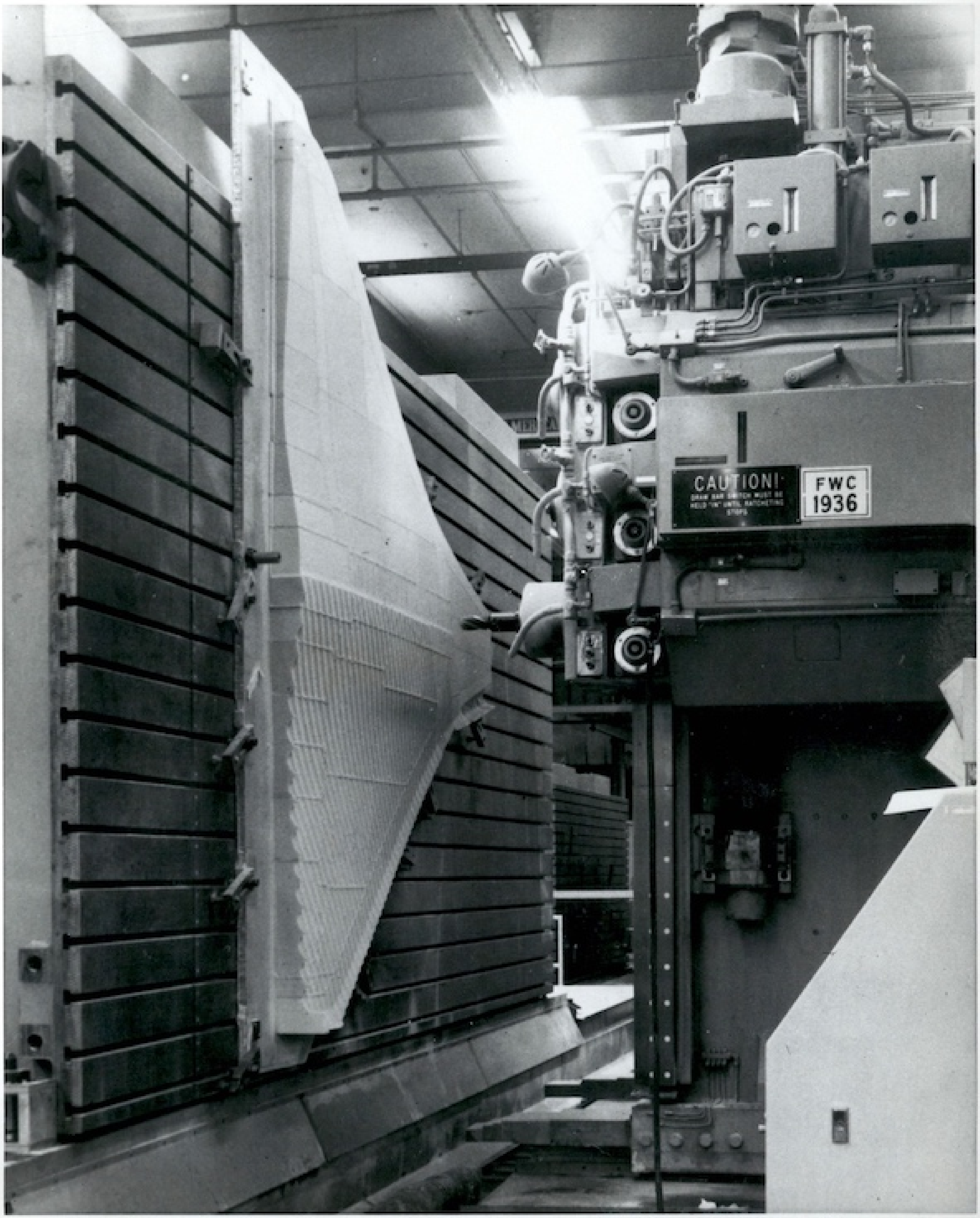
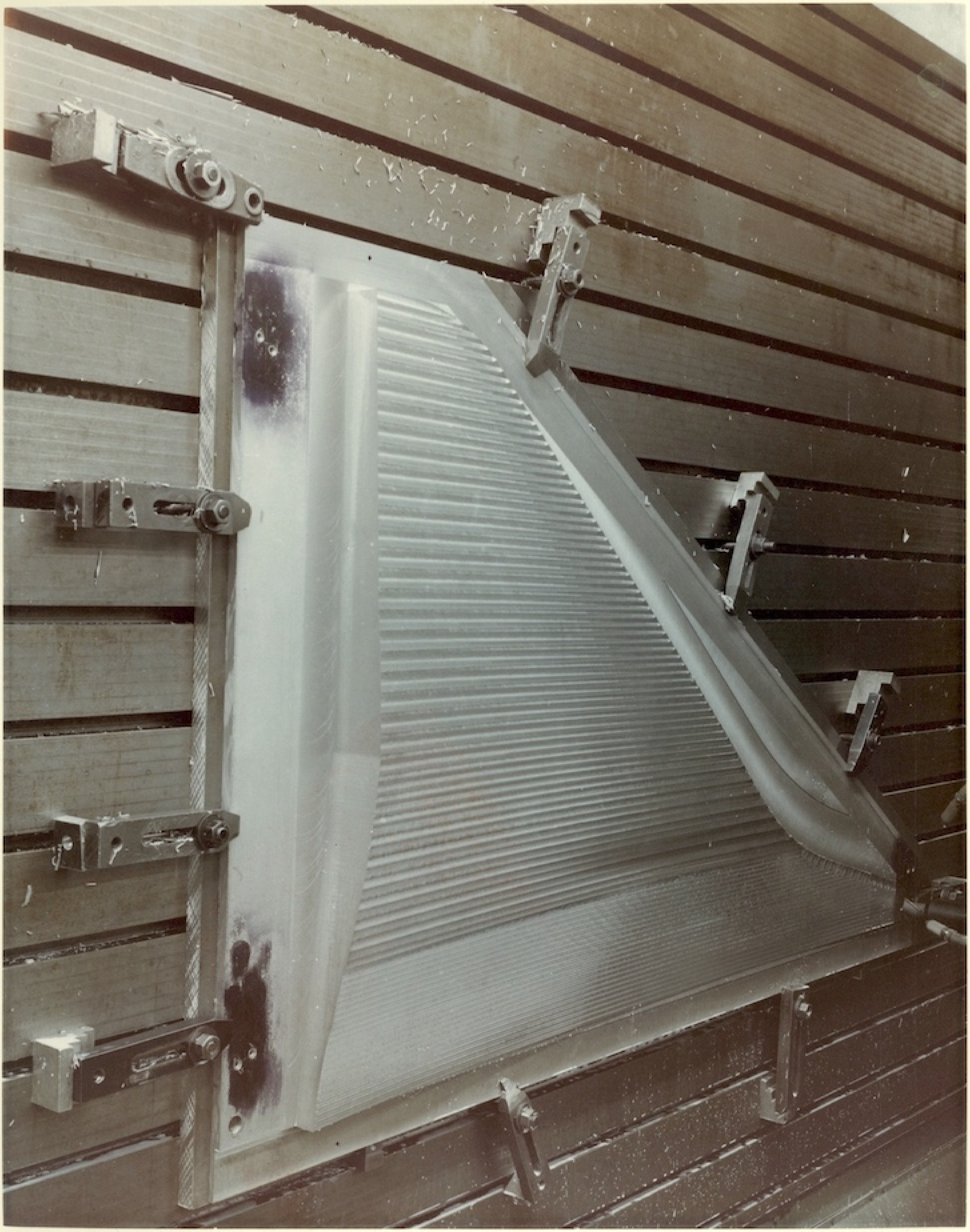


