This points up the fool-hardiness of the "growing belief in the Pentagon and in industry that the U.S. must pull back from high technology" which *Business Week* reports. The magazine quotes Philip C. Norwine of Textron urging a shift toward "the Russian philosophy of adequate quality in sufficient quantity." In fact, as accompanying articles in this Special Report demonstrate, the Russians have abandoned that "philosophy"—which never existed except out of dire necessity—and are now ahead of the United States in many areas of military research and development.

The decline in the technological base of the U.S. industry is also gravely reflected in the current skilled manpower crunch. The technicians and engineers laid off during the early 1970s are not easily reclaimable; and a recent survey by the National Machine Tool Builders' Association reports that 70 percent of its members are seriously short of technicians. "We're facing one of the greatest skill shortages in the history of this country," the association's president James A. Gray told *Business Week*.

Reflecting the shortages of skilled labor, the glut of more profitable commercial business and the deterioration of production equipment, long delivery times are now the rule for large machined parts such as those used in airplane construction. Large aircraft forgings have to be ordered up to 28 months before they will be needed, and the companies that produce them say they cannot handle any more orders, whether for military or any other purposes.

Stocks of critical metals like titanium, cobalt and chromium needed to make specialty steels for aircraft are in short supply. U.S. sources of cobalt are underdeveloped, leaving us dependent on Zaire, which stopped exports in 1978. South Africa, the largest supplier of chromium, would also be subject to cut-off under wartime conditions. Furthermore, U.S. strategic stockpiles of many essential metals are significantly short of goals and the quality of the materials is poor.

But even more significant than the case of such specialty metals is the fact that production of basic industrial materials and fuels that would be essential for any war effort is stagnating. Although U.S. energy consumption has continued to rise, the domestic production of energy has decreased from a high point of 62.5 Quads in 1970 to about 60 Quads during the last several years. During the same time, Soviet domestic energy production has increased from about 40 percent of the U.S. figure in the early 1960s to equality within the last year. The significance of this trend is emphasized by the figures for production of raw steel. While U.S. production peaked in the early 1970s, and has plummeted since, Soviet production has continuously increased, far surpassing the U.S. output and ranking first in world production.

Military R & D:

by Dr. Steven Bardwell

Because of declining expenditures on research and development, the U.S. military has armed itself with too few of the wrong weapons for a type of war which will never be fought and faces an adversary who has, over the past two years especially, accumulated an armory of superior weapons in overwhelming number for the kind of war which they can assure will be fought.

The true picture of the effects of almost two decades of incompetent war fighting doctrine in the civilian leadership of the U.S. military is only now clear: The much vaunted qualitative superiority of U.S. weapons has disappeared—the U.S. military is inferior in quantity *and quality* of almost every weapons system. In a word, the U.S. would lose a war with the Soviet Union.

The most immediate cause for this erosion of the U.S. military posture is research and development. During the 1965-75 period, the overall research budget decreased by over 50 percent in constant dollars. The private industry component of military R and D decreased by even more. This situation was so glaringly serious in 1976 that Secretary of Defense Harold Brown called for a 10 percent annual growth in military-related R and D as the minimum prerequisite for remedying the gap between U.S. and Soviet military progress. However, due to the combined effects of inflation, realignment of budget line items, and Congressional cuts, the research budget has barely grown 1 percent per year between 1975 and 1979. In the fiscal 1980 budget, the Secretary of Defense reaffirmed his evaluation that at least a 10 percent growth in research was necessary and requested that amount in the FY1980 budget; the same combination of congressional cuts, inflation and short-term considerations has already ensured that the final expenditures will be much less than a 10 percent increase over 1979—probably much closer to the 1 percent increase of the last five years. In other words, the situation has not changed over the period since 1965. Military R and D is still treated with contempt.

