This presentation encompasses comments on the economic motivation and potential impact of NDE.

I was rather pleased that the question period following Mr. Lee Gulley's presentation touched on some of the items that have been included here. I think it will make for a nice transition. I have included only a few "horror stories" in this series of items since I think it has been very adequately covered, but I will tell you some of the Army's experiences.

Primarily, I will discuss the cost aspects in terms of dollars and commitments of men and material, all related to nondestructive evaluation. Several projections have been produced in the last several years on the current economic base of NDT and the projected growth in this field. One indicated that the 1969 level in the United States for nondestructive testing equipment and supplies ran to about $85 million, while the 1971 level was $103 million. Sales for 1972 were projected to rise to at least $118 million, which indicates an increase of at least 15 percent per year.

Another major survey conducted in 1970 projected an increase of something in excess of 10 percent per year while a projection of two years ago placed the market in a position of doubling in the next five years. This also represents a growth in excess of 15 percent a year.

The recent trends in the last year would indicate that even that estimate may be too conservative. Another consideration is the large market for NDT services and engineering consultation which is at the level of about $180 million per year and which is projected to grow at the rate of at least 10 percent a year. While this information
addresses current figures and projections for the future markets of
equipment and services from NDT equipment manufacturers and service
organizations to industrial users, a more meaningful figure is the sum of
all goods and services rendered and performed in NDT, both between and
within industrial producers and users. This figure is estimated to be
near $10 billion per annum with a growth factor approaching 15 percent per
year. This figure is essentially what one might call the GNP of NDE
and it is very substantial.

A comparison of these growth figures with the Department of Commerce
publication, "U. S. Industrial Outlook and Projection Series," reveals that
NDT with a growth figure at 15 percent is among the few top growth industries
in the nation today.

There are over 200 producers of NDT equipment and many thousands of
users. A dozen or so companies are identified strictly as NDT equipment
producers; the remainder is a diffuse base of general equipment producers
selling limited NDT lines.

It is the overall size and, particularly, the total annual growth
figures which help to sustain the importance of the NDT field and the premise
that attention should be given to offer rational and cost effective advice to
users and developers in this very fast-growing field.

As a part of the development of the coherency in the national scene
for NDT, it is most encouraging to find the development of a well-organized
effort in basic NDT studies here today.

Let us examine some of the pressures and needs that are bringing
increased use of NDE in the DOD and elsewhere. The first is cost increases
in weaponry. The cost increases in weaponry are well documented in a multi­
tude of sources, and we have all seen these in newspapers. Perhaps the
most "economic" comment which could be made involves a few direct
observations in the cost of catastrophic failure in terms of hardware loss
or replacement, putting aside for the moment regard for human casualty,
and military tactical or strategic loss as a result of a hardware loss. For
example, it is projected that the UTTAS aircraft, an Army utility helicopter,
may cost over three times more than the aircraft it is replacing, $1.3 million versus $400,000; even discounting inflation, it is a substantial increase. The economic need for more widespread and effective NDT is paramount to reduce losses through catastrophic failure.

The second item is "reliability" as a performance characteristic, another pressure that is being brought to bear. A review of materiel requirements documentation issued for the past few years is pertinent. The term "materiel requirements documentation" within the Army refers to the formal document which spells out the characteristics required in a given military system, whether it be field artillery, aircraft or hand weapons. It tells what is wanted in terms of payload or fire power; perhaps even cost and other items.

A review of these documents in the past year shows that reliability has risen to the top position in the list of performance characteristics in a large percentage of major, new proposed systems. This demonstrates the recognition given in this area by the services. Nondestructive evaluation is one of the mainstays of reliability. Even in those systems where reliability does not receive highest weighting on the list, it is almost always near the top. Quality assurance through the use of NDT is one of the main supports for reliability in addition to proper design and suitable engineering and standardization test confirmation.

Additionally, we note in the Army that improved reliability has been set as one of the major goals of the Army Material Command R & D Program. We have been on a round-robin series of visits for the last few months to the major Army Material Commands; the Aviation Command, Tank Automotive Command, Troop Support Command, and so on, to determine what their specific testing needs are, and we are planning to draw up a major program scope for the Army in NDT.

