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THE NORTH CAROLINA A&T STATE UNIVERSITY STUDENT SPACE SHUTTLE PROGRAM A STATUS REPORT 1979 - 1986

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ABSTRACT

Inspired into being in 1979 by the late astronaut, Dr. Ronald McNair, the primary goal of this student centered program is to perform two experiments, Arthropod Development Study and Crystal Growth Study. Since 1979 , 78 different students representing 12 majors have participated in every phase of development of the payload -- from coming up with the original ideas to final fabrication and testing. Students have also been involved in many extra activites such as presenting their results at annual meetings and hosting tours of our lab for local schools. The program has received extensive outside support in the form of funds, technical assistance and donated parts. The payload, made primarily out of aluminum, consists of a central column structure, a battery box, a crystal growth box, an arthropod development box, four control circuit boxes, and a thermograph box. The battery box contains 24, Eveready 6V, Alkaline batteries. The thermograph box contains 3 Ryan TempMentors. Fabrication of the payload is essentially complete and a complete testing program has been initiated.

BACKGROUND

The goal of the A&T Student Space Shuttle Program is to perform two student experiments using a space shuttle flight sometime soon after the system again becomes operational.

In addition, we have a number of secondary goals which we feel are very important. They are: to enchance the classroom experience by putting students in a real world project; to develop in students a strong sense of professionalism about their work; to have students interface with the high technology of the space shuttle; and finally, to motivate students to dream big and then go after that dream.

The two experiments involved are entitled Crystal Growth and Arthropod Development. The objective of the Crystal Growth experiment is to determine the effect of weightlessness on the shape and number of microscopic inclusions in crystals of Rochelle Salt grown from aqueous solution. The objective of the Arthropod Development Experiment is to determine the effects of weightlessness and cosmic radiation on the mating and development of the Milkweed Bug.

Our program's roots are tied to astronaut Dr. Ronald McNair, a member of the 51-L Crew who tragically died aboard Challenger last January 28th. Dr. McNair, an alumnus of our university, was selected back in 1978 as one of the original 35 space shuttle astronauts. His selection inspired us to also get involved with the space shuttle.

In May of 1979, the University made the $500.00 deposit required for involvement in the GAS program. This marked the official beginning of the A&T Student Space Shuttle Program.

To get the program going, a campus-wide contest was initiated inviting students to develop and submit ideas for experiments. The contest ran an entire semester and prize monies totaling $2,500 were donated by two corporations - TRW and Raytheon. A total of 20 papers were received from the students and the top three were chosen as winners by a faculty review committee.

Since the contest, 78 different students, representing 12 different majors, have participated in the program in a variety of overlapping activities. Most of the activities occured in our own Student Space Shuttle Laboratory.

The first activity following the contest was to conduct an extensive literature search in order to get ourselves up to date and to confirm that the three winning ideas had merit. In addition the winning ideas were also researched in the laboratory to confirm that they were feasible within the GAS constraints. The end result of this research was that one of the winning ideas was dropped with much reluctance and the other two slightly modified, giving the two experiments which were discussed earlier.

The next major step was to model each payload component out of balsa wood. We made many trips to the local hobby store. Once we had a working balsa wood model for a given part of the payload finalized, detailed drawings of that part were made. Next it was to the shop. Whenever feasible, we had students do the shop work supervised by professional machinists.

All electrical design, building and testing has been done by the students. We also tried to use computers whenever it was feasible and made sense. Some of our drawings have been done on a CAD system. The computer has also been used extensively by us as a word processor for doing reports and preparing talks such as this one.

Our typical organization over the years has been to divide the 20 to 25 students participating each year into 5 teams, each team having a faculty advisor. These teams then meet weekly to review the previous week's work and set up objectives for the coming week. Once a month all teams meet to compare progress and mutual problems.

At the end of each school year we have held an Annual Meeting to summarize the year's accomplishments. Typically 10 to 15 students make 5 minute presentations, all view graph based and well planned and rehearsed. The audience includes other students, faculty, administrators, including the Chancellor of the University, corporate and NASA sponsors, and when his schedule permitted, our astronaut Dr. Ron McNair. Following each Annual Meeting the presentations are expanded in detail and assembled into Annual Reports.

All work and no play isn't recommended, so each year our program also sponsors a campus-wide contest involving model space shuttles. The models entered are first put on display and judged for accuracy, detail and neatness. Next the models are taken outside and flown. The best combined score for display and flight wins.

