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GEOGRAPHIC DISPERSION OF INDUSTRY

19 December 1946

L47-60

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THE INDUSTRIAL COLLEGE OF THE ARMED FORCES

WASHINGTON, D. C.

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The subject that has been assigned to me for discussion, "Geographic Dispersion of Industry" is not a particularly happy one. It concerns a problem about which there has been a great amount of talk but very little definite action. It brings us face to face with the pressing problem of providing industry with security against enemy attack in a world in which, although the industrial pattern is already well fixed, the rapid strides that have been made in technology have brought us to the realization that distances measured in terms of time are computed in minutes and the destructive power of armaments is measured in miles. Stated simply, my discussion will deal with the problem of maximizing the security of United States Industry against attack whether by land, sea or air.

This morning we will concern ourselves with but one means of accomplishing this objective, namely the relocation of American industry.

A considerable number of the speakers who have appeared before you have alluded to this problem in one way or another. Here this morning I will attempt to bring together many of these remarks, not that I hope by so doing to add much to the information you have but rather to present the problem as a specific problem.

The problem of relocation is in fact two separate problems, a problem of dispersal and a problem of dispersion. For the sake of simplicity, we will define dispersal as the distribution of our major manufacturing units throughout the country. Dispersion, we will delineate to mean the carrying on of a single manufacturing operation in a large number of small plants. To illustrate the difference, we might use an illustration of dispersal the break up of the concentration of the General Motors Corporation in Detroit so that Buicks would be made in New York City, Chevrolets in Atlanta, Ga., Pontiacs in Chicago, Cadillacs in San Francisco. Dispersion on the other hand would exist if the Electric Autolite Company manufacturing spark plugs would set up fifteen factories each making spark plugs in 15 widely scattered cities. Although as I have indicated there is a technical difference between dispersion and dispersal the difference is not important here and we will consider them to be for practical purposes synonymous.

In order that a logical presentation of the problem of geographic dispersion of industry may be made, it will be discussed from the following aspects:

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1. Does concentration exist?
2. If it exists, why does it exist?
3. What was done in World War II to accomplish dispersal and dispersion?
4. What are the implications of the problem?
5. What can be done to accomplish dispersal and dispersion?

The problem that first merits consideration is to determine whether or not concentration of industry exists. We need waste little time with this problem. The answer is simple, concentration has existed, it exists today. A brief glance at the chart on the panel behind me indicates firstly, that American industry is concentrated and secondly that the concentration is one of long standing. It will be noted that practically without exception the states that led in value of manufactured products in 1939 were those that led in 1929. It is also interesting to note that in 1939 the first ten states accounted for \$38,851,000,000 of the total of \$56,843,024,300 in value of product. This is almost exactly two-thirds of the national product. If the situations depicted upon this chart were to be reduced to curves for the years 1929 and 1939, the curves would show marked trend tendencies. We can therefore assume without further discussion that general geographic concentration has existed and does exist. (For chart data see Table I)

Since the concentration of industry is quite apparent and since it presents a serious problem, it would seem desirable for us to learn some of the reasons for its existence. While almost any number of reasons could be cited, the following appear to be basic important ones:

1. Proximity to raw materials. An example of an industry of this type is the heavy concentration of steel in the Pittsburgh, Pa., area, due primarily to the proximity of coal and the ease with which iron ore can be brought to Pittsburgh.
2. Accessibility to markets. An example of the industrial concentration of this type is found in the farm machinery industry, most of which is concentrated in the Middle West.
3. Presence of water power. An example of an industry concentrated for this reason is the abrasive industry center around Buffalo, New York, utilizing the vast water power of Niagara.
4. The presence of fuel. Here again we might use as an example the concentration of the steel industry in the Pittsburgh area.

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TABLE 1

VALUE OF MANUFACTURED PRODUCTS

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1929 — 1939

BY STATES

(000 omitted)

	<u>1929</u>	<u>1939</u>
New York	9,978,556	7,134,400
Pennsylvania	7,443,861	5,475,928
Illinois	6,282,092	4,794,860
Ohio	6,027,903	4,585,665
Michigan	4,656,718	4,348,223
New Jersey	3,937,156	3,428,948
California	3,103,349	2,798,179
Massachusetts	3,392,162	2,459,771
Indiana	2,539,893	2,227,648
Wisconsin	2,156,681	1,604,507
Texas	1,450,246	1,530,220
North Carolina	1,311,924	1,421,329
Missouri	1,917,155	1,388,956
Connecticut	1,471,875	1,229,585
Maryland	1,119,082	1,027,354
Virginia	745,910	988,813
Minnesota	1,173,213	845,771
Tennessee	730,508	728,087
Iowa	893,213	713,531
Georgia	722,453	677,402
Washington	795,561	636,649
Alabama	560,378	574,670
Louisiana	685,036	565,265
Rhode Island	666,368	516,390
Kentucky	502,638	481,029
Kansas	751,613	464,353
West Virginia	513,012	441,840
South Carolina	385,892	397,512
Oregon	411,768	365,374
Maine	391,751	345,368
Oklahoma	455,905	312,168
Nebraska	484,168	273,524
Florida	232,386	241,538
New Hampshire	332,534	237,396
Colorado	306,071	221,642
Mississippi	220,917	174,937
Utah	214,628	167,172
Arkansas	210,903	160,166

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VALUE OF MANUFACTURED PRODUCTS
(Continued)

	<u>1929</u>	<u>1939</u>
Montana	271,094	151,885
Delaware	149,642	114,753
Vermont	143,522	103,154
Arizona	200,002	97,529
Idaho	96,352	90,475
South Dakota	81,171	97,697
District of Columbia	88,972	79,875
Wyoming	96,348	45,423
North Dakota	55,321	43,767
New Mexico	21,697	25,123
Nevada	33,717	20,581
TOTAL U. S.	70,434,863	56,843,024