The third item is the cost limit policy and value engineering. There is a newly instituted cost limit policy of DOD which specifies, as a development limitation, the maximum dollar sum under which each unit or system must be developed and procured while still meeting the required military characteristics, particularly reliability. The effect of this limitation will be expressed in simple designs and less unnecessarily sophisticated equipment and in the utilization of less expensive materials and simpler
manufacturing processes, but assuredly, with a demand for increased reliability and nondestructive quality assurance procedures. The point here is that we will be stretching performance with lower cost for manufacturing and with designs aimed at lower costs, however with a military requirement for fire power or payload greater than prior models.

Another item is the relationship between reliability, maintainability, nondestructive evaluation and the modern volunteer Army. Additional pressures are indirectly placed on the need for increased reliability because of increased payroll costs where enlisted pay can reach levels of $15,000, and some of the reenlistment bonuses in certain instances that can reach as high as $6,000. This, along with climbing civilian payroll costs, is escalating dramatically. With payroll being the top cost in the military, the cost of noncombatant support personnel for maintenance repair in the field becomes more difficult to sustain and more reliance will be placed on initial equipment reliability through nondestructive testing coupled with automatic field inspection devices.

A corollary problem to increased payroll costs in the Modern Volunteer Army is a drop noted in the educational level of recruits. With the cost of expanded educational programs for training of personnel from a lower educational base for equipment maintenance and test being sustained by the Army now, the Army has opted for simplified equipment.

Another area is product liability. Here we address the civilian area, but there is a military counterpart as well. The new national trend toward consumer protection has brought an entirely new series of responsibilities to organizations producing goods. Most apparent has been the national recall of automobiles numbering in the millions for adjustment and parts replacement. The economic cost is very large. While statistical data is difficult to obtain, the cost is undoubtedly running in the hundreds of millions of dollars per year. It is staggering just to consider the cost of mailing when companies send out notices to a million owners. With certified mail at 30 cents, the postage on one notification may run to $300,000. A substantial amount of this sum might have been saved if adequate application of NDT had been made in areas where lack of bond in motor mounts, critical
parts missing in hidden assemblies, and so on had been detected at the
time of manufacture. Additionally, discovery of severe deterioration in
reactor components in this country and overseas presents need for improved
NDT monitoring equipment. One of the large problems was not known to
exist until routine replacement of components was taking place. This caused
the restriction of power level of those power plants and an economic
loss which is now known to be severe. Now to look for the relationship
to the military system, the military has arrived at a situation where
court suits are brought by survivors of accidents involving military
equipment or by their estates in the case of failure of military equipment
where it is believed that malfunction was a cause. Needless to say, these
cases are very expensive.

Now, let's turn to the view where NDE may be applied in the life
cycle of equipment and we find several categories.

Primary materials is one in which an increasing awareness of the
necessity to expand RDT & E efforts in characterization is now taking place.
The prime objective is to establish a thorough knowledge of the important
material - energy interaction phenomenon as well to develop the means for
predicting the quantitative and qualitative characteristics pertaining to
flaws and their effects on mechanical and other properties of the material.

NMAB Report 252 in June of 1969 recommended that a long-range
interdisciplinary research program be initiated to insure that all possible
energy material interaction phenomena are recognized for their potential
use for NDE. Coverage was to include refractory materials and super alloys,
physics of adherence, adhesive bonding, and prediction of bond strength.

It should be noted here that on this recent round robin of visits we
made, the one overwhelming inspection problem facing the various Army
Commodity Commands and their contractors is NDT bond strength evaluation.
We think, that bar none, this is the number one problem in NDT today.
Other important NDT problems noted were evaluation of sprayed coatings,
prediction of elastic and mechanical properties of materials nondestructively,
characterization of composites and the necessary hardware to obtain such
colorization.
Nothing surpasses the initiation of manufacturing with the availability of well characterized and nondestructively tested material. If you start with something that's good, it makes the road much easier on the way.

Now, on the design of the equipment, it is also very important that consideration be given to the incorporation of accommodations for NDE in design: access for probes, steps for transducers, surface availability and other kinks to be included to permit testing or more economic testing than would otherwise be possible.

Bad design geometry creating sudden changes in sections or sharp corners creates problems. The improper choice of materials such as dissimilar metals in contact can cause differential coefficient of expansion. Underestimates of stress can cause explosion. Poor casting techniques can result in cavities, blowholes, segregation, shrink, porosity, tears, as well as other flaws. Faulty heat treatment can cause overheating, oxidation, improper hardness, and other deleterious mechanical conditions.

