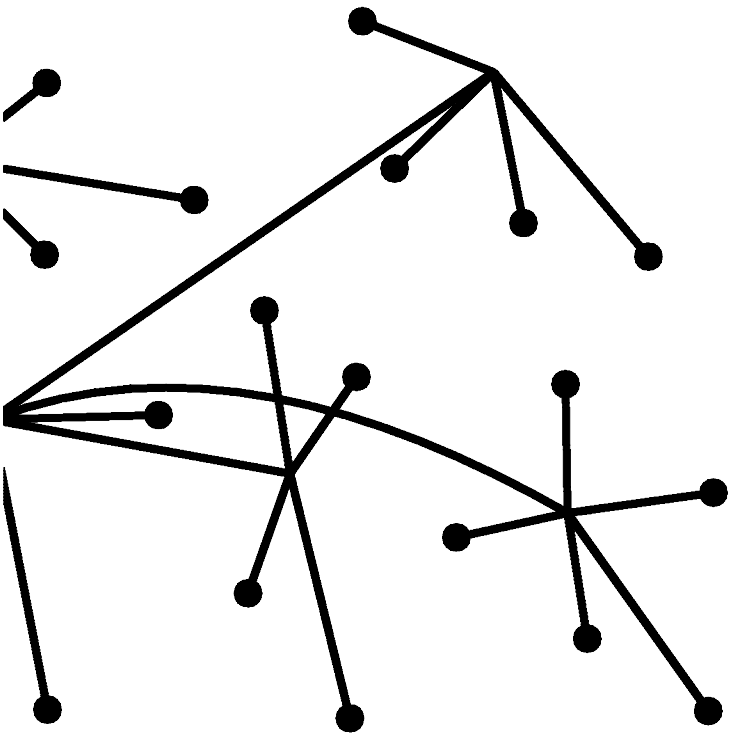
Decentralized network.
Source: Baran, "On Distributed Communications."



War against the Center

PETER GALISON

1. Dispersion

In the 1980s, we learned to view postmodernist architecture as a form of de-centering, a dispersion of form and function away from the critical node. For half a century, the Empire State Building had stood for modernism, pinpointing not only the symbolic dead center of New York City, but even focusing its own central axis around its needlelike antenna. When postmodern theorists like Fredric Jameson sought to contest that centripetal force of modernism, they gestured to the Westin Bonaventure Hotel with its repetitious cylindrical structures iterating elevators and escalators so numbingly that visitors wandered disoriented, unable to find the same place twice. For David Harvey and other late-twentieth-century theorists of urban design, the postmodern celebrated "dispersed, decentralized, and deconcentrated urban forms" that had become "technically possible" only in the previous decade. The modernist trope of concentration became that postmodernist dispersal, cohesion shifted to fragmentation, and metropolis to counterurbanization.[1] A city-world more like William Gibson's Sprawl seemed in the offing for the early twenty-first century, rather than the compact star of Walter Benjamin's Paris, radiating from its heart, capital of the nineteenth century. Our vision of the late twentieth century: an urban geography of Deleuzian rhizomes burrowing every which way without beginning or end—no tracking back to an ultimate origin, center, or peak; no hierarchy; in short an end to the modernist, arboreal dream organizing all around a rooted center predicated on located cities, centered societies, and integral psyches.

Among the many meanings of postmodernism (historical quotation, stylistic pastiche, multiple coding, depthless meaning), the removal of hierarchy was crucial for the move toward counterurbanization, easily adapting itself to the 1990s salvational narrative in which the Internet starred as postmodern, democratic, and liberatory. (Even the briefest of Web searches yields hundreds of sites with titles like "Internet = Postmodernism" or "The Internet as Post-Modern Culture."[2]) How did we lurch from the centered modernism to this aesthetic, architectural, economic, and, according to some, metaphysical placelessness? Less clear. For Harvey and Jameson, the underlying transformation in the disposition of buildings and cityscapes lay in the ever-widening gyrations of multinational corporations: the cultural logic, as Jameson put it, of

late capitalism. Others, like Charles Jencks, mapped the de-centering back to a cultural context of literary theory and philosophy. More recent work by Peter Rowe and others importantly attends to the remarkable juxtaposition that has characterized suburban growth—on the one hand pulling toward technical, rational planning and on the other toward an arcadian imaginary.[3]

Here I would like to point toward an architectural dispersion rather less abstract than that celebrated by a generalized zeitgeist, by a shift in an economic base "reflected" in the cultural superstructure, by an epochal postwar taste change toward suburban life, or by an entropic flow away from an ordered city core. No doubt such intellectual, pragmatic, aesthetic, and stochastic drives did contribute to the pressure driving dense city cores outward. But today I want to begin elsewhere. Not in 1973 with the oil crisis and subsequent economic upheaval, nor with the social upheavals or deconstructivist literary-theoretical work of the 1960s. Nor, for that matter, will I start with the Internet, though I will come back to it.

Instead I will address bombs: the bombs of the long war that, in a certain sense, began in the 1930s, accelerated after the Nazi seizure of power, continued across the end of World War II, through the cold war, and even past the fall of the Soviet Union into the present unsettled moment. But we need to step back two decades before the 1960s.

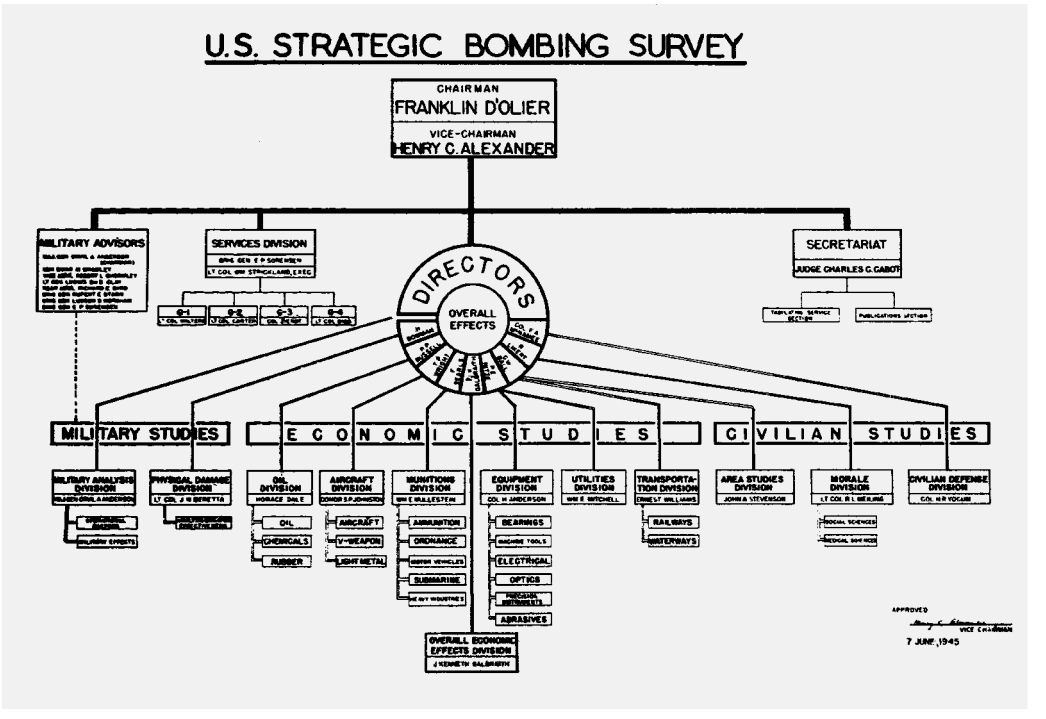
As British and American planners began designing their strategies for the massive bombing campaign of the war, the targeters joined the elite civilian sectors of law, business, academic social science, and economics. Together they composed the Army Air Force's Committee of Operations Analysts. "Operations analysis" was essentially a methodical theoretical reconstruction of the interconnections that held together the German economy and war machine and that asked how it could be blown apart. Where, they asked, were its nodal points, the linchpins that, when pulled, would topple the economy, forcing the Nazi war machine to a halt? Analyzing this whole process—that is, the effects of the bombing effort—was the U.S. Strategic Bombing Survey, founded in 1944 while Flying Fortresses were still leaving each day for German targets from the airfields of East Anglia. The Survey was an immense affair, employing well over a thousand people, including, as "directors," specific, mostly industrial experts on their topics. For example, the head of a major mining firm directed work on munitions, the executive vice president and general manager of Standard Oil directed the petroleum division, and a former vice president of the Curtiss-Wright Corporation ran the Aircraft Division. Appropriately enough, Franklin d'Olier, president of Prudential Insurance, ran the whole of the Survey—the greatest damage-assessment program in history. Among the major figures running other divisions were John Kenneth Galbraith (overall

Organization chart, U.S. Strategic Bombing Survey (USSBS). Source: U.S. Strategic Bombing Survey, Overall Report (European War), **30 September 1945, reprinted with an introduction by David MacIsaac (New York: Garland, 1976).**

economic effects), George Ball (transportation), and Paul Nitze (equipment and utilities).[4] Starting on the lower rungs of the ladder were Marxist economist Paul Baran and poet W. H. Auden.[5]

