The elegant front door of America's science brain bank.

WILL THE SCIENCE BRAIN BANK GO CONGLOMERATE?

DURHAM, N.C.

Legend says that the National Academy of Sciences was invented by Abraham Lincoln to help steer the United States of America safely through a potentially disastrous crisis of identity. According to this piece of folklore, Mr. Lincoln was aided and abetted by farseeing Congressmen who understood the role of science in human enlightenment. That it didn't happen that way; that the Academy actually was conceived by a scientific cabal and authorized by a law passed unwittingly in the dying days of a lameduck Congress; that the one legislative sponsor of the law never showed any interest in science before or after; that the first reaction of scientists outside the cabal was outrage over the betrayal of democratic principles in provision of a self-perpetuating Academy membership—these historical details are overshadowed by the practical fact that Mr. Lincoln did sign the law and so became the Academy's creator.

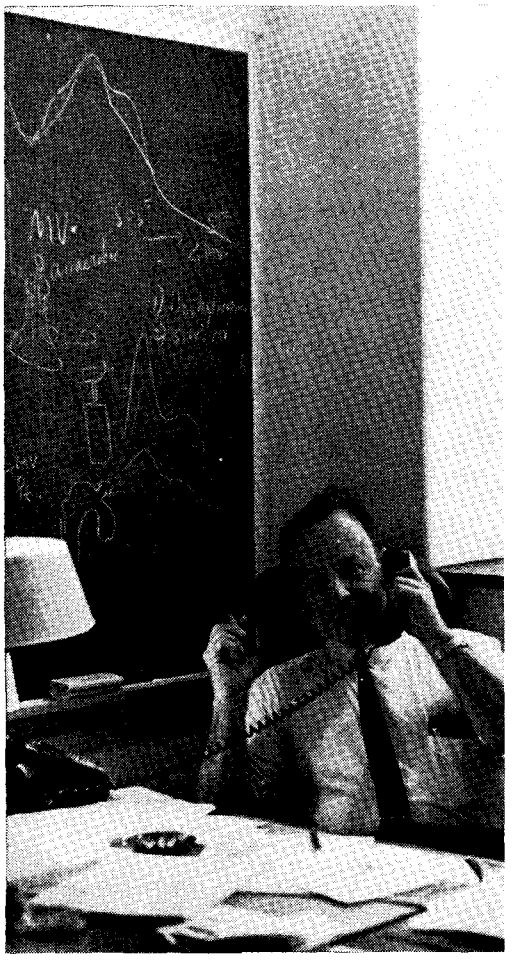
A few more than a hundred years have passed since that event, and the American people again are in the throes of a historic schism. To the extent that it can be described in blacks and whites, the present-day split is a simple extension of that earlier one, and I find a curiously stimulating symbolism in coming here to try to learn whether the National Academy of Sciences is better prepared than it was a century ago to serve the democracy into which it was born.

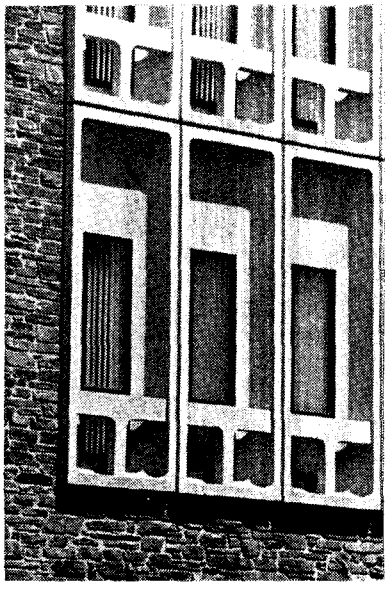
The real end of the Civil War occurred about four miles from here. The Union Army of Gen. William Tecumseh Sherman and the Confederates commanded by Gen. Joe Johnston were still deployed across the countryside when Robert E. Lee formally capitulated to Ulysses S. Grant at Appomattox Court House. The opposing troops continued to confront each other for several weeks after that before their leaders concluded the final agreement to lay down arms. During the interval of suspended violence, an itinerant peddler named Washington Duke packed tobacco back and forth on his mule, selling the stuff indiscriminately to the Blues and to the Grays.

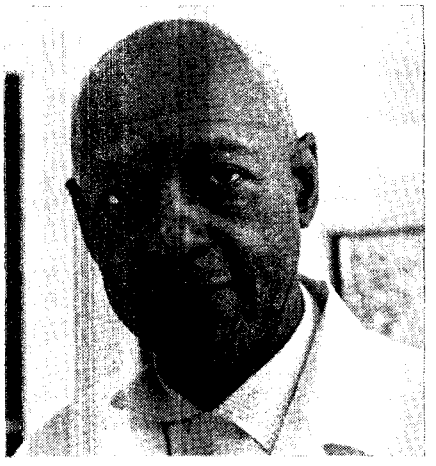
After the soldiers were mustered out and sent home, they grew nostalgic for Mr. Duke's tobacco and ordered it by mail—from North and South alike. The address they used was "Dr. Durham's Store." The store may or may not have been run by a doctor, but the tobacco was supplied by Mr. Duke. To keep the orders coming, he identified the brand as "Bull Durham."