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VALUE OF MANUFACTURED PRODUCTS
(000 omitted)
SPECIFIC INDUSTRIES
1939
BY CENSUS DISTRICTS

	AIRCRAFT AND PARTS INCLUDING AIRCRAFT ENGINES		CARS AND CAR EQUIPMENT RAILROAD STREET and RAPID TRANSIT		BLAST FURNACE PRODUCTS	STEEL WORKS and ROLLING MILLS		
TOTAL U. S.	279,496	100.00	168,381	100.00	550,802	100.00	2,720,019	100.00
New England								
Middle Atlantic	35,495	12.70	40,577	24.10	211,230	38.35	1,026,263	37.72
East North Central	10,870	3.90	67,226	39.92	230,466	41.84	1,218,314	44.79
West North Central	3,417	1.22	12,721	7.56				
South Atlantic							79,794	2.93
East South Central					37,085	6.73		
West South Central			539	.32				
Mountain								
Pacific	89,327	31.96						
Other	140,359	50.22	47,316	28.10	72,019	13.07	395,646	14.54

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5. Favorable climate. An example of such an industry would be the large production of aircraft in Southern California where moderate temperatures coupled with favorable flying conditions have resulted in a heavy concentration of the industry.

6. Availability of labor. An example of such an industry would be the production of garments in New York City with its teeming millions of garment workers.

7. Availability of capital. Examples of industries of this type are found in the heavy concentrations of industries in the New England area, many of which date back to the whaling days of this country, when large accumulations of capital took place which were made available to local industries.

8. The impetus of an early successful start. Numerous examples of concentration of this type are found. Perhaps the most important one is the example that is found in the automotive industry centered around Detroit, due primarily to the success of the Ford automobile in the early days of the automotive industry.

9. The availability of transportation. This is perhaps one of the most important of the reasons for the concentration of industry. Our railroads were started in the northeast and industries coincided largely to the extent and nature of our railroad network. It is futile here to argue whether the hen or the chicken came first, that is, whether industry or the railroads came first. The fact of vital importance to us is that railroads and industry appear to coincide in areas. The greater the concentration in railroad mileage the greater the concentration of industry.

While these reasons for the concentration of industry have been selected as the principle reasons, they are by no means all of them and in many cases concentration of industries results from a combination of the reasons rather than from one particular reason.

With this brief discussion of the reasons underlying the concentration of industry, let us turn to a consideration of what was done in World War II to accomplish dispersal and dispersion.

Perhaps the best approach to the problem is a consideration of the expansion that took place in war manufacturing facilities during the War Period. Let us look at the problem first from the general picture, second, in the light of expansion of specific industries, and third, in the light of specific products. Any consideration of the expansion in manufacturing facilities that took place just preceding and during the war indicates that little was accomplished to bring about greater dispersal and dispersal

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The data available indicates that of the 10 states having the largest value of manufactured products in 1929 and in 1939, 8 were states which witnessed the greatest expansion in manufacturing facilities in the period from June 1940 to December 1944. I have here a chart which shows in graphic detail the expansion that took place in industry. Expressed percentage wise, 10 states in which the greatest expansion took place accounted for \$13,212,000,000 of expansion or just 60 percent of total expansion. Please do not consider my remarks to be critical. We are considering this problem in the hope that better results may be obtained in the future. It is true that during World War II the expansion in industry followed the pattern of existing industry concentration. This was a perfectly natural result of the conditions that prevailed prior to the outbreak of war. America being generally a peaceful nation wanted no part of war or planning in connection therewith. When the gathering war clouds let loose their storm upon the earth and the armed forces and industry were faced with an unprecedented load it was only natural that those responsible for the prompt procurement of quantities of munitions and supplies that were necessary to turn to existing industry. This naturally resulted in the heavy concentration of war expansions in the same states and areas where specific industries had chiefly operated before the war. National security from the aspect of diversion and dispersion was a minor consideration. Effective dispersion was the exception rather than the rule.

Having seen that the expansion of industry followed the existing concentration let us now examine the expansion pattern in certain industries. Let us consider an important but relatively small industry, the machine tool industry. The expansion in the machine tool industry was concentrated in areas where machine tools previously had been made. The expansions in this industry were almost entirely expansions in existing facilities or new plants adjacent to old establishments of the same operator. Of a total expansion to May 1944 of 344 million, the East North Central region had 53.5 percent, the New England region 22 percent, the Middle Atlantic region 20.6 percent. Four states, Ohio, Michigan, Pennsylvania and Connecticut, totalled nearly two-thirds of this group.

A somewhat similar pattern prevails in the expansion that took place in the electrical equipment and appliances field. The East North Central, the Middle Atlantic and the New England Regions witnessed almost 90 percent of the expansions in these fields.

Turning from a relatively small industry, let us now consider the aircraft industry, the most widespread war industrial activity. We find aircraft, aircraft engines and parts to have developed tremendously in the East North Central and to a somewhat lesser extent in the Middle Atlantic regions as the automotive industry turned to large scale production in this field. Together these two regions received 85 percent

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of the value of expansions. The Pacific and West South Central regions which accounted for a large volume of aircraft deliveries received small proportions of the value of expansions, 3 percent and 6.8 percent, respectively. This was due to the relatively lower cost of constructing assembly plants as additions to existing aircraft establishments. The West North Central region with 6.5 percent of the national total was the result of expansions and additions to the industries in Wichita, Kansas City and St. Louis plus an entirely new plant near Omaha and numerous small expansions for parts manufacturers and plane modifications in Minnesota. Most of New England expansion, 5.5 percent was centered in Connecticut where engines and parts accounted for most of the facilities. In connection with the aircraft industry it is to be noted that only 3 regions had less than 200 millions in facilities expansion and that each 19 states had over 40 millions in aircraft expansion alone. This was relatively satisfactory dispersion and was accomplished to a large extent by government direction. It would be pleasant to be able to tell you that the relative satisfactory dispersion accounted for by the aircraft industries continues but unfortunately such is not the case. The industry is rapidly returning to its prewar locations and the benefits of dispersal accomplished during the war are being lost.

