Strange, colossal flare-up in Orion

People often think of astronomy as a rather timeless, ageless occupation. After all, the universe is billions of years old and changes very slowly. The pattern of stars alters so little over the years that for centuries astronomers could think of the stars as "fixed." Ironically, a large part of what fascinates modern astronomers are transient phenomena, not merely those that are transient in a millenial sense, but those whose transiency is a matter of days or even hours.

As astronomy has moved from visual light to other parts of the electromagnetic spectrum, the variety and incidence of such things has increased. The latest example, according to a report from Dartmouth College, is the identification of a strange new transient X-ray source in the constellation Orion with a very odd star that is doing something highly unusual and extremely violent. The visual identification is claimed by Forrest I. Boley, chairman of Dartmouth's physics and astronomy department, and Richard L. Wolfson, a doctoral candidate at the college. It is a tale that combines astronomical serendipity and purposeful multimedia cooperation.

The story begins rather quietly in the middle of August. The British satellite Ariel 5, routinely watching the X-ray sky, picked up a flare source in Orion. Such flaring X-ray sources have been known for more than a decade. They flash up suddenly and then decay quickly. In between flares they may perk along as low-level sources.

This one seemed a mild example, according to Ariel's report, but since such X-ray flares remain, as one might say, shrouded in mystery, it seemed worthwhile to get a fix on its location to see what information that might add. The American astronomy satellite SAS-3 was called into the act for a better triangulation of the flare's position. (To underline the international flavor of things, Ariel was launched from the United States by NASA for the British, SAS-3 was launched from the Italian San Marco station off the coast of Kenya.

It took SAS-3 about 24 hours to fix the position. At the same time, it became clear that something highly unusual was coming off. The source intensity had increased until it had become entirely surprising, five times as powerful as any X-ray source previously registered. So the world of astronomers began to buzz, and reports appeared in at least one newspaper.

At the time Boley and Wolfson, whose specialty these flare sources are, were at the McGraw-Hill Observatory on Kitt Peak in Arizona ready to begin a course of observations. (The McGraw-Hill Observatory, which opened in May, was set up with the main purpose of making optical studies of X-ray sources.) With the precise triangulation of the direction the X-rays were coming from provided by SAS-3 (which has a special collaborative operational link to the observatory that was set up for just this kind of situation), Boley and Wolfson could zero in on the location with the observatory's 52-inch optical telescope.

But there was still a complication. At Kitt Peak's location at this time of year Orion comes above the horizon only for about half an hour before sunrise. Normally the brightening sky would render photography difficult or impossible at that time of day, but the astronomers were able to use one of the recently developed optoelectronic image intensifiers to take pictures with two-minute exposures instead of the 30-minute ones that would normally be required.

On Aug. 15 they got eight shots of the target area. The number is important for confidence in the findings; a single photo might be suspect. In the light of what they found, the precaution was worthwhile: "We looked at the newly defined region and found something amazing to behold," Boley relates. "There was an object more than 1,000 times brighter than what had been found in that location in the Palomar Sky Survey 20 years earlier." The implication is that a star in Orion has flared to 1,000 times its base luminosity, a truly stupendous achievement. If the sun did that, we wouldn't have to worry about X-ray sources or anything else ever again.

Replacing the camera with a spectrograph, Boley and Wolfson got four spectrograms on the mornings of Aug. 16 and 17. These served to screw up the amazement a couple of notches. They show no differentiated light emission or absorption lines such as stellar spectra usually show. "This is a clue to us that we're looking at an unusual thing," Boley says. "Such a spectrum suggests it is made from something of incredible heat intensity, a ball of something or other burning with a high temperature undifferentiated in any way, with no part of it hotter or cooler than any other." That would be a most unusual kind of star.

"Sometime between the time that Palomar Sky print was taken 20 years ago and the night of Aug. 15 something had happened to that star," Boley sums up. "A star of undetermined characteristics—a star of some kind that we have *not* yet been able to model—has in some way changed its mode of life. And since it is precisely in the same area as the X-ray definition given us by SAS-3, the inference is strong that we are onto something." Exactly what that is is likely to be vigorously debated by astrophysicists when they see the full data extracted from these and other studies that are sure to be done while the flare lasts. □

Centaurus A is now a gamma source

Gamma rays are astronomy's newest frontier. They represent the shortest wavelengths of the electromagnetic spectrum, less than a tenth of an angstrom and down to hundred-thousandths of an angstrom. They behave more like particles than waves. Scientists tend to prefer to describe them by particle energy (hundreds of thousands to millions of electron-volts), and their detection is accomplished by particle detectors rather than reflecting telescopes.