The aura of poverty

The Pentagon policy of down-grading research and development investments is unfortuantely part of the larger decline in R and D capabilities of the country as a whole. Without detailing the full scope of the tragic condition of U.S. industrial R and D, the depth of the decay of American research capabilities is dramatically shown by comparing the number of scientists and engineers involved per capita in the U.S.S.R., the U.S., and several European countries. Most striking is the rapid and constant growth in the Soviet commitment. The Soviets passed the U.S. in per capita number of R and D professionals in 1968 and now have more than *double* the number of scientists and engineers involved in research activity. The accompanying graph of the total expenditures on R and D in the U.S. over the past 20 years shows the same trend. These expenditures have decreased in every category except civilian expenditures, which themselves are heavily inflated by R and D costs associated with environmental regulation. The net result of these trends was concisely summarized by William Perry, Undersecretary of Defense for Research and Engineering, in testimony before the House of Representatives last spring:

> We are being confronted with a significant challenge by the Soviet Union ... Last year I reported that the continuation of current trends in the U.S./U.S.S.R. military technology and acquisition balance could result in significant Soviet military advantages in the next few years. My present assessment of the balance and of the near-term trends has not changed appreciably. By all accepted measures of growth, the Soviet military investment effort continues to increase steadily, resulting in both improved R and D capabilities and the deployment of improved weapon systems. During the past year, for example, estimated Soviet investments were about 75 percent greater in dollar value than the corresponding RD and A [research, development and acquisition] program in the United States—*that* is the nature of the challenge.

The cumulative difference in expenditures on military R and D since 1972, when the Soviet expenditure began to exceed that of the U.S., is now conservatively estimated at $65 billion in the Soviets' favor.

The chickens come home to roost

The decline in research and development capabilities in the U.S. over the two decades since the beginning of the McMamara era was not merely a policy of benign neglect; it was a conscious, direct consequence of the strategic doctrine which informed McNamara and his accounting staff at the Pentagon. The McNamara theory of war developed in Vietnam and was elaborated into a strategic military posture. Simply stated, this doctrine claims that full-scale nuclear exchange is "unthinkable"; since both sides in such an exchange would be totally destroyed, and hence neither could emerge as victor, such a war will never be fought. The McNamara think-tankers in the Rand Corporation, Hudson Institute and the like, deduced two conclusions from this doctrine for military deployments; first, nuclear weapons strategically deliverable (ICBMs, B-52s, and submarines) function only as a deterrent, ensuring our half of the mutually assured destruction implied by their use—they will never be used, but must be maintained to ensure the balance of strategic force. Secondly, the only wars fightable or thinkable are local wars, which may involve the use of tactical nuclear weapons. But, there is a sharp distinction between such "theater" nuclear deployments and strategic deployment.

In the sphere of R and D and acquisition of new weapons, this war-fighting doctrine leads quite naturally to emphasis on a relatively small number of highly sophisticated weapons systems, with a consequent down-

playing of the role of infantry, force in depth, and backup capabilities. Wars are envisioned to be short, localized, very violent, but controlled—much like the Yom Kippur war. Hence questions of attrition, of massed infantry deployments for occcupation, and such central traditional concepts as firepower and anhiliation of the enemy's military capability are replaced by the cabinet warfare emphasis on the blitzkrieg, wunderwaffen, and the like.

Like all cabinet warfare, the McNamara doctrine only makes sense if both sides agree to fight according to its rules. The Soviets have said for more than 25 years that, for them, full-scale nuclear war is not only thinkable, but fightable, winable, and survivable. Even if they are wrong on the last count, the fact that they do not agree with the McNamara doctrine invalidates the doctrine. The Soviets have directed R and D efforts to war-winning on the strategic nuclear plane. The U.S. military, thanks to the McNamara doctrine, now faces an enemy better equipped, in greater depth, prepared to fight a war which we find "unthinkable."

Such an evaluation was unique three years ago when *EIR* first put it forward; 18 months ago, the response was the same. But now *EIR*'s evaluation is prevalent even in the military itself.

The general determinants of the McNamara doctrine's R and D policy are the emphasis on technological gadgetry—often unsuited to military application or unusable in battlefield conditions, and the wunderwaffen or a "wonder weapon" supposed to be capable of totally reversing battlefield odds by the terror it strikes in the hearts of the enemy.