A high point in the program was a bus trip in early 1984 to Kennedy Space Center for Dr. McNairs's first flight. During the first day we toured the entire center and on the next day we witnessed the successful launch of flight 41-B.

None of the activities discussed so far would have been possible without extensive outside support. Outside support has come in three forms: financial, technical and parts.

Financial support through the years has come from two corporations and NASA-Ames. The corporations involved are Raytheon, TRW - Energy and Defense Sector, Digital Equipment, RCA, Owens-Illinois and General Electric. Private funding, which is what started the program, now totals approximately $120,000. NASA-Ames' funding which started 4 years ago is through a Joint Research Interchange and now totals approximately $200,000. Of this $320,000 total, roughly 25% has gone as stipends to the students participating in the program, 25% for release time for the program's director and other faculty who have served as faculty advisors, 25% for equipment and supplies and 25% for university overhead.

Technical support has come from several sources. Representatives from TRW and NASA-Ames have made many vists to our campus to interact with the students in the program. Additional technical support has come from AT&T Bell Laboratories through one of their engineers who is on loan to the university as a visiting professor of electrical engineering and is also serving as a faculty advisor to the program.

Finally there is the area of parts support. Three additional corporations have participated in this way: Amp; Union Carbide; and NRG-Barriers. Amp donated all of the rather expensive, mill-spec connectors which we are using. Union Carbide donated 240 Eveready Energizer, No. 528 lantern batteries to meet all of our needs for both testing and flight. NRG-Barriers donated the poyurethane insulation which we used in several parts of our payload.

PAYLOAD

The payload (Fig 1) consists of a support structure, a battery box, a crystal growth box, an arthropod development box, 4 control circuit boxes and a thermograph box.

The support structure (Fig 2) consists of two circular plates bolted to a central column. The top plate of our support structure is bolted to the top plate of the GAS cannister. Bumpers required by NASA are attached to the bottom plate to prevent the suspended support structure from hitting and damaging the inside wall of the cannister.

The battery box (Fig 3) contains 24, 6V Eveready Energizer Alkaline Batteries. Twenty of the batteries are designated as heater batteries, and are dedicated to keeping the payload warm during the entire flight. The other 4 batteries are designated control batteries and are totally dedicated to running the control electronics.

The crystal growth box (Fig 4) will be used to grow a single crystal of Rochelle Salt. While still on earth a supersaturated Rochelle Salt solution is placed in the growth chamber. A seed crystal of Rochelle Salt is placed on the end of a narrow shaft, retracted and then stored behind a rupturable diaphragm in the cover. The cover is then closed down over the growth chamber. The experiment is activated shortly after launch at around 60,000 ft.by the NASA provided baroswitch. First the solution is heated and stirred to dissolve all the granules of Rochelle Salt. Following this an automatic controlled cooling process is initiated. After two days of cooling the seed crystal is inserted into the solution which has become supersaturated in the meantime due to cooling. After two more days the growth process is automatically stopped. This is accomplished by turning off the heat, retracting the cover and the grown crystal, and absorbing the left-over solution with silica gel dessicant. The recovered space grown crystal will then be compared with earth grown control crystals.

The arthropod development box (Fig 5) will be used to yield baby Milkweed bugs. While still on earth, males and females will be put into separate compartments, males in the top one, females in the middle one. The bottom compartment is left empty and will later serve as the nursery. In addition a total diet paste is put into each of the three compartments. The compartments are covered and the box is sealed shut and covered with insulation. The heaters and lights for this experiment are also activated by the baroswitch. Approximately 1/2 hr. after achieving orbit, the door is retracted uncovering an opening between the male and female compartments and uncovering the nest between the female compartment and the nursery. Hopefuly there will then be mating and 1-2 days later the females will be laying eggs in the specially prepared nest. After 4 days the door will be closed by astronaut command, thus preventing any further egg laying in the nest. As the eggs in the nest develop and hatch out, the babies unable to crawl out through the top of the nest because of the closed door above, will crawl out through the bottom of the nest into the nursery below. The babies later recovered from the nursery will be compared to earth-born and raised, control, Milkweed bugs.

Four control circuit boxes (Fig 6) contain all the electronics to run the payload. Two boxes are dedicated to the crystal growth experiment. A third box is dedicated to the arthropod development experiment and the last box is used for overall system control and interfacing with the orbiter.