9A 11824

SST FLUTTER MODEL.
11-11-70



$22 BILLION AT STAKE

A RE-ASSESSMENT OF U.S. BALANCE OF PAYMENTS AND THE SUPERSONIC TRANSPORT

The potential balance of trade effect of a successful American SST program in international competition during the next two decades becomes a consideration of major national significance with the serious deterioration of our balance of payments outlook as viewed after the first quarter of 1970. It is now estimated that this balance of trade impact could reach as much as $22 billion over the period of the SST program.

MAY 1970

In mid-1969 when the Administration decision was being reached to go forward with the SST prototype, considerable weight was given to the importance of the SST in maintaining America's historic position as principal exporter of aircraft to the airlines of the world. But through the intervening months the balance of payments problem has received less emphasis. Despite an alarming outflow of dollars in 1969 the high interest rates prevailing in the United States attracted sufficient foreign-held funds to provide a positive balance when the official central bank settlements were made between the countries.

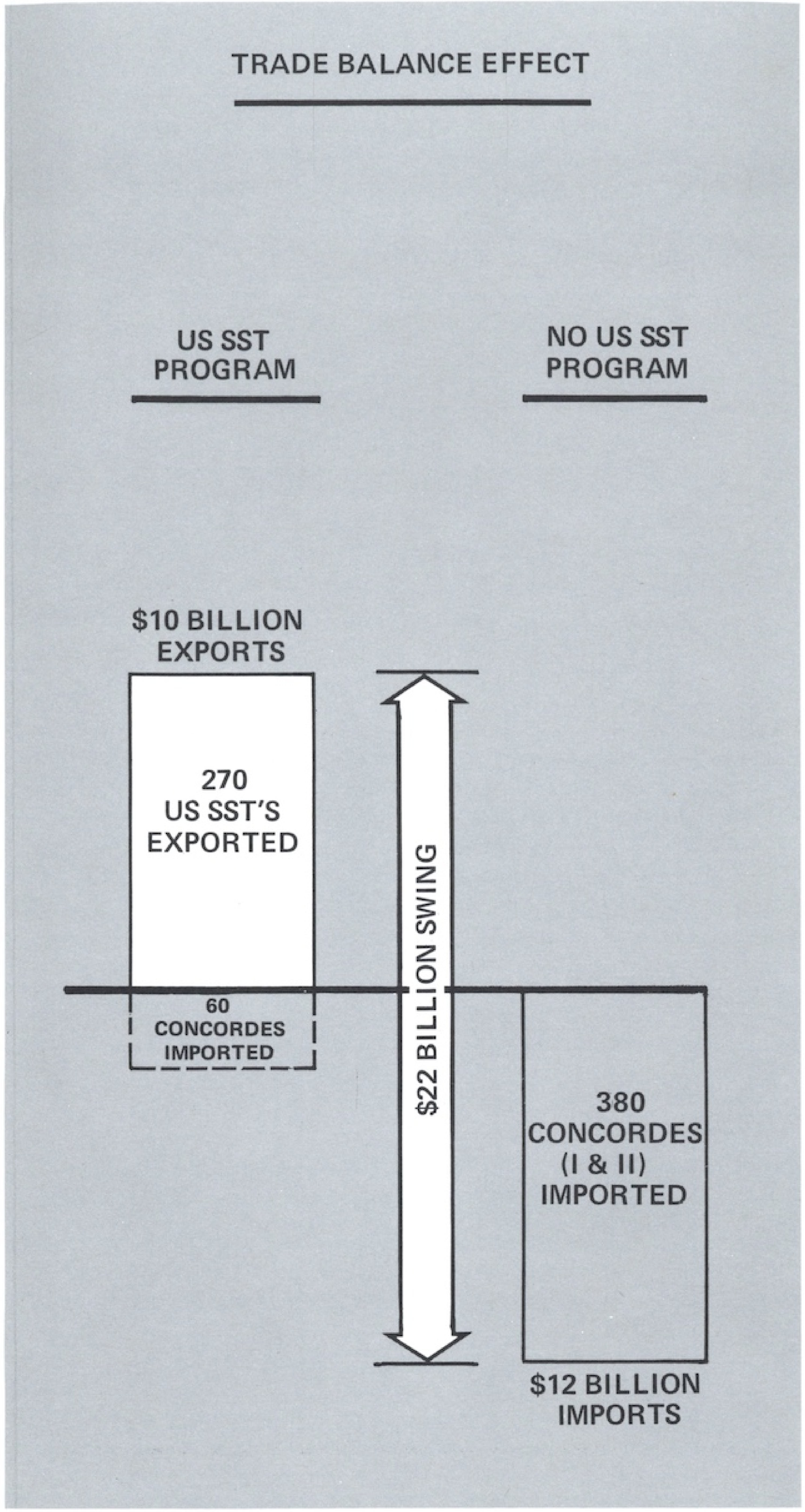
But the U.S. business slowdown and the desire to avoid prolonged recession effects have recently brought these high U.S. interest rates down somewhat, while foreign rates have stiffened. Thus, the inflow of foreign money has decreased and the outflow of dollars has significantly increased during the first quarter of 1970. As a consequence, the balance of payments is expected to dip to a $4 billion deficit for this year even when computed on the favorable basis of official bank settlements. It does not appear that high interest rates can be counted on as a means of overcoming large scale balance of payments difficulties.