Let's now examine the situation in combat and other motorized vehicles. As is to be expected, the pattern of war facilities growth in combat and other motorized facilities has followed almost exactly the location pattern of the prewar automotive industry. The East North Central region acquired the preponderance of these facilities with over 77 percent of the expansion, with Michigan alone accounting for over 50 percent. The Middle Atlantic region and the West North Central regions had small expansions of 7.1 percent and 6.2 percent, respectively. There was little expansion in the rest of the country. I could go on indefinitely concerning major concentrations but enough has been said to illustrate the busy concentration of industry that exists. (For chart data see Table II)

The two large maps of the United States bear out the story I have just told.

Having seen the extent to which general concentration exists, having examined some specific industry concentrations let us turn for just a few minutes to a consideration of certain specific products.

The data compiled by the Resources Protection Board clearly reveal the extent to which this country is dependent upon single facilities for all or for an indispensable portion of the supply of vital products and the extent to which these facilities are concentrated in limited geographical areas. Some indication of the extent of this concentration is presented in the following paragraphs.

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TABLE II. VALUE OF FACILITIES AUTHORIZED BY MAJOR PRODUCT BY REGION AND STATE
 JULY, 1940 - MAY, 1944

	TOTAL		AIRCRAFT		COMBAT MOTORIZED VEHICLES		EXPLOSIVES		MACHINE TOOLS		ELECTRICAL EQUIPMENT	
UNITES	\$20,325,788		\$3,755,265		\$620,408		\$2,521,850		\$344,346		\$863,698	
VISIONS												
	1,037,961	5.11	205,316	5.47	7,570	1.22	5,938	.24	75,486	21.93	124,012	14.36
ic	3,811,432	18.75	708,779	18.87	43,838	7.07	171,881	6.82	70,798	20.56	297,844	34.49
entral	6,200,464	30.51	1,738,448	46.29	479,398	77.27	767,521	30.44	184,157	53.48	340,926	39.47
entral	1,405,083	6.91	244,123	6.50	38,558	6.21	440,889	17.48	4,680	1.36	22,409	2.59
c	1,369,471	6.74	147,594	3.93	1,197	.19	177,130	7.03	77	.02	37,476	4.34
entral	1,231,765	6.06	53,102	1.41	1,247	.21	565,789	22.44	30	.00	8,966	1.04
entral	2,153,864	10.60	253,654	6.76	17,402	2.80	321,744	12.77	3,775	1.10	2,011	.23
	686,018	3.37	27,437	.73	415	.07	69,491	2.76	162	.05	1,550	.18
	1,783,221	8.77	290,221	7.73	7,396	1.19	1,494	.02	5,039	1.46	24,209	2.80
	646,509	3.18	86,591	2.31	23,387	3.77	73	.00	142	.04	4,295	.50

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In the chemical field alone there were at least 30 critical war products of highest importance for each of which there was but one source of supply, while there were at least 82 additional chemical plants each producing over half of the total output of one or more essential military products. One of the most important single facilities in the chemical field supplied quantities sufficiently large to obtain RPB ratings for 19 essential chemical products. It was the sole source of tertiary butyl catechol for synthetic rubber; it accounted for over 50 percent of the supply of monochlorobenzene, polystyrene, and thiokol FA, and an indispensable part of the supply of phenol, ethyl cellulose, ethylene dibromide and twelve other chemicals. This same facility was also an important producer of magnesium products, accounting for about one-third of all magnesium extrusions, two-thirds of all magnesium forgings, and almost one-fifth of magnesium sheet and plate.

The supply of aviation gasoline, a product of highest importance to the war effort, is dependent upon the supply of several critical chemicals, other than those obtained from the refining of crude oil. Tetraethyl lead, which is necessary to raise the octane rating of gasoline to aviation grade was produced by only two facilities, the loss of either of which would severely limit our ability to carry on the heavy scale bombing which made possible the invasion of German and Japanese held territory. The production of tetraethyl lead is dependent upon the supply of metallic sodium and ethyl chloride. One of the two producers of tetraethyl was one of two producers of metallic sodium and ethyl chloride.

Concentration in the aircraft field may be illustrated by the B-29 Superfortress, the only long range very heavy bomber tested in actual combat. Many of the major subassemblies are fabricated within the west coast area. The central station fire control system of the B-29, a complex assembly of electrical and pneumatic controls for the automatic sighting of one or more sets of remote turret guns, was produced by only two facilities, both of which were dependent upon single subcontractors for all or most of their components.

The supply of many other critical aircraft components was also dependent upon a small number of key facilities. Bi-metallic brake disks, necessary for all disk type landing gear brakes, were made only in two plants, both located within the same city. One plant supplied approximately two-thirds of the special Adel type hydraulic valves used in many of the aircraft controls. Another facility of outstanding importance in the field of aircraft components supplied a large portion of many aircraft instruments including 100 percent of all flux-gate compasses, gyro drift meters and air position indicators. It was also an important source for sextants, aircraft generators, pumps, starters, and other components.

Concentration in the production of ordnance items may be illustrated by a few typical examples. One facility produced all of the rangekeepers for naval fire control system. Another produced over 75 percent of naval gun director control mechanisms. The largest producer of directors for the Army's 37mm and 40mm guns accounted for 74 percent of total output. One facility produced most of the barrel assemblies and mechanisms for all 40mm anti-aircraft guns. One plant produced over 50 percent of all 105mm howitzer carriages and mounts, and over half of all 81mm mortars. The largest producer of each of the two types of cal. .30 rifles accounted for over 80 percent of total output.