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The thermograph box (Fig 7) will contain 3 Ryan TempMentor thermographs. Each thermograph is a totally self-contained unit. Each thermograph will be activated when the payload is handed over to NASA personnel at KSC. Thereafter, until we get the payload back approximately two months later, each thermograph will measure every 20 minutes and store in its own memory for later readout, the temperature of a given payload location. The three locations which will be monitored are: the battery box, the growth chamber of the crystal growth box and the arthropod development box.

ACKNOWLEDGEMENTS

Over the years many, many individuals have contributed much time and effort to the development of this program. They are to numerous to list here. It is however, fitting to list those students and faculty who carried the program forward last year: ** Students -- Electrical Engineering: Kelvin Brooks, Jonathan Hampton, Brian Burnette, Chris Webley -- Mechanical Engineering: Nate Hines, Karen Sidbury, Jerry Lang -- Chemistry: Saundra Flowers, Toni Lamberth -- Biology: Mark Melton; ** Faculty -- Electrical Engineering: Mr. Wayne Crigler -- Chemistry: Dr. Vallie Guthrie -- Biology: Dr. Jerry Bennett. A special thanks to Mr. Crigler for his extra help in getting this talk prepared.

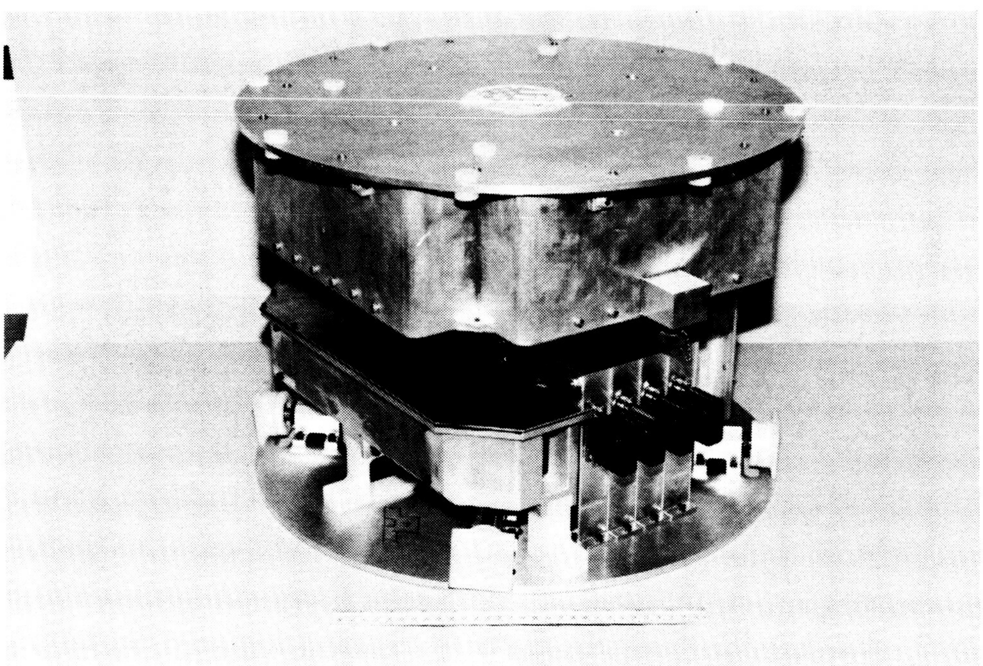

Figure 1. Payload

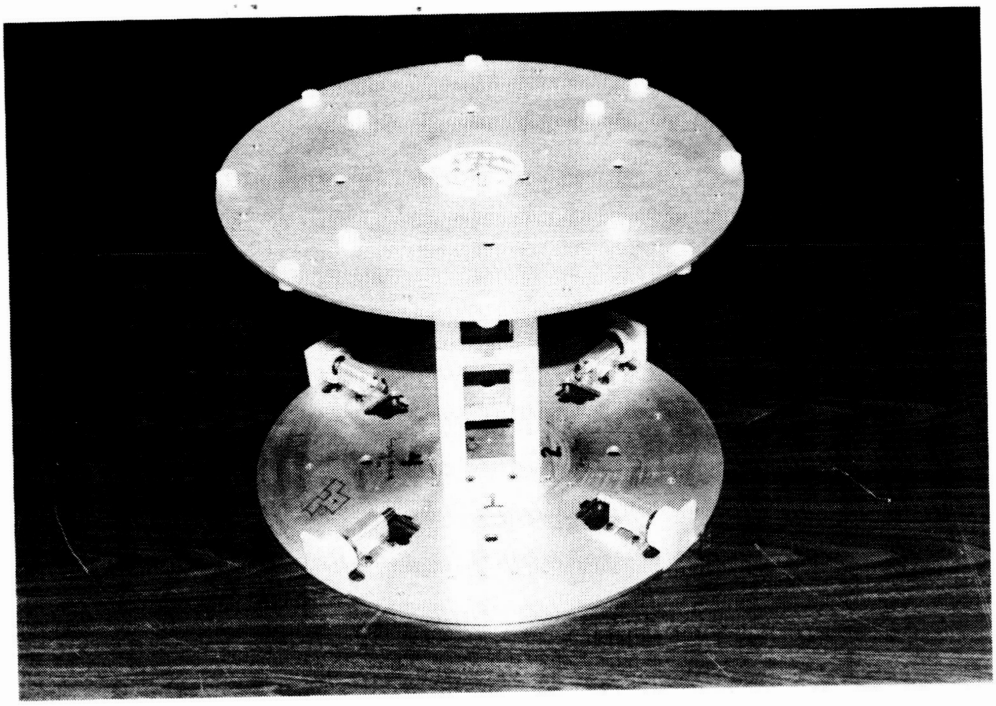

Figure 2. Support Structure

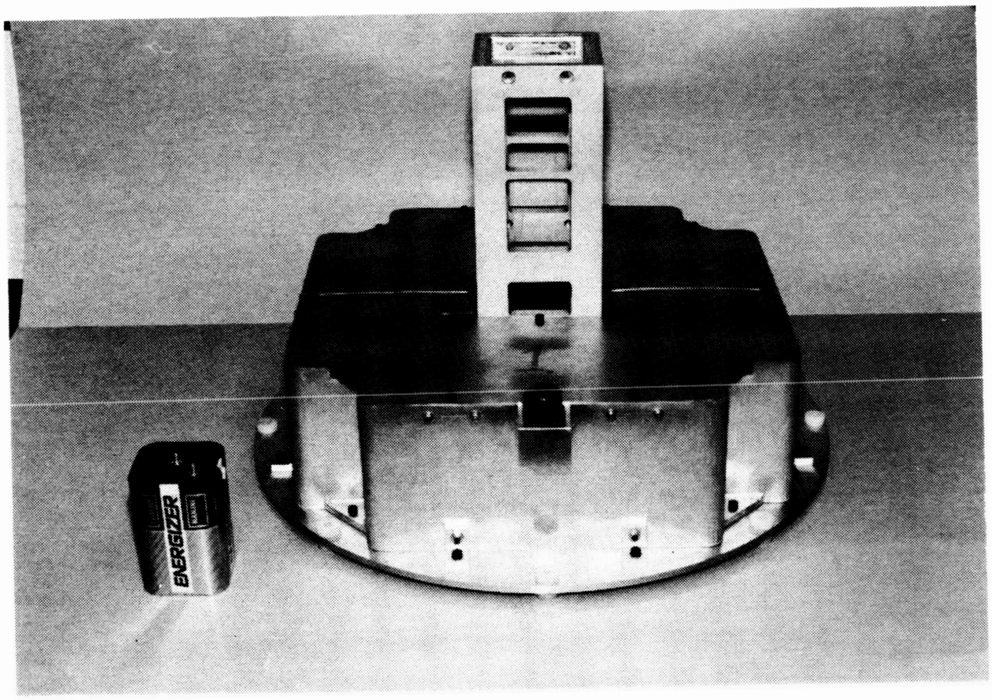

Figure 3. Battery Box

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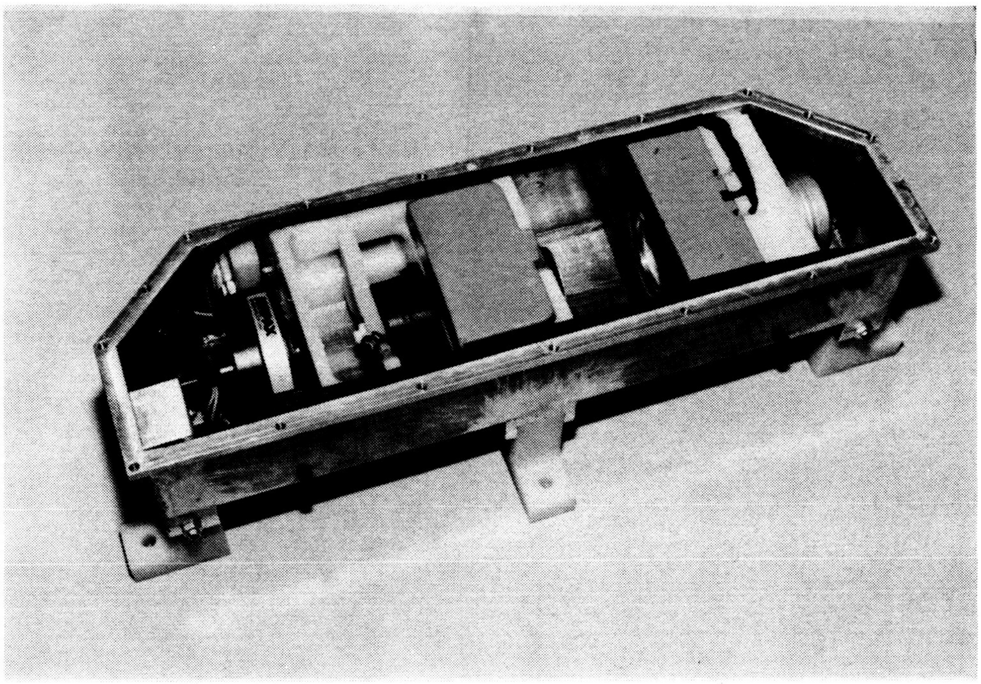

