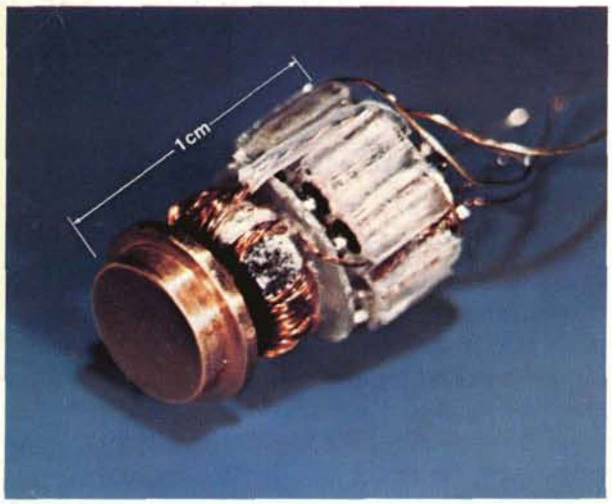
NASA is developing a means for detecting hardening of the arteries by measuring arterial pulse waves. A "non-invasive" pulse sensor, affixed externally, eliminates the need to penetrate the skin. The sensor is an aerospace spinoff, as are other elements of the arterial pulse wave detector.

can be instructed, for instance, to survey a wheat crop. The wheat would appear in a designated color, the non-pertinent background down-played. The resulting image corresponds roughly to a newspaper's political situation map in which the significant areas are shaded.

NASA's Goddard Space Flight Center is adapting these image-processing techniques to X-ray usage. The simple and inexpensive system consists of a filter and an optical decoder developed by NASA. The filter is placed between the patient and the X-ray apparatus. Using the lung-cancer example, the filter blocks out the bone and the optical equipment displays a clear picture of the lung tissue.

A transducer originally used to measure air pressure in aircraft wind tunnel tests is the basis for a development important in diagnosis and treatment of certain types of brain damage. A totally implantable device, the intracranial pressure monitor measures and reports brain pressure by telemetry.