Meanwhile the balance of U.S. exports over imports, long relied upon to offset much of our other dollar outflow, has lagged for the past two years at less than 1 billion dollars per year, as compared with 4 to 6 billion dollars per year in the preceding four years. The trade balance is expected to exceed 1 billion for 1970 but the effort to build it back to the earlier levels in the face of U.S. costs and capable foreign competition is going to be a struggle for a number of years.

In foreign trade our imports typically exceed exports in such categories as fuels, food and miscellaneous manufactured goods. The principal categories where exports exceed imports are chemicals, machinery and transportation equipment, of which transport aircraft are a major part. A relatively few products must bear the burden of our trade balance recovery. To a large extent our advantage is in lines involving highly developed technology, and aerospace products lead the list of these.

Because of technology advance, traffic growth and economic factors, the SST after 1978 will account for an increasingly large part of the potential aircraft export market, and in the 80s will constitute the major part of it. If, instead of being the leading exporter of transport aircraft our country should become a net importer of such equipment by allowing the SST market to go to European producers, we could be sacrificing the leading edge of our entire trade balance recovery program.

We could begin to feel this loss in the near term. The volume of orders to be placed for supersonic Anglo-French Concorde aircraft by both U.S. and foreign airlines will be determined in large part by the progress of the U.S. SST program in the next two years. The present model Concorde is expected to be available for delivery to airlines by 1973 or 1974. To obtain such deliveries, orders would need to be placed in 1970 or early 1971. Down payments and progress payments by U.S. airlines would begin from this time, all affecting our balance of payments.



Market forecasts on which the American SST program is based assume that a major portion of the market will go to the U.S. product in competition with the Concorde and the Russian-built SST, because of the substantial advance in performance and operating economy which it will offer. This justifies the withholding of orders by airline purchasers for a substantial portion of their ultimate fleet requirements to take advantage of the more advanced equipment. However, if the completion and demonstration of the U.S. prototype were to be delayed, a telling portion of these orders could be lost.

Further, the foreign competitors would be afforded the time to develop advanced models approaching the performance, size, and economy of the present American design, thus hazarding the loss by the United States of the subsequent export market. It is the combination of these contemplated export sales and the avoidance of greater purchase by U.S. airlines of European equipment which accounts for the large balance of payments effect.

A re-calculation of the dollar dimension of balance of payment loss in the event there were no U.S. SST program now indicates that the amount could reach a total of $22 billion by 1990 instead of the $16 billion estimated a year ago. The earlier figure had included estimates for the purchase of 300 first generation Concordes by U.S. arilines at about $20 million each. It now seems quite probable that the European producers will bring out a second generation Concorde in the effort to match the capability of the planned American SST. There are strong indications that the foreign governments and airlines involved are now pressing the Concorde producers to do this. In the absence of an American SST, the Europeans would then be selling to U.S. airlines a more productive and expensive airplane. It is estimated that some 250 of these advanced Concordes would go to U.S. airlines, plus approximately 130 of the earlier model, adding $6 billion to the previously estimated $16 billion unfavorable balance of trade effect.

These estimates are in current dollars and at historical inflation rates could amost double in dollar amount by delivery of the 250th airplane. Additional balance of payments effect could be gained by reason of construction of most or all of the SST on U.S. soil, in view of the high technology involved, whereas subsonic aircraft may be constructed increasingly with portions of the work subcontracted overseas.

Some contentions that the balance of payments return from the American SST program would be largely offset by increased dollar outflow because of additional Americans traveling abroad are not regarded as valid. The same traveler dollars could be expected to flow out on the foreign-built SSTs, including advanced models, and without the offsetting export sales. This could only be avoided by severe travel restrictions on American citizens, marking not only a deterioration of U.S. trade leadership but a serious deterioration in privileges for Americans. It would constitute a reversal of previous roles, foreign citizens becoming the advantaged and Americans the deprived.

Also regarded as important is the economic effect of employment and an estimated $6.7 billion in Federal and State income tax revenues from the industrial and individual employee participants in the SST production program and those secondarily involved. These revenues are in addition to the royalty payments due the U.S. Government on the sale of production airplanes, which are expected to return to the government its full expenditure for the prototype development plus interest amounting to some $1 billion.