Many other programs, including ships, trucks and communication equipment, were dependent upon key facilities for the final assembly, the manufacture of components, or the processing of raw materials. There were high concentrations in the production of shipboard aircraft handling equipment; large diesel engines and bearings, and submarine batteries; in the production of heavy crankshafts, axles and transmissions; in the production of some electronic tubes and wire mill products. There are high concentrations in the production of many critical common components, many types of tools and general industrial equipment; and many metals, such as tantalum, platinum and nickel.

A substantial part of total production of critical materials is concentrated in limited geographical areas. The city of Niagara Falls might be selected to illustrate concentrations of war products and producers within relatively small geographic areas. Niagara Falls is the source of many essential chemicals, artificial abrasives, carbon products, and ferro alloys. Here a well known producer makes eight important chemicals, including 100 percent of polyvinyl alcohol, virtually all sodium cyanide, and about two-thirds of all perchlorethylene, trichlorethylene, and metallic sodium. Trichlorethylene is a degreasing agent which is considered one of the most important industrial chemicals. Metallic sodium is essential to the production of many products in addition to tetraethyl lead, such as sodium cyanide, acrylic resins, sodium hydrosulphide, lauryl alcohol and sodium peroxide. It is also used in the production of stainless steel, airplane engine valves, sulfa drugs, and in secret military projects. Another producer in this area is the sole source of sodium methyllate which is required for the production of sulfadiazine, probably the most important of the sulfa drugs, while still another produces 73 percent of vinyl acetate, the source material for most vinyl plastics. A fourth is the sole source of phosphorus pentasulphide for copper flotation and oil additives, and make about 95 percent of all per chloric acid for metallurgical and direct military applications. Three companies make about half the electrodes required for operation of electric furnaces. Six facilities within a five mile radius supply over 80 percent of crude abrasives.

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Many plants at Niagara Falls, Buffalo and nearby places are dependent upon the supply of 25 cycle electric power. The two largest sources are the Schoellkopf Hydro-Electric Station and the Huntley Steam Electric Station of the Niagara Hudson Power Corporation. The loss of these facilities could not be offset by bringing in additional power from other areas. The use of 60 cycle power would be impossible or impracticable. The minimum time required for the conversion of 60 cycle capacity to the production of 25 cycle current is estimated to be 15 months. The Schoellkopf plant was one of the objectives of the saboteurs arrested in June 1942.

If time permitted and I thought I could keep you awake I could continue this story of expansion and concentration, but no useful service would be served.

I have gone into the problem of concentration in such detail in the hope that by so doing I would emphasize the extent to which it exists for it is of great consequence to us.

We have thus seen that concentration existed, we have examined some of the reasons for its existence; we have considered what was done in World War II to accomplish dispersal and dispersion. Let us now pass on to consideration of the implications contained in the problem of geographic location of industry. If industry were to be dispersed, a considerable amount of the fear and consternation caused by the advent of atomic bombs and their effect upon our war machine. It would reduce problems incident to manpower, shortages, housing and transportation such as were experienced in Detroit. It would result in the fuller utilization of natural resources, oil, gas and water power by placing industry nearer these sources. It would facilitate any stockpiling plan according to industrial usage. It would diminish the disruption of production resulting from localized strikes, floods, fire, etc. in a concentrated district. More important than all of these combined, dispersion of industry would minimize the danger of a sudden sneak attack upon America and of a prolonged bombardment of the country.

We can accordingly see that our lack of geographic dispersion presents us with a vital problem. Let us therefore examine some of the possible solutions.

One means of improving the security of industry against enemy attack is detailed dispersion of each major production program, along the lines of the British and German "complex" systems. What actually is involved in this type of operation is the use of a large number of small plants, dispersed within a radius of from 50 to 100 miles, instead of one very large plant. Two or more sources are provided for each part or assembly just as two or more plants of final assembly are provided. The entire group of plants, or complex, operate under one management and works on the same aircraft or engine model.

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This system was used extensively by the British and Germans, as you probably know. The British began dispersing on a large scale as a result of the heavy German raids in the Autumn of 1940.

A typical British complex was one turning out 135 Spitfires per month. That complex consisted of 40-odd different factories, located within a radius of about 50 miles. It had three final assembly fields, four final wing assembly shops, four fuselage shops, four machine shops, three press shops, twenty-four or so other plants for detailed parts. In addition, 47 percent of the work was subcontracted to other companies. Other complexes involved literally hundreds of individual manufacturing sites, including basements in private homes, village garages, converted stores, and the like.

The British report that the complex system proved very effective, and, indeed, was just as efficient as the more conventional type of manufacturing operation. They claim that the man-hour cost was no higher than it would have been, had the entire operation been concentrated in one plant.

The British, of course, found that their transportation costs were higher. Production control was greatly complicated; it took a lot more supervision. Larger stocks of raw materials were required at the various points and in the pipe lines. 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 far as the atomic bomb is concerned, it may call for spreading out beyond the fifty-mile radius and providing greater distances between plants, but the principle would still appear to be valid. It's still a matter of not putting all your eggs in one basket.

It would not be realistic to expect industry to operate under such conditions during peacetime. As a matter of fact, most manufacturers have sharply reduced their decentralization so that now production on any given product is concentrated almost completely in one plant. Thus, even the dispersion accomplished during the war has in many cases been lost. Therefore, any plans for dispersion based on the British and German complex systems must be purely plans for a future emergency. We should pursue the matter as far as we can, on paper, and in our industrial mobilization planning for a future emergency careful consideration will be given to this problem. We should try to arrange to have the manufacturers included in our plans, work out, in advance, the methods by which they would operate under a complex system.