During manufacturing and assembly of military materials, there are many pitfalls that can be avoided if processing information were more readily available and more widely disseminated. Faulty joining by improper riveting, welding, brazing, soldering or bonding, can cause poor fusion, slag inclusions, overheating, cracking or lack of bond in porous metal. The variety of faults is endless.

Now, a more recent upswing is noted in the use of various NDE approaches to assure the complete and correct assembly of mechanical devices or hydraulic systems to confirm the presence of all parts, and in some instances, to indicate whether they can be exercised properly.

Another area is field test and built-in tests. Nondestructive evaluation in the field during overhaul and rebuild is now expanding rapidly. Test cells are utilized for diagnostic equipment to sense any irregularity occurring while engines are run in. Ultrasonic, radiographic,
and magnetic particle testing equipment is being used right on the flight line for checking aircraft parts prior to use. During rebuild operations, virtually every part is subjected to a nondestructive test which varies from visual to penetrant, acoustics, x-ray, magnetic particle, eddy current and other tests. Built-in sensors are rapidly gaining favor in aircraft operations and can be in the form of warning lights similar to those in automobiles or perhaps a meter readout to show vacuum changes in composite propeller blades caused by cracks propagating.

With regard to interdisciplinary aspects of NDT, this is an important area since there are developments coming out of other fields which are of interest to us.

In the medical field, a rapidly-growing utilization of so-called nondestructive testing methods is taking place, and perhaps, in medicine, the tests have to be more "nondestructive" than in any other application. For many years radiography and fluoroscopy were used to detect irregularities in diagnoses of patients. Now the field has grown to the use of electrocardiographs, electronic temperature sensing, infrared scanning, color radiography, ultrasonics, and liquid crystals, to name a few.

In addition to the recent, vast increase in the medical use of so-called nondestructive testing, there are other fields which bear a close relationship with NDE. These fields are related in that they employ forms of energy material interaction in many instances, but do not necessarily have quality assurance as the end purpose. These fields are telemetry, metrology, and remote sensing. Their innovations and advances are being monitored closely for their potential application to NDT. There are economic gains to be had from pursuing and adapting them. In this way we can take advantage, for NDT, of the heavy R & D outlays and achievements of the past decade in space and medicine.

Another area is the application of computers for nondestructive testing. Since the advent of small sophisticated computers, considerable effort has been expanded on their utilization as aids in developing nondestructive tests. An excellent example is that of the automated,
computerized ultrasonic cleanliness rating system developed by International Harvester for the DOD. It is used for rating internal cleanliness of semi-finished materials for gun barrels, automobile crankshafts and bearing steel, just to name a few. We have suggested it for the inspection of the cylindrical steel energy storage flywheel used in the wireless electric car system for urban transportation. (it is two feet in diameter and two feet tall made of steel, rotating at 15,000 rpm). The computer linked NDT field has grown and will continue to grow rapidly in the future. Computer systems especially adapted to process control and on-line data processing are now practical.

There are many new fields of technology applicable to NDT which have emerged, and their utilization is being investigated at the present time. We see a long list of these: neutron radiography, Kryptonation, microwaves liquid crystals, ultrasonic spectroscopy, holography, Barkhausen effect, remote television optics, fiber optics, magnetic recording devices, and so on. Here it is evident that the wide variety of techniques which can be used in NDE will increase the economic costs of maintaining NDT personnel, skills, research and instrumentation in these areas because of the diversity. The field keeps widening constantly.

Now, a few words on the economics of NDT information. In 1969, the National Materials Advisory Board in its Report 252 recommended: "The collection and dissemination of information is an acute problem in all technical fields and particularly so in nondestructive evaluation. It is essential to the needs of the Department of Defense and the nation that knowledge both in current techniques and in new developments be quickly available to those engaged in research, development, production, and field service of material. Lacking such dissemination, work may be duplicated, money and material wasted, and lives endangered because known solutions may not be applied to existing problems." That was in 1969 and we now have action on this item. The Department of Defense has executed a contract this year with the Southwest Research Institute, San Antonio, to operate the Nondestructive Testing Data Support Center at Southwest Research Institute in support of the Nondestructive Testing Information Analysis Center (NTIAC)
at the Army Materials Research Center at Watertown, Mass. With the assistance of Southwest Research Institute, the NTIAC at Watertown will be able to offer greatly expanded services in nondestructive testing information, bibliographies, newsletters, bulletins, state-of-the-art studies, handbooks and so on.