One of the first targets was the Luftwaffe itself, a task in destruction that the Army Air Force aimed to complete by pulverizing airframe factories. This proved vastly more difficult than the Allies expected. After dismissing the Versailles agreement forbidding the construction of air power, the Nazi regime hammered into place a German air force proofed, as far as possible, against enemy attack. Emphasizing protection for their factories against air raids, the Luftwaffe planners sited new plants away from frontiers, in suburban or country districts, concealing structures, deploying camouflage, separating buildings within the plants, and providing on-site air raid shelters for workers. The Reich pooled patents and structured the airframe "complex" so that spatially separated plants could stamp out replaceable segments of their completed product. It was an efficient, powerful apparatus that, as the Survey promptly conceded, continued to produce an abundance of fighters and bombers even under the years-long rain of explosives.[6]

Responding to some fourteen attacks on the German aircraft industry between July and December 1943, the Germans dispersed their factories as rapidly as they could. For example, initial American and British attacks against the Focke-Wulf plant at Bremen and the Heinkel plant at Rostock were not very successful; worse, for the Allies, the bomb runs led the German authorities to splinter Focke-Wulf production from the heartland in Bremen into East Prussia and Poland. Not only did this dispersal open new, forced labor supplies to the Nazis, but it would also, the Germans believed, put the plants out of harm's range. Large-scale dispersion began during the Allied assault of the second half of 1943, and compulsory dispersion took hold in February 1944.[7]



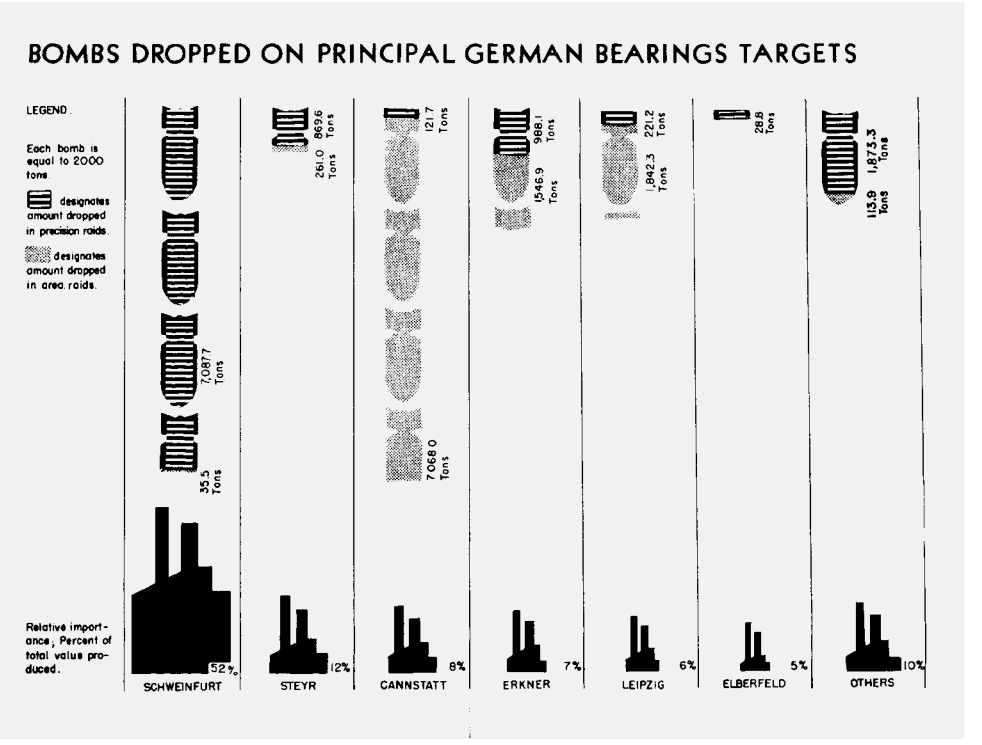
To realize these goals, Albert Speer's assistant, Karl-Otto Saur, created a vast "fighter staff" from which one member was dispatched, permanently, to every airframe factory in the Reich even as the fighter staff partitioned the factories into hundreds of sites, many of which stood in forest clearings.[8] Acknowledging the success of the dispersal program, the Strategic Bombing Survey allowed that Nazi airframe production actually *increased* during 1944. They concluded that Germany lost control of the air not by a lack of planes, but by the shortage of well-trained pilots and aviation fuel.

But the operations analysts selecting targets were not just after particular pieces of munitions factories; their goal was to precipitate a collapse of the German economy as a whole. To that end, they directed a series of studies designed to locate just those plants where destruction would cause shortages to ripple through the entire system. Operations followed. Henry "Hap" Arnold, for example, tempted Harry Hopkins with the notion that blasting the German ball bearing industry "would probably wreck all German industry."[9]

At the top of the Allies' bombing priority list stood ball bearings, without which, they reckoned, German machinery would, quite literally, grind to a halt. As the authors of the Strategic Bombing Survey put it,

> On the afternoon of the 17th of August 1943 some 200 Flying Fortresses, flying from their bases in England deep into Bavaria and unescorted after reaching the German border, struck the first great blow aimed at the complete destruction of an entire and essential segment of the German war economy.[10]

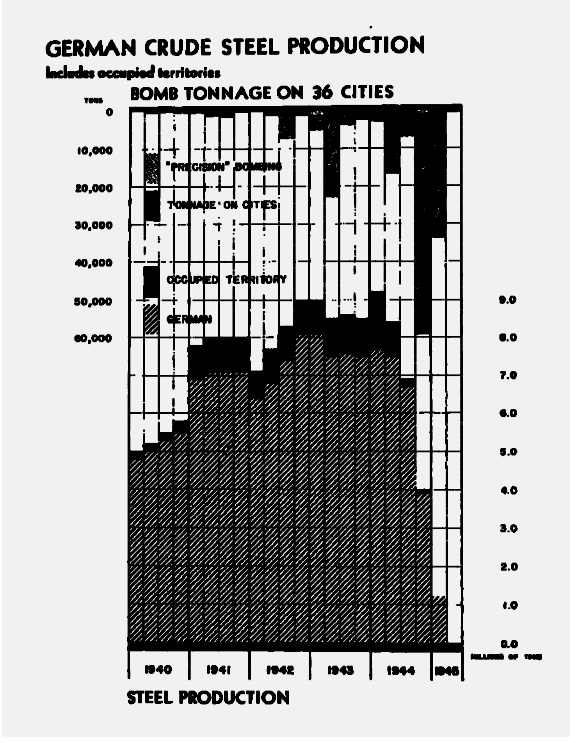
Some 52 percent of German bearing production lay in an enormous factory complex at Schweinfurt. U.S. Army Air Force planes hit the



city with some four hundred tons of bombs, while the Germans struck down thirty-six of the attackers. The raids continued, with some eleven thousand tons of bombs dropped, the most destructive of which took place on 14 October 1943. Again, over two hundred planes descended on the plant, letting loose 450 tons of high explosives and incendiaries, destroying 10 percent of the machinery, 20 percent of the stock, and 350,000 square feet of plant. German anti–aircraft batteries and fighters shot down an even greater number of planes than on the earlier big raid, killing some six hundred airmen. As a direct result of that attack, Speer, near panic, put his closest associate, Philip Kessler, in charge of protecting and dispersing the bearing industry. By August 1944, when the Allies flew an eight-hundred-plane raid against Schweinfurt, half the factory was elsewhere.[11] Having faced this barrage, the Germans bragged at war's end, "Es ist kein Geraet zurueck geblieben weil Waelzlager fehlten." (No equipment was left behind because bearings were lacking.) American analysts ought to take the lesson to heart, the authors of the Strategic Bombing Survey insisted, "even in the case of a very concentrated industry very heavy and continuous attack must be made, since otherwise the enemy, if he can survive the initial shock, will be able to take successful countermeasures."[12]

These target categories, airframes and bearings, were supposed to have choked the German war-making capacity. Both, after a frantic dispersal, lost the vulnerability that the Americans expected. Consequently, starting in spring 1944, Allied strategy broadened, in large measure because, by then, they had air superiority over the entirety of Germany. Planners began to plot two new "bottlenecks" to squeeze shut. First, the operations analysts began directing airplanes against the synthetic oil industry—that is, oil produced with the massive coal deposits of the Ruhr. They hit the steel industry hard and drove massive missions against chemical plants. By doing so, they aimed simultaneously to damage the German home economy and to cripple rolling armor at the front.

While reporting successful "bottleneck" attacks, such as the campaign against oil, the report itself was, in essence, doing its own reconstruction of the German economy—and its authors did not hesitate to point out where the original planners had failed to find a vulnerable point. For example, they lamented that the combined Allied air forces let loose only 0.5 percent of their bomb load on the electrical industry even though the



Opposite: Bombs dropped on German bearing targets. Source: USSBS.

Left: German crude steel production. Source: USSBS.

Germans themselves (as Speer later asserted) were terrified of an engulfing Allied drive against German generating stations. Power plants were concentrated in a limited number of locations, generators could not stockpile their electrical product, and the Germans had a terrible time repairing damaged power stations. Perusing captured documents, the Strategic Bombing Survey authors reported,

> The secret minutes of the central planning committee, studying the power shortage, make this weakness clear. The difficulties of adding capacity, the limitations of the so-called grid system, the relationship of curtailment and shortage of electric energy to production losses in industry, and their fears that their extreme vulnerability would be discovered, are all paraded openly in these minutes made by the Germans in the midst of the war.[13]

Hitting forty-five plants would have been dangerous for Germany as a whole—a result they justified by testimony from Speer himself. And these plants, unlike much else, could not be dispersed. Similarly, "a major opportunity in the Allied air offensive against oil was unexploited" in that the production of ethyl fluid was crucial for aviation fuel, and ethyl fluid required tertraethyl lead. There were only two tetraethyl lead plants in Germany. These, the report insisted, should have been hit.[14] Or again, "concentration on the few synthetic rubber plants as a primary bombing target early in the war would have proven profitable."[15]

Again and again, the bomb analysts repeated their message: Aerial warfare worked when it hit concentrated, centralized production standing at a functional node, upstream of many other industries. Bombing failed when the Germans effectively dispersed their factories. Separation in space worked exceedingly well in other sectors. Beginning in 1934, the Nazis had already scattered their explosive and propellant plants, but only in 1944 had they launched (rather unsuccessful) attempts to decentralize plants producing nitrogen (needed for gunpowder) and methanol (crucial for high explosives).[16] Similarly, Speer and his most valued lieutenant, Edmund Geilenberg, scrambled desperately in the final months of the war to disperse J-2 jet fuel for their last-ditch attempt to stem air losses with their new wonder weapon, the jet fighter.

