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THE DEBATE OVER POSTWAR RESEARCH POLICY, 1942-1945:  
A POLITICAL INTERPRETATION OF SCIENCE -- THE ENDLESS FRONTIER

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To date, the origins of Science -- The Endless Frontier, the famous and influential report issued in 1945 by Vannevar Bush, the director of the Office of Scientific Research and Development (OSRD), remain obscure behind the veil of memory. Bush himself has attributed the conception of the report to a casual conversation with President Franklin D. Roosevelt, who asked for it when Bush remarked that science might well languish in the postwar United States. More recently, Oscar M. Ruebhausen, the General Counsel of OSRD, has attributed the initiative for the report to Oscar S. Cox, the influential government lawyer, who wanted the administrative techniques pioneered by OSRD for defense research adapted to a peacetime program. <sup>1</sup>

Though Ruebhausen's quarter-century old recollections are closer to the truth, neither account squares with the contemporary documentary record. More important, both ignore that the report was written in a highly political context which was generated by a growing debate over a major policy issue -- the issue of how the federal government should advance science for the general welfare in peacetime. <sup>2</sup>

The debate originated in a cluster of concerns centered among Americans of a liberal political persuasion about the extent to which defense research was dominated by big business in alliance with the leading universities. Vociferous complaints had cropped up charging unfair evaluation of technical suggestions submitted by the public at

large to OSRD, the armed services, and the National Inventors Council. Trained scientists and engineers were said to be in critically short supply, yet, spokesmen for numerous colleges, universities, and a volunteer technical group reported that they had offered their services and laboratories to the government, only to be politely thanked and ignored. <sup>3</sup> In part the complaints reflected the discontent of Edisonian inventors in having to deal with a hierarchy of professionally trained scientists and engineers. In part, they bespoke the policy of OSRD and the armed services to rely upon the better-staffed and better-equipped academic and industrial laboratories. But even Fortune concluded that dollar-a-year men rejected the suggestions of small businessmen and inventors for the self-interested purpose of protecting the competitive positions of their own corporations. "Edison may have been the last of the heroic inventors," the New York Times added, "but the country is full of university professors and graduate engineers who can make a notable contribution to technology and who are now shackled when they deal with a highly standardized monopoly. . . ." <sup>4</sup>

No less disturbing was the distribution of research and development contracts to industry. In the late Thirties about two-thirds of all industrial research workers were employed in fewer than ten percent of all industrial laboratories. Now, some 66% of wartime R&D contract dollars was going to only 68 corporations, some 40% to only 10. Moreover, more than nine out of ten of these

contracts granted the ownership of the patents deriving from this publicly funded research to the industrial contractors.<sup>5</sup> To a number of critics, this patent policy seemed an unwarranted giveaway -- and a dangerous one, considering the widely publicized allegations made during the war about the patent practices of big business.

Giant American firms had entered patent agreements with foreign, including German, cartels. These agreements were said to have permitted the flow of vital technical information to the nation's potential enemies and also to have kept the United States from developing sufficient supplies of such strategic raw materials as beryllium, magnesium, optical glass, chemicals, and, above all, synthetic rubber. Then, too, in the assessment of the Temporary National Economic Committee, the giant corporations had found a variety of ways to use the patent system "to control whole industries, to suppress competition, to restrict output, to enhance prices, to suppress inventions, and to discourage inventiveness."<sup>6</sup> In the worried conclusion of many liberals, the distribution of wartime contracts for research and development was intensifying the concentration of the resources of industrial research in the major corporations. Worse, the patent clauses were vesting considerable control of the commercial applications in corporate giants whose patent practices often seemed so defiantly contrary to the public interest.

Assistant Attorney General Thurman Arnold, the administration's chief trustbuster and a central figure in the wartime patent

controversies, explained to a congressional committee: If science and technology were to serve the public interest, you had to do more than just break up patent pools. You had to do something about the increasingly concentrated control of the underlying knowledge and know-how from which patent pools germinated. The monopolizing practices of big business would never be cured by denunciations, Arnold emphasized; corporate executives would always try to maximize profits in any way possible. If science were to serve the public interest, the system by which big business exploited research had to be reconstructed by the federal government. Only government, Arnold concluded, could preserve opportunity for independent inventors. Only government could "break the corner on research and experimentation now enjoyed by private groups."<sup>7</sup>

Arnold was on somewhat shaky ground when he claimed that big business held a commanding corner on scientific research in the United States. In his analysis, the large corporations controlled even university science, determined the subjects of academic inquiry, and prevented the dissemination of the results of research. Actually, industrial corporations provided only a small fraction of academic research funding, and for the most part professors of science and engineering studied what they wanted and published their results in the professional journals. Nevertheless, Arnold had put his finger on a trend that thoughtful liberals found disturbing. The kind of research, especially technologically related research, done in the

United States was determined to a disturbingly large degree by how big business responded to market forces rather than by any disinterested assessment of national needs.

Waldemaer Kaempffert, the liberal science editor of the New York Times, argued that public needs pertinent to science and technology were simply not being met. If the United States had made enormous progress in physics and chemistry, Kaempffert averred, pursuing a Thurman Arnold-like line of analysis, it was "because the profits . . . and the military advantage" lay there. Only the Soviet Union had attempted to organize science to achieve social security, happiness, and contentment. In the United States, research had "grown up like Topsy," without "concentrated social purpose in planning. . . , direction . . . , organization." Kaempffert strongly disapproved of the Russian social and political system, but he saw no reason why the U. S. government could not develop a New Dealishly purposeful scientific program consistent with the principles of freedom. OSRD exemplified how science could be properly mobilized for the purposes of war, Kaempffert argued. Why not do the same for the purposes of peace? As Kaempffert summarized the emerging issue: "Laissez-faire has been abandoned as an economic principle; it should also be abandoned, at least as a matter of government policy, in science." <sup>8</sup>

Kaempffert's point provoked considerable controversy once it caught the attention of Senator Harley M. Kilgore of West Virginia. A

small town lawyer, National Guardsman, Legionnaire, Mason, past exalted ruler of the Elks Lodge, and recently judge of the county criminal court, Kilgore was quick to admit "utter, absolute ignorance" of science and technology. <sup>9</sup> The son of a wildcat oil prospector, he was equally quick to discourse on the power of big business, including its power to deprive ordinary people of a fair shake. While on the bench in the Thirties, Kilgore won a reputation for his willingness to help juvenile defenders get a new start. In 1940 the pro-Roosevelt faction in the bitterly divided West Virginia Democratic party found him a natural, if last minute, choice for the Senatorial nomination. Kilgore squeaked through a three-way primary with less than 40% of the vote, won mainly with the support of the CIO. <sup>10</sup> Handily elected on FDR's coattails, he went to Washington a down-the-line New Dealer eager to do all he could for the plain folks back home, especially the pro-labor folks who had put him into office.