Half a century later, the Duke family owned so vast a part of the cigarette industry that James Buchanan Duke, Washington Duke's son, was characterized by the Supreme Court of the United States as a personal monopoly in restraint of trade; he was instructed by the Court to divest himself of his monopolistic trappings.

Mr. Duke dutifully sold his stock in three cigarette manufacturing companies, using the considerable proceeds to buy, at bargain prices, patches of wilderness bordering various waterfalls along the entire length of the Allegheny Mountain chain. As he had foreseen, these falls soon became desirable sites for generation of electric power. Ultimately, the Duke Power Company grew many times more prof-







Philip Handler (top) in his Duke lab (facade, left); Sam Sellers, lab's oldest worker (above); Handler's first graduate student, Professor Henry Kamin (right).

fitable than the tobacco monopoly once embodied in James Buchanan Duke's person.

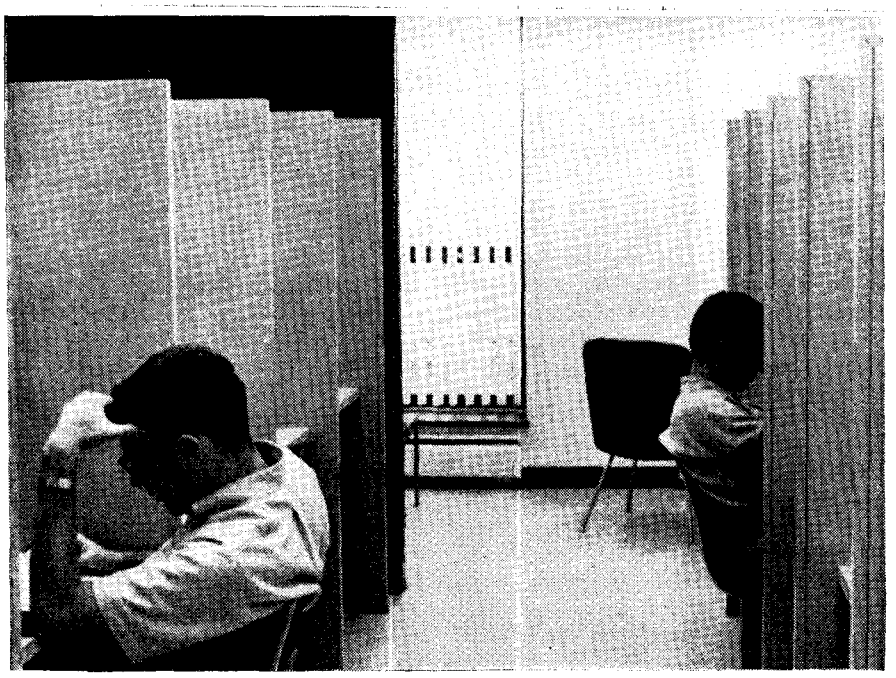
Among the many recipients of Mr. Duke's generosity was Trinity College, a small Methodist school near the farm where he was born. A year before he died in 1925, he indentured a portion of his millions for the conversion of Trinity College into Duke University. Thanks to his largess, Duke University today has a 7,000-acre campus, including the only forest in the country with a forestry school of its own to experiment in its management. Strung neatly across a big clearing in the forest are some buildings called "science row." At the end of the row is an architectural innovation not easy to classify: Duke's home for basic science, in which is housed the distinguished faculty chair of the James B. Duke Professor of Biochemistry. About to vacate this chair on indefinite leave of absence is the retiring chairman of Duke's Department of Biochemistry, Professor Philip Handler, who will spend at least the next six years in Washington, D.C., as president of the National Academy of Sciences.

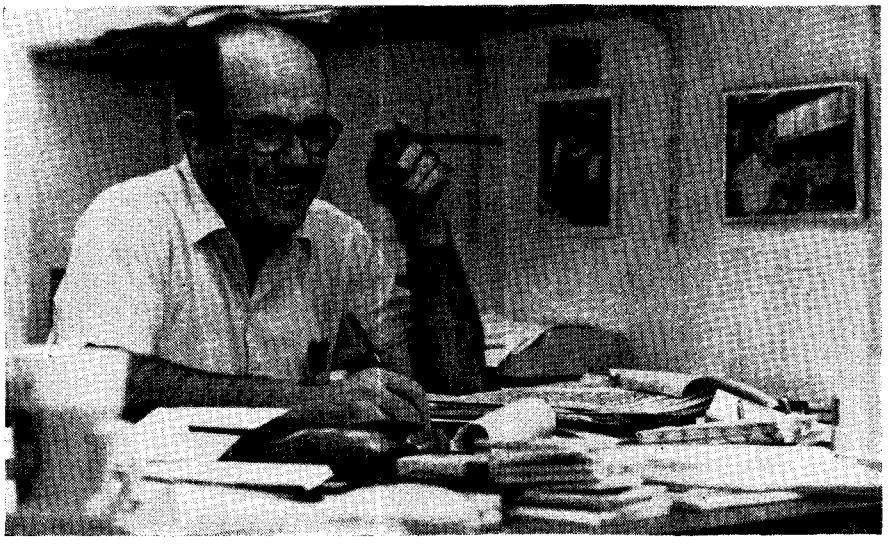
I have placed the new Academy president in the long perspective of history because that is the perspective in which he presented himself to me. He plainly believes in something that too many modern scientists ignore: the inability of human greatness to thrive in isolation. Relating to the "surround" is to him an imperative that asserts itself at every turn. He knows that he owes his Academy election to his work at Duke and to events that stemmed naturally from it. He knows, too, that he could not have done what he did at Duke if the Civil War had not ended within the reach of Washington Duke's mule.