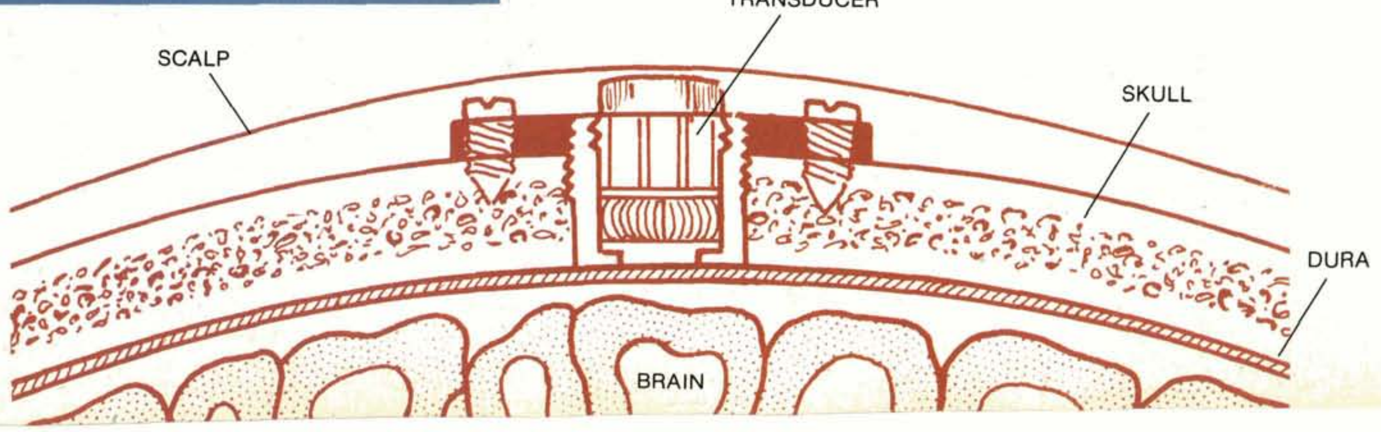
Brain Pressure Monitoring

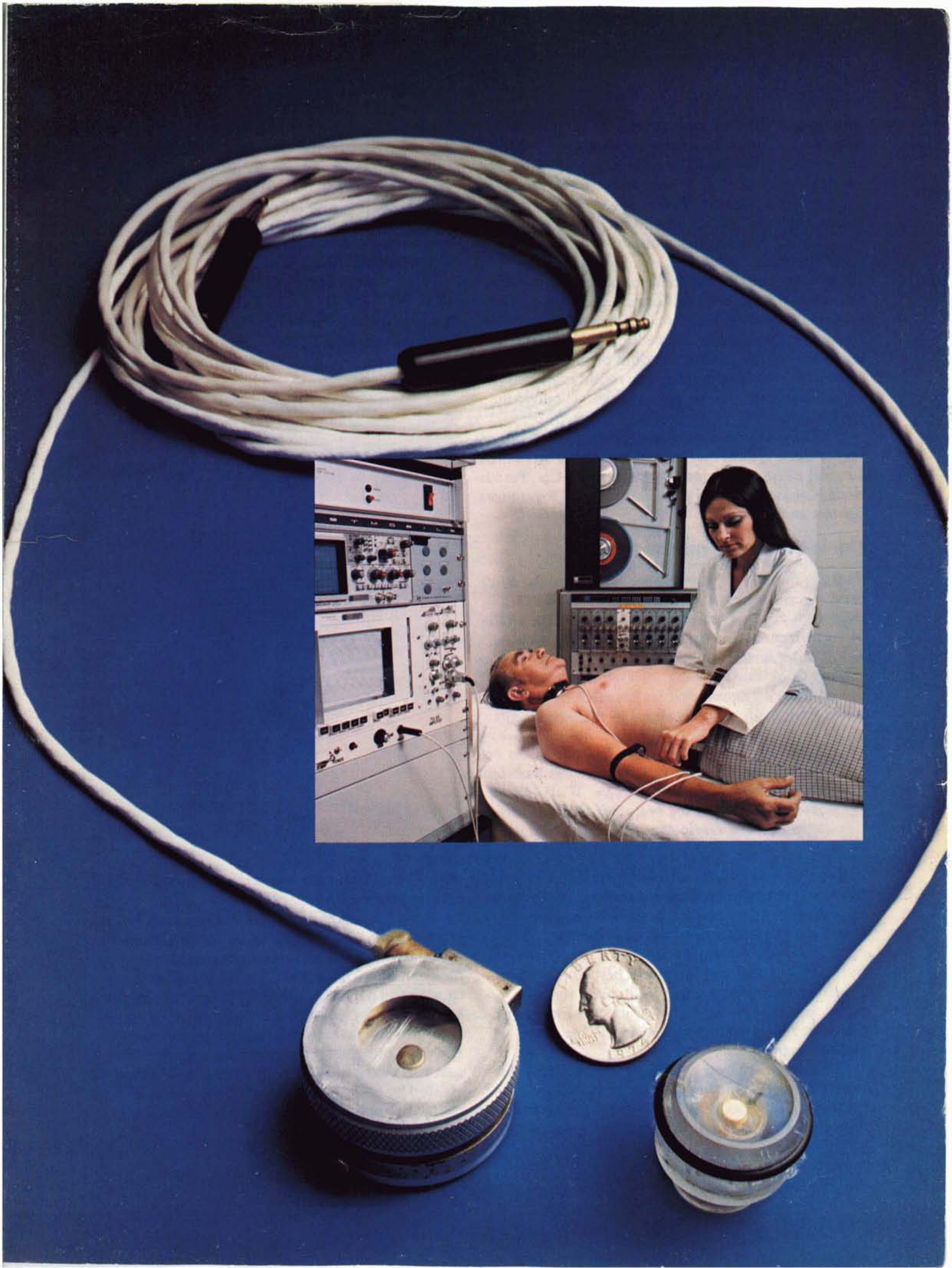
Another type of aerospace sensory device offers promising application in diagnosis and treatment of brain damage caused by increased pressure.