His suits wrinkled, his pockets crammed with papers, pencils, and a good luck horse chestnut, Kilgore threw himself into his Senatorial duties and soon established himself as an outspoken member of the Truman Committee. The more Kilgore learned about the rubber shortage, patent abuses, and the power of dollar-a-year men, the more he was convinced that a good deal was wrong with the war production program. He often discussed the subject with Herbert Schimmel, a Congressional staff member and Ph. D. in physics, who shared Kilgore's outrage at the rubber shortage and, not least because

of his work on the House equivalent of the Truman Committee, the Senator's distrust of big business.<sup>11</sup> Sure that crucial technological developments had been "strangled," Schimmel focused Kilgore's attention on the technical side of the war production program. The more Schimmel and Kilgore talked, the more they became convinced that if the war production program were to succeed -- and succeed equitably -- its technological operations would have to be centralized in an agency run by disinterested professionals -- a technological high command.<sup>12</sup>

In 1942 quite similar thoughts occupied Maury Maverick, the outspoken Texas liberal and small business-minded member of the War Production Board. With the aim of breaking big industry's hold on the technical side of war production, Maverick proposed that Donald Nelson, the head of the Board, establish an OSRD for strategic materials.<sup>13</sup> Reports in mid-August that Nelson was about to create such an agency disturbed Schimmel, who was convinced, as he told Kilgore, that the proposed technical office could accomplish little inside Nelson's big business-oriented Board. Better that Congress should establish the office as an independent agency of the government. Hurriedly drafting a bill for the purpose, Schimmel urged Kilgore to introduce it quickly, emphasizing the importance of preempting Nelson -- and adding that Kilgore might well be made chairman of his own subcommittee to consider the measure.<sup>14</sup> Kilgore promptly introduced the Technology Mobilization Act.

Aimed at breaking "the bottlenecks" choking the mobilization

of the nation's technical resources, the measure called for the exploitation of all war-related patents and production processes; the better use of small business and inventors; the provision of adequate substitutes for strategic raw materials. To these ends, the bill established an Office of Technological Mobilization, a super agency which would incorporate all the government's technical bureaus, both military and civilian. The Office would be empowered to draft technical personnel and facilities; compel the licensing of patents for war uses; and finance research projects which might contribute to victory.<sup>15</sup> By the fall of 1942 Kilgore had his subcommittee, and in October he opened hearings on the measure.

Kilgore's bill ran into considerable opposition, especially from the Army, the Navy, industrialists, and Vannevar Bush. The opponents flatly denied the existence of bottlenecks serious enough to warrant the radical changes Kilgore proposed (even friends of the bill joined one witness in urging of OSRD: "Leave them alone and do not touch them. I pray you, Do not touch them.")<sup>16</sup> Bush, insisting that inventors' suggestions were adequately reviewed, attributed their complaints to the impossibility of informing them, because it would reveal data on the status of Allied military technology, why their ideas were not used. More generally, the critics roundly attacked the proposed centralization of all federal technical agencies in one office as unwarranted regimentation. Fastening on the vast powers which the office would possess, especially the power to draft

technical facilities and personnel, they decried the bill as virtually totalitarian.<sup>17</sup>

Kilgore acknowledged that the bill had been hastily drawn Schimmel had produced it literally overnight -- but he had no intention of dropping it. His measure had won support from small businessmen and inventors, even from the Sears, Roebuck executive at the top of the War Production Board, Donald Nelson, whose predilection for centralized management, including the centralized management of technological development, had been intensified by the headaches of running the W. P. B. Though in response to Maverick's proposal Nelson had recently established an Office of Production Research and Development, he endorsed Kilgore's scheme because the WPB had neither sufficient money nor power to do the job that needed to be done in the technological area. Moreover, Nelson and other witnesses had called Kilgore's attention to the alleged waste of scientific manpower, the concentration of R&D contracts, the patent giveaway -- in short, to the mobilization of science for war and its wideranging implications for peace. His vision enlarged, Kilgore redrafted his bill and introduced it shortly after the new Congress convened in 1943.<sup>18</sup>

Called the Science Mobilization Act, the new measure established an Office of Scientific and Technological Mobilization, or OSTM, as a permanent independent agency of the government. To meet the charges of regimentation, OSTM was awarded less sweeping powers than its predecessor. It could draft technical facilities and patents only as a last resort during and not at all beyond the war emergency,

It could not draft scientific personnel, merely certify them for deferment to Selective Service. And OSTM would not incorporate, just coordinate, the scientific and technical agencies of the federal government. Bespeaking Kilgore's new emphasis, especially his liberally purposeful emphasis, on science, OSTM was empowered to finance through grants and loans scientific and technical education and the advancement of pure and applied research. (To an alarming degree, Kilgore explained, the academic world's increasing dependence on industrial grants and fellowships had reduced much of university research to "the status of handmaiden for corporate or industrial research, and has resulted in corporate control of many of our schools.")<sup>19</sup> In addition, OSTM was to be administered with the help of a board and an advisory group, both of which were to include representatives of industry, agriculture, labor, and small business, as well as science and technology.

Equally important, OSTM was to stimulate the research enterprise of scientists, inventors, and small businessmen, in part by compelling the disclosure and nondiscriminatory dissemination of information about important technical processes developed in any, including the major corporate, laboratories. Most important, to safeguard the public interest, OSTM was granted ownership and empowered with the exclusive right to use or to license "any invention, discovery, patent, or patent right" which had resulted from research supported with "any money, credit, physical facilities, or personnel" by the federal government since the declaration of national emergency

in 1941.<sup>20</sup>

Kilgore's revised bill drew considerable attention, not only in a new round of hearings but in the scientific and technical press. Numerous favorable letters poured in from scientists, small businessmen, and inventors. Privately, twenty-two Congressmen and Senators joined Kilgore in urging James F. Byrnes to establish in his new Office of War Mobilization a central scientific agency designed to achieve the same wartime purposes as Kilgore's OSTM. Publicly, Vice-President Henry Wallace testified to the peacetime importance of a socially liberal scientific program, especially one which avoided the concentration of the benefits of research in any geographical area or type of institution. Thurman Arnold added his outspoken voice to the chorus in favor of the bill, eloquently analyzing the need for such a measure and confidently proclaiming Kilgore's "the magna carta of science."<sup>21</sup>

But the bill earned considerable opposition from trade associations, industrial research managers, and the Army and Navy. The National Association of Manufacturers typically denounced the measure as a threat to "socialize" all of science the United States.<sup>22</sup> The armed services, some of whose officers agreed with the NAM, objected in particular to the patent provisions on grounds that they would raise the cost of, if not make impossible, industrial R&D contracts. Both the Army and Navy dissented most vigorously from vesting any control over the development of military technology in a civilian-dominated agency. For one thing, the agency's access to

classified information would jeopardize security. For another, it was one of the military's deepest-seated canons that, since the armed services were responsible for the use of equipment, they should control its research and development.<sup>23</sup>

The bill also provoked emphatic dissent from the nation's scientific leadership, only a fraction of whom shared the objections of the NAM and the military. Some scientists opposed the Kilgore bill for the same reasons as Frank Jewett, the President at the National Academy of Sciences and former head of the Bell Telephone Laboratories. Unalterably opposed "to being made the intellectual slaves of the State," Jewett proudly reported, these scientists considered federal aid to academic research in any form a threat to the freedom of science.<sup>24</sup> Others, apparently a much larger group, while no less eager to maintain that freedom simply disliked the Kilgore bill in particular.