The great Depression that almost paralyzed the country in 1929 was still being felt in 1939, and jobs of any kind were hard to locate when Handler first came to Durham. Appointments to university faculties were even harder to arrange. Handler considered himself lucky to get an instructor's post at Duke, even though the school was then known only for two Rose Bowl football teams and for Professor J. B. Rhine's studies of extrasensory perception.

Duke, it turned out, was also lucky to get Handler. Born on a New Jersey farm, son of a man with a mechanical bent, he somehow acquired—perhaps intuitively from his father—an intense interest in gadgets. With the family's move to Brooklyn when he was in the fifth grade of public school, he began lugging home from the public library armloads of books about science—up to seven at a time, he recalls. The specific subjects did not matter much, as long as they were scientific. His sense of community soon propelled him into a decision to become a physician.

In the last year of a pre-med course





Dr. Philip Handler's photographer son Mark, from the staff of the "Chapel Hill Weekly," took these pictures and those on the page opposite during a visit to his father's lab. Mark found genetics professor Samson Gross (left) in a relaxed mood, new graduate students reading intently (top left) while awaiting assignment of individual lab space, and a stairway to the stars.

at the City College of New York, he discovered a new language he had never heard—or heard of—before. One of CCNY's timeless teachers, Benjamin Harrow, spoke it eloquently. It was biochemistry: the only language, Harrow said, in which living things could be discussed and understood.

Handler at that time was not yet eighteen years old. He had one whole year to devote to study of the biochemical tongue before going to medical school. But where would he do the studying? Harrow suggested the University of Illinois. William Rose was there. Rose had just discovered threonine, the last of the essential amino acids. His feat was the hottest gossip item in the chemical world. So, with Harrow's backing, Handler applied for and obtained the chance to become one of Rose's graduate students.

Since the amino acids are the building blocks from which proteins are made, it was inevitable that Handler's graduate work should be with proteins. It divided itself into a practical phase and a theoretical phase. The practical phase involved interactions of proteins with formaldehyde and their implications for the making of better adhesives and plastics. Ford was already beginning to mold motorcar dashboards from soybeans. As a junior chemist in the Regional Soybean Byproducts Laboratory of the United States Department of Agriculture, Handler learned enough about the processes to obtain two patents which he sold to the Government for "one dollar and other considerations." He remembers collecting the dollar. He still wonders about the "other considerations," but doesn't brood over them because of the incalculably greater rewards he has won from the theoretical aspects of his study. He left Rose's laboratory with a Ph.D. that stamped him as one of the few young men in America with a thorough understanding of the metabolism of amino acids. He had metamorphosed from a biologist intent on learning the language of chemistry to a chemist determined to use the new language to interpret living systems.

Handler had metamorphosed in several other ways. Being quick with his hands and light on his feet, he had taken a brief fling at boxing. It ended with a terrible beating he has never forgotten. Gifted with a fine singing voice, he had gone on stage for a time as a college band accompanist. He still enjoys playing to an audience and still sings on occasion. But the only person whose applause he really cares for is his wife Lucille (nee Marcus), who captivated him from a distance in the lobby of Manhattan's Biltmore Hotel thirty years ago.

The Biltmore elevators in those days were openwork iron cages. When he saw her stepping into one, he jumped into the one beside it and dramatically

ordered the operator to "Follow that elevator!" He got off the car just in time to see her disappearing into a room down the hall. Violating all the rules of personal conduct that his parents had taught him, he knocked on her door and was quickly advised that her mother had warned her to stay clear of the bold adventure-seekers of New York. Later, back at the University of Illinois, he discovered that she lived a mere campus block away. She married him in time to share his beginnings at Duke here in Durham.

In eight Southern states at that time, the leading cause of death was pellagra. A non-contagious disease, it began with body weakness, mental apathy, loss of appetite, indigestion, and extreme nervous irritation. The skin of victims would roughen, watery diarrhea would develop, headache and depression would follow, then confusion and hallucinations, disorientation in time and place, and finally death.

At Duke, a Cambridge-trained Englishman, William John Dann, was doing research on pellagra under a grant from the Markle Foundation. Handler joined Dann's hunt for vitamins that might solve the pellagra puzzle. They concentrated on nicotinic acid long enough to establish that it was a component of two co-enzymes in the catalytic process that led to the disease. But they could not trace, in any step-by-step fashion, the avenues through which the vitamin worked.