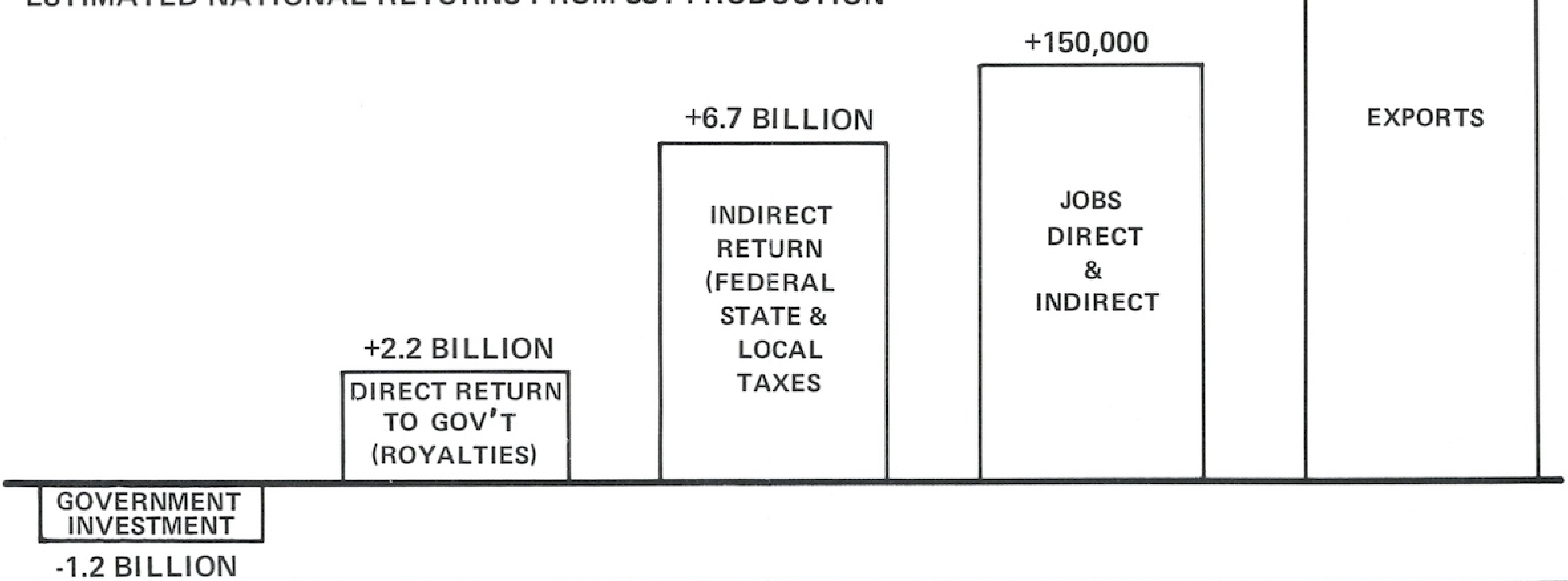
In the assessment of the crucial balance of payments contribution of the SST and its generation of Federal revenues, some may question the validity of the projected market for the airplane in competition with conventional subsonic jets. This skepticism repeats the pattern of the period preceding the introduction of subsonic jets, when many felt that the jet could not compete with the established piston-powered airplane. Insufficient significance was given at that time to the greater productivity of the jet by reason of the economics of speed. A jet of equivalent size could do twice the work of the planes it replaced, in the same amount of time.

The SST in turn will triple the speed of the jets, giving rise to a further major step-up in productivity. While the fuel consumption of the SST per mile is greater, this cost tends to be offset by the greater productivity in terms of labor costs both direct and indirect. Again, the most recent forecasts of economic trends serve to reaffirm the competitiveness of the SST in the time period of its production and operation. There is general agreement that labor costs will continue to rise, as has been the almost unbroken pattern for the past three decades. This cost rise will affect the slower airplanes more than the SST. The added productivity of the SST in passenger-miles per hour will make it strongly competitive in total operating cost in the later time period in which it will join the expanding world air transportation fleets.

In addition it will offer the bonus of substantial time-saving on long distance trips, increasing the demand for such trips. It is this type of bonus from technological progress that has accomplished air transportation's remarkable growth to date.

While the domestic economic effects are therefore positive, the balance of payments effect appears to be of even greater significance in overcoming a difficult negative condition which our country now faces. To forego this opportunity to help resolve our critical balance of payments problem in the years ahead would be to hazard serious economic and monetary consequences. This is rapidly becoming one of the foremost considerations calling for the on-schedule pursuit of the SST program.

