A Tale of (Perhaps) Two Novas

Novas are not terribly rare astronomical objects. About half a dozen a year are seen. At the moment three rather ordinary ones are under observation, one in Aquila, one in Scutum and one in Perseus. But Nova Cygni 1975 was the star performer of recent decades, unprecedented in its change in brightness and intrinsically the brightest nova in at least 40 years (SN: 9/13/75, p. 164).

Among unusual transient stellar objects Nova Cygni 1975 shares the spotlight with a possibly stranger object, the X-ray source in the constellation Orion designated A0620-00, which is beginning to look like a nova too.

According to theory a nova occurs when a dark star receives an influx of thermonuclear fuel that it can't handle properly from its companion in a close binary system. The result is an unstable system that can explode in a blinding thermonuclear flash. Chemical elements are synthesized in the explosions, and so novas "may be part of the key to understanding the evolution of all matter from the simple hydrogen which it is theorized constituted all matter when the universe was created," says Harlan J. Smith, director of the McDonald Observatory.

As Nova Cygni 1975 continues gradually to fade, reports continue to come in, filling in detailed data about its behavior. At peak it was as bright or slightly brighter in infrared than in visible light (about 1.79 magnitude at 2.7 microns), but no radio or X-ray emission could be found.

Spectra taken by Ch. Fehrenbach and Y. Andrillat at the Haute Provence Observatory indicate the presence of hydrogen, oxygen, nitrogen, silicon, calcium, sodium, iron, titanium and manganese. A series of spectra taken by A. Burnicki, Wilhelmina Iwanowska, S. Krawczyk, A. Strobel and A. Woszczyk at the Toruń Observatory in Poland trace the evolution of the shell of matter driven outward by the explosion. The explosion velocity grew rapidly from 1,100 kilometers per second to 2,250 km/sec where it stabilized from Sept. 1 to Sept. 4. J. C. Kemp and R. J. Rudy of the University of Oregon found some splittings of spectral lines that look like magnetic effects that would require fields in the kilogauss range. "This seems impossible if the outgoing shell has reached a radius of 100 million kilometers, unless the shell is concentrated in lobes," they point out.

A periodic brightness fluctuation that seems to be superimposed on the gradual decline was noted by P. Tempesti of the Collurania Observatory in Teramo, Italy. It had an amplitude of 0.1 magnitude and a period of 3.2 hours.

Unlike Nova Cygni 1975, A0620-00 is an extremely strong X-ray source, and it began to create excitement when it rose to five times the brightness of any other during the second week in August. By Aug. 15 weak radio emission had been observed by at least three observatories (Arecibo, Nançay, Jodrell Bank). By Aug. 22 the radio source had decayed to about a sixth of its Aug. 15 brightness according to reports from the U.S. National Radio Astronomy Observatory.

By Aug. 15, also, an optical star had been identified as a counterpart to the X-ray source (SN: 8/23-30/75, p. 122). The first spectra taken of that star showed a very unusual featureless continuum, but by mid-September lines were appearing in the spectra that led some astronomers to think it might be a nova. Furthermore Lola J. Eachus of the Smithsonian Astrophysical Observatory found from a study of old Harvard plates that the same star erupted in 1917.

So it is beginning to look as if A0620-00 may be an example of a recurrent nova whereas Nova Cygni 1975 is taken for a virgin nova, blowing off for the first time. Why a recurrent nova should be a strong X-ray emitter while a virgin nova has no apparent X-rays at all is not known. This would be the first recurrent nova to appear since there has been X-ray astronomy, so there is nothing to compare it with. In fact many of the observed details are not well understood at present. As they are fitted into the theoretical models, they are likely to increase significantly the understanding of one of astronomy's fastest-changing phenomena. □

Oldest shipwreck yet discovered

"It's as though you took the ship and her cargo, mixed them all up in a cement-mixer, then laid them out on the seabed and poured a couple of feet of concrete over everything." Such an unseemly mess is what may be the oldest shipwreck ever discovered. The "concrete," explains archaeologist Peter Throckmorton, is the accumulation of approximately 4,500 years worth of sediment and marine encrustation.