In dogs, the analogue to human pellagra was called "black tongue." Trying to help the pellagra victims, Handler did laboratory experiments on dogs. He noticed that as the black tongue progressed, the animals became severely dehydrated. He decided that death must be due to dehydration. By putting the dogs on a diet heavy with salt and water, he caused the black tongue to disappear. But six months later, the dogs would be down to skin and bones. At autopsy he found shriveled livers.

Obviously, black tongue and its human analogue, pellagra, were nutritional disorders. The victims must be dying of the weakest link in the nutritional chain. What was that link? The classical diet of the southeastern states was fatback, cornmeal, and molasses. However, the southeastern United States was not the only part of the world scourged by pellagra. The disease also took a heavy toll in Italy, Spain, and Egypt. In these countries, the diet had been found to contain a substantial amount of nicotinic acid. Lack of nicotinic acid then could not be the whole answer to the pellagra puzzle. In the mid-1940s, the Duke researchers developed a synthetic diet that included no nicotinic acid. The diet was varied in repeated experiments. When protein was low, the animals died with shriveled livers without developing black tongue. When the protein was high, the dogs lived on.

With these facts in hand, it was possible to piece together the real story of pellagra—after results of related research at the University of Wisconsin were in place. At Wisconsin, experiments were done on rats. The rats proved not to need nicotinic acid in their diet; they made their own. Therefore, it was not enough to add nicotinic acid to the diet to cure pellagra. The diet also had to include whatever it was that the rats used to make nicotinic acid. This turned out to be tryptophan. In the end it was the tryptophan that put pellagra into its true perspective. Corn had very little tryptophan in it. Pellagra, basically, was a corn-eating people's disease.

In the course of those experiments, Handler and his research associates immersed themselves ever deeper in the secrets of life. They learned, for example, that the mammalian body follows a strict and rigorously logical system of priorities in the use it makes of protein available to it. The first priority goes to manufacture of hemoglobin, the chemical in red blood cells that carries energy-giving oxygen to the tissues. The second priority is given to the making of blood plasma proteins: the albumin that prevents the arteries and veins from leaking, the globulins that carry antibodies to fight off infection, the fibrinogen on which clots form in times of crisis. Not until these fundamental requirements of survival are met does the body divert incoming protein to the rebuilding of tissues.

Far down at the molecular level of life, Handler studied the movement of electrons and found—as other scientists did—fascinating parallels between the internal happenings in proteins and the events that follow capture of light by the chlorophyll in green plants. He devised ways of putting enzymes to work on tailoring molecules especially for laboratory purposes. He performed experiments that strongly suggested a common genetic ancestor for men, flounders, and rabbits, as well as chickens, sweet potatoes, and microbes.

Three years after coming to Duke, Handler was an assistant professor of physiology and nutrition at the School of Medicine. Three years after that, he became associate professor of biochemistry. After five more years, he was professor of biochemistry and chairman of the biochemistry department. Eleven years later came the honor of assuming the James B. Duke chair.

Given native imagination, thorough

—National Academy of Sciences.

Dr. Detlev Wulf Bronk—"the most imaginative president the National Academy of Sciences has ever had."

intellectual preparation, and a rare degree of determination, it is not overwhelmingly difficult for a virile personality like Philip Handler to drive up through the hierarchy of academe. But the National Academy of Sciences is the science brain bank of America. Its internal workings are as obscure to most people—indeed, to most of its members—as is the elaborate decision-making apparatus of the Vatican. How did Handler become president of the Academy only five years after his own election to Academy membership?

There was precious little time for internal politicking, even if he had held minor Academy office as a base of operations. And he held no Academy office whatever prior to the placement of his name on the ballot for the presidency. In all the thousands of words that have been written about his accession to this high office on July 1, no reasonable explanation of the phenomenon has appeared. I asked Handler if he would tell me how it came about. He says he isn't entirely sure, but he thinks the process began with an accident of timing like the one that put Mr. Duke's mule where it was at the close of the Civil War.

It seems that the American Society of Biological Chemists was looking for a secretary at the time Handler was moving into the chairmanship of Duke's biochemistry department. Since scientific societies are chronically short of funds for administrative purposes, the biological chemists were focusing their search on institutions that might provide free space for the secretary's office. Duke University had seldom reflected any pinching of funds. As its

—*Fabian Bachrach.*

Dr. George Kistiakowsky, after visiting India, begged President Eisenhower "to do something to dramatize" birth control.

new chairman of biochemistry, Handler was a prime candidate for secretary of the chemists, a job he accepted just in time to square off with the late United States Senator from Wisconsin, Joseph McCarthy.

McCarthy was insisting that all scientists receiving government funds in support of their research should sign loyalty oaths. Handler's mind was too independently disposed to consider any such restriction. He drafted an opposing resolution that other scientific societies copied after the chemists passed it. The effect was multiplied by Handler's old conviction that science had to seek the understanding and acceptance of the surrounding community. For the first time in years, the American Society of Biological Chemists published a brochure to encourage the young to take up biochemistry as a career. It also began to invite to its meetings lecturers from other scientific disciplines and even from precincts of culture beyond the borders of science.