The war had decidedly sharpened the scientific community's wariness of official bureaucratic interference with its members' professional autonomy. There were the security regulations, which required them to work in a closed-mouth fashion repugnant to the vitality of scientific communication. There was the endless red tape, which, as Karl Compton sniped, seemed to have been established on the assumption that "all who deal with the government have dishonest and selfish inclinations."<sup>25</sup> There was the necessity of submitting to the central direction of research, which even under the relatively permissive auspices of OSRD forced virtually everyone to spend his

time on technical problems of someone else's choosing. While OSRD scientists were willing to put up with these annoyances and infringements to win the war, they were unlikely to submit to a similar regimen for any purpose in the peace.<sup>26</sup>

"Beware in times of peace," James B. Conant warned, "of coordinating agencies with dictatorial powers -- of ideas of a peacetime scientific general staff."<sup>27</sup> Beware, in particular, Conant might have added, of the Kilgore bill's nonprofessional administrative scheme. For its own purposes, the bill defined scientific and technical personnel to include anyone who had at least six months training or employment in any technical vocation ("under this provision," a high-ranking Navy liaison at OSRD fumed, "the village idiot who had washed test tubes for six months . . . would be a scientist").<sup>28</sup> Worse, the administration of OSTM was to include representatives of small business, labor, and the consuming public. In the apprehension of professional scientists, OSTM would be run by scientific laymen whose appointments were bound to hinge on political criteria rather than on their qualifications for advancing the best science.

Equally important, to both academic and industrial scientists, sure of the effectiveness of the current scientific mobilization, the bill was not only unnecessary; in the phrasing of an oil company scientist, its passage might well be worth "one hundred divisions to our enemies."<sup>29</sup> As for Kilgore's peacetime program, the critics dissented from OSTM's power to commandeer scientific and technical data which, in the claim of a scientist at General Electric, would

essentially force big business to aid small business by the disclosure of proprietary technical secrets. Worse, according to the way the bill's patent clauses defined federal aid, an industrial corporation would lose all patent rights in an invention if, while working on a government research project, an armed service officer merely supplied it with technical advice. Unless industry received at least a fair quid pro quo for its contribution to governmentally sponsored developments, the critics were sure, there would be no incentive for industry to participate in federal research programs.<sup>30</sup>

In 1943 and 1944 the threats of the Kilgore bill received a good deal of attention in the scientific and technical press. The editor of a prestigious technical journal admonished his colleagues that, unless they wished the future of science to be taken out of their hands, they had better start organizing for political action. Breaking away from their normal apolitical posture, various scientific organizations solemnly resolved against the bill, including the Council of the American Association for the Advancement of Science and the War Policy Committee of the American Institute of Physics.<sup>31</sup> But the scientific community found its most influential spokesman in the nation's most influential wartime scientist, Vannevar Bush.

Bush actually found a good deal to commend in the overall peacetime aims of Kilgore's bill. He endorsed in principle the coordination of federal scientific agencies and the establishment of a scientific advisory system in the government. Bush was no special

enthusiast of federal aid for scientific research and training in the universities. All the same, he worried that the country might get "over-convinced" of the importance of military research as such, worried, too, that private universities might not be able to provide for themselves sufficiently in the postwar. Bush deemed it essential to foster basic research, in part because any program of development would rest on it, in part because he keenly respected the urge of "free men everywhere and at all times" to know for its own sake. <sup>32</sup>

No less important, Bush empathized with Kilgore's eagerness to enlarge the technological opportunities of small business. Bush was an anti-New Deal conservative, but he had always backed governmental curbs on the domination of markets by large industrial combinations. In the early Twenties, Bush had been associated with a fledgling electronics firm, the Raytheon Corporation, which had almost been forced out of business when General Electric, RCA, Westinghouse, and AT&T formed an exclusive patent pool and marketing agreement for vacuum tubes. In the coming postwar, Bush was sure, the nation's prosperity would depend to a considerable extent upon the appearance of small businesses applying new knowledge in a useful manner. Not least for that reason, Bush believed it necessary to prevent large corporations from using the patent system to bar the entry of small firms into lucrative new technological markets. <sup>33</sup> To accomplish this purpose, Bush had a variety of proposals in mind, but they did not include the measures specified in the Kilgore bill. <sup>34</sup>

Save for the bill's thrust at better treatment for scientists

under the Selective Service System, Bush saw nothing to commend the wartime features of the bill. The restrictions on big business would wholly disrupt industrial cooperation in the development of new weapons. War or peace, the patent provisions in particular would not serve the public interest, Bush was certain, not if it was in the public interest to encourage useful invention and its transformation into a marketable product. In Bush's analysis, the temporary monopoly inherent in a patent was essential to encourage entrepreneurs or industrial corporations to invest capital in technological development. To vest patent rights in the government, Bush was certain, would be to destroy that incentive and, hence, to deprive the public of the commercial development of whatever technological advances might emerge from federally sponsored research. <sup>35</sup>

Like so many other scientists, Bush had his doubts about the scientific features of the bill, which seemed to threaten the political control of research. To Bush's mind, Kilgore simply did not yet understand the operation or role of science in the United States. Perhaps the Senator's staff kept steering him into "strange paths." Whatever the case, because he found a good deal in the bill appealing, Bush had no intention of indulging in a blanket rejection of the measure. While he was ready to do battle with Kilgore if necessary -- he bristled when the Senator called for information on OSRD contracts -- he counted it the better and more responsible part of wisdom to attempt to steer him onto the proper path by persuading Kilgore to draft a new and more constructive measure. The Senator had made a good deal

of progress in the last two years; Bush hoped that under his expert guidance he would make a great deal more. <sup>36</sup>

In a long, carefully phrased letter at the end of 1943, Bush urged Kilgore to forget about the wartime mobilization of science and concentrate on a peacetime program. He applauded Kilgore's goal of coordinating federal scientific agencies, so long as coordination meant cooperation rather than centralized control. He endorsed the establishment of a scientific advisory system in the federal government, so long as it was staffed by the best scientists -- they were bound to be "disinterested," Bush assured -- rather than by representatives of such interested groups as labor, small business, and consumers. He backed federal support for academic research and training, so long as such support advanced the work of the most brilliant, not the generally mediocre, minds and so long as it did not infringe upon the professional and intellectual independence of the scientist or his laboratory. And Bush commended Kilgore's concern for assuring that industrial laboratories operated in the public interest. But the best way to achieve that goal, he insisted, was not to establish restrictions on industrial research or to impose a senseless patent policy. It was to assure industrial competition. <sup>37</sup>

Kilgore tended to write off much of the opposition to his measure to "vested interests." <sup>38</sup> But by now, with industry turning out tons of war goods, including tons of synthetic rubber, the wartime provisions of his bill seemed unnecessary. Though still "obsessed" by the patent issue, in the report of a scientist who discussed the

matter with him, Kilgore appreciated many of the scientific community's dissatisfactions with the existing measure. <sup>39</sup> In early 1944 Kilgore and his staff drafted a new bill, a measure for the postwar promotion of pure and applied research as well as scientific education and training under a National Science Foundation.