For practical output, Southwest is currently preparing a state-of-the-art study in filmless and automated film-reading radiography, while the NTIAC at Watertown is issuing the proceedings of the last tire symposium for wide distribution. In order to accomplish fast response to NDT queries, new computer retrieval systems for NDT information have been inaugurated. Wide publicity is being given to the Center.

The contract calls for the preparation of two state-of-the-art studies each year and also for other special studies to be prepared. With the annual support for the contractor at the two-hundred-fifty-thousand-dollar level and with the additional internal support at Watertown, we expect a dynamic program in nondestructive testing information gathering, analysis and dissemination.

NTIAC now has a newsletter and a bulletin issued by Southwest Research Institute. One is a subscription item, the other is a free item. Organizations and individuals desiring to be on the free mailing list should send name and address to the Nondestructive Data Support Center, Southwest Research Institute, San Antonio, Texas and they will be glad to accommodate you.

Now, in conclusion, there are in the Department of Defense striking dollar savings to be made through the use of NDE. We would like to tell you a few of these from the Army standpoint.

The first one is something we are deeply involved with at the very moment. There is a particular aircraft component which, after several years of use in the inventory, has exhibited catastrophic failure. These components cost $5,000 each, and there is something approaching eight thousand of these now in the inventory. This adds up to approximately forty million dollars' worth. The failure mode and its precursor conditions have now been fingerprinted, and it remains to find the nondestructive evaluation procedure to check the inventory for those individual units which contain conditions
which can lead to the failure and to eliminate them. We see nondestructive evaluation as the only way to proceed. The alternative, if it can be called that, would be to drop the entire inventory and scrap it and build new units or to reduce very sharply the allowed life hours. Both of these alternatives, if they can be called that, are extraordinarily inexpensive.

In another instance, in a survey during a recent five-and-a-half-year period, it was determined that bearing failures cost $20 million in premature engine overhaul costs. Because of this and other related problems, we now have in the Army an extensive program for development of improved nondestructive evaluation techniques for the detection of the quality characteristics detrimental to bearing life.

In another instance, using radiographic procedures gained from one of our programs, previously accepted M114A personnel carrier road-wheel arms were examined and rejected due to cracks, misruns, shrinkages, cavities and unfused shaft links. As a result of this work, the manufacturer returned approximately $700,000 to the Department of the Army.

In yet another instance, there was a savings estimated at a half a million dollars to the government in the inspection of the M-1 rifle, fifteen thousand of them in particular. In these, an unknown number of receivers (one of the parts of the rifle), was inadvertently made of 8600 leaded steel instead of the required 8620 steel. If not separated, these could have resulted in catastrophic service failures. The method successfully established was the electromagnetic probe which proved capable of accurately sorting a thousand rifles a day with partial disassembly as compared to the prior sorting rate of twenty-five rifles per day with extensive disassembly, a drastic savings in time and money.

There is a distinct move toward the demand for 100 percent inspection of items by nondestructive evaluation. We see it in the inspection of explosives and high explosive artillery shells. Currently in one production program, two shells are radiographed in each lot of fifty. As the modernization of the ammunition plants moves from manual pouring of the explosive to automated fill of the shell, the need for inspection reaches toward 100 percent, both for quality inspection and manufacturing feedback.
requirements. The need for these high testing rates of the explosive is to prevent in-bore explosion due to premature explosion from fill defects. The cost of radiography and subsequent film interpretation by inspectors in the new manufacturing plants becomes virtually impossible and demands the development of automation. These items are produced in many thousands per shift. A particular round in question is 17 inches tall, and the radiographic requirements would be horrendous if film were to be used or, if it were used, if it were to be read visually.

Two distinct moves which are seen for nondestructive evaluation are its incorporation into the basic materials production processes and the manufacturing operations rather than a separate test operation. This is a long-term trend. We also note the integration of NDT into what may be called the diagnostics areas where the end item carried its own instrumentation for monitoring and in some instances for subsequent decision-making. We have documented instances in the Army (it is very difficult to measure savings through NDE) approaching $100 million in the last ten years. We think the sum is much larger than that, but we just have not been able to fully measure it.

We have noted only a few of the instances here. Equivalent or greater savings have been made in other military services. There remains, however, a large number of difficult and unsolved inspection problems awaiting NDE solution. We need to reduce the cost of testing through automation, and to eliminate the human evaluator in the system with his fatigue and subjectivity, and we need to develop real time evaluation during manufacturing.