The Soviet approach to R and D for military application is fundamentally different. In February of 1979, the Rand Corporation provided the Air Force with an uncharacteristically honest study of the different "styles" of U.S. and Soviet military expenditure. Included in this report ("The Significance of Divergent U.S.-U.S.S.R. Military Expenditure"—N 1000-AF) is an illuminating discussion of the differences in R and D in the two countries. In contrast to the American emphasis on very sophisticated electronic technologies and weapons systems with a great many applications, the Rand report characterized the Soviet R and D as devoted to the acquisition of weapons systems which were simple, almost single purpose, and revolutionary. Their description of a Soviet jet engine is quoted here in full:

> One of the best examples in design simplicity comes from a detailed comparison between a Russian engine and an American engine of about the same vintage and having roughly comparable performance. Although the Soviet engine was acknowledged to be an outstanding design, atypical of Soviet engines in general, the design philosophy and approach were quite similiar to that found in other engine examples of Soviet origin.
>
> The Soviet engine had only about 10 percent of the total moving parts of the American engine, and about 18 percent of the parts requiring detailed drawings. It was designed, according to the analysts, for utmost simplicity and concern for costs. Engine idle, for example, was a simple throttle stop; idling RPM therefore varied with ambient conditions, whereas the U.S. engine had a fixed RPM requirement (for no apparent good reason) necessitating sensors, servomechanisms, increased complexity, and greater cost. Standard guage material throughout increased weight but reduced materials cost. Lower turbine inlet temperatures allowed use of conventional materials. As a result of these and other practices, raw materials cost per pound for the U.S. engine was 2½ times greater than for the Soviet.
>
> Open clearances reduced manufacturing cost and resulted in some test-stand performance degradation, but these levels did not degrade further in operations, as was the case for the more precisely machined U.S. engine. Although the Soviet engine was highly innovative in concept, it was rather conservative in execution. Parts were stressed to about half the level of the U.S. example. The Soviet engine was demonstrated to be unusually reliable and required only one-twelth the maintenance hours per flight hour of the comparable U.S. engine. Furthermore, estimated production cost was one-third that of the American, and crude estimates of the life-cycle costs indicated a Russian advantage of about 50 percent.

A similar story is told for armament, ammunition, armor, and naval vessels; the Soviet work is characterized by incremental innovation, simplicity of execution, all with an emphasis on usability under the most adverse conditions—for example, war. It emphasizes maintainability (because the war may last more than 7 days), and cheap production costs (because the Russians produce huge stockpiles rather than several hundreds).

An R and D impact statement

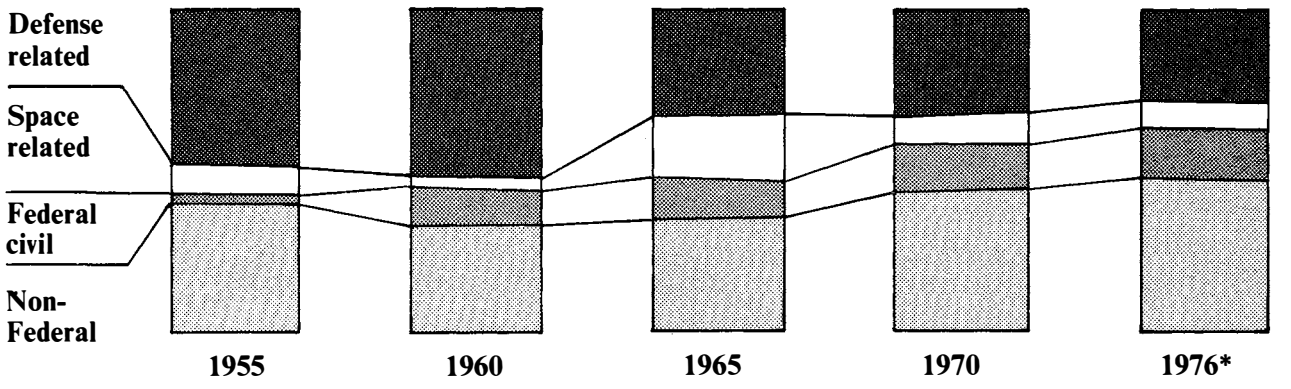
The most damning indication of the impact of the U.S. military R and D policy is provided by a *current* assessment of the relative U.S. and Soviet capabilities and a measurement of the direction of change of that assessment.