As secretary of the biological chemists, Handler automatically became involved in the affairs of the Federation of American Societies for Experimental Biology. As a functionary of the federation, he was a natural choice for membership in the biochemical study section of the National Institutes of Health: the advisory panel that decides on the worthiness of applications for NIH grant money. As a member of this advisory panel, Handler acquired the biggest audience he ever played to. He wrote his own lines and delivered them with emphasis that came from the heart.

In his own research at Duke—whether it had to do with pellagra, alleviation of severe burns, the purine breakdown products of DNA-RNA, parathyroid tumors, or the relationship of a rice diet to pituitary hormones—Handler had seen the virtual impossibility of predicting where a chosen line of research would go, even when the line originally had been directed along a particular path. As a member of the NIH advisory panel, he witnessed the degrading spectacle of reputable scientists parading patent falsehoods before their government patron. These transparently contrived lies were fabricated to get around a law that said NIH could grant no money for projects not clearly related to the mission of NIH, which was to say the clinical treatment of disease. Handler endured patiently for a while; then his intellectual integrity staged a rebellion.

There simply had to be a way to ask honestly for money for research that could promise no foreseeable outcome. He went privately to Senator Lister Hill of Alabama and then to Representative John Fogarty of Rhode Island, the two most conspicuous champions of federal subsidy for biomedical research, and laid his proposition before them. At the next session of Congress, a limited appropriation was put through for the specific purpose Handler sought. Later, a brand new institute was added to the National Institutes of Health—the National Institute of General Medical Sciences—as a clearinghouse for basic research projects. That agency today spends more government research money than any other arm of the health establishment.

Even before the new engine of medical science financing was installed, Handler had acquired heroic proportions in the eyes of fellow scientists, especially the biologists. Who could better represent them in their pleas for support from the National Science Foundation? Almost as a matter of course, Handler became a member of NSF's biological research facilities panel, then a member of its divisional committee for biology and medicine. Presidential appointment to the National Science Board—the group that sets NSF policy—followed, and after that the vice chairmanship and finally the chairmanship of the board. Handler was plainly "Mr. Biology of America."

Handler was elected to membership in the National Academy of Sciences in 1964, the same year in which he was appointed to the President's Science Advisory Committee. It is not true, despite frequent repetition of the story, that he was the first representative of the life sciences to sit among the White House elite. The original spokesman for the biological sciences on PSAC was Dr. Detlev Wulf Bronk, the longest tenured and by far the most imaginative president the Academy of Sciences has ever had.

Bronk came out of the old Academy tradition, which held that the prestige of membership was all that truly mattered. Scientific advice was given to the Government, as provided by the charter Lincoln signed, only upon request and then reluctantly. On a single occasion, at the outbreak of World War I, the honorable assemblage roused itself to perform a major service to democracy by attaching to its body a workaday arm, the National Research Council, which helped to repulse the Kaiser's armies. When World War II roared over the horizon, this working arm had gotten so little interim exercise that its muscles were atrophied; President Franklin D. Roosevelt therefore bypassed the Academy and summoned a former Massachusetts Institute of Technology dean of engineering, Dr. Vannevar Bush, from the Carnegie Institution of Washington to put together an Office of Scientific Research for Defense.

Bronk could not entirely escape this musty tradition; he had belonged to it for too long, first being the Academy's foreign secretary and then the president of NRC. Loyalties won during that extended service put him into the Academy presidency by a voice vote from the floor in opposition to the notable named on the formal ballot: Professor James N. Conant of Harvard. But none of that could block Bronk's vision, which had an enormous range. In pursuit of it, he broke Academy precedent repeatedly.

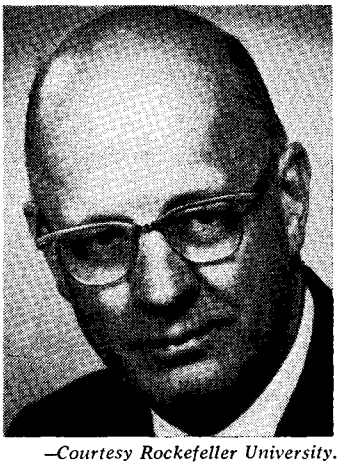
Bronk habitually quotes Francis Bacon and Benjamin Franklin in support of the principle that science cannot for long recognize national boundaries or prejudices. It is for this global view that he would prefer to be noticed in history books. Seen in this perspective, his most remarkable action as Academy president was taken privately. In personal conversation with John D. Rockefeller 3d, he suggested the wisdom of studying ways and means of slowing down Earth's rapidly proliferating population. Not long after that talk, Rockefeller money baptized The Population Council.

Thus the groundwork was laid for unpremeditated performance of a prodigy by the inscrutable workings of the Academy apparatus. The performance itself did not begin until an eminent Academy member, Harvard chemist George Kistiakowsky, became the late President Dwight D. Eisenhower's chief science adviser. On a

—U.P.I.