The wreck, discovered by Throckmorton in 75 feet of water off the Greek island of Dhokos, is believed to have been a Cycladic trading vessel. During the early Bronze Age, when the Greeks were beginning to create artistic pottery and statuary, the Cyclades islanders prospered as exporters of pottery, vases and carved figurines. They were among the first voyagers of the eastern Mediterranean. The Dhokos ship is expected to yield the greatest amount of Cycladic pottery ever found in one place.

Throckmorton, an advisor to the Hellenic Institute of Marine Biology, made his discovery while taking part in a survey of ancient shipwrecks in the Mediterranean. (The survey is being made by the Hellenic Institute with a grant from the National Geographic Society.)

Fragments of large storage jars, along with jugs of many shapes and sizes used for eating and drinking, suggest that the ship was a trading vessel, explains George Papathanasopoulos, president of the institute. Preliminary examination of some of the recovered pottery indicates that the ship sank sometime between 2,700 and 2,200 B.C.

The ship itself has long since decayed, and nothing of it has been recovered. But, explains Throckmorton, "We found all these broken pots lying on the bottom near the shore. They were cemented together in four or five massive lumps, each roughly the size of an office desk." Underneath and around the pottery were round ballast stones from the ship. The archaeologists plan to concentrate on surveying the wreck in the near future so that complete excavation can begin next year.

Until now, a 3,300-year-old shipwreck discovered off Cape Gelidonya on the southern coast of Turkey was the oldest wreck ever found. That wreck was also discovered by Throckmorton. □

Ford and science: Honors, warm words

It was good day for science at the White House last week. President Ford spoke glowingly of the virtues of scientific research, 13 prominent scientists and engineers personally received the National Medal of Science from the President, and Vice President Rockefeller predicted passage of the bill to reinstall a science adviser in the White House.

In the awards ceremony before about 200 persons in the East Room, Ford referred to the men and women of science as "true movers and shakers of human events" to whom "we owe a profound debt."

"The whole spirit of science, one that urges us here in the United States to innovate, to explore the unknown, to answer the unanswered, is the true spirit of

Frank Johnston/Washington Post

Ford and Pauling: "Nourish that spirit."

America. Today more than ever we need to nourish that spirit and to do it in every facet of American life."

Ford noted that changing priorities have resulted in funds for energy research increasing at a rate of 21 percent a year; environmental research, 17 percent a year. But he emphasized that the commitment to basic research has not diminished, with funds for civilian R&D due to increase 12 percent to $7.3 billion in fiscal 1976.

"Our nation's future and that of the world depends on the creativity and genius of people such as these today," Ford said. After his remarks, read from note cards, Ford greeted each recipient and handed him his medal. The National Medal of Science is the Government's highest award for scientific achievement.

In a luncheon for the scientists and guests at the State Department immediately afterward, Rockefeller referred to the recipients as "outstanding heroes in the fields of science and engineering" and said the Administration has "a deep respect for science and the scientific mind."

Rockefeller said he and Ford were confidently looking forward to favorable Congressional action on the bill to establish an Office of Science and Technology Policy in the White House. The bill is now in conference. Rockefeller said Ford "is tremendously excited" about the bill "and feels that this has the highest possible priority."

Rockefeller drew warm applause when he noted that he had voluntarily spoken on behalf of the bill at committee hearings this year. "It was the first time in the history of the United States that a Vice President has testified before a Congressional committee—and it was in the interest of science."

Those receiving the National Medal of Science were Britton Chance, Erwin Chargaff, James V. Neel, James A. Shannon, Rudolf Kompfner, Ralph B. Peck, Abel Wolman, Kurt Gödel, Nicolaas Bloembergen, Paul Flory, William A. Fowler, Linus Pauling and Kenneth S. Pitzer. □

Arthropod academy: Flies learn maze

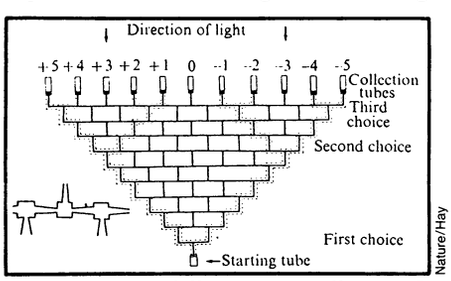
The salivary chromosomes of *Drosophila melanogaster* are among the best-charted territories in the atlas of biology. This fix on fruit fly genetics has had practical implications throughout biological research. Scientists are trying, for example, to trace the origins of behavioral traits to the responsible band or bump on the striped chromosomes, to illuminate the roles of "nature" and "nurture" in behavior. Learning behavior has been a major target for such studies.