Thank you.
DISCUSSION

DR. DAVID KAELBLE (Science Center, Rockwell International): Mr. Darcy, I am very interested in this concept of automated NDT during production. Would you feel that this is essentially the design of the production process rather than the design of parts to accommodate the inspection techniques? This would make the NDT design and test method something which would need to be developed concurrently with the production design itself.

MR. DARCY: Yes. There are requirements now in the Army in the preparation of the bid package by bidders for R & D and production contracts to incorporate a quality assurance program for the product as a specific part of the bid package, and incorporated within the quality assurance package, is, of course, NDT. The requirement is upon the bidder now or the designer to do one of two things, certainly, or perhaps two things. One is to accommodate nondestructive evaluation in the design so that there can be subsequent nondestructive evaluation with ease, and also to accommodate the manufacturing procedures with probes or whatever is required. In fact, the Air Force has programs where they are incorporating nondestructive testing at the winding head of lay-up machines to insure that the tapes are laid down properly.

DR. DON THOMPSON (Science Center, Rockwell International): Do you refer to composites in your latter statement?

MR. DARCY: Yes, that particular one involves composites. There is demand also for monolithic metal parts to have ease-of-testing included.

LIEUTENANT MICHAEL BUCKLEY (Air Force Materials Laboratory): You described the field here as approximately $10 billion a year and the research expended in the field is certainly a very small fraction of that.

MR. DARCY: Yes, it is. It is infinitesimal.
LIEUTENANT BUCKLEY: Right. That's just my point. Do you have an opinion why it is so low for a field that costs so much money to the nation; how have we gotten to that point?

MR. DARCY: Well, NDE is an orphan. It is not appreciated. In some instances it is disliked, disliked by the producer who has to get so many out the shipping door at a certain time. It is a difficult discipline. It is a broad discipline. There are relatively few courses in NDE in schools. It is something that has just developed poorly for a variety of reasons.

LIEUTENANT BUCKLEY: Then I guess the follow-along is: What is the trend in the Army today?

MR. DARCY: The trend has been good in the industrial area as opposed to the research area. We are still wanting for money. The Army's basic NDT program is still limping on and on with relatively few dollars. In the industrial area, we have been able to get more money. The testing technology program at Watertown, that is, the national program where the various quality commands are funded out of AMMRC by the Quality Assurance Branch, started some ten years ago at something like $300,000. It has now reached the level of three or four million dollars, and it has been a long hard struggle to get it to that size. That program incorporates nondestructive testing, mechanical and destructive testing, and chemical testing. The larger share of that sum of money is for nondestructive testing, however.

DR. OTTO GERICKE (Army Materials and Mechanical Research Center): I would like, as a humorous footnote to your comments, to point your attention to the recent drawing in Physics Today. Some of you may have seen it. It is the first nondestructive tester who, evidently, went to work, and what he is doing is, he is applying Archimedes' principle to the evaluation of the composition of gold in crowns, royal crowns. I couldn't help being impressed by the discrepancy between the cost of the item—that happened, of course, maybe a thousand or two thousand
years ago—the cost of the item compared to the condition of the poor guy who was doing the work. He was just wearing a jockstrap standing in a wooden bathtub doing his work. I think we have made some progress in the meantime, but we still have a long way to go.

PROF. H. TIERSTEN (Rensselle Polytechnic Institute): I am puzzled your answer to Lt. Buckley's question when you said the producer is not happy with nondestructive evaluation. Since the Army is buying the thing, why does what he thinks have any bearing at all?

MR. DARCY: Well, by "not liking it," I meant that frequently nondestructive testing is looked on as a bother by producers.

PROF. TIERSTEN: What does that mean?

MR. DARCY: It means that there are hurdles to be overcome, psychological hurdles, to sell NDT.

PROF. TIERSTEN: Within the military?

MR. DARCY: No, no. I am not talking about within the military. Within the military, we appreciate it.

PROF. TIERSTEN: Can't you write specifications that require it?

MR. DARCY: That is part of the problem and that is being attacked right now, the specification end of it. I am not familiar with the other services, but certainly within the Army the problem is that the weapon performance specifications are given. It is not required in all instances that a specific NDT test can be accomplished on a given component. The trend is towards performance specifications for items, but this is changing a little bit, slowly and with difficulty. There is a study that is being accomplished now, on a review of the standardization area in nondestructive testing. The Area Assignment, so-called, for standardization of NDT in DOD is at AMMRC, Watertown, in the Standardization Branch, and over this past year a series of surveys were made, both by personnel at Watertown and through a contract with the Battelle Memorial Institute to survey all the nondestructive testing specifications. There are hundreds of them. They are in a state of overprofusion and overlap. This has now been studied and recommendations
have been prepared on clearing up the situation by simplifying, eliminating, and improving. A series of meetings are being held with the military services in the next half year. A program will be developed in DOD to attempt to rectify this situation.