The next possibility for accomplishing better geographical location of industry is in effect a modification of the complex system we have

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just discussed. It consists of a complete allocation of facilities, together with a carefully integrated plan of subcontracting, integrated and planned to accomplish the basic purposes of the complex system. This solution to the problem is similar to the complex solution just discussed. We must be realistic about it. Insofar as peacetime operations are concerned, American industry cannot be expected to subcontract on a predetermined compulsory basis. Such a plan would almost without question in their minds represent a regimentation. It would cause the break up of friendly business relations that they have had for years, and in peacetime I doubt very much that such a plan could be placed in operation. Therefore, let us face the matter with a realistic attitude. Any plans for dispersion based on an integrated system of subcontracting must be purely plans for a future emergency that must be carefully considered to determine whether they are sound, for it is highly probable that the burden upon our transportation system resulting from such a solution to all probability would be too great to be borne.

The last possibility for increasing the military security of the Aircraft industry is underground plants. Underground production was used most extensively by Germany, as you probably all know. The British, of course, also used it to some extent. In both cases it was part of the dispersion program.

I would like to go very briefly into the pattern of the German move underground. The Germans began going underground as early as 1941, but the movement was on a very small scale, because the Germans were quite confident that they would not suffer much from aerial attack. However, in the fall of 1943, when the United States Strategic Air Forces and the RAF began to mount greater and greater attacks, the effort to get underground began to gather speed. The great thousand-plane, fighter-escorted raids of February 1944 convinced the German high command that underground plants were the only solution to the problem of providing security against Allied air attacks. They, therefore, set up a special organization in the government and in the Luftwaffe to handle the movement underground. The government took complete control of the program and established rigid priorities on the plants and operations to be moved underground.

At first the Germans planned to move their key programs underground in order of their importance; "V" weapons first, then jet fighters and jet engines, and later the conventional fighters. The sequence in which each plant was to be moved underground was also planned in advance. The more important machine tools, production and test equipment was to be moved first and then the less important machinery and equipment. The very heavy Allied air attacks, however, completely disrupted this orderly planned dispersion and movement underground. The Germans were forced to move plants underground in the order in which they were bombed by the Allies. Thus, when a particular plant was destroyed or damaged by Allied air attacks the usable machinery and equipment of that plant was moved to another.

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In recent months, considerable attention has been devoted in this country to the possible utilization of underground sites. There is no question but what these sites offer a marked degree of protection. Underground sites are apparently desirable for protection against demobilization bombs and atomic bombs and it is highly probable that they offer considerably better protection against poisonous gases and biological warfare. Other advantages possessed by them are:

1. Protection against sabotage.
2. Protection against detection from the air.
3. Protection against the elements, hurricanes, tornadoes, etc.
4. Protection against earthquakes.

There are two types of underground sites that might be used. The first type is the cave, tunnel and mine. The second type is the underground Bunker built into the side of a hill or on a plain with adequate cover. Much ado has been made of the natural caves with which this country abounds. Although I am neither an authority nor a student of caves, it seems probable to me from several that I have seen that caves are of doubtful if any value for their geographic formation is such that most of their walls are porous, most of their ceilings are low, and most of them are long winding and treacherous. Tunnels and mines on the other hand present interesting possibilities. The third possibility is the factory built into a hill side or, as indicated, on a plain with adequate cover. This potentiality presents interesting aspects. Germany put the largest oil refinery in Europe underground. It functioned perfectly and was not damaged. They put the airplane plant in Europe underground. It is an assembly plant for V-1's, V-2's, etc., with the production of something like 200 per month. At first glance, the use of underground sites appears possessed of insurmountable difficulties. First, there is the problem of getting labor to work there. This, I deem, to be a relatively minor problem. With modern lighting and air conditioning, working conditions should be pleasant; in fact, many industrial plants above ground are already being constructed without windows. The second problem that presents itself is the problem of access. Everyone seems to think that this would be an insurmountable problem for the reason that the need for getting a great many people to one spot at one time might present too great a burden on transportation. That this is no problem is proven by the use of the Pentagon building, where at the peak of the war between 30,000 and 35,000 people reported for duty with comparatively little disruption to transportation facilities.

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The final objection is the problem of costs. I do not think that anyone can talk with great authority on the problem of costs but from present indications, the cost is not prohibitive. Not too long ago, the Underground Sites Committee of the ANMB under the Chairmanship of Captain Granum presented certain conclusions concerning underground sites. I think it would be wise to note them:

"1. That underground sites afford superior and" -- this is the important thing -- "continuously effective protection to the nation in an atomic age for military and civilian requirements.

"2. That underground sites of suitable charactersites for nearly any required use exist in large numbers well dispersed throughout the United States.

"3. That the nature and distribution of underground sites would afford a sense of security which would strengthen and improve the national morale in the fears of an atomic age. The improved morale, especially among war workers, will be an important factor in war production.

"4. That underground site facilities can be provided at costs lower than comparable facilities above ground in an atomic age.

"5. That to be effective in a future war, such facilities must be actually established and plans for future conversion completed in advance.

"6. That the considerations above mentioned warrant immediate specific action in order to secure their advantages."

If industry can be sold on the use of underground sites, it must be done on the basis of economic operations and if it can be proved that they are cheaper to construct and operate and if it can be demonstrated that working conditions are satisfactory I think a long step forward will have been taken towards geographic dispersion of industry.

We have now seen that concentration exists, we have seen why it existed, we have seen that little was done in World War II to accomplish dispersion and we have examined the implications of the problem, together with a consideration of certain means of accomplishing better distribution of industry.

Let us now turn to the final aspect of the problem--how can better dispersion be brought about. The first imperative step in mind calls for the establishment of a top level group to study this problem in all

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its implications and its extent. The second step involves keeping the public and particularly industry informed of the problem of security and the danger incident to the unsatisfactory situation now prevailing. The third step involves the preparation of a plan whereby existing industry will be encouraged to disperse. Such a plan cannot be dull theoretical approach to the problem. It must be factual and provide incentives, inducements, and to the extent possible compulsion to bring about better distribution of industry.