2. The Bombsight Mirror

While they were assessing the air war against Nazi Germany, the Strategic Bombing Survey analysts had under way a massive inquiry into the assault on Japan. Without reviewing the bulk of their study of conventional bombing, I want to turn to the report they filed on the atomic attacks on Hiroshima and Nagasaki. That text chronicles the horrific

effects of the blast, separately and methodically outlining its effect on buildings and bodies by pressure, heat, and radiation. Taking the testimony of hundreds of survivors, the analysts asked about morale, inquired about feelings of rebellion toward the government, about attitudes toward the United States. The bomb surveyors even, if briefly, explored the effect of the nuclear devastation on internal, high-level Japanese deliberations about the future of the war.

Suddenly, in the concluding section of the report, the authors took a different tack, and the tone changed. Gone was the absolute distance the surveyors had managed to maintain toward industrial targets, cities, and military objectives. All at once the weapons dropped on an enemy just months before began to appear in an inverted vision in which those same weapons appeared turned against the United States:

> The Survey's investigators, as they proceeded about their study, found an insistent question framing itself in their minds: "What if the target for the bomb had been an American city?" True, the primary mission of the Survey was to ascertain the facts just summarized. But conclusions as to the meaning of those facts, for citizens of the United States, forced themselves almost inescapably on the men who examined thoughtfully the remains of Hiroshima and Nagasaki.[17]

Sifting the rubble, interviewing the wounded survivors, the Bombing Survey investigators began to see similarities between Japanese buildings and American ones, between surviving structures at Hiroshima and possible shelters in the United States. They made it clear in print that they thought the two nuclear-devastated sites were the best argument against war itself, but they also began to speculate on how Americans might survive the kinds of attacks they themselves had just visited on the Japanese:

> The fate of industries in both cities again illustrates the value of decentralization. All major factories in Hiroshima were on the periphery of the city—and escaped serious damage; at Nagasaki, plants and dockyards at the southern end of the city were merely intact, but those in the valley where the bomb exploded were seriously damaged.[18]

Medical facilities, typically located in the central parts of the cities, lay in smoldering ruins. So it had been in Hamburg, where survivors of the raids had lain in shock, without assistance, in their hours of greatest need.

Looking at Hiroshima, Nagasaki, and Hamburg, Survey personnel began to see their own large cities. Already, in 1946, they pressed for a dramatic shift in the way those cities were conceived:

> The similar peril of American cities and the extent to which wise zoning has diminished it differ from city to city. Though a reshaping and partial dispersal of the national centers of activity are drastic and difficult measures, they represent a social and military ideal toward which very practical steps can be taken once the policy has been laid down.[19]

Efforts toward decentralization remained desultory during 1947. But already, Congress had ordered the National Security Resources Board to begin exploring industrial relocation. Abruptly, in the summer of 1949, the laissez-faire mood ended. For it was in August that the Russians detonated their first atomic bomb, named, by the West, Joe 1. Despite nearly four years of warning that the Russians would probably have nuclear weapons within five years of the Trinity test, American policy experts, politicians, military officers, and atomic scientists reacted with an alarm bordering on panic. Called to offer a response to the Russian bomb, in October 1949 the General Advisory Committee (GAC) under J. Robert Oppenheimer convened, only to harden their resistance to further escalation of the arms race. In a surprising and unanimous vote, the GAC recommended *against* building the hydrogen bomb, on moral grounds. A weapon of genocide, they asserted; an "evil under light." It was that anti-H-bomb decision, soon ratified by the Atomic Energy Commissioners, that sent a fissure straight down the center of a community of scientists grown close-knit during the war.

The GAC's H-bomb report catalyzed a swift, hard struggle between opponents and proponents of this new category of weapon. Lobbying began in secret—and then burst into the public arena after a congressional leak. Editorials in newspapers, magazines, and television erupted on both sides, with debate continuing all the way up to President Harry S. Truman's decision in January 1950: The country would, in fact, build the hydrogen bomb. In June 1950, the Korean War began—mobilization, industrial and military, heightened as never before, and the government inaugurated a still-continuing national commitment to a huge military establishment.

It was in this context that in August 1951, the president announced a national policy for industrial dispersion, and the National Security Resources Board quickly followed with a booklet entitled *Is Your Plant a Target?* that proclaimed, "The risk of an all-out atomic attack on the United States grows greater each day, since we are no longer the sole possessor of the secret of the atomic bomb. This means that no industrial area in the Nation can be considered safe from attack."[20] To guarantee survival, the National Security Resources Board insisted, would require that productive capacity be protected: "The dispersion (or

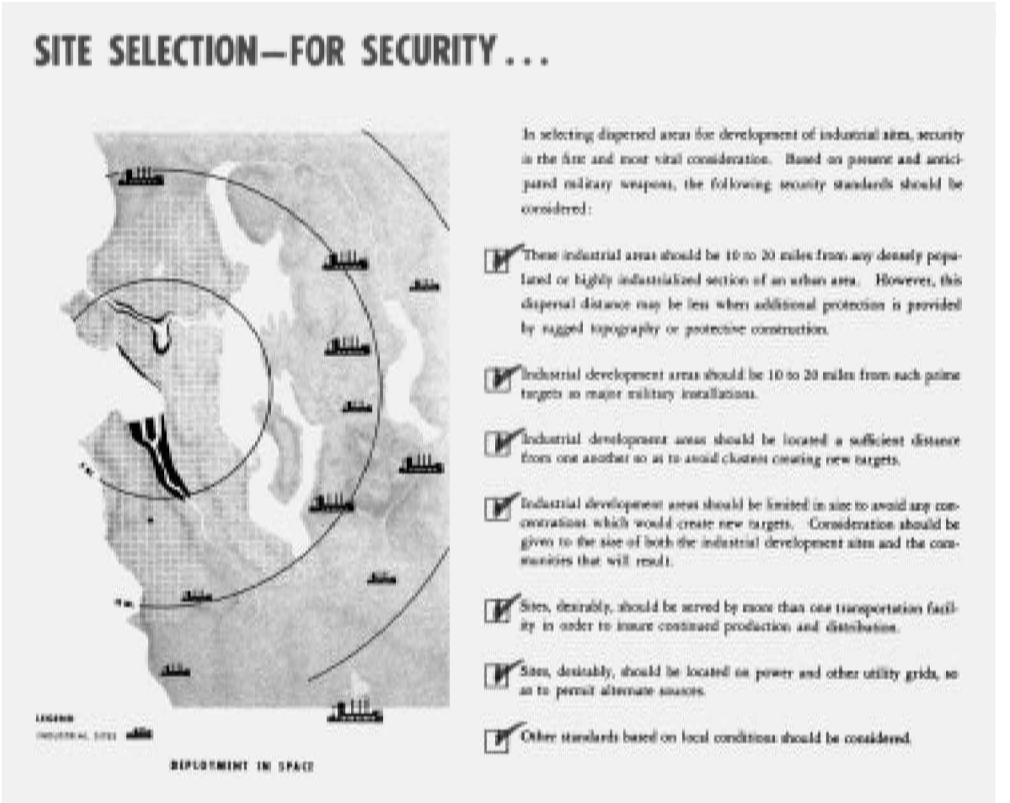
Site selection for security. Source: Industrial Dispersion, National Security Resources Board, Is Your Plant a Target? **(Washington, D.C.: U.S. Government Printing Office, 1951).**

deployment in space) of *new* plant development for war-supporting industries can make American production less vulnerable to attack." Space could protect men at the battlefield, the authors continued, and space, by multiplying targets, would diminish "the vulnerability of any one concentration."

Behind this national program lay four principles: First, the dispersion would be of new industries rather than old; second, "no region of the country is to be built up at the expense of another"; third, the dispersion would take place within so-called "marketing areas"; and fourth, state and local governments with private industry would initiate the change, and the federal government would encourage and provide technical guidance.

To tempt industrialists, the Feds advertised additional benefits that would accrue to those industries that dispersed: better working and living conditions for workers, greater production by avoiding urban congestion, a healthier, more stable economy. Adding further, quite material sweeteners to the mix, the federal government promised to allocate "certificates of necessity," critical materials, emergency loans, and defense contracts to those industries that escaped the confines of urban concentration. Reading the booklet, the industrialist and the civic leader could begin asking themselves these questions:

> The handy cow pasture on the edge of town may look like a good site, but does it measure up to the all-important security standards? Is it strategically located in relation to labor supply, fuel, transportation, and other requirements for efficient and econom-



> ical production? Is the site properly located in relation to future homes, shops, schools, and other community developments? Has full consideration been given to . . . efficient wartime production and long-term benefits to industry and community? . . . When you have answered these questions, you are on the way to developing a sound industrial dispersion program.[21]

Industrialists swarmed toward Washington to assess the new plans.