Congressman Emilio Daddario of Connecticut (opposite), looking for a way to set priorities for science spending, sought help from Academy president Frederick Seitz (immediately below) and Academy's COSPUP chairman Harvey Brooks (below, left). Academy thus acquired a broader mandate to attack the problems of a divided society. Philip Handler, new president of the Academy, has inherited this mandate. Can he execute it?

—Courtesy Harvard University.



—Courtesy Rockefeller University.

presidential mission, Kistiakowsky visited India for the first time in his life. He came home appalled by the poverty and suffering imposed by the sheer numbers of India's people. He begged Eisenhower to do something to dramatize the importance of birth control. Eisenhower refused "to intrude into peoples' bedrooms."

Immediately upon his retirement from presidential service, Kistiakowsky appealed to Bronk to take the initiative that Eisenhower had rejected. As godfather of The Population Council, Bronk had no difficulty in wheedling from the Council a grant of $5,000 to pay the expenses of an Academy study of the population explosion.

Having lifted a weight from Kistiakowsky's conscience, Bronk felt free to invite Kistiakowsky to reciprocate. Bronk's own conscience was laden with the gist of a series of letters that Kistiakowsky had written to him before the end of the Eisenhower regime.

The letters pointed out that government spending for science, which had been escalating steadily for a long period, would have to be slowed. Other sectors of society desperately needed money to attack immediate and threatening problems. What could the Academy do to help set science priorities? Kistiakowsky had tried to persuade one richly supported scientific discipline— high energy physics—to take a hard look at itself in relation to the culture enfolding it. The attempt was a dismal failure. Could the Academy possibly establish an overview committee of broad-gauged men to do an across-the-board audit of science?

Recalling that exchange of correspondence, Bronk now offered to appoint some such committee if Kistiakowsky would chair it. To sweeten the bait, Bronk stipulated that the committee's initial assignment would be a population study entailing a broader standard of public service for the Academy.

Kistiakowsky accepted the assignment. Bronk named what later became a standing Committee on Science and Public Policy (COSPUP). A report on the global population crisis was issued, and when it was criticized for advising other nations to do what Americans themselves seemed to have no serious interest in doing, a second report was specifically aimed at the population problems of the United States. In it, for the first time, a prestigious scientific body recommended publicly that the federal government subsidize distribution of explicit birth control information to the citizenry.

After a dozen years of life under two successive chairmen (Kistiakowsky and Harvard Professor Harvey Brooks) and two Academy presidents (Bronk and Dr. Frederick Seitz), COSPUP today still falls short of functioning as a clearinghouse for science's responsibility to society. COSPUP has not even been involved in two of the most significant Academy actions of recent years: the classification of useless drugs to be ordered off the market by the United States Food and Drug Administration under the Harris-Kefauver Law, and the report that said supersonic transport planes should not be allowed to rake the countryside with thunderous booming by flying overland. COSPUP is not geared to motivate the work of either the Academy's highway research board or its building construction research board, both of which ought to be making fundamental contributions to solution of the urban crisis. But to say this is not to say that COSPUP has been moribund. No one who takes the trouble to look closely at the record can fail to feel the spirit of public service pervading the headquarters of COSPUP's hard-working secretary, Robert Green, a young Kansan who preserves the Midwestern trait of plain speaking and direct dealing.

It was Green who, at Kistiakowsky's instigation and with the subsequent encouragement of Brooks, began exploring a path on which he met congressional committee staffman Philip Yeager halfway. Yeager, under instructions from Connecticut Congressman Emilio Daddario's subcommittee of the House Committee on Science and Astronautics, was looking for the best scientific advice he could get on priorities for congressional action in support of science. Green was looking for a respectable chance to broaden the area of receptivity to suggestions the Academy might generate through COSPUP. Up to that time, virtually all the Academy's advice had been funneled into departments of the Executive branch of the Government. Congress had been shunned as a treacherous nest of selfish opportunists.

Through Yeager and Green, Daddario invited COSPUP and other key Academy members to relaxed backyard gatherings at his home. Dr. Frederick Seitz, who by that time headed the Academy hierarchy full time, moved more warily, asking members of the Daddario subcommittee to formal Academy functions. Gradually, the scientists came to see occasional good in the politicians, while the politicians came to believe that the scientists were human. At last, Daddario felt

sufficiently confident of the growing bond of mutual trust that he asked for a COSPUP report on how Congress should order its appropriations for basic science.

Though adroitly disguised in baroque semantics, this was the old issue of priorities that the Academy always had avoided. COSPUP avoided it, too, turning in what amounted to a reminder that the setting of priorities was properly the business of the Congress. Daddario tried again, asking COSPUP for a report on appropriate directions for applied research to follow. Again, COSPUP dodged consensus but did come up with a varied batch of approaches. Daddario tried a third time, appropriating money for two different studies of the feasibility of predicting and attempting to forestall undesirable social effects of technology. One study was assigned to COSPUP, the other to the National Academy of Engineering, which had been organized in the year 1964 under the charter of the Academy. Due to be published before the end of the summer, these reports will reflect the Academy's adjustment to the social crisis.