In addition, there are a number of things happening nationally. The standards program that Lee Gully mentioned this morning is a wonderful effort through NBS to tie together and improve the NDT standards area. We have the Standardization Area document which Watertown is pursuing. We have the recent contract for the expansion of NDT information services. We have this area here today, on basic research in NDT. We have a number of things going very favorably for NDT today. We have the Army finally requiring, in bid packages, the incorporation of a quality assurance program for a given item to be designed. So just within this last year or two, there have been some rather dramatic increases in the national recognition and the military recognition of the need for improving the total scope of nondestructive evaluation.

DR. FRANKLIN ALEX (Ogden AFLC): There has been a number of things alluded to this morning. We are all, of course, aware of the technological problems of NDT and NDE, but one of the things that has been alluded to is the fact that even though we may be talking about a fairly simple technique, there is an awful lot of work to be done to use it in a scientific manner. Even though we may have quite a lot of knowledge about something, we don't have very good reproducibility and very good response when we go ahead and try to apply this thing in a production environment.

One of the things that I think that we should probably look at fairly carefully is the psychological problems accompanying the inspector and the individual who has to do the work. One of the things that has been suggested is to go ahead and automate it, automate the technique and let a machine do all the work. Of course, this is very good where you can make the machine do all the work, but when you go ahead and you have to tie an operator to a machine and
the operator has to do a portion of it, the more automation you have, sometimes the more boring the job becomes.

I think there is a very definite need here to get some people in the area of behavioral science to look at the NDT job itself, to try to go ahead and look at the job so once we come up with the technique, we can now combine it to the human aspects and get a reliable result. I don't believe there has been much done in this area and I don't think we have anybody in this particular meeting that is involved in that aspect.

DR. THOMPSON: In the behavioral sciences, no.

DR. ALEX: And the reason I say this, is you keep hearing about the fact that the producers, the people putting the parts out, are very uncomfortable with the NDT operations. I think that has a twofold reason. One, of course, is that every time they find a reject, it costs them money. There is another problem. If you have to do the work, it is very difficult to manage the NDT effort from a standpoint of human behavior. A good example would be: "How do you go ahead and keep these people motivated when they --especially when your quality goes up, day after day--they look at good parts. You train an individual not to see a bad one. When he runs across a bad one, he doesn't even see it."

DR. THOMPSON: Very good point.

MR. DARCY: Perhaps we should get back to the old Roman days. When the Triumphal Arch was built and the forms were still around it, the architect and the building engineer had to stand under the arch while the forms were removed.

MR. EDWARD L. CAUSTIN (B-1 Division, Rockwell International): I would like to take exception to your statement that the producers don't care. Being a producer for a long time, I felt that we have been the big energy in the nondestructive testing field. Before customers could even spell NDT, we were inventing it. I don't know who your
producers are, but surely they are not in the aerospace industry.

DR. LEE GULLEY (Air Force Materials Laboratory, WPAFB): Back on the subject of the Nondestructive Test Information Center that you have, I can foresee the requirement that is going to be the most frequently needed item and that is the requirement where you have got a problem in the field and you are looking for a way to solve it. How would a person go about doing this through the NDT Information Center? Would it be possible through it to ask, "Give us a printout of the past experience in this area," based on our submission of, say, key words and key information on that problem?

MR. DARCY: Yes, there is such a system coming into being now on terminology. Southwest Research Institute is developing it. We can do it in a limited sense now with the mechanical retrieval system we have at Watertown, but it isn't going to give what we will have in the future. We have a reference base of some 7500 articles at Watertown and inquirers can call us on the phone. We will do a scan. We will read the references over the phone to them or send them copies of the references and the abstracts and they can take it from there. We will tell them what our experiences have been. We will steer them to where we think, perhaps, the problem has been solved and where someone is working on it.

DR. GULLEY: Also, very briefly, the Center that you are talking about, is it open to private contractors as well as to the DOD?

MR. DARCY: Yes, it is open to the public.

MR. GULLEY: I see.