ESTIMATED NATIONAL RETURNS FROM SST PRODUCTION

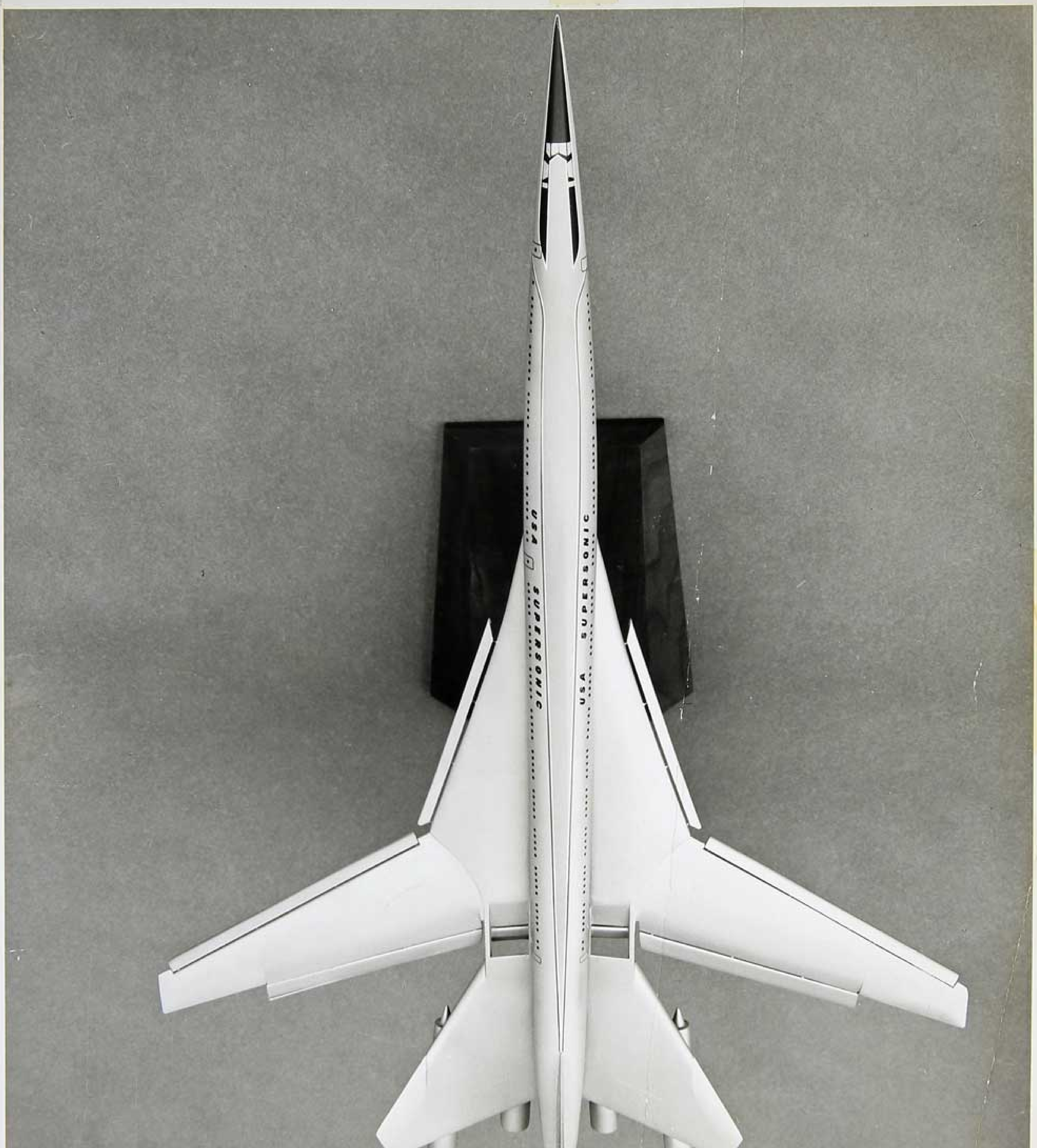


BOEING/SST

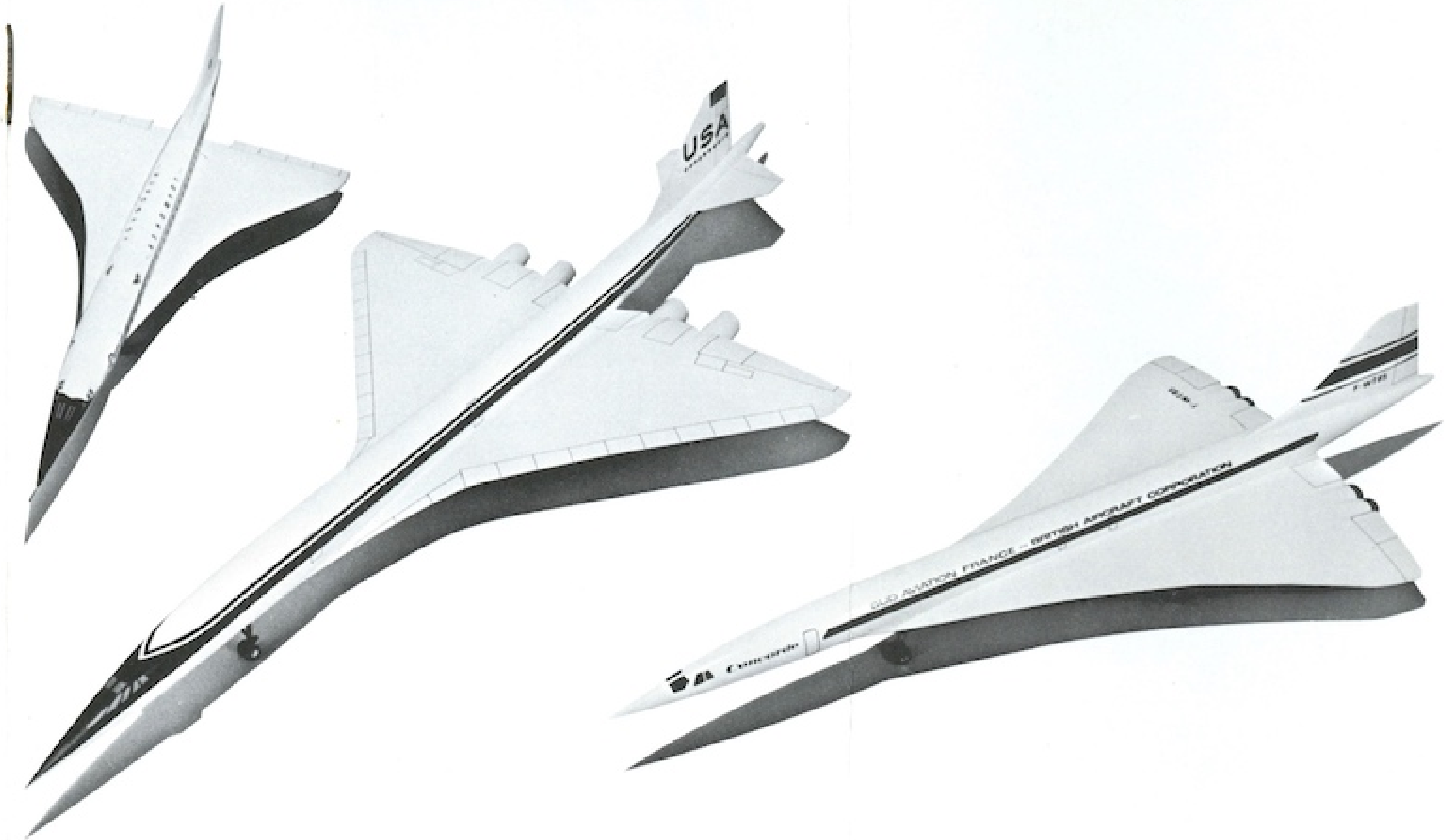
GENERAL DESCRIPTION

SST 00 10 Routes

THE BOEING COMPANY / MAY 1969


USA
SUPERSONIC
USA
SUPERSONIC
6A71252-5


BOEING
USA / SUPERSONIC



THE USA/SST AND THE COMPETITION

THE BOEING COMPANY COMMERCIAL AIRPLANE GROUP
SUPERSONIC TRANSPORT DIVISION

FEBRUARY 1971

Airline Interest

Twenty-six airlines have reserved 122 delivery positions for the United States SST. Of these, twelve are U.S. airlines and fourteen are foreign. Airline interest is evident in the total financing to date of $80.9 million they have invested in the program.