Kilgore's new bill conceded a number of points to his critics. While the proposed Foundation could encourage the coordination of the government's technical bureaus, its recommendations were not to be binding on any agency. The Foundation was also to include a separate division for defense research dominated by members of the War and Navy Departments and explicitly guaranteed a minimum percentage of the agency's total annual appropriation. Scientists and engineers supported by the Foundation were to be assured free rein in the exercise of their creative talents and were to be protected in their right to hold and express independent opinions on scientific and technical matters. On the industrial front, instead of compelling the disclosure of proprietary secrets, the Foundation would aid small business and inventors simply by publishing reports of progress in research. As for patents which resulted from publicly aided research and development, the Foundation would still own all patents which resulted from federally funded research, but it would recognize the proper interests of private individuals and organizations who had contributed to the invention or process in question. <sup>40</sup>

Kilgore had come a long way since 1942, when he had been primarily concerned with the problems of inventors, entrepreneurs, and war production; his bill of 1944 amounted to a generally meritorious response to Waldemaer Kaempffert's call for an end to laissez-faire in science. Its powers limited, Kilgore's National Science Foundation was unlikely to be a dictatorial superagency. While his NSF was to give government laboratories priority in the dispensation of its funds, it was also to award research contracts and scholarships to colleges and universities. Kilgore's NSF was designed well enough just possibly to have advanced basic science in the successful manner of the emerging National Institutes of Health. At the same time, Kilgore's NSF was to be administered by a single director with the aid of a presidentially appointed board that included representatives of industry, labor, agriculture, education, and the consuming public; as such, Kilgore's Foundation would have been prone to sponsor programs of fundamental and applied research pertinent to the nation's current social and economic needs.<sup>41</sup> In all, Kilgore's NSF would preserve the intellectual freedom of the scientists whom it sponsored, but it would be programmatically responsive, in a liberal fashion, to the political system.

Before introducing his new bill, Kilgore invited the leadership of OSRD to participate in a final revision. To Frank Jewett, the latest draft merely incorporated all the "iniquities" of the previous version and added a few more. Though Bush considered it an improvement, he doubted that "such a setup will do much good, and it certainly will do strange things."<sup>42</sup> The

differences between Bush and Kilgore boiled down to a basic issue: Kilgore wanted an NSF responsive to lay control and prepared to support research for the advancement of the general welfare; Bush and his colleagues wanted an agency run by scientists mainly for the purpose of advancing science.

In late October 1944 Oscar Cox, the imaginative and influential administration lawyer, gave Bush an opportunity to seize the initiative from Kilgore. Perhaps with an eye on the upcoming election, Cox had come away from a talk with Harry Hopkins with an idea: Why not have the President send a letter to Vannevar Bush, asking for a

report on what steps should be taken to utilize the results of wartime research and development -- produced at public expense, the results belonged to the public, Cox supposed -- to create a higher standard of living and full employment in the postwar? <sup>43</sup>

Cox drafted just such a letter and, late in the afternoon of October 24, discussed it with Bush and the General Counsel of OSRD, Oscar M. Ruebhausen. Bush readily agreed that it would be appropriate, consistent with military security, to arrange for the expeditious release of classified scientific information of potential peacetime use. Turning to the broader question of federal research in the postwar, Bush also registered his dissent from establishing an OSRD-like program in peacetime, including, as he made emphatically clear to Cox, the program in the Kilgore bill. But Bush did allow that he favored some sort of governmental support of academic science in the postwar, especially in the lean years when private industry and private universities might be unable to underwrite much research themselves. Since the Kilgore bill seemed unlikely to receive any action before the new Congress convened in January 1945, Bush and Cox agreed that it would be worthwhile to develop an alternative legislative approach. To that end, Cox would attempt to have the President request Bush's views on the broad issue of postwar research and development, a request which would give Bush an opportunity to go on record with his proposals about what the government should do to advance science for the general welfare. <sup>44</sup>

Ruebhausen promptly drafted a new Presidential letter for Cox. The document made its way to the Oval Office through Harry Hopkins, who had Cox modify it slightly, and Samuel I. Rosenman, FDR's chief wordsmith, who spruced up the language in conformity with the President's style. Bush and Conant had urged delay until after the election, since the publication of the letter beforehand might prejudice its reception. <sup>45</sup> Issued by the President on November 17, 1944, it was released on November 20, to a nationwide flurry of favorable news stories and editorial comment. <sup>46</sup>

Opening with a preamble upon the success of OSRD, the letter declared that there was "no reason why the lessons to be found in this experiment" could not be profitably employed in peacetime to improve the national health, create new jobs and enterprises, and raise the standard of living. With that objective in mind, the President asked Bush for recommendations in response to four questions:

1. How might the scientific information developed during the war be made known, consistent with military security, to advance the general welfare?
2. What might be done to organize a program of medical research?
3. What might the government do to aid research generally in public and private institutions?
4. What might be done to discover and develop scientific talent in American youth? <sup>47</sup>

Bush appointed four committees, each consisting of prominent men drawn from appropriate fields, to report on the four questions. Each was left largely to its own devices, though Bush did emphasize

to all of them how important it was to complete the report before Kilgore's legislation was passed. Bush anticipated no serious problems for the committees on the release of scientific information, medical research, and the development of scientific talent. But committee 3, he expected, faced quite a difficult and sensitive task, since, in the words of the letter, it was charged with considering the "proper roles of public and of private research, and their interrelation" -- charged, in short, with reporting upon precisely the controversial issues manifest in the Kilgore bill.<sup>48</sup>

Eager to have an unimpeachably balanced panel, Bush appointed seventeen men to committee 3, nine of them academics, mainly administrators, who were divided almost evenly between public and private institutions. He included two representatives of big business, Robert E. Wilson, the chairman of the board of Standard Oil of Indiana, and Oliver E. Buckley, the president of the Bell Telephone Laboratories. He also appointed two small businessmen, Bradley Dewey, the president of the Dewey and Almy Chemical Company, and Edwin H. Land, the president and director of research of the remarkably successful young firm, the Polaroid Corporation. The chairman of committee 3 was the high-ranking member of the National Academy of Sciences and president of The Johns Hopkins University, Isaiah Bowman.<sup>49</sup>

Despite its broad mandate, the Bowman Committee took as the chief issue before it whether the federal government ought to get into the business of supporting scientific research in the universities

outside of agriculture. Like Georgy Ellery Hale in World War I and Frank Jewett now, part of the committee, including a number of its academic members, opposed such support on grounds that it would open the door to political control of the academic world.<sup>50</sup> But the committee was dutifully surveying the needs of academic science in the postwar. As the information came in, the opposition to federal support diminished, because without it the prospects of peacetime research seemed decidedly bleak.

The academic world seemed likely to lose able scientists permanently to industrial and defense research. The war effort had given professors the heady taste of doing research

with few financial restraints. Typically, the young physicists at the MIT Radiation Laboratory had grown accustomed merely to signing an order for a new instrument whose cost would have deadlocked a faculty before the war. University administrators doubted that able scientists would be satisfied to return to the routine of heavy teaching loads, limited equipment budgets, and low salaries. And if they did not, the advance of fundamental knowledge, which the war effort had brought virtually to a halt, would proceed at a decidedly slow rate in the peace.<sup>51</sup>

Equally troubling, by any standard the nation faced a serious deficit of trained scientific manpower. The Selective Service system had just about stripped the graduate schools of candidates for Ph.D.'s in the sciences, and the wholesale drafting of able-bodied undergraduate males had sharply reduced the pool from which future doctoral

candidates could be recruited. According to the studies of the Bowman committee's counterpart on scientific manpower, the war had cost science some 17,000 advanced and 150,000 first degree graduates. The production of scientific doctorates was not expected to reach normal levels again until the mid-1950's. Based on projections of the prewar growth rate, analysts predicted that by 1955 there would be a deficit of 2,000 Ph. D. 's in physics, which was sizable measured against a skyrocketing demand for physicists in industry alone. <sup>52</sup>

