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CONTROLLING ELEMENTS IN SITE SELECTION FOR WAR FACILITIES

27 February 1948

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COLONEL HOFFER: Before the recent war and during the early stages of the war there was considerable concern in defense circles over the concentration and the location of U. S. industry. Steps were taken, particularly in the early part of the war, to locate new industries farther inside the zone of the interior. Generally these attempts were futile. Now, with the advent of the atomic bomb, we have finally come to realize the importance of, and we are very much concerned over, the sites selected for our industry. Our speaker this afternoon is a member of the Plant Relocation Committee of the Munitions Board and is thoroughly familiar with this problem. I take great pleasure in presenting Mr. Poorman, Office, Chief of Engineers, to the College. Mr. Poorman.

MR. POORMAN: Gentlemen, I am very grateful for the opportunity of talking to this group here. I hope that what I have to say will be worth while to you.

I am speaking as an individual. I have been associated with the limited activities of the Armed Forces that have had to do with this problem thus far. Very few policies have been formed or enunciated. So don't accept this as anything other than merely ideas to stimulate your thinking in connection with this problem.

This is, of course, a controversial problem; and perhaps a wise individual would lean heavily on what has been printed or said and avoid a lot of embarrassing questions. I can't be too wise, because I think you ought to pull it out and push it around and see what the possible solutions are.

I have elected to divide the talk into five separate sections. The first will be the World War II experiences and their evaluation. The second will be a brief summary of studies and investigations under way now to expand our knowledge in several important respects. The third will be the political and military conditions which should receive consideration in selecting future war plant sites. The fourth, site selection for war plants; and the fifth, because it cannot be ignored entirely, is the system of transportation.

World War II Experience

With reference to World War II experiences, United States industry was not subjected, of course, to attack. But that was not a foregone conclusion at the time our construction was started, and there were certain

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higher. Production control was greatly complicated; it took a lot more supervision. Larger stocks of raw materials were required. But by and large the British felt that this was the answer to air attacks of the type, of course, that they experienced in World War II.

As to Japan, their entire economic structure is dissimilar to ours. There are some things that we learned from their experience. The strategic bombing people worked up at least three publications. I refer you particularly to one on "Japanese War Production Industries." They had one lesson that we should by all means capitalize on. I am going to quote from this publication.

"Intensive strategic bombing of the Japanese Home Islands began in March 1945, although the aircraft industry had been subjected to attack before that time. By the beginning of March, production of military supplies was already 20 percent below its peak, indicating there were factors other than strategic bombing, forcing war production down."

They list the results of the bombing. They say that army ordnance was affected 26 percent, naval ordnance 28. They go on to say that items other than bombing affected army ordnance 12 percent and naval ordnance 12 percent. In the aircraft industry they affected production from 33 to 57 percent, in three items--airframes, engines, and propellers.

One very outstanding statement is: "In the motor vehicle industry--never a target for sustained air attack--the consequences of direct bomb damage were not significant, but the loss of vital production capacity through dispersal, dealt the final blow to an industry already crippled by a lack of steel.

"The greatest dispersal took place in the aircraft industry and the loss of production as a result of unsuccessful dispersal was most important in that industry. About 68 percent of the production capacity of the aircraft industry had been dispersed by July 1945 and this dispersed machinery and equipment was then operating at about 25 percent of its capacity. Therefore over 55 percent of the entire industry's facilities were out of production as a result of dispersal alone."

There is more, but we will move on.

Germany. There is a wealth of data on Germany, and we believe that is where we should concentrate a greater part of our study. There are several documents which would be of interest to you. One is "An A. F. Industrial Planning Project," a recommended program for the underground manufacture of aircraft, a study made at Wright Field. The second one is the "U. S. Strategic Bombing Survey," the over-all report of the European War, dated 30 September 1945, unclassified. The third is the second of a series of monthly reports, prepared, incidentally, by the Corps of Engineers on the basis of information supplied from Army and Air Force sources, termed

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Where plants were placed underground, plant damage from air attack was almost entirely eliminated. We find as a part of the conclusions from this aircraft study as follows:

"Underground facilities are considered one of the most effective means for affording protection against air attack, evolved in World War II. As between semi-underground installations such as submarine pens and bunker plants, and completely underground plants, the latter appear more desirable.

"German experience clearly indicates that plans for the execution of an underground program must be formulated well in advance of an emergency in order to assure that the program will be implemented effectively should the need arise."

It is unfortunate that time does not permit more attention to the U. S. Strategic Bombing Survey report. We mentioned dispersion and underground sites as a means of protection. This U. S. Strategic Bombing Survey contains an analysis of actual bombing results. We find that the air war in Europe cost the U. S. 43 billion dollars. We dropped approximately a million and a half tons of bombs and the British slightly less. Chart A shows how they were divided by targets; and here for the first time, although recognized in the other reports, an additional consideration of the greatest importance, namely, land transportation, is brought into focus.