Seven United States and nine foreign airlines presently hold options on 74 Concorde I airplanes. More than 20 Concordes are planned for delivery to the airlines in 1974. A production rate of 3-½ per month will be achieved by 1976.

The TU-144 could enter service with Aeroflot as early as 1972. It is estimated that Aeroflot and other Russian satellite nations will require 20 of these aircraft. Other airlines negotiating routes through Russian terminals are under pressure to buy the TU-144. It is expected that the price of the TU-144 will be legislated to offer further incentive to purchase by non-Soviet airlines.

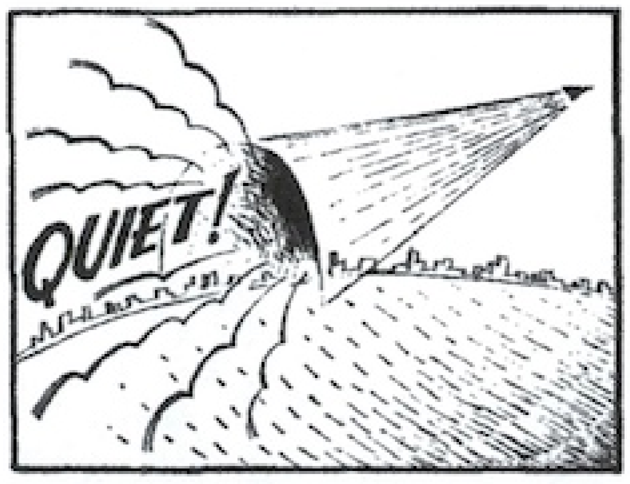
The highly competitive nature of air transportation results in airlines flying similar equipment on competing routes. Thus the introduction of more attractive equipment, such as an SST, into service by one airline forces competing airlines to offer similar or better service to avoid operating at a loss.

THE AIR TRANSPORT ASSOCIATION REPRESENTING THE U.S. AIRLINES SOLIDLY ENDORSES THE DEVELOPMENT OF A U.S. SUPERSONIC TRANSPORT.

SST DELIVERY POSITIONS/OPTIONS

U.S. SST	AIRLINE	CONCORDE I
15	PAN AMERICAN	8
12	TRANS WORLD	6
6	AMERICAN	6
6	NORTHWEST	
6	UNITED	6
2	BRANIFF	3
3	DELTA	
5	EASTERN	6
3	CONTINENTAL	3
1	AIRLIFT INT'L	
3	WORLD	
2	TRANS-AM. A.C.	
6	KLM	
6	ALITALIA	
6	BOAC	8
6	QANTAS	4
6	AIR FRANCE	8
6	AIR CANADA	4
5	JAPAN	3
3	CANADIAN PACIFIC	
3	LUFTHANSA	3
3	IBERIA	
2	EL AL	
2	AIR INDIA	2
2	IRISH	
2	PAKISTAN	
	MIDDLE EAST	2
	SABENA	2
122	TOTAL	74

(Airline commitments for the TU-144 not available.)



—Doug Anderson.

SR / Research

SCIENCE & HUMANITY

DEPARTMENTS: Research in America • Science in Journals • Research Frontier

ARTICLE: The Undersea History of America

RESEARCH IN AMERICA

THE ERA OF SUPERSONIC MORALITY

JUST before this issue of *Saturday Review* went to press, the National Academy of Sciences accepted involvement in the design and construction of an airplane capable of flying 2,000 miles per hour. On invitation from the Federal Aviation Agency, which is responsible to President Lyndon B. Johnson for spending up to a billion dollars of the people's money to put the plane into the air, NAS agreed to "provide scientific and technical advice and assistance related to problems posed by the phenomenon of sonic boom."

Sonic boom is the unnerving thunderclap that reverberates through the air in the path of planes flying faster than the speed of sound. The swiftly moving ships compress the atmosphere around them and literally drag a cone of noise for miles behind them (see sketch, this page). The faster the plane travels, the greater the compression, and the louder the thunder.

Sonic boom was first produced during level flight of the rocket research plane, X-1, in 1947. Later, pilots of military jets found they could cause booms by diving steeply. At British air shows twelve years ago, booming was done deliberately to entertain the crowds. A United States pilot practicing reproduction of this novelty over a western air base dove at supersonic speed to within 8,000 feet of the ground before pulling up. The boom that followed broke windows in most of the buildings on the base, loosened door frames and cracked ceilings and floors.

The booming-for-fun period ended there. But sustained research of a serious nature did not ensue. Air Force experiments were sporadic, fragmentary, short-span. They established that any plane flying at supersonic speed below 40,000 feet (cruising altitude is 70,000 to 80,000 feet) will trail a loud and annoying boom behind it. Windows can be broken when the plane is below that altitude, and damage to buildings is expectable when the altitude is much less than 25,000 feet. But the possibility that movements of the atmosphere can focus and intensify the compressive effects, or that cumulative damage can build up through successive booms, has not been examined in depth. And exceedingly little is known with certainty about the range of variation in the effects of sound waves on the physiological and neurological systems of animals including man.

The published record of SST (short for supersonic transport) hearings conducted last October by the U.S. Senate Subcommittee on Aviation includes a warning from the board of directors of the American Association of Airport Executives. This document says it "would be a serious mistake" not to try to develop a supersonic plane that boomed less than subsonic jets of the present day, for "the noise emanating from the present jets is in many areas not acceptable to the general public."

FAA has stipulated that its approval of an SST will be conditioned on public acceptance. Unfortunately, the method FAA has adopted to measure public acceptance is not reassuring.

To begin with, Oklahoma City was chosen as the original site for a test of reaction. About one in every four jobs in Oklahoma City is found either in an aircraft factory, or at the Tinker Field base of the U. S. Air Force (largest air materiel center on earth) or at FAA's own headquarters installation. In addition, FAA gave the city a grant of $877,000 to pave an unusually long runway at Will Rogers Airport, a gesture that could only heighten an impression spread by the local Chamber of Commerce—that Oklahoma City had been promised the country's first supersonic plane port. Tolerance of any nuisance due to plane flight therefore could be expected to exceed the national norm.