The members of the Bowman committee considered the situation worrisome. Science was essential to the nation's economy, defense, and prestige, and the United States could no longer rely on war-ravaged Europe for its supply of basic knowledge. Moreover, it was well-known that other world powers, including Soviet Russia, had husbanded their scientific manpower during the war and intended to foster scientific research vigorously in the peace. To the Bowman committee, it seemed imperative that basic scientific research and training proceed at a vigorous pace in the postwar United States, too. But private resources, they were convinced, would not suffice to meet the needs of the nation's academic scientific enterprise. All things considered, the Bowman committee found itself "forced," in the claim of its final report to Bush, to conclude that some measure of federal aid would be necessary to maintain an appropriate level of scientific research and training in the United States. <sup>53</sup>

To the extent that the Bowman committee recommended such

a federal program, its report resembled Kilgore's implied call for an end to laissez-faire in science; like Kilgore, the Bowman report urged the establishment of a new agency, the National Research Foundation. But unlike Kilgore, it insisted that this agency must be prevented from dictating -- their word for central direction of any sort -- the nation's scientific program. It also had to be kept free from the influence of pressure groups, from administration by anyone who did not have a thorough understanding of science, and from the necessity of producing immediate practical results. Kilgore may have wanted his agency to spend its money primarily in governmental laboratories capable of high-quality applied research. The Bowman committee's National Research Foundation was to support research and training solely in nonprofit institutions, meaning mainly those leading educational institutions usually responsible for the best basic research. <sup>54</sup>

Save for the minority report of thirty-six year old Edwin H. Land, the recommendations of the Bowman committee ran no less contrary to Kilgore in their approach to the problems of small business. Land, whose social imagination matched his remarkable

technical ingenuity, saw a new and humane industrial frontier in the small manufacturing corporation oriented towards research; as such, it could be a small social and economic unit, a haven of individual opportunity located far from the slums of the cities. Like Kilgore, Land argued that the federal government ought to stimulate the launching of such new scientific enterprises by aiding young people who were more interested in applying new knowledge than in pursuing basic inquiry. Let the government encourage undergraduates to invent solutions to unsolved technological problems, Land proposed, and then help them after graduation to perfect their inventions and strike out for themselves in an actual business enterprise.<sup>55</sup>

But the Bowman committee did not endorse Land's proposal. To encourage the growth of small research enterprises, it proposed merely that the government establish technical advisory clinics for small business around the country. It also noted that inconsistent rulings from the Bureau of Internal Revenue about the tax deductibility of research expenses placed small business -- and big business, too, their report might have added -- in an uncertain and financially hazardous position, and it urged the government to award such deductions clearcut legal sanction. Otherwise, the committee declined to discuss the patent issue (because President Truman had recently asked Bush to serve on a committee under Secretary Henry Wallace to study the entire national patent system). While the Bowman committee acknowledged the "increasing concentration of industrial research in this

country," it generally proposed no strong governmental action to offset the trend.<sup>56</sup>

Delivered on May 9, 1945 -- it was the last to come in -- the Bowman report was complemented and reinforced by the conclusions of the other three committees. Convinced that the country would profit more by revealing than by restricting wartime scientific knowledge, committee 1 urged the speedy release of classified scientific information. Committee 2 recommended a program of federal aid to medical research and training, emphasizing the necessity of keeping the program free of political control. And committee 4 eloquently analyzed how financial circumstances kept many talented youngsters out of science. Warning against developing an oversupply of scientists and against diverting too much talent away from the social sciences and the humanities, the committee endorsed a limited program of federal scholarships and fellowships, including, partly to discourage the participation of the children of well-to-do families, a national service obligation for all such scholars and fellows.<sup>57</sup>

Long before the reports were in, Bush had decided to top them all off with an overall interpretive statement of his own. He worked on the statement through the spring of 1945, with considerable help from Oscar Ruebhausen, Carroll L. Wilson, his chief assistant, and Bethuel M. Webster, a New York lawyer and able writer who was engaged to draw up the preliminary draft. All the committee reports had certain key points in common, including the point that any mechanism for federal support of science must contain certain

essential safeguards against political control, interference with internal institutional affairs, and excessive instability in duration and amount of funding. But the reports differed about how to establish the necessary safeguards. Bush chose not to attempt to reconcile the differences. For one thing, it would drag out the writing of his report endlessly. For another, it seemed wiser simply to take the best suggestions from each report, not least because some of the rest violated democratic principles and, in any case, fell beyond the bounds of what Bush expected that Congress might reasonably accept.<sup>58</sup>

Bush disliked the proposal of committee 2 that medical research and training be supported by a separate independent agency. To Bush's mind, it made more sense administratively to establish the medical program in the same agency as the program for the basic sciences. Equally important, he suspected that it would be difficult enough to persuade Congress to create just one new independent agency, let alone two, or worse, if military research were considered, three. Because of the spectacular success of OSRD, the Army, Navy, and most defense scientists agreed that the federal government ought to provide for a civilian-run peacetime research program on long-range military problems. Instead of establishing a separate agency for the purpose, Bush deemed it both wise and feasible to incorporate it, like medical research, in a single agency, the National Research Foundation.<sup>59</sup>

But Bush could not go along with the scheme for the Foundation proposed by the Bowman committee. To assure stability in its

funding and to insulate it from political control, including the political pulling and hauling of the annual Congressional appropriations process, the Bowman committee proposed that the Foundation be an independent government corporation. While the President would appoint its board of trustees, he would have to choose the members from a panel nominated by the National Academy of Sciences. Moreover, the Foundation was to be financed by a large non-interest bearing capital fund -- \$500,000,000 was suggested -- which could be spent at its discretion. To insulate the academic world from control by the Foundation, the funds were to be awarded automatically on a matching basis to qualified universities which agreed to participate in the plan. Clarence Dykstra, whose duties as the new chancellor of UCLA had prevented him from participating in the deliberations of the Bowman committee, commented: The proposed Foundation seemed a way for "private universities to get large public support through the back door . . . [without] the sort of responsibility to the public that state institutions must accept."<sup>60</sup>

Of course the board of trustees should consist of persons who understood the "peculiarities of scientific research and education," Carroll Wilson advised Bush. But the board of trustees should "truly" represent the public interest and not "primarily . . . those groups which will be the recipients of support."<sup>61</sup> Of course, stability of support was essential, and so was freedom from political interference with basic research. All the same, the Bureau of the Budget had made pointedly clear that any federal venture in research would

have to be subject to the normal fiscal and policy controls of the Congress and the Executive Branch.<sup>62</sup>

Withal, while Bush endorsed the arguments for a program of federal support and the warnings against political control, he had his own version of a National Research Foundation to recommend. Bush's Foundation was to advance research and training in all the natural sciences, including biology and medicine, and it was to have a division for long-range military research. His Foundation was also to be run by a part-time board selected and appointed by the President from the public at large. It was to be funded annually and subject to the normal fiscal controls of the government. Instead of supporting research by providing funds to participating universities automatically on a matching basis, it was to award grants and contracts for specific research projects.<sup>63</sup>

Yet however much Bush's interpretive summary departed from the reports of his committees, his final version ran no less contrary to Kilgore's approach on key points. If Kilgore's agency was to be governed by a coalition representing such interest groups as consumers and small businessmen, Bush insisted that his Foundation had to be governed by citizens selected only on the basis of their interest in and capacity to support the work of the agency. If Kilgore aimed to fund socially and economically useful research primarily in federal laboratories, Bush's Foundation was to support pure science in non-profit research institutions, mainly universities. If the military

[ p. 30a follows ]

research division in Kilgore's Foundation would be dominated by military men, in Bush's Foundation it would be controlled by civilians. Then, too, the director of Bush's Foundation was to be responsible to the part-time board, not to the President, which would make Bush's agency much less responsive to the political system than Kilgore's.