I don't know whether it is generally recognized how important the land transportation target was. Briefly, here are the bomb tonnages dropped: aircraft factories, 1.8 percent of all bombs; miscellaneous manufacturing, 2.6; naval and water transportation, 4.2; V-weapon launching sites, 2.0; airfields and airdromes, 6.9; oil, chemical, and rubber, 9.6; military, 11.1; industrial areas 23.7; land transportation 32.1; and all others 9.3.

In this same U. S. Strategic Bombing Survey we find graphically outlined the concentration of effort to knock out in their entirety key industries, primarily antifriction bearings, oil and gasoline, rubber, chemicals, etc. Despite efforts to destroy antifriction bearing plants, we find this statement: "The total loss in production throughout the entire period of bombing was equivalent to the output of 2 or 3 months at the preraid rate. This loss, however, must be attributed in part to the immobilization of machinery and labor during the period of dispersal and not to direct bomb damage alone." The complete collapse of transportation and its terrific impact on production is clear. The relative freedom from air attack of cities of less than about 100,000 population is brought out vividly. The entire publication is worthy of your study.

As we leave Germany, I give you a conclusion from this report of Major General Robbins as a result on the on-site study, which included underground plants. He said:

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Dispersion and underground construction are time-consuming and if delayed until the need is upon us, the loss in production during relocation can be expected to far exceed loss through bombing. This was true for both Japan and Germany.

Land transportation is extremely vulnerable and in congested areas within short bomber range can be so damaged as to completely nullify protection afforded by either dispersion or underground construction.

Smaller cities have not normally constituted a worth-while target.

England reports small "complexes" requiring only limited interplant transportation as advantageous.

Total destruction of key items is more profitable than indiscriminate bombing of industry.

As background information I might mention briefly the studies that we have performed or now have under way.

Summary Studies and Investigations Under Way.

We have a three million dollar test program inaugurated to determine the effects of large explosive charges on underground structures in representative types of soils and rock. Charges will range from 320 to 320,000 pounds. These charges will be placed at various distances from scale model and prototype underground structures constructed for the purpose near Dugway Proving Ground, Utah, and Grand Junction, Colorado. This program includes a subcontract with Engineering Research Associates, Inc., for the development of electronic and mechanical gages to measure the transient effects of underground explosives, including pressure, particle velocity, acceleration and displacement, as well as target measurements. This contract is costing us approximately a million dollars and requires the development of many types of gages for the use of previously developed gages in a new way or a new function entirely. The data obtained and the results of the tests will provide essential information on which to establish design criteria for subsurface structures and tunnels.

At the request of the Munitions Board, in 1946 and 1947 we made a survey of existing mines in the United States. The results were given in a "Report on Existing Mines." Many millions of square feet of floor space were found in existing mines which would be adaptable for housing manufacturing or storage installations. Many of these are shown on Chart B. This is not a particularly good chart, gentlemen; but the smaller dots represent the mines which were included in this investigation.

It might be of interest to say that it was a gratuitous survey. It was done with almost no funds, in order to provide maximum information at minimum cost. We used criteria which eliminated mines with less than around

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We hope out of this study to be able to develop a plastic or paint or some other protective application which could be used to treat this room or any type of building, which either would be impervious to or resistant to penetration of BW or CW agents or at most would permit its removal after being subjected to such an attack. If you want, you can speculate, of course, on the question of whether you can incorporate DDT in a plastic coating which in itself would counteract BW agents. The Chemical Warfare Service is working with us in this study. We are very much in hope that something worth-while will come out of it.

Also we have an observer being assigned to the Navy Westcoast Radiation Study Center.

Political and Military Considerations

Our talk thus far has been background. We haven't even touched on site selection. We still have one other phase we believe we need to touch on before we hit the real meat. That is Political and military considerations affecting war plant site selection.

We might mention probable enemy, probable date of attack, and evaluation of improved or new weapons. I might appear to be going out on a limb with you folks, who are professional soldiers. I was, however, privileged to be present at all the conferences of the War Department Protective Construction Board, which developed policy for the Army as relating to protective construction. In connection with those studies the outstanding proponents of strategic bombing, BW and CW agents, and atomic work were all present and talked at length.

It is not necessary to go into classified materials in order to serve our purpose here. We have, however, contacted these various people and find no marked change in the evaluation of those agents as given at the time of those hearings, which were about eighteen months ago.

We assume, of course, that Russia is the only nation strong enough to be a potential enemy; and that as a totalitarian state, preparation for war can be carried out without serious consideration of the will of its people; or that controlled propaganda could be used to build up or to mold public sentiment as desired. Of course, as an aggressor it will strike without warning or without a declaration of war.

The time is frequently given as 1952, apparently because the scientists think they cannot have the A bomb in quantity before then.

An evaluation of the potential weapons, of course, is worth while. We will assume that the attack will be by planes or by guided missiles, balloons, wind-carried materials, and so forth.

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He concludes that fission material is essential for warheads and warrants use only against the most important targets.

Free balloons for great distances proved relatively useless as used by Japan. Carrying BW agents, they probably would remain ineffective due to time of flight and uncertainty of reaching a receptive target.