The first extension of gamma-ray astronomy to specific sources outside the solar system was announced last week at the 14th International Cosmic Ray Conference in Munich by a group of scientists from Rice University in Houston led by Robert C. Haymes. In recent years, it is true, gamma-ray recorders on satellites have detected bursts of gamma rays coming from some unknown source or sources, but Haymes's report is the first of gamma rays from an identifiable source, the radio source Centaurus A.

The observation was made with an 1,800-pound detector carried by balloon to a height of 24½ miles over Argentina (gamma rays of this type do not penetrate the atmosphere well). These gamma rays are generally produced by energy changes within atomic nuclei, and recording them from astronomical sources will give information about the nuclear physics going on in those sources. The analysis of the Centaurus A data indicates the presence of particular isotopes of carbon, neon, silicon and magnesium in that radio galaxy, confirming theories that have predicted the presence of those elements. The group hopes to make the next data-gathering flight over Brazil sometime in November. □

Earth's plantlife: Ultraviolet peril

Practically overnight, like a mushroom in damp soil, an entire scientific issue has sprung up, involving the effects of chlorofluorocarbons on the earth's ozone layer. A sense of urgency accompanies most discussions of this issue because it hinges on the belief that decreased stratospheric ozone and increased ultraviolet light penetration will harm life on earth. But life already exists quite happily in a continuous shower of ultraviolet light. Is all the fuss, one wonders, really justified?

Biologists met this week to consider that question, and the answer seems to be an unequivocal yes. Photobiologists presented a symposium on the biological effects of increased ultraviolet radiation at the annual meeting of the American Institute of Biological Sciences in Corvallis, Ore.

The researcher considered by them to be the father of photobiology, Arthur C. Giese of Stanford University, explained the seeming paradox between life in the existing ultraviolet shower and harm to life by a slightly hotter shower. "Organisms on earth live continually in an uneasy balance between ultraviolet light damage and repair of that damage." DNA, the cellular molecule most essential to the continuation of life, is also, Giese says, the most vulnerable to ultraviolet light, since there are only one or two copies of DNA in the cell compared with the many copies of other nucleic acids and proteins. Life has evolved several mechanisms for repairing damage to DNA from the levels of ultraviolet light that penetrate the earth's atmosphere. Therefore, any increase in the amount of ultraviolet light that strikes living organisms (particularly those which, unlike man, cannot hide from the sun), "might overwhelm life," Giese says.

Increased numbers of skin cancer cases are often cited most prominently among the negative results of such imbalance between ultraviolet input and evolutionary mechanisms for repairing ultraviolet damage. There seems to be little doubt that more skin cancer cases would be one effect, although attempts to quantify with predicted numbers of cases have been less than precise. ("To paraphrase Winston Churchill," says dermatologist researcher Frederick Urbach of Temple University, "never have so many said so much about something they knew so damn little about.") But skin cancer is probably not the most significant effect. "I personally," Urbach says, "am a lot more distressed by the effects on wheat and on phytoplankton."

NASA photobiologist Stuart Nachtwey outlined the potentially larger effects increased ultraviolet light would have on aquatic ecosystems—shorthand term "the phytoplankton." Speaking mainly about algae, perhaps the most significant effect, Natchwey says, would be reduced productivity due to decreased efficiency of photosynthesis, a decrease in the standing crop (the number of algae cells) and a slowing of cell division. A decrease in the amount of algae, a primary producer in the food chain, would undoubtedly cause a commensurate decrease in the rest of the food chain, he says.

But the effects of increased ultraviolet light would not stop there. A major function of protozoa, with their tiny cilia waving incessantly, is to help in the exchange of carbon dioxide and oxygen at the surface of the water. Interference with their survival or growth rate (and thus the exchange of gases necessary for plant and animal survival) even to a minor degree, would affect the entire food chain. Similarly, small effects on tiny zooplankton and phytoplankton could have major effects on nutrient sedimentation, nitrogen fixation and water purification, Natchwey says. All of these could combine to shift the community structure or reduce the diversity of life in the oceans and fresh waters. And this breakdown of natural order will affect all life in unknown ways.