As a member of Bush's staff summarized his boss's agency, "While created by Congress, [it] is a new social invention -- of government sanction and support but professional guidance and administration." <sup>64</sup>

Going along with the Bowman committee on the more general issues raised by Kilgore, Bush proposed little more to help small business than technical clinics and a clarification of the tax laws as they affected industrial research. He acknowledged that "uncertainties" and "abuses" in the patent system had "impaired the ability of small industries to translate new ideas into processes and products of value to the Nation." But though Bush was of course deferring his full thoughts on the patent system to Secretary Wallace's study, he did suggest how he regarded Kilgore's insistence on governmental ownership of patents developed in the course of federally sponsored research. Bush proposed that the disposition of rights in patents deriving from work supported by the National Research Foundation should be left up to the discretion of the director, with the understanding that the public interest would normally be adequately served if the government received a royalty-free license for governmental purposes. <sup>65</sup>

By the beginning of June 1945 Bush had finished his report and sent it off to the printer. Science -- The Endless Frontier -- "new frontiers of the mind are before us," Oscar Cox had concluded his original draft of the letter from FDR to Bush -- was an eloquent, well-argued document which enjoyed the endorsement of Bush's four committee's, all of whose members found his changes in the institutional

mechanism of support acceptable. <sup>66</sup> Released to the public on July 19, it was also, as an OSRD staff member happily remarked, "an instant smash hit," applauded in scores of editorials across the ideological, partisan, and geographical spectrum. <sup>67</sup> On July 19, too, Senator Warren G. Magnuson of Washington introduced legislation based on the Bush report to establish a National Research Foundation.

But Bush's report was no smash hit with Waldemaer Kaempffert or the New Republic, which commented: "Research needs to be coordinated carefully and the projects should be selected in terms of our national necessities, and not the accidental interests of various scientific groups." <sup>68</sup> It failed to inspire Kilgore, who responded to Magnuson's legislative move by promptly introducing his own revised bill for a National Science Foundation. No less important, Bush's report received a decidedly cool response among officials in the Truman administration responsible for advising the President upon the reconversion of the country, including its science, to a peacetime footing. It was not just that Harold Smith, the Director of the Bureau of the Budget, wondered, only half-puckishly, whether the "Endless Frontier" implied the "Endless Expenditure." It was that many influential officials simply believed with James R. Newman, a high-ranking staff member of the Office of War Mobilization and Reconversion, that the proposals in Bush's report did "not fulfill the broad, democratic purposes which a Federal research agency should accomplish." <sup>69</sup>

Analysts like Newman recognized Science -- The Endless Frontier

for what in so many respects it was -- essentially a conservative response to Kilgore's liberal initiative. Bush was willing to endorse an end to laissez-faire in American science insofar as he was willing to put the government into the business of funding academic research. But while Kilgore's program aimed at organizing scientific research in the best interests of meeting the nation's social and economic needs, Bush essentially aimed at enlisting the nation's social and economic resources in the interest of advancing the best science. With Science -- the Endless Frontier, Bush had produced what in context was a political document, a textual weapon in the political battles already joined over the shape, purpose, and choice of federal policy for scientific research and development in the postwar era.

## FOOTNOTES

1. "A Visit with Vannevar Bush," Mosaic, I(Winter 1970), 10; Milton Lomask, letter, Science, October 12, 1973, p. 116.
2. I wish to acknowledge the aid of P. Thomas Carroll, Jr., whose senior thesis at Caltech contributed to the early exploration of this subject. The research for this paper was done in part with the support of the American Council of Learned Societies and the National Science Foundation (grant no. GS-39675). This article is the first of two on the origins of the National Science Foundation.
3. See, for example, New York Times, May 2, 1941, p. 15, March 11, 1942, p. 11; "The Bottleneck in Ideas," Fortune, 27(May 1943), 82-85, 177-86. U.S. Senate, Subcommittee of the Committee on Military Affairs, Hearings, Technological Mobilization, 77th Cong., 2d Sess., 1942, Vol. I, 159, 163, 169, 19, 42-44; Vol. II, 504-509.
4. "The Bottleneck in Ideas"; New York Times, April 18, 1942, p. 14.
5. Carroll W. Pursell, Jr., ed., The Military Industrial Complex (New York, 1972), pp. 165, 168-69.
6. U.S. Senate, Investigation of Concentration of Economic Power: Final Report and Recommendations of the Temporary National Economic Committee, 77th Cong., 1st Sess., Sen. Doc. No. 35, 1941, pp. 36, 32, 249, 269. For salient aspects of the controversy surrounding the relationship between the control of patents

- and shortages of critical materials, especially synthetic rubber, see the New York Times, February 23, 1942, p. 30; March 26, 1942, pp. 1, 16; March 29, 1942, p. 9; April 12, 1942, p. 48; April 15, 1942, pp. 1, 7; April 18, 1942, p. 32.
7. U. S. Senate, Subcommittee of the Committee on Military Affairs, Hearings, Scientific and Technological Mobilization, 78th Cong., 1st Sess., 1943, pp. 11, 25.
  8. Hearings, Technological Mobilization, 1942, pp. 67-68; Kaempffert, "The Case for Planned Research," American Mercury, 57(October 1943), 445.
  9. Kilgore, speech, May 10, 1943, copy in Records of the Office of Scientific Research and Development, RG227, National Archives, Washington, D. C. (hereafter, OSRD MSS), General Files, Cooperation: Kilgore Committee.
  10. New York Times, May 16, 1940, p. 24. For information on Kilgore's background and career, see Cyclopedia of American Biography, Vol. G(1946), 457-58; Congressional Record, Senate, Vol. 102, part 9, July 9, 1956, 12091-12112. I am indebted to Prof. Robert Maddox of Marshall University for sharing with me his doctoral research on Kilgore.
  11. Lyman Chalkley, "Prologue to the United States National Science Foundation (1942-1951)," pp. 5-8, Harley M. Kilgore Papers, University of West Virginia Library, Morgantown, West Virginia (hereafter, Kilgore MSS), file A&M 967, series 8.
  12. Henry H. Collins, Jr. and Herbert Schimmel to Senator Kilgore,

- August 14, 1942, Kilgore MSS, file A&M 967, series 1; Schimmel to the author, October 3, 1973.
13. Bruce Catton, The War Lords of Washington (New York, 1948), pp. 124-26.
  14. Schimmel to Kilgore, August 14, 1942, and New York Times clipping, August 12, 1942, reporting the proposed establishment of the agency in the WPB, Kilgore MSS, file A&M 967, series 1.
  15. The bill is printed in Hearings, Technological Mobilization, 1942, Vol. I, 1-4.
  16. Ibid., II, 537.
  17. Bush to Kilgore, December 7, 1942, printed in Hearings, Scientific and Technological Mobilization, 1943, 260-63. For the general arguments against the bill see Hearings, Technological Mobilization, 1942, passim.
  18. Hearings, Technological Mobilization, 1942, 273-88; Nelson also emphasized how the big corporations would come out of the war with a tremendous advantage if they controlled the patents for new products and processes developed at public expense in the course of defense research, and he agreed that the situation might be remedied if such patents were vested in Kilgore's proposed technological office, ibid., p. 280. The enlargement of Kilgore's legislative interest is clear from his correspondence, winter 1943, Kilgore MSS, file A&M 967.
  19. Kilgore, "The Science Mobilization Bill," Science, 98(August 13, 1943), 152.

