"Empedocles was wrong in speaking of light as 'traveling,... its movement being unobservable by us; that view is contrary both to the clear evidence of argument and to observed facts: if the distance traversed were short, the movement might have been unobservable, but where the distance is from extreme East to extreme West, the draught upon our powers of belief is too great."

(On The Soul, 418b, 20-26; Oxford Edition)

In the above quote, Aristotle dismisses Empedocles' claim that the motion of light is unobservable primarily because of the vast distance it travels across the horizon without an observer detecting any motion. Viewed anachronistically from our present understanding of the speed of light and relativistic effects, we would naturally side with Empedocles. The above dialogue is representative of some of the earliest efforts (in Western civilization) at studying and explaining natural processes by specific "sciences" rather than attributing natural phenomena to the whims of mythological "gods". But who were the characters that played out these earliest of scientific dramas? It is important to note that science was carried out exclusively by a small group of erudite thinkers without assistance from those outside the scientific/philosophical community.

Physics has come a long way since the time of Aristotle. It was Galileo Galilei (1564-1642) who insisted that the "Book of Nature" was written in mathematical characters, dethroning Aristotle's dialectical logical/verbal method of doing science after an 1800-year reign. This ushered in the modern era of scientific inquiry that was driven by the "experiment" rather than rhetorical arguments and syllogistic logic. This macrocosmic paradigmatic shift changed the course of science forever. But one thing remained largely unchanged. The modern scientist did most of the work of science himself. He devised theories and built the tools needed to do experiments, functioning as scientist, inventor, and technician. As the scope of scientific experiments became larger and more complicated, scientists began to call upon craftsmen, those outside the scientific community, to help them build the tools and develop the technologies they needed to do their research.

Craftsmen have played an important role in many other fields as well. Robert R. Wilson has compared building accelerators to building cathedrals because cathedral design pushed the architectural technology of the day to its limits. But behind each
architect stands a myriad of craftsmen who actually did the work, laying hundreds of seemingly unrelated stones in a beautifully choreographed effort that culminated in a unified structure.

In much the same way, modern-day high-energy physics experiments call upon a large support structure of craftsmen, technicians, and engineers to design, fabricate, and install the seemingly unrelated devices that compose an apparatus used at Fermilab. These people remain the "unsung" heroes behind physics publications. In a sense, watching shutdown activities at Fermilab is like peering into a small window of history, for it is during shutdown periods that we witness an important part of the history of science in progress; newly-designed beamlines are installed, civil construction is in full swing, beamline transport systems to monitor, energize, and cryogenically cool beamlines are fabricated, assembled, and tested with high precision. Behind all these accomplishments stands a legacy of craftsmen who are not scientists. This collection of pictures and captions attempts to focus attention on a few shutdown highlights in the Research Division, and on some of the people who are performing the tasks.
Under the direction of the Research Division (R/D) Operations Department, the Meson and Neutrino SPICS controls systems were recently moved from the 13th floor of Wilson Hall to the R/D Operations Center. The new location will allow direct terminal hook-up, faster response time on the CAMAC serial link in the Operations Center, and local access for trouble-shooting systems problems.

(Fermilab photograph 86-141-6)
A schematic drawing of the EPICS control system upgrade. The PDP11/84 pictured above with its 22-bit address and up to 4-Mbyte memory capacity replaces the smaller 18-bit address, 256-Kbyte PDP11/34. One of the advantages of the new 84 is its private memory bus. Formerly, when the CAMAC controller addressed the PDP11/34 it became "bus master" tying up the bus for the duration of the cycle. Now, when the CAMAC controller addresses the PDP11/84, it only ties up the 18-bit bus, allowing the 22-bit private memory to continue executing operations. The new system processes CAMAC throughput at about twice the speed of the old system. The upgrade was a collective activity of the R/D Operations and Electronics/Electrical Departments.
supervises the construction of the new M-Polarized (MP) target pile in the Meson Detector Building. The conception, design, and engineering of this type of target pile originated in the R/D Mechanical Department. This is the last in a series of target piles built as part of the Tevatron II project. It will service the new M-Polarized proton beam which is scheduled to run tests during the 1987 running period. (Fermilab photograph 88-142-2)
Walt Jaskierny (R/D Electronics/Electrical Department) opens the back of a Trans-Rex 240 kW power supply in the Proton Area. The power supply in the background is one of 32 new PRL 500 kW power supplies currently installed in the Experimental Areas. Along with magnet tests, a multitude of upgrades and component modifications, and routine maintenance, the Power Systems Group insures the reliable operation of over 400 magnet power supplies throughout the Experimental Areas. (Fermilab photograph 86-143-3)
The picture above shows installation of the new N-East beamline transport system in the Neutrino Area. The installation of beamline components is progressing under the direction of the R/D Experimental Areas Support Department. Also, the R/D Mechanical Department is fabricating magnet stands needed to support the magnetic elements. This project will convert the N-East beam from a proton to a pion beam. The new beam will service experiments located in Lab D. (Fermilab photograph 86-143-10)
Under the direction of the B/D Experimental Areas Support Department, pipe fitters are at work on the new industrial chilled water (ICW) system in MS6 of the Meson Area. This system will service the new M-West and Polarized secondary beamline enclosures and the M-West and Polarized experimental halls. Similar systems will be installed at Lab D in the Neutrino Area and the High Intensity Lab in the Proton Area. The Neutrino and Proton Area installations are part of an energy management plan which will replace low conductivity water (LCW) cooling towers by pumping ICW from Casey's Pond. The conversion to ICW will save on power costs, having about a 4 year pay-back period.