The slow accretion of the COSPUP concept is undoubtedly related to Philip Handler's election as president of the Academy. Such respected and popular scientists as *Science*'s editor Philip Abelson, COSPUP chairman Brooks, and Academy foreign secretary Harrison Brown would not have withdrawn their names from the nominating list as early as they did without first assuring themselves that the honor and authority of the presidency would not be jeopardized. All these men were aware that the Academy staff and membership had been violently split for several years over the tardiness of what one of the elder statesmen delicately describes as "certain evolutionary changes." Put briefly, these changes would work for more selective acceptance of government requests for advice, greater independence of judgment in rendering the advice, and a much greater involvement of the whole membership of the Academy in the shaping of the advice. Perhaps the most significant action taken by Handler's predecessor in the Academy presidency, Dr. Seitz, was initiation of an endowment fund drive designed to make Academy operations less dependent on government fees, which now total 85 per cent of the Academy's operating budget.

In conversation with me here, Handler has confirmed his personal belief in the desirability of a major evolutionary change. His thinking begins with the fact that the Academy membership as presently constituted is far from reflecting the scope of prevalent social concerns. Although England has only a fraction of the population of the United States, the Royal Society of London has as many members as the Academy does. Although there are a hundred medical schools in the United States, with a total faculty many times that number, the Academy has only twenty-two medical men on its rolls. The NRC, on which the Academy depends for the bulk of its work, is organized by traditional scientific disciplines, whereas most of the challenges society now presents to science require interdisciplinary responses.

To an outsider, solution of the dilemma seems easy. Having worked all his life within science, Handler knows the opposite is true. He obviously cannot say to his Academy colleagues, "Let's not elect any more physicists as members until the biologists and the social scientists catch up." Social scientists especially must be recognized. A handful of them are in the Academy now, and Herbert Simon has made skillful use of their talents in the behavioral science unit he heads. But his lack of a larger and broader constituency has stopped the Academy from approaching many problems. What Handler has to devise is an unabrasive way of making up the deficit. At least a year or a year and a half will be required for preliminary reconnaissance. The speed of what happens after that will be determined to a considerable degree by what happens in Vietnam. Without peace, science will have no more new money to spend than anyone else.

Handler has already demonstrated where he stands on the issue of the war by flatly declining a request that he serve on the scientific research advisory board of the Pentagon. Retiring Academy President Seitz had not only sat on this board but had served as the board's chairman for several years. Seitz told me the Academy presidency automatically carries with it ex officio membership on this Pentagon body. Nevertheless, Handler has declined to serve on the grounds that he has no competence in military thinking.

Under the Handler regime, Congressman Daddario may get more sharply pointed advice from the Academy than he has bargained for. For Handler has observed that the Academy charter, thus far interpreted to allow only passive reaction to government requests for help, actually contains no prohibition against initiative from the Academy.

Handler is already known for willingness to seek out inconspicuous staff people three and four tiers down from the names that make the news. He is equally at ease at the top of the heap, and enjoys playing song-and-dance man when such performance holds promise of a payoff. The chairman of the committee on which Daddario serves —Congressman George Miller of California—once interrupted a formal hearing to praise Handler's rendition of "On the Road to Mandalay." Miller insisted that Handler was the only man in Washington who knew all the words to that rollicking ballad. But Handler told the people at the hearing that Miller knew the words every bit as well; he and Miller had sung them together many times.

By pulling more scientists into the act, Handler may to some degree be able to dissipate a persistent cause of dissatisfaction with the American scientific advisory apparatus. This is the occupancy of overlapping jobs by powerfully placed individuals. A student of government who speaks more bluntly than most of his colleagues points out that "Detlev Bronk, Harvey Brooks, Philip Handler, and many others have given the Government supposedly disinterested advice from the Academy and then have implemented that advice as policymaking members of the National Science Board, thus establishing the principle that a reigning scientist may both advocate and

THE REAL LIMITS

MOST OF OUR social problems are not science-limited. By "science" I mean an understanding of the physical world as distinguished from the social world. There is not much more we have to know about science in order to be able to deal with these problems. The limitations are social, political, and economic rather than scientific.

We need the will to solve the problems and the mechanisms to get at them.

Second, we need to bring together creative persons who, on the one hand, are able to understand the needs of the society in which they live, and, on the other, are sufficiently familiar with the techniques and capabilities of science to be able to invent politically and socially feasible solutions.

Changing a society is always difficult, and the fellow who does that changing must be willing to take personal risk.

—J. HERBERT HOLLOMON,
in *Education for Innovation*,
(Pergamon Publishing Company, $6).

J. Herbert Hollomon was assistant secretary for science and technology, U. S. Department of Commerce, and is now president, University of Oklahoma.

judge his own cause." Handler says he will continue as a member of the National Science Board but will resign the chairmanship of the board and a directorship he has held in the Squibb-Beechnut Company.

Whether the National Academy of Sciences will prove adequate to the needs of today's divided society is an open question. In preparing this report, I asked the opinions of a selected group of scientists, scientific administrators, and legislators concerned with science as a social force. One influential Senator said: "It may be preferable for Congress to inquire into the nature of the mandate it gave this organization so casually a century ago."