20. The full text of the bill is in Science, 97(May 7, 1943), 407-412.
21. "The Science Mobilization Bill," p. 151; Kilgore et al to Byrnes, July 8, 1943, Kilgore MSS, file A&M 967, series 8; Hearings, Scientific and Technological Mobilization, 1943, pp. 25, 705-709.
22. Quoted in Hearings, Scientific and Technological Mobilization, 1943, p. 309. For typical expressions of opposition, see ibid., pp. 240-41, 245, 271; Walter S. Landis [Vice President of American Cyanamid Co.] , What's Wrong with the Kilgore Bill (privately printed, October 1943); Legislation . . . That Could Radically Change Our Whole Economic Structure (Commerce and Industry Association of New York, November 1943), copy in Kilgore MSS, file A&M 967; L.A. Hawkins, "Regimentation of Science," Electrical World, June 26, 1943, copy in OSRD MSS, General Files, Cooperation: Kilgore Committee.
23. See, for example, Julius A. Furer, "Memo for Files," March 26, 1943 and Ralph Bard to Chairman, Senate Committee on Military Affairs, June 2, 1943, Records of the Naval Coordinator of Research and Development, in Records of the Office of Naval Research, RG298, Federal Records Center, Suitland, Maryland, Kilgore bill file; Harvey H. Bundy to Colonel Ege, April 3, 1943, and attached documents, Records of the Office of the Secretary of War, RG107, National Archives, Washington, D. C., Entry 82, Box 73, Technological Mobilization bill.
24. Jewett to Bush, September 2, 1943, OSRD MSS, General Files, Cooperation: Kilgore Committee.
25. Karl T. Compton and Vannevar Bush, Scientists Face the

- World of 1942 (New Brunswick, New Jersey, 1942), p. 26. See also the Diary of Admiral Julius A. Furer, Julius A. Furer Papers, Library of Congress, Washington, D. C., April 9, 1942; John E. Burchard and Lincoln R. Thiesmeyer, Combat Scientists (Boston, 1947), pp. 84-86.
26. Frank Jewett testified in May 1945: "The whole thing is repugnant to the ordinary civilian-life ways of scientists-- the restrictions under which they have to operate and the cellular structure. The uniform experience in talking to all of the men who have given a lot of time and effort, to OSRD, is that they want to get out of this thing and get back to their work as soon as possible." U. S. Congress, House, Committee on Military Affairs, Hearings, Research and Development, 79th Cong., 1st Sess., May 1945, p. 58. See also Caryl P. Haskins, "Cooperative Research," The American Scholar, 13(April 1944), 223.
27. Conant, "Science and Society in the Post-War World," Vital Speeches, 9(April 15, 1943), 396-97.
28. Lyabrand Smith to J.A. Furer, March 19, 1943, OSRD MSS, General Files, Cooperation: Kilgore Committee.
29. Quoted in Kilgore, "The Science Mobilization Bill," Science, 98(August 13, 1943), 151.
30. L. A. Hawkins, "Regimentation of Science"; see also Hawkins to Kilgore, May 8, 1943, OSRD MSS, General Files, Cooperation: Kilgore Committee.
31. Review of Scientific Instruments, 14(July 1943), p. 195; "The

Mobilization of Science," Science, 97(May 28, 1943), 483;  
"Resolution of the Council . . .," ibid., 98(August 6, 1943),  
135-37.

32. Bush to E. B. Wilson, March 23, 1945, OSRD MSS, General Correspondence in re Reports to the President, Report #4; Carnegie Institution of Washington, Yearbook, 41(1941-1942), 4; Bush, "Memorandum on Some Factors to be Considered in the Post-War Organization of Scientific Research," attached to James B. Conant to Bernard Baruch, February 9, 1944, Bernard Baruch Papers, Princeton University Library, Princeton, New Jersey, Part IX, Section 1. I am indebted to Dr. Martin Sherwin for this last document.
33. Bush to Oliver E. Buckley, July 25, 1945, OSRD MSS, General Correspondence in re Reports to the President, #3; Bush, Pieces of the Action (New York, 1970), pp. 198-99.
34. Bush thought that the government might make it less expensive for small firms to defend a patent by supporting the firm's case in court. The law might also be modified to help small firms defend themselves against infringement suits by big firms: It would be a valid defense to show that, by exchange of patent rights in combination with others, the big firm had acquired more than a reasonable fraction of the market; if the plaintiff won, he would be awarded only royalties, not an order to cease and desist. Bush was even willing to go so far as to compel the licensing of patents held by large producers who were found to be participants in an exclusionary cross-licensing agreement. See, for example, Bush to Conway P. Coe, November 4, 1943, Vannevar Bush Papers, Library of Congress,

Washington, D.C. (hereafter, Bush MSS), Box 24, file 567; Bush to John T. Tate, February 8, 1945; Bush to Delos G. Haynes, February 21, 1945; Bush to Robert E. Wilson, March 10, 1945, OSRD MSS, General Correspondence in re Reports to the President.

35. Bush, "The Kilgore Bill," Science, 98(December 31, 1943), 571-77; Bush to A. A. Potter, July 1, 1943, attached to Bush to Kilgore, September 20, 1943, OSRD MSS, General Files, Cooperation: Kilgore Committee.
36. Bush to Frank Jewett, August 21, 1943, OSRD MSS, NDRC, Jewett O.F. 48.01; Bush to Thomas Barbour, January 17, 1944, OSRD MSS, General Files, Cooperation: Kilgore Committee.
37. The letter was printed as Bush, "The Kilgore Bill," Science 98(December 31, 1943), 571-77.
38. Kilgore, "The Science Mobilization Bill," Science, 98(August 13, 1943), p. 151.
39. George B. Pegram to Frank B. Jewett, June 2, 1944, OSRD MSS, General Files, Cooperation: Kilgore Committee.
40. U.S. Senate, Subcommittee on War Mobilization of the Committee on Military Affairs, Proposed Revision of the Science and Technology Bill, 78th Cong., 2d. Sess., November 10, 1944.

41. Ibid. A different and less sympathetic view of Kilgore's proposed legislation is suggested in A. Hunter Dupree, "The Great Instauration of 1940: The Organization of Scientific Research for War," in Gerald Holton, ed., The Twentieth-Century Sciences: Studies in the Biography of Ideas (New York: Norton, 1972), p. 461, and in Committee on Science and Public Policy, National Academy of Sciences, Federal Support of Basic Research in Institutions of Higher Learning (Washington, D.C.: National Academy of Sciences-National Research Council, 1964), p. 28. It is interesting to note that Kilgore's program may be construed to satisfy both the Cartesian and Baconian approaches to the organization of science discussed by Dupree.
42. Jewett to Bush, June 16, 1944; Bush to Lyman Chalkley, n. d., OSRD MSS, General Files, Cooperation: Kilgore Committee.