(Fermilab photograph 86-143-11)
Ray Yarema (R/D Electronics/Electrical Department) examines the circuitry of a board which uses the new surface mount technology. Surface mount components are mounted using a special solder paste rather than using pins that penetrate the board. Because the components are smaller than standard components, thousands of them can be mounted on both sides of a board. Although surface mount technology has been used before both by other laboratories and the electronics industry, its use here at Fermilab represents the largest application of this technology anywhere in the United States. The board being examined contains 2200 components all of which are mounted on a single side of the board. Surface mount amplifier-shaper discriminator boards are currently being used for the Vertex Time Projection Chamber, the central tracking chambers, and the forward tracking chambers of CDF.
Pictured above is a new energy saver dipole (ESD) bend string which will service the new M-West beamline in the Meson Area. Downstream in MP2 a string of 4 ESD magnets is being installed for the new M-Polarized proton beamline. Both systems will be operational by mid-summer. Further downstream in the Polarized Beam, a second string of 4 ESD magnets has been completely installed and is currently under vacuum. All Meson cryogenics systems will be completed by mid-summer, at which time the Cryogenics Department will begin a shakedown run in preparation for the 1987 fixed-target physics run.

(Fermilab photograph 86-142-6)
Jerry Morris and Ed Justice (R/D Cryogenics Department) work on part of the cryogenics system of the new Wide Band beamline. Following last year's commissioning and operation of the Wide Band beamline, the Cryogenics Department installed and operated a second compressor which services this ESD bend string. The department is currently performing a diagnostic and measurement run, attempting to measure the capacity of the refrigerator and overall system, tune control loops, and detect and repair system leaks.

(Permilab photograph 85-141-10)
Rich Stanek (R/D Cryogenics Department) delivers a cryogenics lecture to the R/D Operations Group. All R/D operators are being trained to execute first level trouble-shooting of the Experimental Areas cryogenic systems. In addition, most cryogenic monitoring status are being moved to a central location in the R/D Operations Center. Each cryogenics system is controlled by one or more modified Apple computers which display status locally at each system location. The Apple computers will now be linked to the PDP11 EPICS control system and most status' brought to the Operations Center. This will enable operations personnel to monitor most cryogenics systems remotely, bringing decreased response time when a component fails.

(Fermilab photograph 86-125-2)
Mark Obrycki (R/D Electronics/Electrical Department) operates the test station for the new R/D radiation interlocks system. The Control and Interlocks Group is installing the new solid state system throughout the Experimental Areas. They have recently completed installation and testing in the primary enclosures of the Meson Area. The new system has several advantages over the older relay based system: (1) It's modular, allowing technicians to add or delete gates leading into enclosures from the system loop without major systems revisions. (2) The gate sensors use a modulated infrared signal, eliminating the old micro-switch sensors which could fail mechanically at any time after having tested the electronic components of the system. (3) The wiring to all three Experimental Areas enclosures is identical, enabling technicians to trouble-shoot systems problems.
Dan Graupman (R/D Facilities Department) works on the R/D Electronics/Electrical Department's PCAD system, designing low voltage power supply controller boards used for remote operation of proportional chambers in the new Muon Beamline tagging system. The PCAD is a computer system based on an IBM PC used for design of circuits. The Facilities Department is also using this system for design and layout of trigger divider modules, general purpose NIM to TTL and TTL to NIM converters, and "mother-boards" for pre-amplifiers for the Muon Beamline tagging system.

(Fermilab photograph 86-140-6)
Shirley Jones (R/D Administrative Support Group) using the new MASSll word processing system on the VAX. Word processing software packages change rapidly and user preference of various systems makes standardization a difficult task. The Research Division has been training Administrative Support personnel on the MASSll system in an attempt to standardize word processing throughout the Division. This training will be completed this year.

(Fermilab photograph 86-140-10)
In the picture above, backward muon toroids, backward calorimeters and electromagnetic shower counters are ready to be moved into the CDF collision hall. These components should be in place in early March. The forward muon toroids, calorimeters, and electromagnetic shower counters will be installed in the collision hall in early June. After a brief period of Accelerator operation starting September 1, the Central Detector will be moved back into the collision hall in early November in preparation for the next CDF running period.

(Fermilab photograph 86-121-8)
Construction of the new M-Polarized and M-West Experimental Halls and the secondary beamline enclosures leading to those halls are part of the final phase of the Tevatron II Project. Pictured above is the M-West secondary beamline enclosure which leads to the M-West Experimental Hall. The M-Polarized Experimental Hall is seen in the center of the picture, rising above the concrete casts of M-West. The Research Division will get beneficial occupancy of M-West by early March. In M-Polarized, beamline components are currently being installed upstream of the Detector Building, with downstream component installation beginning in late March. (Fermilab photograph 86-96-4)
August J. Mier was as much a part of the rich tradition of Illinois' Fox River Valley as were the arrowheads and Indian artifacts he collected over much of a 93-year lifetime. Mr. Mier passed away on February 25th of this year, but the more than 500 arrowheads he collected on the Fermilab site and donated to the Lab in 1977 are on permanent display on the 15th floor of Wilson Hall.

An article published in the Aurora, Illinois, Beacon-News noted that "One of Augie's proudest moments was being honored by [Fermilab's then-Director] Robert R. Wilson for donating his huge collection of arrowheads...found on what became [the] Fermilab site. He took great pride in being a personal friend of Dr. Wilson's."

Margaret Pearson, Manager of Fermilab's Public Information Office, told the Beacon-News that Mr. Mier showed his collection of Indian artifacts to Lab officials when Fermilab first opened in 1970. "The artifacts, all found on Lab property, represented 60 years of collecting. He had every one marked as to the date and location found. The collection is invaluable to us. We were newcomers here, but this gave us some roots to the area. It helped put our genealogy in place. We continued a warm, friendly relationship with Mr. Mier since then, and we will miss him."