1) Armor

Conventional wisdom in the Pentagon is that the acknowledged Soviet numerical superiority in armor

Trends in U.S. defense, space and all other R&D outlays

(as percent of annual total)



Source: National Science Foundation, NSF 76-310, "National Patterns of R&D Resources," April 1976

* estimate

(tanks, armored personnel carriers, etc.) was more than compensated for by American qualitative superiority. But in congressional testimony during the spring of 1979 from Percy Pierre, Assistant Secretary of Defense for Research, Development, and Acquisition, and Lt. Gen. D.R. Keith (Deputy Chief of Staff for Research, Development and Acquisition, U.S. Army), we read:

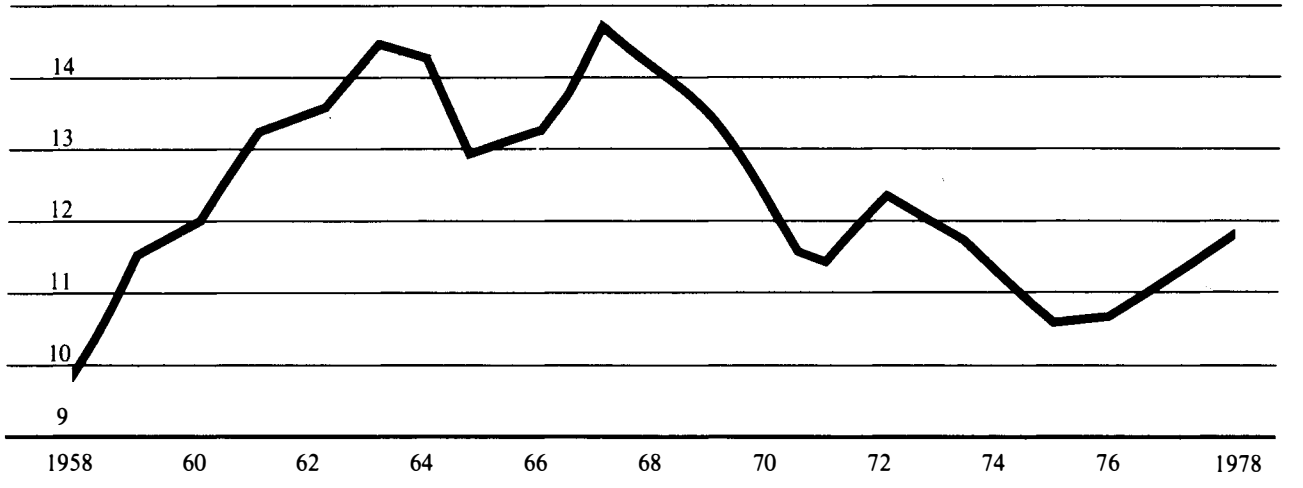
> The past 15 years has seen an erosion of the qualitative advantage in ground forces equipment and weaponry to the point where the U.S. Army is now inferior in virtually every major category of items with which wars can reasonably be expected to be won.
>
> We mention tanks. The more we learn about the Soviet T72, the more we are convinced of its superiority to all the M60 series. Last year we told you that it was superior to all the M60 series but the as-yet-undeployed M60A3. As we have learned more about it—particularly its ballistic protection—we no longer list the A3 as an exception. The T72 and T64 are probably the world's best operational tanks.