Gathered under the auspices of the Executive Office of the President, the National Security Resources Board assembled the key players on 7 September 1951 in the Executive Office Building in Washington, D.C.

Jack Small, chairman of the Munitions Board, told the assembled that he was more scared now than when he came down to Washington some nine months earlier:

> In the intervening time that God has given us we have made progress in the production of weapons, getting new weapons made and creating a force strength, but we are not yet ready and we are in really desperate danger in the event that our enemy attacks. . . . For God's sake, don't get the idea that this thing is over or that the danger has finished or that these fanatic enemies of ours have changed their plans or objectives one iota. They have not. . . . We will have achieved by next year a posture of more strength . . . but still it will not be enough strength to prevent aggression.

The "all-out" could come at any moment, Small insisted to the industrialists, and it could come by intention or by accident. There was only one hope: "Space is the one thing that really works."[22]

Soon, however, the discussion turned away from plutonium and toward profits. How, queried the representatives from Alabama and Louisiana, might this dispersion bring industry to their areas and away from the Northeast, which already had such access to the federal silver spoon? Industrialists wondered aloud how much federal force-feeding there would be, and the officials reassured them that they intended in no way to damage business interests, lower productivity, or threaten a loss of labor supply. This was to be dispersion within a marketing area—not wholesale relocation to distant states.

Small and his colleagues in dispersion left the audience with somewhat vague injunctions. But the national policy did vastly more; it aimed to make citizens of every community into target analysts of their own region: As the Bureau of Commerce patiently explained, "materials and methods for identifying the potential target areas are described on the following pages."[23] Those "potential target areas"

were the cities and towns of the United States.

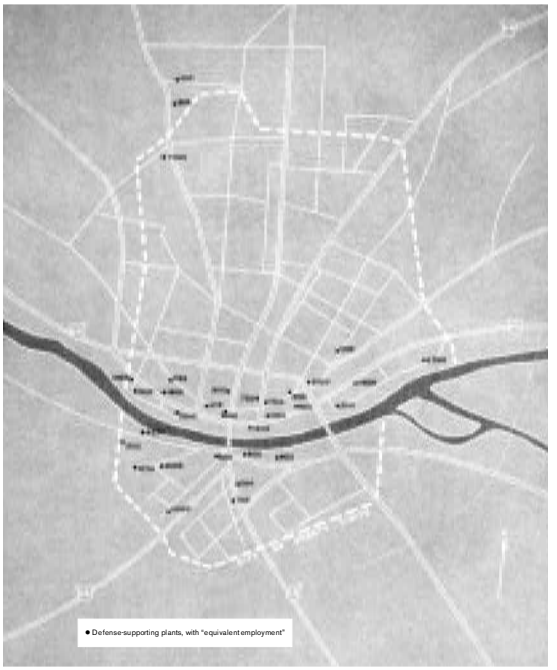
Here is how the Commerce Department directed every community, but especially the top 168 metropolitan areas, to proceed. First, check the list of industrial classifications and identify all those plants employing more than one hundred workers per peak shift. These ran from industrial inorganic chemicals, coke, and byproducts to steel mills, engines, aircraft, scientific instruments, photographic equipment, and ordnance. Then identify those locations on a map (naturally not disclosing the precise role of any single plant to unwanted eyes). Combine this information with outlines of heavily populated sections, following the information of the Census Bureau. Lay out two large maps (one inch equals one mile) showing political subdivisions, arterial highways, railroads, ports, and harbors alongside industrial areas. Next draw a series of four-inch (four-mile) circles on transparent overlays—these correspond to the area destroyed by an atomic bomb.

Now you are ready to identify your region's target zones, "those areas that contain sufficient concentrations of industry or population so as to constitute attractive atom-bomb targets."[24] Just "attractive atom-bomb targets," not sites "likely to be targeted by the Russians"—the reified shorthand compresses all those years of wartime and then postwar targeting. Your goal in what follows is to use these circles to form a target out of the city as a whole by transecting the four-mile-diameter circles once they are judiciously located. In particular, the full target will contain both valuable defense-related industries (employing 16,000 workers in toto) or a residential population of 200,000 people.

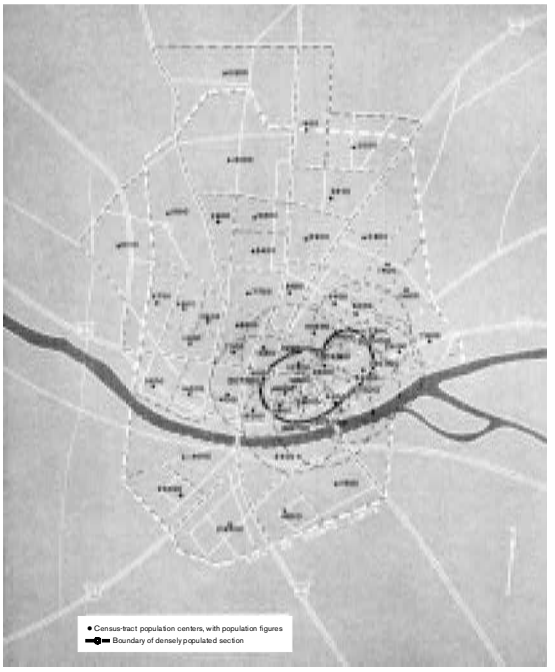
Here is the schematic procedure:

This region, outlined by the dark line, encloses the "highly industrialized section" as defined by the National Industrial Dispersion Program. Next each community is to plot the census tracts on the second set of working maps. At the center of each tract goes a dot and the population. Again you overlay a four-mile transparent circle, moving it until it circles a population of 200,000. When you connect the centers of these 200,000-person circles you have formed a "densely populated section." Next, join the two maps in such a way as to form a combined area embracing the high density of regions of both industry and population. This joint region, the Commerce Department declared, would be known as a *potential A-bomb target zone*. From that zone, measure ten inches (ten miles) out to form the dispersal limit line. There is your goal: Locate all future critical industry and its associated populations past the line of safety, taking care not to create inadvertently a secondary potential A-bomb target zone.

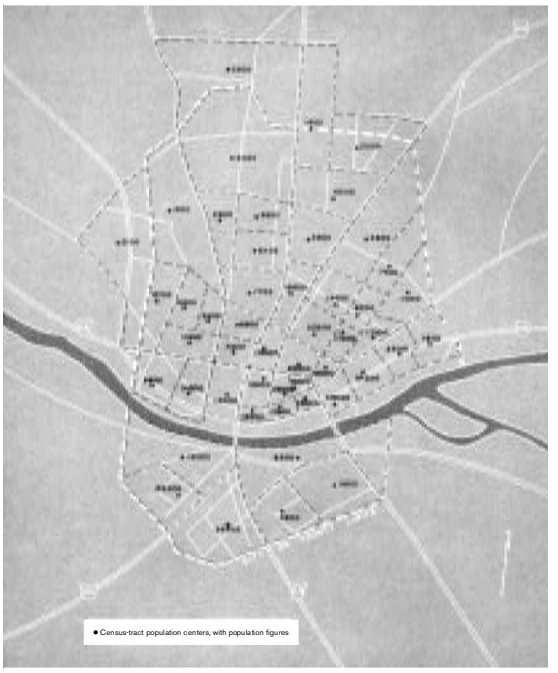
These maps were not designed just to scare; they would form, with a factory proposal, an application for a "certificate of necessity" (granting

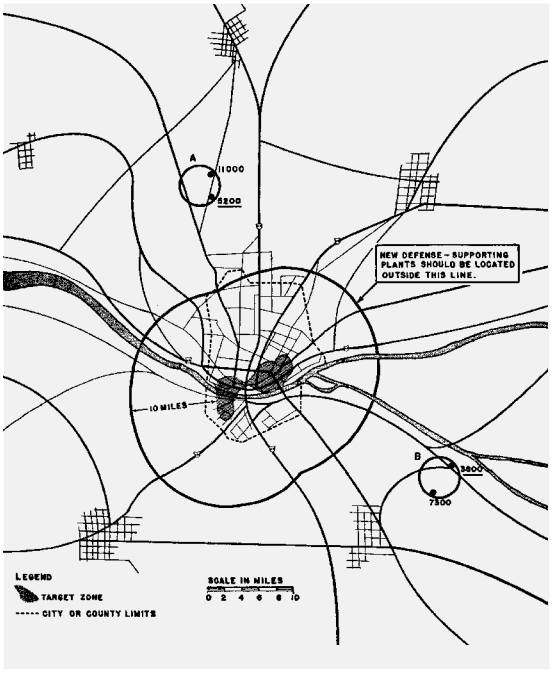

● Defense-supporting plants, with "equivalent employment"


● Defense-supporting plants, with "equivalent employment"
Boundary of highly industrialized section


● Census-tract population centers, with population figures
Boundary of densely populated section


Boundary of densely populated section
Boundary of highly industrialized section





Top row, left to right:
Self-targeting, step I: Take the list of government designated defense-related industries and plot their location and employment. This is the first task towards the construction of areas known as the highly industrialized sections. **Source: U.S. Department of Commerce,** Industrial Dispersion Guidebook for Communities, **Domestic Commerce Series no. 31 (Washington, D.C.: U.S. Government Printing Office, 1952).**

Self-targeting, step II: To complete the construction of the perimeter of the highly industrialized sections, draw circles of four-mile radius, connect centers of circles containing more than 16,000 workers. Source: Industrial Dispersion Guidebook.

Self-targeting, step III: Label populations from census tracts. Source: Industrial Dispersion Guidebook.