Wind-borne or cloud-borne CW or BW agents are a remote possibility. If used, they would be directed against densely populated areas.

Site Selection for War Plants.

Normal site selection procedures are well established and need receive only brief mention here. It is that "something extra that has been added" which we need to analyze. Much time has been consumed in providing a suitable background for a proper evaluation of site selection considerations particularly applicable to plants designed for output of vital munitions under war conditions. We can now concentrate in this latter portion of our paper in only its direct application to site selection, with a hope that the salient features will remain with you.

Several broad site considerations are worthy of mention. We need to discriminate between the type of plant which is tied to rigid requirements and those with considerable freedom. Basic industries, which process raw materials in large bulk, such as the steel industry, must locate where transportation costs of raw material to the plant and finished products to markets are highly favorable. Milling has greater freedom in site selection; however, economical transportation is essential. Milling in transit rates, that is, grain freight rates, are applicable under certain circumstances until the flour reaches the wholesaler. In other words, as I understand it, you could mill flour someplace en route between the West and the wholesaler in New York without charging any higher freight rate for the second portion of the trip. I believe there are many other products which have that freedom.

Electrochemical and electrometallurgical products will seek areas of low-cost power. Some of our larger industries initially grew in some areas through the ability and enterprise of local individuals. The automobile industry in Detroit and the airplane industry are examples of this. Perhaps we should add Battle Creek, Michigan, as the breakfast food center, where the name became so completely associated with this product that companies located elsewhere endeavored to associate the name of this town with their produce. These centers then represent a substantial pool of skilled labor and attract additional industries of the same or allied types.

The requirements of the individual sites I will mention very briefly. These are not in the order of importance. There are, of course, the size and topography of site, climatologic and meteorological conditions, regional

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Recapitulating these, then, we find that against guided missiles or bombs the value and area of the plant should determine its location with reference to other military targets or the protection which should be built into the plant. Evaluation of BW and CW agents indicates the desirability of plant site away from high-density population areas, which, of course, should include location of housing for employees. Land transportation is vulnerable to air attack, and alternate facilities are highly advantageous or mandatory depending on importance and location of the plant.

To be of value to the civilian engineer engaged in site selection, these criteria should be reduced to some formula. We timidly suggest an approach to such a formula. The War Department Protective Construction Board in considering military targets and recommended protection, classified them as priority I, II, III, etc., and indicated what the targets are and what the protection should be.

If we were to try that, this might be one approach: Priority I would be a plant manufacturing an item invaluable to the war effort and which cannot be supplied in minimum quantities from invulnerable sources or the plant restored promptly to meet minimum needs in the event of serious damage. Priority II, plants manufacturing an item or items of very great importance to the war effort which cannot be supplied in minimum quantities from other sources or the plant (or plants where the item or items are produced at more than one location) restored promptly to meet minimum production needs in the event of serious damage to all plants manufacturing such items which are susceptible of attack. (The list prepared by the National Resources Protection Board of the War Production Board during the war covering critical items of very great importance manufactured by only a very few, frequently only one, plant provides many examples falling within this category.) Note that in this and subsequent priorities, probable damage and immediate restoration of plant facilities at all plants should receive consideration. Plants covering large areas or items manufactured at several locations will materially change probable need for this category of protection. Frequently storage in protected locations will permit meeting minimum needs pending plant repairs cheaper than costly or impractical protection. Priority III might be a plant manufacturing an item of great importance, with all the other provisions as given under "II." These might be airplane motors, antifriction bearings, rubber, and fuel. Priority IV a plant manufacturing an item of importance, again with the limitations given under "II." These might be airframes, land vehicle engines, ammunition, etc.

As to the type of protection for each priority, we might for purposes of argument only say that with Priority I, which covers invaluable items, we should protect against a ground burst of an A-bomb.

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What are the ways and means of inducing industry to meet such a challenge? We have a slight trend in this direction now. An article by C. P. Wood in the March 1947, issue of "Proceedings A.S.C.E.," points out that of 83 plant locations chosen since 1940 by six of our larger companies, only 23 are in cities of over 100,000 population. The 35 plants of General Electric in this group also show a marked trend towards smaller plants. Many of the 83 are in heavily industrialized states, but the trend to smaller cities is worth-while.

Possible action would include:

- a. Announcement of a national policy for plant location or relocation, and urge industry to comply where feasible in siting all new or relocated facilities.
- b. Make concessions in tax legislation to assist owners in construction of new plants or relocated plants for the manufacturing of selected items.
- c. Modify ICC freight rates and regulations to equalize transportation costs where location selected for protective or strategic reasons involves increased transportation costs.
- d. Zoning regulations to preclude building of critical plants in certain areas. This would involve legislation on a national scale, with strong opposition. Incidentally, we have, of course, city zoning now.
- e. Subsidies to assist in construction or operation or both.
- f. Government ownership.

Those are about in the order of desirability.

I have used up my time, gentlemen and will be unable to discuss the fifth and last part covering transportation.

COLONEL HOEFFER: We have time for a few questions. (No response)

Thank you very much.

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