The final step that needs to be taken concerns itself with the military. The military has itself been one of the greatest offenders. The relatively few production plants maintained by it are highly concentrated, the same situation prevails with regard to laboratories and research installations to say nothing of posts, camps and stations. The military must devise and plan now to disperse its establishments to shake off historical and political shackles that bind it to certain specific areas. History indicates that the odds are against the dispersion of industry. The most important bottleneck is and will probably continue to be:

1. Inertia.
2. The immobility of labor.
3. The absence of transportation facilities.

After the first world war, we relaxed into impotence. We scuttled our ships and virtually destroyed the effectiveness of our Army. Unless we start planning now to accomplish geographical dispersion, unless we exercise every means at our disposal to bring about this dispersion, we will again lapse into slumber and the approach and outbreak of a future emergency will find the present highly industrialized area the only areas available for production and our production will be placed upon these loaded areas. Gentlemen, these areas are a most inviting target for any enemy. We must see that that target is not available. All of you remember the late General Stillwell's remarks when he returned from the jungles of Burma and was asked what happened. He explicitly stated, "we took a hell of a beating." Gentlemen, if you who constitute the intellectual aristocracy of the armed forces, ignore this vital problem, if you do not in some way, and frankly, I know not how, accomplish better distribution of industry in America in any future emergency we will take a hell of a beating.

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LIEUT. COL. GALLAGHER: I will be glad to answer any questions, to the extent of my knowledge.

A STUDENT OFFICER: Colonel, I would like to make a couple of points that I don't believe got as much attention as they might. One of them is the question of people, the populations of the States. Now I believe the black areas there (referring to one of the charts used in the course of the lecture) are also the most populated States.

LIEUT. COL. GALLAGHER: That's right; yes, sir.

A STUDENT OFFICER: In other words, the businesses are there because the people are there, or the people are there because the businesses are there.

LIEUT. COL. GALLAGHER: Frankly, Colonel, I did not feel we could discuss whether the hen came first or the egg came first.

A STUDENT OFFICER: I think that is a very important point.

What I am trying to get at is this: I think we will find, if we look at the black areas, that, to some extent, in places like Texas or California, it is because of the climate. I think that is proven by the migrations to those States. People go there without necessarily having a job. It is also proved, to a certain extent, in the State of Washington, which also has a good climate. On the other hand, the sections in the interior of the country are well known for being rather unfortunate in their climate; people certainly are not encouraged to migrate there.

Again, I think perhaps we are thinking largely in terms of a trend, in which some of the prophets may be right or they may be wrong. There has been a good deal said about the large States having reached their peak in size. Whether they have or not, I do not know; but they have reached somewhere near their peak. I think that is demonstrated in your chart showing the difference between 1929 and 1939, where New York fell off considerably between those times, indicating that business did not return to New York State. It is also indicated in the State of Pennsylvania. But, on the other hand, you find a much sharper level in those States where the people like the climate and have moved during those ten years.

It seems to me that before we can lick this problem of decentralization we have to think of the decentralization of Government. In other words, if we are going to have industry spring up in places where it is not now, there has to be some means of getting it there, either by decentralization of procurement, decentralization of wealth, decentralization

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of interest--something to get away from having it go to the lowest bidder. There has to be something to encourage the local man to bring people there, to bring capital there, or something of that kind. Unless we can look at it in terms of trends which will favor the development of more and more self-sustaining communities, I don't believe we will get very far on the problem.

LIEUT. COL. GALLAGHER: Do you have a specific question, sir? I fully agree with everything you have said. It was because I agree with everything you said that I mentioned that any plan or any approach you might make to industry, encouraging decentralization, must be predicated on reason, not desire. You must be able to point out to him some of the nine factors I mentioned that are available to him if he should settle there.

You are quite right in saying there are definite migratory trends in industry today; but they are not sufficient. They are not adequate to solve the problem.

A STUDENT OFFICER: My question is, How can we solve the problem without considering the American people?

LIEUT. COL. GALLAGHER: You cannot solve the problem without considering the American people. As I have indicated, or tried to indicate, if you try to sell them a bill of goods and your goods are inferior you are not going to sell them. He isn't a boob. He is going to do just what he wants to, when he wants to, how he wants to, unless you can show him a good reason, in his own personal interest, why he shouldn't.

I do not for a minute forget the human element. It is one of the primary determinants of the situation. I don't know how you can correct it other than by showing him why it is to his personal advantage to migrate to Kansas or Iowa, or some other State. I have no answer to your question, sir.

A STUDENT OFFICER: How far do you go on this migration? New York is a black state (referring to chart), but there is an awful lot of barren country in New York State. If you simply estimate migration fifty miles, say, from some minor center-line area, it wouldn't give you a nice, even map.

LIEUT. COL. GALLAGHER: I don't particularly care about the map.

A STUDENT OFFICER: California is shown as solid black there, but I know of several hundred thousand square miles of country in California that they would not have to move to New Mexico or Nevada. I think we should state that all we want them to do is move fifty or a hundred miles

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from the center. We do not have to stress the Middle West or the "unfortunate" Far West.

LIEUT. COL. GALLAGHER: You're quite right. All during the World War II emergency almost all steps (few that they were) that were taken along the line of dispersion were predicated on a hundred-mile belt inland from the coast. Unless you were within a hundred, 200 or 300 miles, it was felt that there was no danger whatsoever; the hundred-mile belt was the critical one.