The advantage of the Soviet tanks is not merely numerical—the Soviets enjoy at least 3 to 1 advantage over the U.S.—nor merely that their tanks are better. There is persuasive evidence that U.S. tanks are so complicated and delicate that they do not work, cannot be effectively operated by the "volunteers" in the U.S. army and cannot be easily repaired. On a three day maneuver in 1978, the 3rd Armored Division (Europe) had major mechanical failures in 150 tanks—one-third of the tanks involved in the maneuvers. German staff officers explained the failures by pointing out that "today's weapons are too complex for today's soldiers." Even in tank driving, these German officers said, skill-levels are so low that U.S. tanks do not maneuver individually, but only charge in massed formation.

Of almost equal importance to tanks are infantry fighting vehicles (much like a heavily armed, armored personnel carrier). The Army head of R and D described the U.S.-Soviet matchup this way:

> Infantry fighting vehicles are a critical component of mechanized and armored units—especially in European terrain. In this category our M113 is so inferior to its Soviet BMP counterpart that it cannot even accurately be considered a fighting vehicle. It is at least a generation behind in firepower, mobility, and overall design .... Its deficiencies are glaring: it is too slow over rough terrain; it is too thinly armored, it has, as its only armament, a .50 caliber machine gun mounted on a totally exposed mount. Even if the .50 caliber could be fired in a violent combat engagement, it is incapable of penetrating its enemy counterpart, the BMP, frontally even at point blank range ....
>
> The BMP, by contrast, can destroy it, and our M60 tanks at ranges of 3 kilometers with its SAGGER missiles, and can also penetrate it with a 73mm automatic loading smoothbore gun at ranges up to 800 meters. In short, the M113 does not belong on the same battlefield with the BMP.

Defense department research, development, test and evaluation obligations
(FY 1978 billions of dollars)



Source: Arms, Men and Military Budgets. NSIC, N.Y.:1978.

2) Munitions and artillery

One of the arguments against Soviet superiority in armor rests on the role of wire-guided and laser guided infantry anti-tank weapons. These "smart" and "semi-smart" rockets can, in theory, destroy masses of enemy tanks. The impact of these weapons was clearly demonstrated in the Yom Kippur war. Nevertheless, the relevance of current U.S. versions is doubtful. The primary U.S. infantry antitank weapon is the Dragon, a wire-guided missile. Costing tens of thousands of dollars for each round, very few U.S. infantry men have ever been permitted to fire one, let alone enjoyed regular "target practice." The hazards of untrained operation are painfully clear from the anecdotes that circulate among NATO troops in Europe: The Dragon is too heavy to fire standing up and if it is fired from a prone position, the blast from the rocket can easily burn off the firer's buttocks. A sergeant in charge of training soldiers on a simulator of the Dragon, when asked whether he had ever fired one, said no, but he did know someone who had, at a special Dragon school he attended. When asked if he had hit the target, the instructor replied, "No. He was a big man, real big. But that Dragon kicks a bit. Oh, you should have seen what it done to his neck."

The Soviets have solved this problem with the development of a hand-held anti-tank missile whose simplicity of design was called "frightening" by the Rand Corporation—the result of the simplicity is a price roughly one-fifth that of the comparable U.S. weapon. The Soviet troops can afford to shoot their anti-tank weapons.

The same situation prevails in artillery in general. Here the problem is not primarily qualitative, but rather a superior Soviet appreciation of the fact that artillery is to be used in mass, for concentrated firepower against an enemy. The Soviets simply have many more artillery tubes than the U.S., and many more kinds of delivery systems. The Soviets for a long time have been firm believers in rocket artillery (the Katusha 122mm rockets in Vietnam, for example), and have deployed a large, new rocket system in Europe which uses submunitions dispensing warheads. The U.S. has *no* operational free-flight rockets.

3) Air power

The situation is no better in the arena of traditional American superiority—the air. Our air defense systems are either obsolete because of vulnerability to Soviet electronic countermeasures (the Hawk, the Nike Hercules, the Redeye), are only fair-weather (like the Chaparral), or lack range and accuracy (like the Vulcan). Officials in the German Defense Ministry have said simply, "The Soviets are decisively ahead in the air."