As I noted earlier, the Academy charter has already been employed to cover the creation of a National Academy of Engineering. Before very long, the realization of an Academy of Medicine may be expected under the NAS aegis. Will even those institutions together be enough? Handler has considered the problem and occasionally has dreamed—he won't discuss it except as a dream—of a single American Academy to serve all sectors of the society equally. Such a conglomerate seems far in the future, but it may be the only alternative to disintegration.

An embryo that could grow into an American Academy has been in being since 1944. It is the Conference Board of Research Councils. Once a year, sometimes more often, it brings together representatives of the National Academy of Sciences, the Social Science Research Council, the American Council on Education, and the American Council of Learned Societies to exchange information of common interest. One regular item of business is nomination of candidates for post-doctoral Fulbright Scholarships. One extraordinary mission will be finished this year with publication by Russell Sage Foundation of a report on manpower studies of the Presidential Commission on Human Resources and Advanced Education. This report may focus attention anew on the ludicrously small membership of the National Academy of Sciences—839 men and seven women.

Philip Handler is a hard-driving man. He can exasperate those who disagree with his objectives. His daring is conceded by his severest critics. What they dispute is his ability to harness his boldness for the general good of society when that is in conflict with the selfish interests of science. A mild example of what they fear was the recent White House fracas over Cornell Professor Franklin Long's nomination as director of the National Science Foundation. Handler helped to advertise that affair as a partisan political intrusion into the province of science. Actually, under the usual rules of politics, Long—a Democrat and a declared opponent of some of President Nixon's policies—would not have been eligible for a presidential appointment. Yet, he was nominated by the National Science Board under Handler's chairmanship and his name was cleared in the customary way with the two Senators from his home state, New York. The appointment was withdrawn at the last moment because of protests from the conservative Republicans who had put Nixon into office. The President was not guilty of political direction; he was obligated to exercise it; he simply backed down on a commitment.

Because of his proclaimed concern with bringing the Academy more into tune with society's needs, Handler lacks the freedom enjoyed by his more magisterial predecessor, Dr. Seitz, who frankly considered the Academy a part of the Establishment and left it to the press to expose abuses that might arise from that relationship (a responsibility the press has not understood).

When asked where he is going, Handler says he can't tell until he sees where his current experiment takes him. But we know where he has been (here at Durham, building from scratch one of the top ten biochemical schools in the country; at Woods Hole, Massachusetts, in the summers, with the "invisible Academy" of the biological science; at Washington, shaping biological science into a force almost certain to dominate the close of the twentieth century) and who has intimately shared his travels—principally his wife Lucille and their two sons, school teacher Eric Paul, and news photographer Mark (on the *Chapel Hill Weekly*). We know, too, that although Handler is retaining title to the chair of James B. Duke Professor of Biochemistry, he is abandoning a beautiful Durham hilltop home surrounded by grass, trees, and flowers that he planted himself. He has encouraged the Academy to sell the quarter-million-dollar mansion in Washington that goes with the presidency in order to allow him to live in the posh Watergate West apartments. "We don't think the home of the Academy president should be a museum exactly, but we do expect to furnish the apartment with the best we can find of America," he says. Somewhere among the Americana will be a herd of 300 miniature cows. They are all sizes and breeds, including at least one Brahman (see photo, page 38). Some are of clay, some of ceramic, some of metal, some of wood. He says he doesn't know why he keeps the cows, except that he likes cows. Maybe they are a subconscious recognition of the importance in his life of Bull Durham and Washington Duke's mule. —JOHN LEAR.

WHAT WE CAN'T KNOW

by JACOB BRONOWSKI

Of course, we never know with certainty what the social consequences of any discovery will be. Who would have thought that the unfortunate character who invented photographic film would have been responsible for the California film industry? And thus, indirectly, for contracts that would prevent film stars from having affairs that might give rise to gossip and scandal? That consequently stars would lead their love life in public, by repeated divorce and marriage? That therefore the beautiful pin-ups of films would, in time, become the models of the divorce business? And the climax, that one-third of all marriages contracted this year in California are going to end in divorce—all because somebody invented the process of printing pictures on a celluloid strip?

On the same lines (which I leave you to trace), who would have supposed that Henry Ford's devising of the sequential method of assembling a motorcar would finally result in upsetting the whole moral code of the American middle classes? For it is evident now that the car provided young people with more privacy than the home, and that as a result it became usual to begin sexual experience on the backseat of a motorcar.

Although my examples may seem extravagant, they are not. The fact is that, in a strange way, the side effects of technical innovation are more influential than the direct effects, and they spread out in a civilization to transform its behavior, its outlook, and its moral ethic. For morality is an organization of life that grows spontaneously from activities, and not a

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Jacob Bronowski, one of the foremost living philosophers of science, is a senior fellow and trustee of the Salk Institute for Biological Studies. The remarks here constitute a preview of a forthcoming Columbia University Press Book, *The Environment of Change* edited by Aaron W. Warner, Dean Morse, and Thomas E. Cooney.