation for only two or three months a year, during which period it is exposed to fierce gales. The ground is permanently frozen to a depth of some hundred feet rendering the pipe line transportation impracticable, and a range of mountains shuts off the region from the south side, which bars railroad transportation. Still it may be that in the distant future a hunger for oil may force development of this field and in the meantime it costs us nothing.

#### THE SHALE RESERVES

In 1916 the Naval Fuel Oil Board was convened to re-examine the question of future supply and was in session for six months. Its report emphasized the seriousness of the existing situation and the immediate necessity for additional conservation measures. It deplored the constant attack by private interests and corporations on the Navy's tenure of its oil lands. It directed attention to the policy of Great Britain with respect to petroleum and quoted the president of the British Board of Trade as saying in the House of Commons "we must keep control of

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the world's coal, we must secure control of the world's oil." As a result of one of the recommendations of this Board the Naval Oil Shale Reserves, Nos. 1 and 2, were set aside in December of 1916. No. 1 Reserve comprises 45,000 acres in Garfield County, Colorado, near Rifle. No. 2 Reserve has 91,000 acres in Utah near the town of Price. Later in 1924 an extension of the No. 1 Shale Reserve comprising 22,600 acres was set aside as Shale Reserve No. 3 to provide an area for refuse of the shale distillation.

These shale deposits have a large potential yield but because of the mechanical difficulties involved in handling the large volume and the transportation required from this inaccessible area it now looks as though the importance of these reserves is projected well into the future. A much more likely source of petroleum when our oil fields have been dissipated lies in the lignite and soft coal fields.

#### COAL RESERVES

In 1914 the real estate department in the Bureau of Engineering having been so successful in securing the petroleum reserves became interested in the coal lands of Alaska. At that time no good coal was available to vessels in the Pacific except that shipped from Norfolk, Virginia. Laboratory tests of samples of coal from the Fering River Field and the Matanuska Field indicated that these coals were as good as the Pocahontas and New River coal which the Navy then got at Norfolk. Accordingly, 5520 acres in the Fering River field and 7680 acres in the Matanuska field were reserved for the Navy. At the time these reserves were created they appeared to be of great value in the event of a war in the Pacific, but later when our Navy had come to burn oil exclusively we lost interest in these coal lands. I am not sure now what their present status is.

A process of converting coal into oil and gasoline by hydrogenation (distilling under high pressure (3000 pounds) and regulated temperatures in the presence of a catalytic agent) has had a very successful development in Germany so that new deposits of low grade coal or lignite have a new value to the conservationist. There are in certain areas of the United States extensive deposits which heretofore have been considered to be unsuitable for fuel but which lie on the surface and can be mined by a steam shovel. An Executive Order of June 6, 1929, withdrew two coal reserves, No. 1 in Montana, constituting about 2000 acres, 110 miles east of Billings, and No. 2 in Wyoming, 1758 acres, 4 miles southeast

of Gillette. These are constituted as coal reserves for the benefit of all branches of the Government for utilization only when confronted with an emergency whose existence is to be determined by the President.

#### PLACE TIME ACCUMULATION AND STORAGE OF OIL

The underlying purpose of the fuel reserves of the Navy is to provide within the continental limits of the United States an assured supply for war time use. Foreign sources of supply in war time would be denied us unless we have command of the sea. The Navy, I believe, has adequate provision in this respect in the Naval Petroleum Reserves. Whether the industries of this country have a reasonable security of war time supply is worthy of investigation. Although our geologists have been perhaps unduly pessimistic in predicting the early extinction of our petroleum deposits, there is no doubt that sooner or later we will depend largely on importations for domestic consumption and the situation that will obtain then under war conditions is well worth examining.

At present we are experiencing a hectic period of overproduction with a resulting extraordinarily low price of oil. Through the entire period in which the Navy has been interested in oil for fuel there have occurred periodical cycles of cost changes in which there have been variations as much as three hundred per cent in the price per barrel of fuel oil. I fully believe that eventually oil will cost at least twice, and perhaps three times, its present price. Sometime ago a study was made in the Navy Department with a view to providing tankage in which to accumulate oil when the market was low and it was shown that in one year the cost of such tankage would be absorbed within the fluctuation in price of oil. Recently Major S. M. Decker, a Consulting Engineer of the Army Reserve Corps, has suggested that the Government in this period of over-production buy large quantities of oil and store it in abandoned salt, zinc and lead mines, or in pumped out oil fields. I believe that in 1927 Professor E. D. Huntceon made a report to the Bureau of Mines on the subject of storage of helium in which he advocated the use of abandoned mines for storage of that gas under pressure. In a recent issue of the magazine "World Petroleum" is an account of the successful underground storage of crude oil and also of gas in depleted oil sands. The article states that for three years the Union

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Oil Company has stored, with success, thirteen billion cubic feet of gas, and during the past twelve months 750,000 barrels of oil in the semi-depleted sands on its own properties in various California oil fields.

I have not had time nor opportunity to think through this idea but it is a very interesting one and I hand it to you gentlemen for what it is worth