WITHOUT consulting, much less asking formal consent of, Oklahoma City's elected officials, Mayor Jack Wilkes and the eight-member City Council, FAA simply hired Air Force jets and jet pilots under contract to break the sound barrier across the heart of the city half a dozen times a day, beginning at 7 o'clock in the morning of February 3 and continuing on that same schedule every day for six months. The pilots were summoned to work with a vividly descriptive code call: BONGO!

On the second day of BONGO, claims of property damage began coming in. In the first week, there were 655 complaints. FAA spokesmen told newspaper reporters that "nervous people may have to rely on tranquilizers." Two angry citizens who refused to be tranquilized went to U. S. District Court and entered separate suits to enjoin FAA from continuing the BONGO experiment. Judge Stephen Chandler dismissed both actions on the ground that a Federal agency cannot be sued without its consent.

The complainants pointed out that the stated purpose of the sonic boom experiment was to obtain public reaction. Under the circumstances, they said, FAA surely would consent to hear cause.

But FAA did not volunteer its consent, and Judge Chandler's rejection stood.

After three weeks of the booming, protests within such influential groups as the League of Women Voters rose so audibly that the City Council voted, 7-0, to ask FAA to suspend the experiment for three months to allow certain questions regarding invasion of personal and property rights to be resolved. Mr. Gordon Bain, FAA Deputy Administrator in charge of the SST project, told a United Press reporter that if the Council should communicate this word to Washington the Oklahoma City test would be stopped. Not suspended—stopped permanently. Mr. Bain's remark immediately got back to Oklahoma City, of course, and the Chamber of Commerce there rallied support for "more and better booms." C. of C. Secretary Howard Weston complained publicly that the Council's implied criticism of FAA "could well cost us our future"—which was to say the promise of America's first supersonic airport. In response to this pressure from the merchants, the City Council met again next day in extraordinary session, voted again, and rescinded its action of the day before. As one Councilman explained to *SR*'s science editor by telephone: "We saw that it was not really within our competence to pass on scientific questions."

THE citizens who opposed BONGO were not so awed by science. Having been rejected in Federal Court by Judge Chandler, they turned to the Oklahoma State District Court. There Judge Boston W. Smith granted a temporary order restraining FAA Administrator Najeeb Halaby, Air Force Chief of Staff General Curtis Le May, and twenty lesser FAA and Air Force officers—as individuals and as agents of the government—from continuing the experiment.

Judge Smith issued his order on Tuesday, May 12, and the sonic booms ceased.

In Washington that day, an urgent telephone call was received by the National Academy of Sciences from FAA Administrator Halaby's office. An advisory panel of respected scientists was needed as soon as one could be assembled, the caller said.

Ordinarily, NAS is a most deliberate body. But in this instance the panel was named and its members were in Mr. Halaby's office by Thursday of that same week. In a few more days, the panel—composed of three engineers—was in Oklahoma City, engaged in what FAA officially described as "an objective review of the sonic boom study now under way."

"Beyond this initial . . . review," the FAA announcement said, NAS had "undertaken to . . . analyze all aspects of boom phenomena, and provide advice and guidance for future research and study." Questioned by *SR*'s science editor, a spokesman for NAS put in a cautionary reservation that "the scope and magnitude of the amplified study await further discussion."

In this connection, it is worth recalling what the late President John F. Kennedy's Special Assistant for Science and Technology, Dr. Jerome B. Wiesner, told the Senate Subcommittee on Aviation last October: "I don't know of any fundamental law of nature that says this [sonic boom] is inevitable. . . . At the moment no one knows how to do anything about it. . . . Sometimes on a problem of this sort it is not how many people [you have] and how much money you are spending but . . . [whether you have] a few of just the right people."

Here "just the right people" would be talented people whose sense of artistry in science sensitizes them to the human roots of their own gifts. Such people would feel first of all that the problem was worth solving.

However limited or extensive the NAS participation ultimately may be, the scientific community, as well as the general public, ought to remain aware that the onus of the SST project has been subtly shifted to NAS. The bugaboo science, having been successfully

used to frighten the Oklahoma City Council away from proper exercise of its political responsibility, will hardly be neglected the next time it seems useful.

It is to be hoped that the SST advisory panel of NAS will exorcise such mumbo-jumbo with a positive approach to the problem. Further sanction should be denied to the negative view of Air Force researchers who told *Daily Oklahoman* staff writer Claire Conley in Florida's Miami Beach: "for every cracked window" caused by sonic boom "you can point to 8,000 that are not cracked;" "people are more resilient than windows;" "*only 38 per cent*" of the residents of an unidentified town of 11,000 subjected to sonic boom by training planes of the Strategic Air Command "expressed annoyance;" and "eight to ten years from now basic human behavior will be motivated to accept these short blasts of noise."

The impartial ideal of science will have a hard time winning acceptance in Oklahoma City at this point. The opponents of sonic boom have resigned themselves to denial of a hearing of their cause. They now can see no way of stopping the booms before the end of the originally scheduled six months of the test. Court delays could easily be spread over the remaining weeks. Judge Smith's order of stoppage held for only one day, after which Judge Chandler removed the matter to Federal Court and quashed the temporary injunction. On May 21, without hearing argument, he dismissed the joint plea of nineteen complainants. By that time, a total of 5,655 damage claims had been filed with FAA.

EVEN if it were assumed that all the complaints were valid—that the seeing-eye dog of a sightless vendor at the capitol was too frightened to perform its customary guiding function, that human victims of heart disease and muscular spasm were detrimentally stimulated, that older people had suffered falls and other accidents, that a schoolroom ceiling lamp had dropped and knocked a boy out of class for an hour, that fire alarms had been set clanging in unison, that plate glass show windows in stores had been shattered, that plaster from a bedroom ceiling had cut a three-inch gash in a sleeping woman's head, that mirrors had been cracked, that walls and floors and brick facings of houses had been shaken loose, that wild birds had been driven from feeding stations in backyard gardens, that flocks of chickens had been crazed into erratic flight with considerable loss of egg yield and some loss of life—Judge Chandler said the only redress was to wait for processing of damage claims, only 132 of which have been paid to date: a total reimbursement of $7,239, compared to a single claim of $15,000 entered by a chicken grower.