Bottom row, left to right:
Self-targeting, step IV: To complete the construction of the densely populated sections, draw circles of four-mile radius and connect the centers of circles with more than 200,000 inhabitants. Source: Industrial Dispersion Guidebook.

Self-targeting, step V: Now superimpose the highly industrialized area on the densely populated area. Taken together they form the potential A-bomb Target zone. **Source:** Industrial Dispersion Guidebook.

Self-targeting, step VI: Drawing the potential A-bomb target zone on a regional map, planners should now construct a safety margin of ten miles from the outside of the endangered area. All new industrial plants should be dispersed outside this ten-mile radius. Source: Industrial Dispersion Guidebook.

accelerated tax amortization), facilitating the approval of defense loans, and securing defense contracts.

Bombing the Axis economy and dispersing the American one were reflections of one another. When Charles E. Wilson, director of the Office of Defense Mobilization, came before the National Security Resources Board of the President's Executive Office, he needed an expert on how to disperse industry. To the captains of industry assembled for a 1951 hearing, Wilson sought to justify his strictures about splitting plants by ten or twenty miles. "Mr. Gorrie brought me a real expert on that. I call him a real expert because he was one of the men who had done bombing in the industrial arena of Germany, and certainly he convinced me that 10 or 20 miles provides reasonable safety."[25] Bombers braced for bombs.

In 1952, Project East River (Associated Universities contracted to the federal government) reported on how Washington could drive industry outside the expanding urban areas, "leapfrogging" away from urban cores. One role was to create "public understanding" of the need for "satellite town" planning and its defense use. More materially, the East River gang reported, the federal government should provide aid to assist in the construction of urban arteries to the satellite towns, provide rent subsidies to small businesses, send appropriations to match metropolitan planning units, offer tax assistance for new construction in outlying areas, demand dispersal to qualify for federal defense insurance, and promote federal loans and grants for the construction of outlying schools, streets, water, and sewers. The government should subsidize ring roads around cities—like Route 128 around Boston—and strive to locate defense industry on it. Above all, the fast-increasing population, office building, and industry heading into cities had to be reversed. Throughout: constant vigilance against the re-creation of new centers.[26]

Eponymously, the report took as its "area study" the imagined case of a Hiroshima-scale nuclear weapon detonated several thousand feet above a 260-acre rectangle in Manhattan adjacent to the East River. With detailed information about the age, structure, and flammability of individual buildings—and recent census data—this not-so-typical piece of America could then be tracked as it shattered and burned under the assault of nuclear attack. How many of the 35,000 people residing between 59th and 72nd Streets (between 3rd Avenue and the river) would become casualties if a weapon were to be exploded at 2 A.M.? How many minutes' warning would they have to take shelter? How much radiation would they receive? Would a firestorm erupt? Based principally on the results of the U.S. Strategic Bombing Survey on Hiroshima and Nagasaki, this report was, in a sense, a dully terrifying

answer to the question the Bombing Survey had posed seven years earlier. What would the bombs that were let loose over Hiroshima have looked like were they to have been dropped back home?[27]

Under the guidance of these various boards and the lucrative draw of taxes, loans, and contracts, one by one, key industrial and civic leaders learned to see themselves through the reflection of a bombsight. One by one, they began plotting their own dispersion. In September 1955, for example, the *Chemical and Engineering News* reported on atomic vulnerability in the chemical process industry. Nuclear weapons, jet airplanes, and the concept of total war combined, wrote Neil P. Hurley, S.J., to blur the distinction between military force and industrial potential. The role of an industry—its functional interdependence on other industries—fixed the likelihood of its plants becoming targets. Chemical-process industries were vulnerable on two fronts: geographic concentration and functional criticality. The conclusion was as inevitable as it was fearsome: "Three well-directed H-bombs on these key target areas would have serious consequences for the industrial chemical producing complex."[28] Two-thirds of workers making industrial chemicals lived in ten states.

American chemical dispersion in 1955 was directly and explicitly linked to German chemical dispersion in 1945. Over and over again, Hurley cited the Strategic Bombing Survey: "It is worth noting that antifriction bearings represented an Achilles heel in the German economy in World War II. The Strategic Bombing Survey indicated a paralysis of German industry following Allied air force bombings of Schweinfurt where more than 50% of German antifriction bearings were produced." Four H-bombs, for example, could wipe out half the U.S. capacity to produce instruments and related products. "Unfortunately, the U.S. has many Schweinfurts. In the Great Lakes region . . . are to be found 47% of the nonelectrical machinery production." A saturation attack on that region—and saturation would not take many bombs—would, Hurley noted, destroy a vast array of industries, including that of chemicals.[29]

Throughout the 1950s, the Strategic Bombing Survey remained central to thinking about nuclear warfare and the dispersion of industry. Hurley, for example, in constructing his report on American chemical priorities, reproduced the Survey's list of the ten most vital chemicals for the German war effort, from nitrogen, methanol, and calcium carbide down to caustic soda, chlorine, and sodium carbonate. He recapitulated the Survey's conclusions about the shortages of nitric acid on the manufacture of explosives, the reduction of methanol that cut into the making of high explosives, and the Germans' vain, last-ditch efforts to create underground factories. In this new narrative, Americans

played the role previously performed by Germans; Russians took over the bombing role from the Allies. Those who had used their knowledge of American industry had planned the strategic bombing of the Axis; now they became the potential bombing victims readying plans to disperse. Here is Hurley:

> To avoid a repetition in this country of the unfortunate experiences of the Germans during World War II, necessary moves must be made before any outbreak of hostilities. The Germans enjoyed the luxury of learning from their mistakes. It is highly doubtful whether in the atomic age any nation will have the same opportunity—one mistake may well be the last.[30]

Dispersal could aid in reconstruction and also prevention—a stronger nation "protected in space" (as the phrase went) would deter any attacker.

Admiral Ben Moreell, retired from the Navy and in the mid-1950s chairman of Jones & Laughlin Steel Corporation, had just presented to the secretary of commerce the manifesto of the purposes of the Iron and Steel Advisory Council. The council had urged a mobilization plan for steel in light of the threat presented by high-speed jet airplanes, long-range missiles, and nuclear weapons that "our prospective enemy" might, at any time, hurl without warning. Big steel needed a complete control center, one linked by telegraph and radio to the steelmaking plants. Admiral Moreell and his fellow advisers emphasized the proximate danger of Russians with H-bombs, and in fact, as Moreell noted, they had one just a few days after his committee laid its report at Commerce. Worriedly, the admiral allowed that 75 percent of American steelmaking capacity could be destroyed by a mere ten hydrogen bombs. The council's recommendation: disperse 25 percent of the capacity in such a way that the resulting plants would be split up into numerous single-function plants, providing each plant with at least three alternative modes for transporting its products. It was time, Moreell intoned, to take similar measures in a host of other industries, including rubber, copper, glass, aluminum, textiles, automobiles, and electrical products. Prepare for real costs: for steel alone, the dispersion bill would run to some $10 billion.

Moreell: "Perhaps I have overemphasized the hazard under which we now live. I do not believe so. The facts which are coming out with respect to the tactics and policies of the Communist enemy in China and Korea, added to what we already know about them, justify the conclusion that we are facing a ruthless adversary who will permit no humane consideration to influence his decisions, who will strike without prior warning, and whose ambition is to rule the world."[31] Dispersion might help, the admiral concluded. Like so much of this lit-

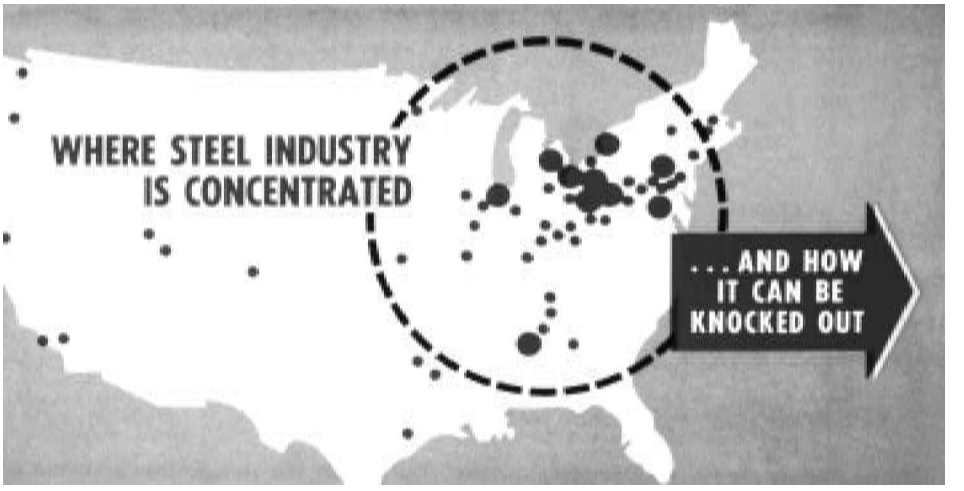
Opposite, top: Where the steel industry is concentrated. Source: Admiral Ben Moreell, "What the H-Bomb Can Do to U.S. Industries," U.S. News and World Report, **7 May 1954.**