Figure 4. Crystal Growth Box

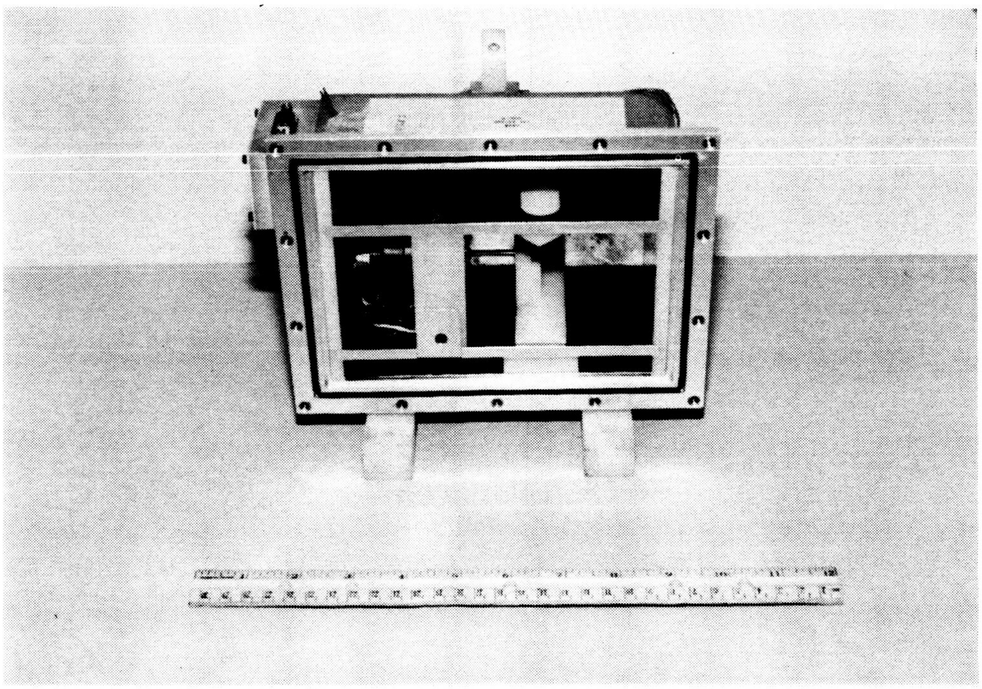

Figure 5. Arthropod Development Box