If we can get them to move further and further--whether it be fifty miles a time--it would accomplish the desired result. You don't necessarily have to take someone from Tonawanda, N.Y.--a vital concentration, incidentally--and stick them some place out in Missouri. To begin with, they aren't going to go there. But if you can show industry why it is so desirable to locate in Missouri, or some other State, then the workmen gradually will follow. Strangely enough, we all have the idea--here in America I mean--that labor is easily moved. It isn't. One of its pronounced characteristics, with the exception of a relatively small flowing segment, is immobility. People tend to live in the areas in which their grandfathers lived. Perhaps the recent war, when we took the GI's and sent them all around the globe, will break down that tendency somewhat. So far, there has been very little relocation of GI's or discharged Servicemen. They have returned, in almost all cases, to the towns from which they originally departed.

A STUDENT OFFICER: With regard to concentration in the Northeast corner of the United States and the East-Central portion of the country, which is a steel--and coal-producing area, how would you be able to concentrate industry anywhere else but in there without terrifically upsetting the transportation system?

LIEUT. COL. GALLAGHER: We have put a very extensive steel plant out in Utah. During the war, almost all of the expansion in Utah was accomplished by the Geneva plant.

A STUDENT OFFICER: Oh, well, there is a reason for that.

LIEUT. COL. GALLAGHER: Let's hear the reason.

A STUDENT OFFICER: It's like your regions up around Pennsylvania. You have your steel plants; you have your coal and iron out there. Take another spot; take another example--

LIEUT. COL. GALLAGHER: Wait a minute! He (referring to the previous student) is asking how are we going to move these. I say we did. During

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the war we moved a steel plant out there and built a big one. I don't know how successful it was, but it did operate, didn't it? It could continue to operate, too, couldn't it?

A STUDENT OFFICER: What about the Fontana plant in California?
(No reply)

DR. PETERSON: Most of us cannot forecast these economic factors very far in advance. I was wondering if you think it would be feasible for us to try to say where we would want industry to be in 1960 or 1970 and then try to subsidize that through the Government, somewhere, to bring it about. Do we know enough, or can we foresee enough, to justify that?

LIEUT. COL. GALLAGHER: I don't believe, first of all, we can accomplish much, if anything, through subsidy. Secondly, where industry should be located, I cannot say specifically. But as military men, faced with the job of protecting the nation against the attack of an enemy, we know the fewer the eggs we have in any one basket the less disruption we are going to have in a future emergency.

It has always been a most amazing thing to me how we held up these nice, juicy plums to the Nazis. As of VE-day, there were some 974 plants, Dr. Peterson, on the Resources Protection Board list, every one of them of vital importance to the war effort. We had practically no sabotage. Now these gentlemen wearing the blue uniforms (referring to the naval officers), who were sweating it out on navy ships, remember rather distinctly, I'm sure, the kamikazi attacks by the Japanese. The Japanese weighed the balance and said, "Hell! This destroyer is well worth the life of one, two, three, or five of our pilots." They threw them at them loaded with bombs. I can't imagine a future enemy not being willing to come over here if he knows there are, say, thirty plants making chemicals, and every one of those plants the sole supply of a vital chemical of the war industry; I can't conceive of their not dropping men over here by parachute or otherwise.

DR. PETERSON: I grant all that. From the military standpoint, we feel it would be desirable. But industry will come to us and say, "What are the answers to these problems? How can you show us that it would be economical?" How can we induce them?

LIEUT. COL. GALLAGHER: Apparently I didn't tell my story as well as I hoped I would. I meant to say you have to have a sound story to tell industry. You have to tell them, "We want you to do this because of military reasons, but it is also going to be to your personal advantage, economically, to do so." Unless you can do that, you are not going to get anywhere. You can go out to a site and you can prove to industry

that if they need capital, capital is available. If they need labor, labor is available. If they should be engaged in the manufacture of product X which requires certain raw materials, they are available. The transportation is there.

DR. PETERSON: The first thing an industrial man might say, it seems to me, is, "Where would you like for me to go?" If you can't answer that, what does he base his judgment on?

LIEUT. COL. GALLAGHER: That is what I have indicated. We have got to know where we want them to go.

DR. PETERSON: That comes back, then, to my original question: Is it feasible for us to try to forecast where we would like for them to go?

LIEUT. COL. GALLAGHER: I think it is not only feasible but desirable. I honestly think it is necessary. We have got to do it. I don't think you have to be able to say this or that specific town, but I do think you have to say, "Gentlemen, you've got to locate here", or there, or wherever we want them to be. We know that unless we do that we are going to be holding up these beautiful targets to the enemy.

A STUDENT OFFICER: I wonder if the Strategic Bombing Survey group has made a survey of this from their own particular specialized angle. We have all heard a lot about the concentration of industry in the United States. I think most of us have had as much experience in connection with this problem as anyone else. Perhaps a hundred miles in Europe might be comparable to 1500 miles here in this country. We have heard various stories about German industry having been bombed. There have been various estimated percentages given for the reduction of their efficiency, ranging from 30 percent on up. They had a much greater concentration in Germany than we have in the United States.

I am just wondering in my own mind whether the so-called concentration, as we see it, is really as serious as perhaps a hostile bombardier might see it.

LIEUT. COL. GALLAGHER: I'm sorry I cannot answer the question for you. It is my opinion that a situation existing in this country, such as existed in the last war, makes us extremely vulnerable.

In so far as the Strategic Bombing Surveys are concerned, they have been made. It is true they did not indicate the bombing precision we thought desirable. I think the most expensive raid we made during the

war cost us 59, 60, or 61--I've forgotten the figure--B-17's. They were aimed specifically at bombing the ball-bearing plant at Schweinfurt. They intended to knock out their vital industrial concentration, one of the few that the Germans had not had good sense enough either to put underground or to disperse.

A STUDENT OFFICER: The U. S. Strategic Bombing Surveys will show definitely there never was a raid on anti-friction bearing plants in Germany, as such. At the end of the war they had seven of those, altogether.