The helicopter, as well, is now a Soviet asset. As Lt. Gen. Keith said in his testimony:

> We have likewise been preempted in a combat field we pioneered: heliborne firepower. The Soviet HIND-D assault helicopter can deliver consider-

ably more ordnance than our Cobra TOW, and it is a more sophisticated aircraft in several other respects, including its ability to destroy our helicopters in flight. Their HIP is a converted utility helicopter with the largest ordnance delivery capacity in the world. They have 8,000 more of them in their inventory that could be converted to the gunship role.

The same story holds for every other area of weaponry with the single exception of strategic ballistic missiles. Noting that one exception, Lt. Gen. Keith's assessment is an understatement: We are now "inferior in virtually every major category of item with which wars can reasonably be expected to be won."

The question of strategic missiles

Some readers will object that "All you have said is true, but it is irrelevant to the real question of our military preparedness. That is, more than anything else, determined by the relative state of our strategic nuclear weapons capability. And, here everyone knows that the U.S. has an overwhelming lead in number of warheads and in accuraccy. In fact, the U.S. may have suffered from some problems in R and D, but it is so advanced in electronics and guidance as to make up for any other deficiencies." On the contrary. In this, as in other cases, the momentum is now with the Soviet Union.

But more importantly, the U.S.A.'s own advance in strategic missiles—precision guidance—actually destroys the possibility of a "limited nuclear war," the only kind for which precision targetting represents an advantage.

From a purely quantitative standpoint, the Soviet Union has more weapons, throw-weight and total megatonage in their nuclear arsenal. This much is well-known.

Not so well-known are two interconnected aspects of the situation:

1) The U.S. weapons, over the past 2 years, have acquired the capability for accurate delivery to any target. With the combination of satellite guidance and more sophisticated guidance systems, these missiles in the next two or three years will be able to hit any target within probable error on the order of 10 meters. These advances are the result of an intense U.S. R and D effort in the areas of computer technology and integrated circuits. While Soviet missiles are rapidly approaching the same capability, there is almost universal agreement that their accuracy is considerably less than that of U.S. misssles.

2) The Soviet effort has concentrated, as usual, on the procurement of a much larger number of weapons, even if these weapons are of simpler design and have less sophisticated guidance. The Soviet numerical advantage is at this point about 2:1 over the U.S. The Soviets have explained this difference as a result of their conviction that a nuclear war, like any other, will be won by the side which wins the last round, not the first. They are preparing to be able to have a second round of nuclear weapons to use—in contrast to the American conception of a spasmodic, one-shot nuclear exchange. The Soviet military envisages a significant fraction of its and our military capability to have survived, against which a second or third "artillery" barrage of nuclear missiles may be necessary.

The American advances in guidance make this scenario the one the Soviets must follow! Again the "wunderwaffen" approach to weapons development has created a weapon whose advantages are irrelevant to an actual war-fighting situation and which increases the likelihood of an unwinnable kind of war. Since U.S. missiles are now accurate enough that a direct hit on a Soviet missile silo is very likely, and since there is no way to "harden" a missile site against a direct hit, the pressure is for the Soviets to launch their missiles as soon as an American attack is evident. American missiles would be hitting—very accurately—empty silos. Of course, the Soviet missiles would face the same problem—but who needs a 10 meter circular error probability to hit a city?

These points were reiterated in a report prepared by T.K. Jones of the Boeing Corporation on the strategic balance of forces. In testimony before the House of Representatives on this report (April, 1979) he said:

> The Soviet Union has turned our own nuclear deterrent concept against us. It has done so by developing a capability to attack the U.S. strategic forces and at the same time hold a reserve arsenal that should deter the United States from retaliating. Indeed, a heavy attack on Soviet cities, a form of retaliation that is very frequently discussed in U.S. media, would be the most imprudent and self-destructive thing that this nation could do ....
>
> There is increasing indication that the Soviets do not believe that the United States would shoot back if its forces were attacked. This country would lose vastly more than it could possibly gain. Yet, the Soviets with their characteristic caution have invested very heavily to protect themselves against what in their view is a possible irrational American retaliation. Civil defense, a subject that I have on earlier occasions discussed before this committee, is but one element of their multilayered defense structure which, together with their reserve arsenals of nuclear and conventional systems, would allow them to survive, to recover as a nation, and to dominate future events.