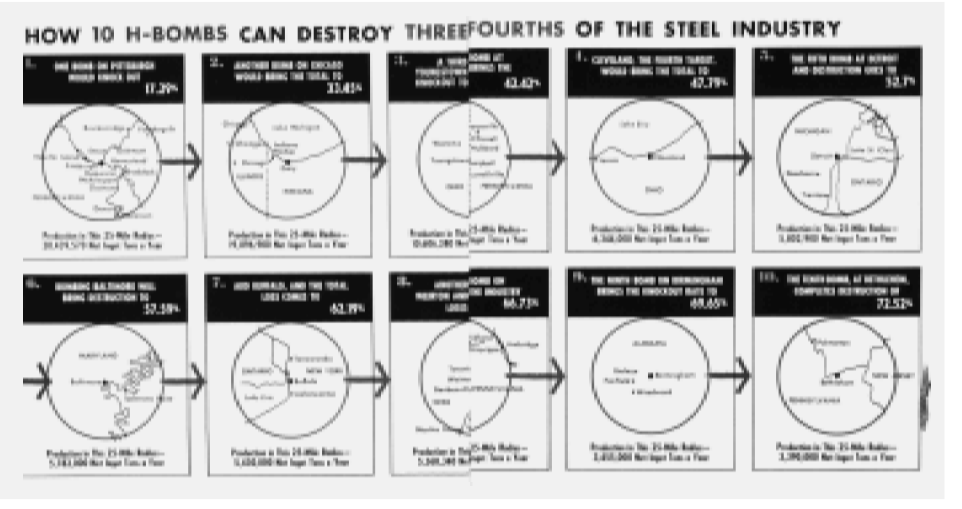
Opposite, bottom: Destroying steel. Source: Moreell, "What the H-Bomb Can Do to U.S. Industries."

erature, issues of profitability and patriotism stood side by side, and he concluded, under the flag, gesturing to the Founding Father, "In time of peace, prepare for war."

Preparations advanced. In 1956, *Industrial Development,* a national magazine dedicated to "area analysis and business site selection," reported that the Office of Area Development had reviewed and approved some fifty-eight of the self-prepared urban area surveys. Money talked. By mid-June 1955, projects valued at $30 billion had qualified for tax abatements under the program.

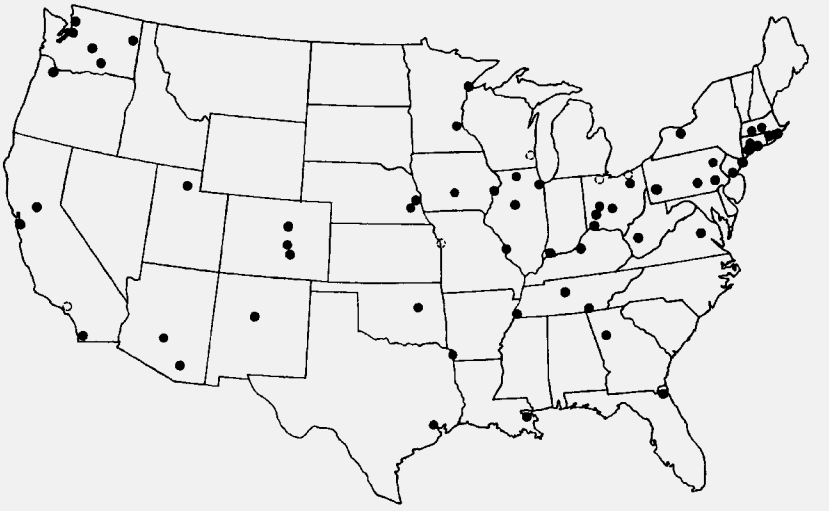
Take Milwaukee. In December 1953, the city's mayor, Frank Zeidler, traveled to the White House where the president addressed some two hundred large-city mayors in stark terms: "For the first time in history, cities have become principal targets for an enemy seeking to conquer our nation. The city has moved from a position of support in the rear. It has moved out . . . into the front line." Immediately, Zeidler arranged to meet with the Wisconsin governor and the mayors of Racine, Madison, and Green. Joining the chorus of civil defense authorities, the mayors agreed that in the short term they would need plans for rapid evacuation in the event of a nuclear attack; at the same time, they needed to begin longer-term planning for the dispersal of the city. By





May 1954, Milwaukee had its report: "New building in the core of an urban target [ought to] be prohibited except when it replaces existing structures. This is intended to halt the pouring of greater target values into areas which are already richly rewarding as targets." Spreading industry wasn't all that the report advocated. The new region would need new school districts, novel tax structures, and alternative types of local governments. Zoning would force dispersal from the center, institute bands of open space, and deliver industrial plants to hinterlands deliberately bypassed by major radial or circumferential roads in order to avoid creating secondary concentrations. "There is little doubt," the report's author reckoned, "that some of [these] measures would have to be fought through the Supreme Court before they were accepted by all."[32] Pressed by national codes, taxes, defense spending, and imprecations by the president on down, local and federal authorities competed to outdo the other in the rush away from the targeted center.

America was not alone in declaring war on the urban center. Canada, in the midst of a major effort to plan urban growth in 1956, also began defensive dispersal. The Office of the Civil Defence Coordinator, in collaboration with the Defence Research Board and McGill University, prepared a *Guide to Urban Dispersal*. "Dispersal is the characteristic of present day urban growth," the authors asserted. Satellite towns and villages made urban regions the right scale on which to re-think patterns of communication, government, and demography. "Defence is critical. In modern warfare the initial blow is struck at the civilian population, to destroy at a stroke the ability to resist. The greatest vulnerability lies in urban concentration—the greatest security would be achieved by urban dispersal." That dispersal would follow a survey of a ring located an H-bomb radius away from the regional center. That is



Solid circles show cities where dispersal plans have been approved. Dotted circles show communities where plans were being prepared in late 1955.

INDUSTRIAL DISPERSAL, 1956*

where the *Guide* came in. Based in part on a real area and in part on generic characteristics, the book was a how-to manual for planning the scattering of the urban into the regional. Slope of the land, location of water, avenues of communication, and transport needs all had to be reckoned. The *Guide* instructed local leaders and planners how to diagram all this for their future. Satellite towns would perch outside the ring of safety—towns that under no circumstances ought to attract more than forty thousand inhabitants. Ultimately, government-propelled "urban regions" would replace the "amorphous form" of current metropolitan development, alleviating social and economic problems while securing spatial defense against thermonuclear attack.[33] City by city, country by country, the bomb helped drive dispersion. Indeed, coming full circle, the Germans, already all too familiar with aerial bombardment, began preparing for a rain of hydrogen bombs. Hannover, Bremen, and Düsseldorf issued the first three analyses, and others would follow. Their comprehensive treatments covered the status of police, fire, hospital, postal service, and road service following a nuclear attack.[34]

Preparation for atomic war was certainly on President Dwight D. Eisenhower's mind as he strove to resuscitate the long-debated federal highway system. Franklin D. Roosevelt had pushed the idea in the 1930s, not least for its promise of providing jobs. Reports rolled in. The Bureau of Public Roads undertook one in 1938, and the chairman of that organization presided over another, called *Interregional Highways,* dated 1943. Other reports and standards marched on through the war, with some actually leading to road building—in 1947, crews began cutting the first miles of interstate highways. Still, by the time Eisenhower came into office in January 1953, there were but six thousand or so miles of road improvements actually on the ground (at a cost of nearly $1 billion).

Eisenhower liked highways. He had struggled across the country in a motorized convoy back in 1919, an unpleasant sixty-two days of slipping on ice, sticking in mud, breaking into wooden bridges, and freezing under snow. The contrast with Germany was stark. As Supreme Commander, General Eisenhower had been astonished by the autobahns, taking particular note of the advantages that road system afforded as he had to move masses of men and matériel across the conquered Reich: "Germany . . . made me see the wisdom of broader ribbons across the land." On July 12, 1954, Vice President Richard Nixon, facing the conference of state governors at Lake George, New York, read from Eisenhower's prepared speech, and the message was clear: The obsolete network had to go; its antiquated byways were clogging the roads and courts while leaving a death toll on the citizenry comparable to

Industrial dispersal, 1956. Solid circles show cities where dispersal plans were approved by late 1955; dotted circles indicate communities where plans were under preparation. Source: Theodore K. Pasma, "Industrial Dispersal, 1956," Industrial Development: The National Magazine of Area Analysis and Business Site Selection **(January-February 1956).**

"a bloody war." But Eisenhower's final jab at the current system was stark, holding up for public contemplation its "appalling inadequacies to meet the demands of catastrophe or defense, should an atomic war come."[35] Radial roads would afford clear routes for city evacuation. Circumferential roads, Project East River had recommended back in 1952, should be encouraged wherever possible to drain industry and population from the dense city centers.[36] In fact, highway designers consulted with federal civil defense agencies, and military planners aimed for interstate highways that would bypass urban areas to avoid "route[s] that had suffered a direct A-bomb hit."[37] It took two years of political wrangling, and it goes without saying that economic, housing, and non-nuclear forces for the interstate were surely among its powerful motors. By the end of 1956, the Interstate and Defense Highway System had funding—some $25 billion of federal support.[38]

3. Distributed Knowledge

By 1960, the Air Force began dreaming worse nightmares than nuke-laden bombers bullying their way past fighter defense: Atomic strikes against the continental United States could be launched with missiles for which range of flight was no longer an issue. The RAND Corporation made its mark with contracts to think about this thermonuclear threat; from the new think tank issued shelves of studies, including the famous (and famously parodied) volume by Herman Kahn, *On Thermonuclear War*. Just as Kahn stepped into the limelight, the much less well known Paul Baran, an electrical engineer coming from Hughes Aircraft Company's systems group, joined RAND. His job was to develop a scheme that would ensure the survival of the U.S. telecommunications infrastructure through a Russian first strike—a vital link not only for domestic communication, but also for command and control. His response, in a series of papers launched in 1960, was a plan to remove, completely, critical nodes from the telephone system. Like the three highways many wanted from each dispersed defense plant, Baran's vision aimed for safety in redundantly connected, spatially distributed mini-centers.