LIEUT. COL. GALLAGHER: I know; I understood that was the case.

A STUDENT OFFICER: And they put the plants underground.

MR. PIERCE: We talk about the large amount of space available in the United States. In the final analysis, factory targets are the same whether they happen to be located in Germany, England, or elsewhere.

Then, too, you have the people to consider. You cannot fall back on the idea of large space because your people, after all, do concentrate in the towns. Remember, everything that is done to Germany from the European bases can be done to America. That is my first point.

I think it is wrong to think that because you happen to have great empty spaces that those empty spaces negate their effect. You have people living in highly-concentrated areas in this country; the most highly-concentrated being New York. Unless you are going in for large-scale aerial bombing, or something of the sort, it is a totally different story.

One other point: I would like to know if you agree with me altogether that your plan, as I see it, consists of two parts: First, an alternative plan or an alternative agreement that we are going to have dispersion in some future war; then working out, in terms of specifics for each particular industry, detailed reports on the industry; making concrete suggestions--as concrete as we can--on the various types of changes in the location; and the integration of all these factors in favor of dispersion, such as the method of moving people.

I take it that your procedure, first, is an overall agreement that this should be done; secondly, working out in detail for each industry all of the actual factors that would govern that particular industry or that particular geographical area.

LIEUT. COL. GALLAGHER: That is correct, Watson, with this qualification: only to the extent that it is necessary. Where we have an

adequate number of sources of supply within an industry we do not need to bother about diversification. Gentlemen, in the bearing industry I will agree that the Connecticut Valley is a relatively limited area. I think most of the bearings are made in that area.

A STUDENT OFFICER: Approximately fifty-six percent of the bearings are made in the Connecticut area; about twenty-five percent in Ohio and the other areas scattered throughout the northeastern section of the country.

LIEUT. COL. GALLAGHER: Is it not your opinion, sir, that this places us in a vulnerable situation in the event of a future emergency?

A STUDENT OFFICER: Yes, sir.

LIEUT. COL. GALLAGHER: That, then, is one of the industries, Watson, that would have to be so considered.

A STUDENT OFFICER: If the abrasive industry, which is a component of the bearing industry, should be knocked out, the average bearing manufacturer, carrying approximately three weeks to a month's supply of abrasives--the abrasive industry itself being concentrated in the Niagara Falls-Buffalo area--would, in turn, be knocked out. This, in turn, would knock out other production which depends upon the utilization of bearings. Our whole economy is so interrelated with one specific thing going out that it makes the whole problem difficult to solve.

There are many other industries in a similar situation. You mentioned, I think, the fact that there are 974 plants or factories which are vulnerable today. Even if we dispersed them and cut each one of them in half, we would still have two thousand strategic targets. Whether those targets are located in New York or New Mexico they still become targets and you cannot break down these strategic targets much lower than half their present size, unless you get into highly inefficient production.

LIEUT. COL. GALLAGHER: I don't go along with you there. It is entirely too broad a subject to go into. Those 974 targets were not necessarily 974 plants. Many of them had five or six ratings; in fact, one of them had 19 ratings. They were the sole source of a product vital to the war effort. They could not be dispensed with. They were either the sole source or one of the very few sources. It would not mean breaking up these plants into little kitchen-cabinet affairs.

A STUDENT OFFICER: I want to say that unless I misunderstand the argument you have put forward, it seems to me your presentation of the concentration of America's industry by States is liable to be most mislead-

Looking at that chart, the left-hand one there, take your figures on the left. If you put the State of, say, Michigan, which is a small State, into the first ten, its concentration of industry is very much higher than perhaps a larger State, like California or Texas. I don't believe those first ten are a true indication of the concentration of industry. You cannot compare states that are so different in size.

LIEUT. COL. GALLAGHER: I think if you would try to compare them in almost any other way you will find yourself in almost the same difficulty, but perhaps of a different sort. All the figures, unfortunately, are not available to the extent we would like for them to be. The last census of manufacturers was taken in 1939. It is from that census those figures were taken.

You are quite right in intimating that to present an exact and true picture you would have to take in a great many other factors. I don't think you could do so and tell any better story or any clearer story than is told here (referring to charts). I think your results would be the same.

Now I have here a map which goes into it in considerable detail. I did not use it because I think it represents an attempt to accomplish precisely what you have suggested solely from a biased, partisan angle. Please don't quote me, gentlemen, but this is Senator Pat McCarran's map and was a part of a report made by him. I think the chart is worthy of a "Nathan" but not of a Nation. The area here (indicating) is drawn up to tell just the story you want it to tell--as Pat McCarran wanted it told. He is the Senator from Nevada, isn't he?

(From the Audience): Right, Colonel.

LIEUT. COL. GALLAGHER: He accompanied this with a report, which I shall hold for light reading some evening.

A STUDENT OFFICER: Pat McCarran, perhaps, might say your maps were drawn up on the same basis. (Laughter)

LIEUT. COL. GALLAGHER: Unless I am very much mistaken, he very probably would. However, I can assure you that the maps and charts I used were not used simply for the purpose of telling my story. They were used because I thought they were the best available. I thought they depicted the policy as well as it could be depicted. I might add they are not the only ones I worked with. There was one which I discarded purposely because it did not give a fair picture. I took the figures which I thought were the most dependable, and the figures that were available to me, and let them determine what the story would be.

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(From the audience): I am not a military man, but if a military strategist had to plan the defense of this country against bombing, would he rather defend a concentrated area with his antiaircraft implements and his airfields, or an area scattered all over the place?

LIEUT. COL. GALLAGHER: I think that is a question for one of the military strategists to answer. I'm just an industrialist and a school-teacher, and an army officer.

Any more questions anyone would like to ask? (No response) If not, gentlemen, I wish to thank you for your splendid attention.

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