Agricultural plants, too, would be negatively affected by increased ultraviolet exposure, R. Hilton Biggs of the University of Florida at Gainesville reported. He and his co-workers recently completed field and laboratory experiments in which agricultural crops were exposed to higher than normal levels of ultraviolet light. Corn, peas, tomatoes, cotton, rice, soybeans, lettuce and many of the other plants tested showed significantly decreased yields in proportion to the increase in exposure to the part of the electromagnetic spectrum, from 320 to 286 nanometers, that would increase with decrease in ozone levels. Plants, too, have evolved systems for repairing ultraviolet light injury, but are also susceptible to injury-repair imbalances. Also, Biggs says, water, oxygen, carbon dioxide, nitrogen, sulfur and other chemicals are cycled through biological systems, and any decrease in biological productivity would affect the recycling of these essential chemicals. □

Energy goal: 25 percent solar by 2020

The Energy Research and Development Administration (ERDA) has announced its plans for developing solar energy, saying that a quarter of the nation's energy in the year 2020 may come from the sun. The savings in conventional fuels would be equivalent to more than four million barrels a day. To begin, ERDA plans to spend some $89.2 million on solar R&D during the present fiscal year—up from a total Government expenditure of only $1 million just four years ago.

The program is based on cycles of demonstration projects, with most solar technologies reaching the demonstration phase in the mid-1980's. Solar heating and cooling and wind energy should come a little earlier.

The most developed technology is that of direct solar heating, with several demonstration projects in operation. As these come to a close, emphasis will shift in the late 1970's to combined heating and cooling applications and to projects involving higher temperatures (such as chemical processes). A separate thrust will be made in agriculture uses of direct solar heat, including crop drying, and heating animal shelters and greenhouses.

By the late 70's, ERDA hopes to work with industry to build a series of pilot plants to make fuels from biological materials. Using this indirect form of solar energy involves collecting agricultural wastes, logging by-products and possibly specially raised crops and converting them into useful fuels. Fermentation processes can be used to produce methane and alcohol, or pyrolysis can be used to convert waste to low-BTU gaseous fuels and oils. Both methods have been proved technically feasible.

Solar photovoltaic demonstration plants will probably have to wait until the mid 1980's, in order to reduce the high cost of collectors. Prior to that time, efforts will be concentrated on research into crystal growth (a key to manufacture of the solar cells) and to providing novel, efficient ways of concentrating the sun's rays on the photovoltaic collectors. When a one- to four-megawatt demonstration plant is finally built, the collector arrays will probably cost $500 per peak kilowatt of generated power—down a factor of 40 from present photovoltaic costs, and comparable to the cost of building a nuclear generating plant.

Generating plants of 5 to 50 megawatts, using conversion of solar thermal energy to electricity, will also probably be built by the mid-1980's. Cost reductions of one-third to one-half will be required. Later an ocean thermal conversion platform may be built—probably in the 25 to 100 megawatt range—but considerable component testing must be conducted first and a decision on building the demonstration plant can be expected by 1980.

Paralleling these research and development efforts will be a technology support and utilization program, which will include dissemination of information, assessment of projects and a proposed Solar Energy Research Institute. Already a technical information center has been established at Oak Ridge, Tenn. ERDA Deputy Assistant Administrator Donald A. Beattie says the agency is receiving 1,000 requests for information each week. Solar energy, he says, "has caught the imagination of the public."

Many problems remain in the development of solar energy. The cost of putting a 1,200-to-1,500-square-foot solar collector on a private home for heating purposes now runs from $3,000 to $8,000, depending on the part of the country and the type of house involved. Raymond Fields, assistant director for direct solar conversion, says that in the next five years these costs may be reduced 30 to 40 percent, but an awareness of "life-cycle costing" (spreading an initial expense over the life of an investment) will be necessary to demonstrate solar energy's value. Also, local architectural firms must be educated in how to incorporate solar collectors into their housing plans. Fields believes solar heating may be competitive with oil furnaces within five years (on a life-cycle basis). □