43. Cox to Hopkins, October 13, 1944 and October 18, 1944, Oscar S. Cox Papers, Franklin D. Roosevelt Library, Hyde Park, New York; the draft of the proposed letter is attached to Cox to Irvin Stewart, October 18, 1944, OSRD MSS, General Files, Postwar Planning.
44. Cox Diary, October 24, 1944, Cox Papers. It is interesting to note that a year earlier Bush wished that Kilgore would "ask some of us who have long given thought to this matter to draft an alternative bill. . . . The time is certainly approaching when it would be helpful to have a bill of this broader nature in the hopper." Bush to Jewett, October 27, 1943, Bush MSS, Box 56, Jewett file.
45. For the detailed story of the successive revisions of the letter, see Daniel J. Kevles, letter to the editor, Science, 183 (March 1, 1974), 798-800.
46. "New Stories and Editorial Comment on the President's Letter . . .," Franklin D. Roosevelt Papers, Franklin D. Roosevelt Library, Hyde Park, New York, OF 4482.
47. The letter is printed in Vannevar Bush, Science -- The Endless Frontier. . . July 1945 (Washington, D.C.: National Science Foundation, 1960), pp. 3-4.
48. "Notes on Meeting of the Chairmen and Secretaries of the Four Committees in Dr. Bush's Office on March 8, 1945"; Bush to

- J. A. Furer, OSRD MSS, General Correspondence in re Reports to the President, Miscellaneous.
49. The membership of all four committees is in Bush, Science -- The Endless Frontier, pp. 43-45.
50. Oliver E. Buckley to Bush, July 18, 1945, OSRD MSS, General Files, Public Interest, Industry.
51. "Notes on Meeting . . . March 8, 1945."
52. Bush, Science -- The Endless Frontier, p. 158.
53. Ibid., pp. 74, 78-80. Reverend J. Hugh O'Donnell, the president of the University of Notre Dame and a member of the Bowman Committee, reportedly justified the conclusion of conservatives like himself in favor of federal aid for academic research by noting that there were two kinds of sin, mortal and venial. "This is a case of venial sin. It can be forgiven in view of the good which it may do." Quoted in Oliver E. Buckley to Bush, July 18, 1945, OSRD MSS, General Files, Public Interest, Industry.
54. Bush, Science -- The Endless Frontier, pp. 79, 75.
55. Ibid., p. 109; Edwin H. Land to the author, August 13, 1973.
56. Bush, Science -- The Endless Frontier, pp. 107-12.
57. Ibid., pp. 49-51, 137-41, 189-92.

58. Carroll L. Wilson to Richardson Wood, May 21, 1945; Wilson to Bethuel M. Webster, May 23, 1945; anon., "Points in Common in All Reports," n.d., OSRD MSS, Correspondence in re Reports to the President; Bush to W. W. Palmer, et al, May 31, 1945, OSRD MSS, NDRC, Jewett O.F. 48.00.
59. Bush to Oliver E. Buckley, June 9, 1945, OSRD MSS, General Correspondence in re Reports to the President, Report No. 3. For the effort to establish a civilian-run peacetime program of defense research, see Daniel J. Kevles, "Scientists, the Military, and the Control of Postwar Defense Research: The Case of the Research Board for National Security, 1944-46," Technology and Culture, 16 (Jan. 1975), 20-47.
60. Bush, Science -- The Endless Frontier, pp. 115-17. Dykstra is quoted in W. Rupert Maclaurin to Bush, May 14, 1945, OSRD MSS, General Correspondence in re Reports to the President, Report No. 4.
61. Wilson, "Notes in Connection with Bush Report . . .," May 22, 1945, OSRD MSS, General Correspondence in re Reports to the President.
62. See Harold Smith to James B. Conant, March 30, 1945, attached to Smith to Franklin D. Roosevelt, March 30, 1945, Harold D. Smith MSS, Franklin D. Roosevelt Library, Hyde Park, New York, White House Memoranda Box. Apropos the issue of stability in funding, Arnold Miles, a member of the Bureau of the Budget, expressed the attitude common among his colleagues: "I'm afraid the scientists will have to learn to take their chances like everybody else, even though it means that they get less support and have to work harder for it." Don K. Price, who had been detailed from the Coast Guard to become the chief Budget staffer for scientific research,

successfully urged Carroll Wilson to incorporate in the final version of the report textual changes which were designed to sharpen the point that, to use Price's phrasing, the proposed program "must be responsible to the President and the Congress. Only by such responsibility," Price added, "can we maintain the proper relationship between science and other aspects of a democratic society." Arnold Miles to Paul David, March 19, 1945; Price, memo detailing revisions dictated to Wilson, n.d., [ June 1945 ] , Records of the Bureau of the Budget, RG51, National Archives, Washington, D. C. , Series 39.32, file E8-20/45.2. See also Price to Colonel David L. Robinson, June 16, 1945, ibid., file E8-20/43.1.

63. Bush, Science -- The Endless Frontier, pp. 34-40. President Truman of course vetoed the NSF bill passed in 1947, which Bush generally favored, not least because it was to be governed by a part-time board rather than a Presidentially appointed administrator. Don K. Price recalled that at the urging of the Budget Bureau, Bush at first proposed a chief administrator, presumably appointed by the President, to run the Foundation along with the part-time board; but Bush eliminated the administrator in the final draft because of protests from some of his committee members. Don K. Price to the author, Nov. 21, 1973. Price's recollection is substantially, though not exactly, supported by "Project Completion Report: Government Organization for Scientific Research - Project AM-220," Dec. 29, 1945, p. 2, Records of the Bureau of the Budget, Series 39.32, file E8-20/45.1.
64. Ibid., pp. 32-40; Laurence K. Frank, "Comments on Bush Report . . . ," OSRD MSS, General Correspondence in re Reports to the President, Miscellaneous.

65. Bush, Science -- The Endless Frontier, pp. 21-22, 38.
66. Draft letter attached to Cox to Irvin Stewart, October 18, 1944, OSRD MSS, General Files, Postwar Planning; Bush, Science -- The Endless Frontier, p. 2.
67. Lyman Chalkley to Carroll L. Wilson, July 20, 1945, OSRD MSS, General Correspondence in re Reports to the President, Distribution: "News Stories and Editorial Comment on the Postwar Program for Scientific Research," OSRD MSS, Director's Files, Postwar Planning Reports.
68. "A National Science Program," New Republic, July 30, 1945, p. 116.
69. Smith to Carroll L. Wilson, July 18, 1945, Records of the Bureau of the Budget, Series 39.27, Box 82, OSRD file; J. E. Doyle and J. R. Newman to Judge Fred Vinson, June 26, 1945, Records of the Office of War Mobilization and Reconversion, RG250, National Archives, Washington, D. C. , Box 277, Research Board for National Security file. Truman approved the recommendation of Vinson, which originated with Newman and Doyle, to transmit Bush's report to the Congress without comment and to appoint his own committee to look into the matter of postwar federal science. It was generally understood in Newman's Office that the President preferred legislation along the lines of the Kilgore bill. See Vinson to the President, n.d. [ July 1945 ] , ibid. and Newman to John W. Snyder, August 8, 1945, ibid., Box 275, Legislation . . . Scientific Research file.