Here is how Baran put it in one of his first papers:

> The cloud-of-doom attitude that nuclear war spells the end of the earth is slowly lifting from the minds of the many. Better quantitative estimates of post-attack destruction together with a less emotional discussion of the alternatives may mark the end of the "what the hell—what's the use?" era. A new view emerges: the possibility of a war exists but there is much that can be done to minimize the consequences.

Definition of redundancy. Paul Baran, "On Distributed Communications: I. Introduction to Distributed Communications Network," RAND Corporation memorandum RM-3420-PR, August 1964.

Survivable atomic war—the goal of the fifteen-year struggle since the Survey crew picked through the still radioactive rubble at Hiroshima. Baran again:

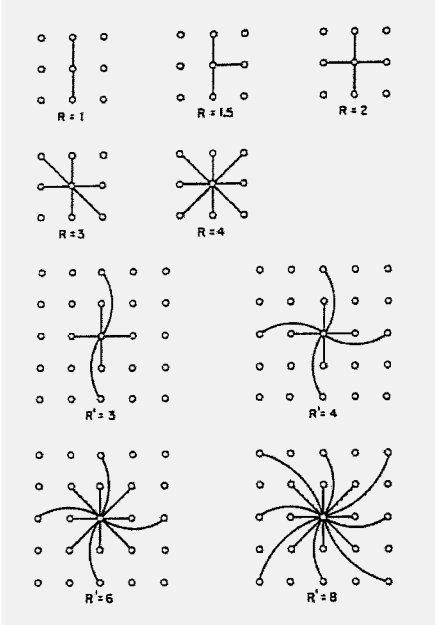
> If war does not mean the end of the earth in a black and white manner, then it follows that we should do those things that make the shade of gray as light as possible: to plan now to minimize potential destruction and to do all those things necessary to permit the survivors of the holocaust to shuck their ashes and reconstruct the economy swiftly.[39]

That reconstruction demanded the elimination of the hierarchical center, alternately referred to over these first decades of the cold war as the linchpin, the bottleneck, and the node.

The problem, as Baran formulated it, did involve new equipment to label, digitally, each packet of information with a "to" and "from" and then to route these fragments over diverse paths toward their eventual reassembly on arrival. But before anything could be built, moved, digitized, or reinforced, the conceptual problem required attention. That reconceptualization now took, as it had not before, a mathematical form: If nodes were replaced with redundant links, how could he exploit the information-theoretic approach of Claude Shannon to count the surviving paths between points in the array?

Here is how Baran reasoned:

> Let us consider the synthesis of a communication network which will allow several hundred major communications stations to talk with one another after an enemy attack. As a criterion of survivability we elect to use the percentage of stations both surviving the physical attack and remaining in electrical connection with the largest single group of surviving stations. This criterion is chosen as a conservative measure of the ability of the surviving stations to operate together as a coherent entity after the attack.[40]



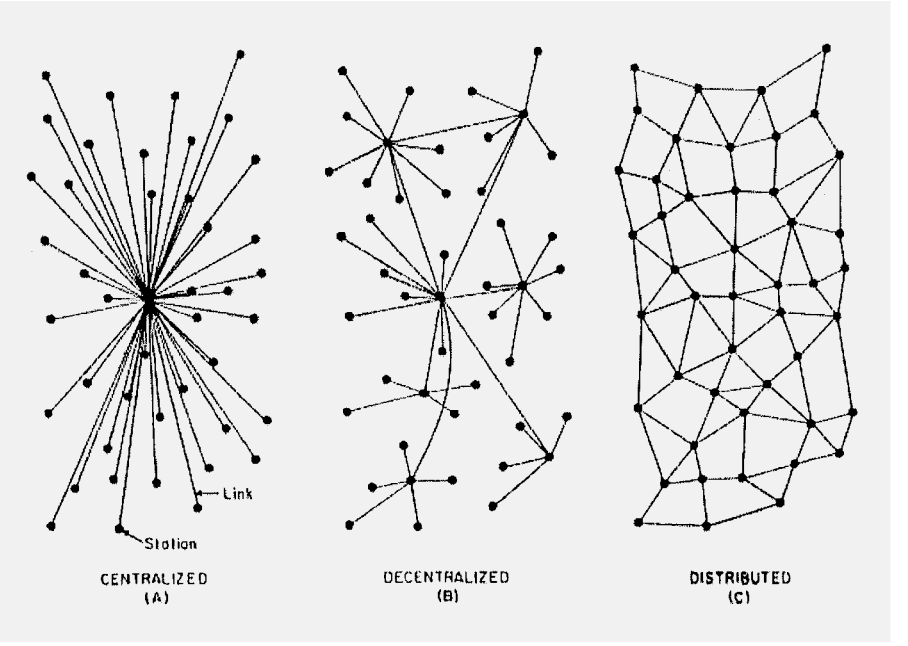
With the result that a redundancy of at least R = 3 would ensure a likely survival rate of nearly 75 percent, Baran could now sketch the distributed system that would vouchsafe communication after nuclear war.

Worst, obviously, was the centralized node that represented the single, critical target. This was the situation with concentrated steel, electricity, or oil plants; it was the structure of the hubbed railway system. It was, in short, the bombing planner's dream and the bombing victim's nightmare. Decentralized nodes that maintained a local hierarchical structure were clearly better;

a complete grid structure was best of all. To a certain extent, such grids stood for the defensive ideal of dispersion more generally. By increasing the number of targets, one decreased the likelihood of incapacitation. Halting, abortive, and awkward though it was, Baran's scheme (along with a similar one developed in England) slowly wended its way through different incarnations in the ARPANET and Milnet. But the elusive goal all through these decades of distributed communication was a distributed grid or mesh, a thrust in the first instance aimed at removing the critical node. Though in the garb of nuclear survivability the grid may not appear as the redemptive Internet of our dreams, that technology grew directly out of fifteen years of longing for a world still standing after thermonuclear war.[41]

4. We Are Become Targets

During the years of World War II, American and British planners and analysts learned to see through a bombsight. Not in a single glimpse, but in the routine killings and losses that accompanied ever more frequently repeated raids. Twenty-four hours a day, day after day, month after month, year after year, the planners and analysts studied and restudied the interdependencies of the German economy, circled targets, blasted factories, leveled cities, analyzed the damage, and struck again. Chemicals: nitric acid, methanol. Basic materials: rubber, steel, oil, aviation gas. Transport systems, electrical generators. And population centers: area bombing by the combined American and British forces killed some 600,000 Germans. In a war that the Nazis rendered ever more vicious even as their defeat seemed inevitable, the Americans' early dreams of precision bombing went by the way. Two hundred planes over Schweinfurt, then four hundred; but also Hamburg, Lübeck, Münster, Berlin, Dresden, Regensburg, year after year. Measuring bomb loads, accuracies, reconstruction time: 3/5 ton of bombs per acre to induce damage of 8 percent, delay time for reconstruction, two and a



half months. A calculus of fractions, probabilities, delays.

By the war's end, a new category of analyst had come into existence, more often than not social scientists and industrialists but also humanists, diplomats, mathematicians, and natural scientists. Piecing together fragments of intelligence, examining reconnaissance photographs, they painted an elaborate portrait of a wartime foe. By war's end, the Survey analysts had come to see German and Japanese cities through what one might call a "destructive functionalism": dependencies leading backward, they kept hoping, to the ever-elusive linchpin that, when pulled, would topple the structure. Schweinfurt was supposed to be one such point with its all-important bearing factories. And after Schweinfurt there were other "bottlenecks" to be targeted, other cities, other plants, other transshipment points.

Perhaps before Hiroshima the bombsight eye had already begun to reflect back. I don't know. But in the atomic rubble, as the analysts interviewed hundreds of blast survivors and canvassed the broken structures, as they methodically noted which kinds of concrete walls still stood at various radii of destruction, they began, quite explicitly, to see themselves, to see America, through the bombardier's eye. They began to wonder what an American city would look like after the bomb had fallen. Returning to the United States and publishing their Strategic Bombing Survey, things began to look different. They began to see themselves, their towns and factories, on the crosshairs of radial targeting maps. Far from a technological determinism, the all-too material technologies and concepts of self were fully imbricated.

One thinks here of the origins of cybernetics, launched when Norbert Wiener began to think of the enemy bomber pilot as a kind of feedback machine that could be mimicked electronically; from there, it was a short step to thinking of the Allied gunner in the same way. Then human physiology began to appear as a cybernetic system, then the human mind, then life, then even the world system as a whole.[42] Somewhere in the midst of total war, a technocratic vision of a technical Enemy Other rose to become a vision of ourselves. It was but a heartbeat before cybernetics saturated the writings of Gregory Bateson and Margaret Mead, not to speak of philosophers, planners, and architects.

But the consequence was this: Three years before the Russians had the bomb, in fact before, on just about anyone's account, the cold war had begun, American analysts were already advocating a massive dispersion of factories and populations against atomic aerial attack.

As the cold war arms race accelerated, the search for "defense in space" grew more desperate: jet bombers, atomic bombs, hydrogen bombs, intercontinental ballistic missiles. With each step, more frantic urging to spread the cities into their "marketing areas." Highway systems,

Centralized, decentralized, and distributed networks. Source: Baran, "On Distributed Communications."

dispersed factories, gridded telephone links. If nuclear war could not be won, it could, perhaps, be survived—if the nodal points of the society could be broken up and scattered, redundantly, through space. Meshed satellite communities joined by an interstate and defense highway system; grids of phone nodes joined by an array of cables and radio links.