Brain damage can result from external injury, as in an auto accident, or internal injury, as in stroke, infection, or tumor. Hydrocephalus, a condition occurring in infancy where an accumulation of fluid within the cranium causes enlargement of the head, is another cause of brain damage. In all these cases, brain damage is largely attributable to increased intracranial pressure, or ICP. Both medical and surgical techniques exist for controlling ICP, but there is widespread need for accurate and continuous information on the degree of pressure.

In current methods, the information can be obtained by drilling a hole in the skull and inserting a catheter, a flexible plastic tube connected to an external pressure-measuring instrument. This method has limitations: the catheter is a source of infection, movement of the subject is restricted, and there are problems with the reliability of the measurements because the catheter may become blocked by shifts in brain tissue.

NASA's Stanford Biomedical Application Team identified the problem and located applicable NASA technology. NASA-Ames and physicians at Stanford University then conducted extensive bench testing and animal studies of various implantable devices for





monitoring ICP. The most promising solution is a sensor originally developed at Ames Research Center for measuring air pressure over an airfoil in wind tunnel tests of aircraft. It is an inductively powered capacitive transducer—that is, a sealed pressure-measuring cell that reports ICP by telemetry.

The ICP monitor has a number of advantages. It is "minimally invasive," meaning that, while penetrating the skull, it does not penetrate the dura, the tough membrane that forms a protective cover around the brain tissue. Once implanted, the scalp is closed over the transducer, reducing risk of infection and allowing the patient freedom of movement. Most important, the monitor can report continuously with a higher degree of accuracy than is currently obtainable.

A program to validate the ICP monitor is under way and the system then will be evaluated on neurosurgical patients. Konigsberg Instrument Co., Pasadena, Cal. is producing pre-production ICP monitors for test and evaluation.

Liquid-Cooled Garment

Because there is no atmosphere to impede the sun's rays, it gets pretty hot on the moon—up to 250 degrees F. For that reason, astronauts working on the lunar surface wore a special suit consisting of a nylon outer layer supporting an inner network of tubing. Cool water flowing through the tubes kept the moonwalker comfortable. Researchers at NASA-Ames have made advancements in the Apollo suit design that offer highly efficient temperature control, and they have applied this technology to development of a water-cooled, brassiere-like garment used to aid the detection of breast cancer.

A liquid-cooled bra, offshoot of Apollo moon suit technology, aids the cancer-detection technique known as infrared thermography. Water flowing through tubes in the bra cools the skin surface to improve resolution of thermograph image.

Cancerous tissue gives off more heat than normal tissue and this forms the basis for a cancer-detection technique known as infrared thermography. However, it has been difficult to interpret thermograph results for detecting cancer in its earliest stages.

The liquid-cooled bra, being evaluated by the Breast Cancer Detection Demonstration Center in Oklahoma City, cools the breast to improve resolution of the thermograph image. Cancerous tissue recovers from cooling faster than normal tissue because of the increased blood flow characteristic of cancerous tumors. By increasing the temperature difference between normal and cancerous tissue through cooling, the differentiation becomes more apparent on the thermograph. The NASA-Ames bra contains tubes which carry the water to and from a pumping refrigeration unit.

Help for Crippled Children

Children with cerebral palsy have nervous system defects which lead to muscular spasticity and loss of coordination. Many of these children have great difficulty walking because certain muscles are in a constant state of contraction.

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Surgical techniques can lengthen muscles or tendons to improve the child's walking pattern, but it is vital to diagnose accurately the particular spasticity problem of each patient; the individual muscles causing the handicap vary greatly from child to child. It is difficult by physical examination alone to determine precisely which muscle groups are most involved. Biotelemetry has provided a solution. For the past two years, the Children's Hospital at Standord, assisted by NASA and the Stanford Biomedical Application Team, has been applying biotelemetry to the cerebral palsy problem.