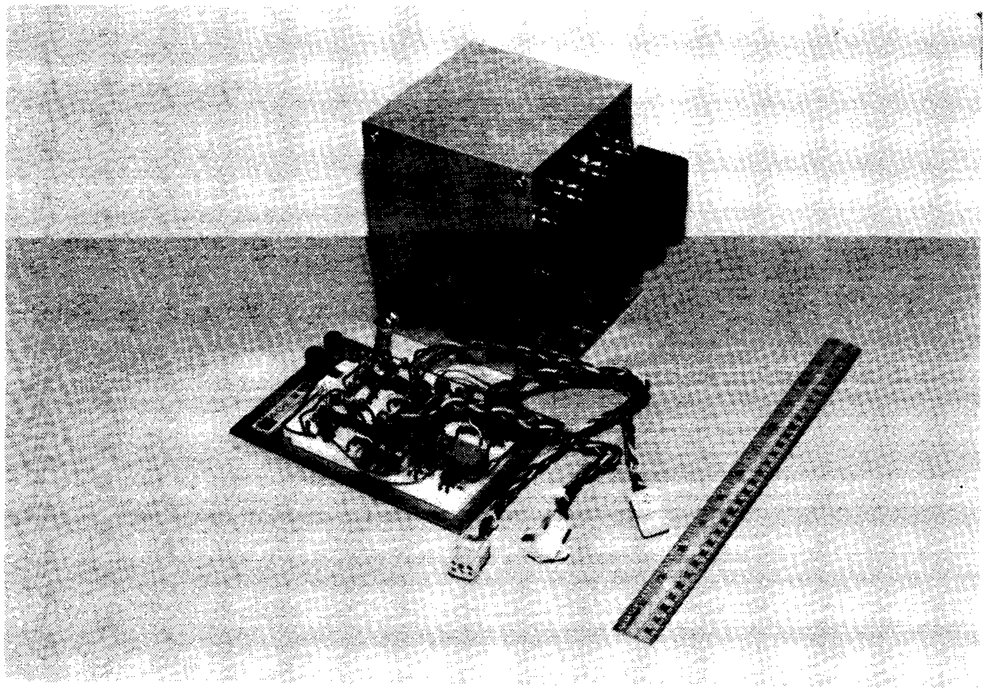

Figure 6. Control Circuit Boxes

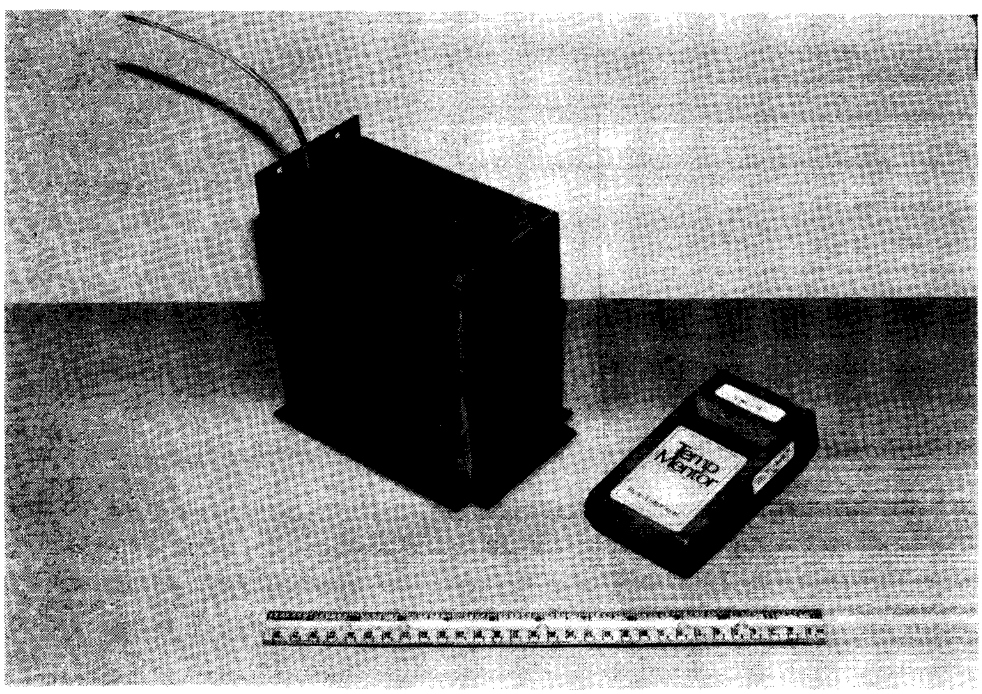

Figure 7. Thermograph Box