This is not to say that the Soviet leaders want a nuclear war. But ...

Jones emphasized the basic instability which has arisen in the last 18 months. It cannot be stressed too heavily that this instability was *caused* by the U.S. war-fighting and R and D policy of the last 20 years: first with the gadgets, last with the weapons.

A case study in current R and D

The current U.S. position was determined by the R and D priorities set 10-15 years ago, whose consequences we are now paying for. The future looks even bleaker. The tremendous changes in warfare which we will see in the next decade are not being pursued by present U.S. R and D, or, if they are, the research is being applied in a way that is actually counter-productive. We take a case study from the advanced research and development activities of the Pentagon to illustrate these longer-term problems.

The directed energy beam weapon

There has been only one weapons system which has even the remote possibility of changing the military strategic situation in a qualatative way—much the same way the nuclear-tipped ICBM did 25 years ago, and that is the directed energy beam weapon. This device, if perfected, would be capable of directing an intense energy (either laser energy or subatomic particles), a beam travelling at or near the speed of light, capable of destroying an incoming missile or plane. Fired either from a satellite or from an earth-based battery, the beam weapon is the first possibility for a true defense against the ICBM.

It is clear that the Soviet Union is actively pursuing research on this weapon, and in the opinion of many experts, they are very close to deploying it as a weapon. William Perry, Undersecretary for Research, Development, Test and Evaluation, summarized the Soviet approach to research on a system that could revolutionize warfare:

> The Soviets are concentrating on several unconventional technologies—high-energy lasers, charged particle beams and surface effect vehicles, for example. In particular, in the high-energy laser field, they may be beginning the development of special weapons systems. We, on the other hand, have decided to keep our high-energy laser technology in the technology base for the next few years. We believe that we understand the technical issues basic to translating high-energy laser technology into a weapon systems, that our decision is correct, and that the Soviets may be moving prematurely to weapons systems.

A statement of arrogance—from a team that has performed so well in the development of new tanks, armor, and electronic warfare!

The exact status of the Soviet program is difficult to judge. Perry's testimony was published as follows:

> It is instructive to look at the corresponding program [in high energy lasers] in the Soviet Union. Generally it is difficult to get information about what is going on in their laboratories and in their technology base ... **DELETED**
>
> I have looked at this program in considerable detail and I have assessed ...**DELETED**
>
> One way of stating this comparison is that if we in the United States were to be doing the same high energy laser program that the Soviets are today ... **DELETED** one technology base alone.

It is so secret, we hide it from the Russians. Other sources (see *Fusion*, June 1979) provide convincing evidence that the Soviets are in fact close to having a deployable beam weapon; a weapon that may be operational as early as 1982-83.

The beam weapon program is at present receiving a plurality of the funds spent on advanced R and D in the U.S. This is certainly a correct decision, but the amount is too small and the program pursued with an appaling lack of urgency. Significant sections of the civilian military establishment continue to insist that the beam weapon will never work (a particularly egregious example being the MIT's Costas Tsipis—see *Scientific American*, April 1979). The present level of funding exists because of a specific Congessional mandate. But perhaps most indicative are the conclusions of a DoD-sponsored report on the beam-weapon program. This study group was assigned the job of assessing the feasibility of the beam weapon, and they concluded that the level of funding in FY79 was "too narrow to determine technical feasibility," but "a 'crash' effort is not warranted at this time." They were careful to state that their opinion that a crash effort was not justified resulted not from "technological barriers"—there are none—but rather their belief that such a weapon would not be needed before the early 1990s. Dr. Ruth Davis, the Deputy Undersecretary of Defense for Research and Engineering said: "We are not technologically constrained. We have passed those major hurdles. We are pacing against what we believe is an adequate schedule. The primary pacing is a differential between ourselves and the Russians, as well as our own desire as to when we think necessary that these ... **DELETED** should be brought on line."

Indeed.