Throughout the transformation of these architectures of infrastructure, computation, highways, and factories lay the remarkable practice of training Americans to see themselves as targets. I have laid particular stress on the step-by-step procedures of laying out regulation maps, identifying critical plants, consulting the Census Bureau's assessment of population, and then circling, outlining, and tracing the perimeters of destruction. I have done so because it is a crucial part of these events that each community, each industry, each factory was pressed into service this way, pressed to *see itself this way,* rather than simply receiving a designated perimeter line drawn by the federal government. This was an enlistment, an attempt to draw localities into a frame of mind, a form of moral-cartographic vision. Factory owners who wanted the tax advantages had to attach these targeting maps to their proposals, and only by doing so would they garner the certificate of necessity they needed. An atomic imaginary joined itself to the most mundane aspects of electrical and phone lines, highway construction, and emergency preparation. A state of vigilance both proximately apocalyptic (at any moment the "all-out" could come) and yet full of the banalities of everyday business: profit margins for the long term, plans for market regions and economic tributaries.

Here stands a new, bizarre, and yet pervasive species of Lacanian mirroring. Having gone through the bomb-planning and bomb-evaluating process so many times for enemy maps of Schweinfurt, Leuna, Berlin, Hamburg, Hiroshima, Tokyo, and Nagasaki, now the familiar maps of Gary, Pittsburgh, New York City, Chicago, and Wichita began to look like them. Radii around impact sites, joined centers to form "attractive," "remunerative," and "profitable" ground zeroes. How many H-bombs to wipe out 60 percent of the chemical or steel industry? How many bombs to sever the connectivity of 30 percent of the telephone system? The micro-technology of targeting and dispersing became everyday reasoning. Duck and cover, so to speak, for the Fortune 500 and for the one hundred largest American cities. Safety in space meant avoid concentration at all costs.

Now as the politicians, planners, military, and industrial captains never tired of saying, there were other reasons to disperse away from squalid city centers. It is surely so that other forces were already driving dispersal: postwar housing shortages for returning servicemen and their families, real estate prices, racial tension, access to transport. But

the obsession with protection in space labeled and levered the process of dispersion, validated deurbanization as a patriotic duty, certified decentering national life as a bulwark of national survival, linked it with Office of Defense Mobilization, published it through industrial journals, tied it to the metropolitan planning processes, and paid for it with billions of dollars of tax rebates and zoning shortcuts.

Finally, it would be absurd to hunt in the forties and fifties for all that came to characterize the architectural scene's fascination for dispersal in the last quarter of the twentieth century: absurd because it is always possible to find antecedents for this or that cultural fragment. And yet, whatever American postmodernism came to mean at the height of the cold war in the eighties and nineties, it included the architectures of dispersion, counter-urbanization, and nonhierarchical grids. That dispersion had a legitimating logic—if one can dignify it by that term—in the pounding, repetitive process of planning, delivering, and analyzing strategic air strikes along with the destructive functionalism of economic life that accompanied it. It has been a long mirrored war against the center.

Notes

First presented to the conference "Architectures, Metaphors, Sciences," Princeton University, 3–4 November 2000.

1. See, for example, Fredric Jameson, *Postmodernism or the Cultural Logic of Late Capitalism* (Durham, N.C.: Duke University Press, 1991), 38–44; David Harvey, *The Condition of Postmodernity* (1980; reprint, Oxford: Blackwell, 1989), 76 and table 4.1, 340–41; Charles Jencks, *The Language of Post-Modern Architecture* (1977; reprint, New York: Rizzoli, 1984); and Andreas Papadakis, ed., *Postmodernism on Trial* (London: Academy Editions, 1990).

2. See, for example, www.heise.de/tp/deutsch/special/eco/6191/4.html; and http://www.usyd.edu.au/su/social/papers/liska.html.

3. Peter G. Rowe, *Making a Middle Landscape* (Cambridge: MIT Press, 1991), which also contains extensive references to the vast field of work (cultural, sociological, historical) on suburbanization.

4. David MacIsaac, *Strategic Bombing in World War II* (New York and London: Garland, 1976), 54–56.

5. Michael S. Sherry, *The Rise of American Air Power: The Creation of Armageddon* (New Haven, Conn.: Yale, 1987), 194–95.

6. U.S. Strategic Bombing Survey, *Overall Report (European War),* 30 September 1945, reprinted with an introduction by David MacIsaac (New York: Garland, 1976), vol. I, 11.

7. U.S. Strategic Bombing Survey, *Overall Report (European War),* 16.

8. Alan J. Levine, *The Strategic Bombing of Germany, 1940–1945* (Westport, Conn.: Praeger, 1992), 124–25.

9. Sherry, *The Rise of American Air Power,* 150.

10. U.S. Strategic Bombing Survey, *Overall Report (European War),* 26.

11. U.S. Strategic Bombing Survey, *Overall Report (European War),* 29; and Levine, *The Strategic Bombing of Germany, 1940–1945,* 106.

12. U.S. Strategic Bombing Survey, *Overall Report (European War),* 29.

13. U.S. Strategic Bombing Survey, *Overall Report (European War),* 83–84, with quotation on p. 84.

14. U.S. Strategic Bombing Survey, *Overall Report (European War),* 45.

15. U.S. Strategic Bombing Survey, *Overall Report (European War),* 49.

16. U.S. Strategic Bombing Survey, *Overall Report (European War),* 53.

17. U.S. Strategic Bombing Survey, *The Effects of the Atomic Bombings of Hiroshima and Nagasaki,* Chairman's Office, 19 June 1946, 44. Available online at http://www.whistlestop.org/study_collections/bomb/large/strategic_bombing/text/bmd1-2tx.htm.

18. U.S. Strategic Bombing Survey, *The Effects of the Atomic Bombings of Hiroshima and Nagasaki,* 48.

19. U.S. Strategic Bombing Survey, *The Effects of the Atomic Bombings of Hiroshima and Nagasaki,* 48.

20. Industrial Dispersion, National Security Resources Board, *Is Your Plant a Target?* (Washington, D.C.:The National Security Resources Board, 1951). Based on an Industrial Dispersion Task Force representing the Seattle Chamber of Commerce and the City and County Planning Commissions, under the chairmanship of Ethan Allen Peyser.

21. National Security Resources Board, *Is Your Plant a Target?* 13.

22. Executive Office of the President, National Security Resources Board, *Conference of Industrial Development Executives, 7 September 1951*, 49–50.

23. U.S. Department of Commerce, *Industrial Dispersion Guidebook for Communities,* Domestic Commerce Series no. 31 (Washington, D.C.: U.S. Government Printing Office, 1952), 3.

24. U.S. Department of Commerce, *Industrial Dispersion Guidebook for Communities,* 4.

25. U.S. Department of Commerce,

Industrial Dispersion Guidebook for Communities, 13.

26. Project East River, *Reduction of Urban Vulnerability,* part V (New York: Associated Universities, July 1952), esp. part II, 17–45.

27. Project East River, *Reduction of Urban Vulnerability.* Reliance on the USSBS was reported in part V(a), sections 1.3 and 3.2.

28. Neil P. Hurley, S.J., "Atomic Vulnerability in the Chemical Process Industry," *Chemical and Engineering News* (September 5, 1955): 3654–60, quotation on p. 3655.

29. Hurley, "Atomic Vulnerability in the Chemical Process Industry," 3655.

30. Hurley, "Atomic Vulnerability in the Chemical Process Industry," 3658.

31. Admiral Ben Moreell, "What the H-Bomb Can Do to U.S. Industries," *U.S. News and World Report,* 7 May 1954, 62.

32. All quotations from Oscar Sutermeister, *Reduction of Vulnerability in the Milwaukee Area: An Exploratory Study,* 17 May 1954 (n.p.).

33. H. Spence-Sales, *A Guide to Urban Dispersal* CD-3 (Montreal: McGill University and Canada Defence Research, Committee on Physical Planning, October 1956).

34. See, for example, Dr.-Ing. Alfred Müller, *Hannover, Städtebauliche Luftschutzuntersuchung* (Hannover: Gebr. Höltje, 1957).

35. Address of Vice President Richard Nixon to the Governors Conference, Lake George, New York, 12 July 1954. Typescript courtesy of Richard Weingroff, Federal Highway Administration.

36. Project East River, *Reduction of Urban Vulnerability,* part V, 37–39.

37. Tom Lewis, *Divided Highways* (New York: Viking, Penguin, 1997), 108.

38. Richard F. Weingroff, Federal-Aid Highway Act of 1956: Creating the Interstate System, available online at http://www.tfhrc.gov/pubrds/summer96/p96su10.htm.

39. Paul Baran, "Reliable Digital Communications Systems Using Unreliable Network Repeater Notes," RAND Corporation memorandum P-1995, 27 May 1960, quoted in Adam Walter Bellack, "Behind the Wizards' Curtain: The Origins of Wide-Area Packet-Switched Computer Networks," honors thesis, Department of the History of Science, Harvard University, March 1999, 29.

40. Paul Baran, introduction to "On Distributed Communications: I. Introduction to Distributed Communications Network," RAND Corporation memorandum RM3420-PR, August 1964, originally from circa 1961. Available online at http://www.rand.org/publications/RM/RM3420/RM3420.chapter1.html.

41. Baran, "On Distributed Communications."

42. Peter Galison, "The Ontology of the Enemy: Norbert Wiener and the Cybernetic Vision," *Critical Inquiry* 21, no. 1 (1994): 228–66.