Though SST was not a military project, the Judge ruled, there might be some future military benefit in it. Therefore, he declared, since the government had power to draft men to fight in battle it had analogous power to pre-empt both men and property for the sonic boom experiment.

If the people of Oklahoma City cannot obtain the help of the law to save themselves from being used as subjects of an experiment by a distant government, can any American citizen anywhere feel secure against invasion of his body and mind at any official's whim?

—JOHN LEAR,
Science Editor.

SCIENCE IN JOURNALS

SCIENCE: A TOOL OF CULTURE

EVER since C. P. Snow's 1959 Rede lecture at Cambridge on *The Two Cultures and the Scientific Revolution*, a great deal has been heard about the cultural role of the natural sciences. Why there was this sudden outbreak of discussion is a little difficult to understand; because, although everything that Snow said was relevant, none of it was very novel. At times, indeed, one is tempted to think that, if educators today would cease confusing contemporaneity with novelty, and if they would have the humility to spend twelve months carefully studying what was said and written on this subject in the nineteenth century, a great many man-hours of repetitive discussion would be saved and a fair number of inconclusive conferences seen to be superfluous.

Snow's dichotomy between "the scientist" and "the non-scientist" exists; but it is not the most fundamental distinction. Increasingly I feel that, if we must identify two cultural camps, they are those of scientists and creative artists on one hand, and purely verbal scholars on the other.

The scientist and the artist day by day explore the properties of the stuff of the universe. Both manipulate the materials of the world and discover what happens when they are subjected to various forces. Both seek for and create significant patterns in nature. For each the thing is primary and the word secondary. Neither can get far without the involvement of the whole personality—mind and muscle, sensuous response to sensual stimuli, persistence and experimentation, reason and imagination. Of course, they are both "base mechanics." Perhaps that is why, in our still essentially aristocratic civilization, both are sometimes looked down on by those cultural mandarins whose special studies need no implement dirtier than a sheet of paper and a fountain pen.

There is another feature of Snow's dichotomy which is perhaps significant. He spoke of "scientists" and "non-scientists." He did not speak of "literati" and "non-literati" or of "littérateurs" and "non-littérateurs." Now this is interesting, for the word "literati" has been in the language at least since 1621, while the word "scientist" was not invented by Whewell until 1840. Yet the newcomer has achieved such potency that it, rather than one of the much older words, is used as the verbal indicator of this cultural distinction. It is not merely that scientists are recognized as sharing a common culture, but also that this scientific culture is dimly seen to be in some way dominant and that others feel themselves deprived because they are largely excluded from it.

The fact is that the attitudes and the temper of science have become the attitudes and temper of the best part of modern culture. The whole of modern thought has become impregnated with science through and through. And, when Snow correctly commented that most non-scientists cannot describe the second law of thermodynamics, he overlooked the much more important fact that they probably think habitually in terms of a universe of flux, in terms of the transfer of energy, in terms of evolutionary processes, in terms of matter of such fantastic complexity that we have as yet barely begun to understand it. As architecture was the great imaginative triumph of one age, and music of another, and poetry of another, the greatest achievement both of the human intellect and of the human imagination during the past hundred years has been that of natural science. It is because science is a triumph of the imagination as well as of the intellect, a thing of beauty as well as of utility, that only the most confirmed of academic troglodytes have been able to escape its all-pervading radiation.

IF THIS dithyramb to the splendors of science seems remarkably remote from the science that one may have learned at school or the science teaching that may be familiar to all in our colleges and universities today, I am not at all surprised. For as yet we have scarcely begun to face the cultural implications of the fact that the scientific revolution has taken the world into its control. Pedagogues are still puzzling about whether they can manage to squeeze one more science period a week into the timetable, instead of asking themselves whether the whole shape and spirit of the school curriculum are not a century out of date. Professors of scientific subjects in our universities are demanding more and more knowledge of the content of science, instead of ensuring that their students become fired by the spirit of science as an adventure of inquiry.

Professors of literary subjects pay an oblique and dubious compliment to science by persuading their postgraduate pupils to waste a couple of years on desiccated little pieces of so-called research in which the techniques appropriate to microscopy or quantitative analysis are misapplied to the criticism of poetry. In the colleges of education where we are today training the teachers who will be at work in the schools when we enter the twenty-first century, all sorts of exciting and culturally valuable approaches to the pedagogy of science are being inhibited by a haunting fear that perhaps the professors will not approve, or by the tremulous hope that if only we take care to be academically respectable for another year or two there may fall on us a little of the magic dust which the universities seem specially licensed to dispense.

I HAVE pointed to the similarity in temper and in personal commitment of the working scientist and the working artist. But there are also important differences which, finally, render my dichotomy of the cultural field not much more satisfactory than Snow's.

In the first place, science is an essentially social activity in which exact communication is as important as exact observation. It is by providing repeated practice in this verbalized statement of what has been done that science teaching can most valuably foster in children that clarity and coherence of apprehension and expression which are the great distinction of the educated person.

Here, incidentally, I must register a strong protest at the manner in which scientific communications have largely abandoned the "close, naked, natural" use of language enjoined by the founders of the British Royal Society, and become clothed in obscure and complex "gobbledygook." I do not refer to the necessary use of specialized registers of technical terminology, but to an apparently compulsive use of the third-person passive, an almost universal phobia of illuminating imagery, an endemic tendency to verbal flatulence. This sort of pretentious pedantry, unfortunately, has filtered down from the research thesis to the undergraduate essay, and even to the eleven-year-old's laboratory notebook.

The better teachers of science already realize that no scientific teaching worthy of the name is possible except it be at every stage brought to the point of exact expression: and, of course, this

SST

SEATTLE STANDS TALL