A new and carefully designed study of fruit fly learning behavior is reported in the Sept. 4 NATURE. Geneticist D. A. Hay of La Trobe University at Bundoora, Australia, has constructed an ingenious maze to test the learning abilities of different strains of *D. melanogaster.* He tried (and seems to have succeeded) to circumvent the plethora of pitfalls in arthropod learning experiments, and concludes that he has demonstrated genetic differences in fruit fly learning.

His maze (see schematic) has opaque tops and sides and transparent inner dividing walls. A fluorescent light shines the width of the maze from behind the collection tubes (labeled +5 to −5) and attracts the flies from the starting tube through the maze. The flies are forced initially to turn either right or left, then to make a series of six turns—right-left, right-left, etc., or left-right, left-right, etc.—depending on the first turning choice at the starting tube. There are two more bifurcations higher in the maze that provide turning choices. If the flies have "learned" the proper turning sequence for following the outer walls, they will end up in the ± 5 tubes. The degree to which they have flunked the learning exercise is reflected when they end up in the ±4, ±2 or ±1 tubes.

Hay tested 100 males and 100 females of each of 10 strains. He found statistically significant evidence that some strains are more likely than others to follow the outside walls and end up in the ±5 tubes. By comparing the chromosomal differences between the smart strains and the dumb strains, it may thus be possible to detect the location of the fruit fly "learning genes," if these indeed exist.

Hay's is not the first *Drosophila* learning experiment. Other investigators, including Seymour Benzer and colleagues of Caltech and H.C. Spatz and colleagues of the University of Freiburg (SN: 6/15/74, p. 391) have attempted to show behavioral conditioning in fruit flies. But the use of positive reinforcements (odors, for example) and negative reinforcements (electric shocks) in the previous experiments have muddied the evidencial waters, Hay believes. In his test, "mere progress seems to constitute some differential reinforcement for repeating the same choice," and thus the flies' behavior can be considered true "exploratory learning," he says. □



Nature/Hay

'Smart strains' follow outer walls to ±5.

Elements 112, 114: Inert gases?

Element 114 hasn't yet been found, but already chemists are worried about its chemical behavior. Such a concern is not merely an exercise in the purest of pure chemistry; it is relevant to attempts to find or manufacture the ultraheavy elements since by their chemical behavior they will be known. In a recently published calculation Kenneth S. Pitzer of the Lawrence Berkeley Laboratory presents "the striking conclusion" that elements 112, 114, and 118 are relatively inert gases (JOURNAL OF CHEMICAL PHYSICS 63:1032).

The three elements considered are members of the so-called island of stability, a sequence of ultraheavy elements that nuclear theorists expect to be stable or relatively so and therefore of physical, chemical and practical interest. Many laboratories all over the world are straining to discover or synthesize them.

To find out what their chemical properties would be requires a consideration of their place in the periodic table and a calculation of the orbits of their electrons. The orbital data lead to closed electron shells, and therefore a prediction of relative chemical inertia. Periodic-table considerations lead to deduced binding energies that would make these substances, in elementary form, either gases or very volatile liquids.

This seems a bit of a surprise because most of the known transuranic elements have been metallic solids. Yet Pitzer points out that predicting the properties of mercury on the same basis would make it out a volatile liquid, which, in fact, it is.

Compounds of 112 and 114 would be far less strongly bound than those of their periodic-table congeners, mercury and lead. With a few exceptions (example: the fluoride of 112) the compounds would be unstable. The moral of Pitzer's tale is that "these properties of great volatility and ease of reduction to the element would appear to provide better separation methods than procedures based on uncertain similarities in solution chemistry of 112 to mercury and 114 to lead." □