A stellar effort in cosmic cartography

During the past quarter-century, the famed Palomar sky plates have provided astronomers with an invaluable reference to the northern hemisphere's night sky. Combined, the more than 1,800 individual photographic plates form a photomosaic, a permanent record of the myriad stars, galaxies, nebulae, quasars and what-have-you visible to the wide-angle eye of Mt. Palomar's 48-inch Schmidt telescope.

Over the years, in the course of their research, astronomers have identified and studied altogether more than a half-million of those objects. And now, for the first time, three astronomers from the radio observatory at Ohio State University (OSU) have completed a heroic five-year effort to review all this information and compile what they refer to as a new "road map to the stars."

The map is made up of 1,037 transparencies, each corresponding to one or more of the Palomar plates. A transparency is printed with certain essential information about each known celestial object. Looked at through the appropriate transparent overlay, many objects on a Palomar plate now can be immediately identified by the names and data appearing next to them.

Astronomers looking at celestial objects using the numerous optical and radio telescopes worldwide frequently wish to corroborate their evidence for an object's existence by finding it also on a Palomar plate. Up until now, this could be a tedious, time-consuming chore, as Robert S. Dixon, one of the OSU researchers attests. "I've used the [Palomar] survey many times ... and it's difficult," he says. "It's just an awful lot of work." A great deal of menial calculating, he told SCIENCE NEWS, is typically involved in locating your object, which sits among hundreds of other similar-looking spots on a photograph.

In compiling their celestial map, Dixon and his colleagues Mirjana R. Gearhart and Paul Schmidtke used the information from 399 published catalogs of astronomical objects. These included the massive Smithsonian Astrophysical Observatory catalog of more than a quarter-million stars and the OSU astronomers' own catalog, published just last year, of 185,000 non-stellar objects. (The OSU catalog was itself a notable achievement, being the first of its kind since the English astronomer J.L.E. Dreyer published his famous New General Catalog and four Index Catalogs in the early 1900s.)

Due to the enormity of the undertaking, a computer was used to help coordinate the great quantity of data the researchers culled from the literature. Even then, Dixon says, "It took years of writing the many computer programs needed for this." In the end, the computer's plotter printed onto paper information about an object, including its name and galactic and earth-centered coordinates; the result was subsequently transferred to plastic.

OSU

Now that the computer programs exist, Dixon told SCIENCE NEWS, it would take less time to complete a similar project for the southern hemisphere's night sky. His decision to begin such an effort, however, is awaiting the outcome of a southern sky survey being carried out by observatories in Australia and Chile. A map of the southern sky would probably include only about 50,000 to 100,000 objects, Dixon says, not because there are fewer objects in reality, but simply because there are far fewer astronomers Down Under looking up. □

A flash in the clay for forming bonds

Brilliant blue-white flashes of light escape from many hard mint candies when they are crushed in the dark. This observation, reported in the June 1979 JOURNAL OF CHEMICAL EDUCATION, sent senior scientists at NASA's Ames Research Center scurrying to darkrooms to crunch mint Lifesavers to see the effect for themselves. It also led to the discovery of a new luminescence phenomenon that has implications for theories concerning the origin of life on earth.

Lelia M. Coyne, Noam Lahav and James G. Lawless report in the Aug. 27 NATURE that several clay minerals luminesce as they dry. Lawless says his group became interested in the energy released when a material fractures after a colleague noted that clay platelets bend and may fracture as clay dries. They decided to look for light emission from clays.

Although the emitted light could not be seen with the naked eye, a scintillation counter sensitive to blue and violet light detected the release of energy as a thin film of clay dried on the inside surface of a glass tube in the counter. They achieved the effect by drying the clay over a desiccant or by gentle heating to 85°C. The luminescence lasted up to several days.

Just as surprising as the luminescence itself is the distinctive and reproducible patterns of light emission produced by different clays. Generally, light output declines from its initial peak and then rebuilds to produce a delayed burst. The burst appears to be released when the average moisture content approaches 40 percent water. Coyne and others are studying the significance of this moisture content level and developing a quantum mechanical model, analogous to semiconductor models, to account for how the light is produced.

The relative proportion of light given off initially and in the delayed burst depends also on the treatment the clay receives. The intensity of the initial luminescence increases by several orders of magnitude if the clay is irradiated with gamma rays or if it is ground up.

The researchers are also interested in discovering why different clays behave differently. Clays are mainly layered mixtures of aluminum oxide and silicon dioxide formed into platelets. Experiments on common clay impurities, such as titanium dioxide, hydroxyapatite and calcium carbonate, show that the effect is unlikely to arise from the impurities.

Lahav and his colleagues have been using clays to promote the formation of peptide bonds and the polymerization of amino acids in their study of the origin of life on earth. Lawless says clays, the most abundant surface mineral, were an important feature of the early terrestrial environment. Recently, researchers were able to show that glycine polymerized on clays when they applied wetting, drying and heating cycles to the clay-glycine system. This fluctuating system could correspond to cyclic wetting and evaporation from lagoons and small lakes.

Light from fracturing clay platelets may be an energy source for peptide bond formation. "It's an ideal energy source for doing chemical work on earth," says Lawless. "There doesn't need to be a lot of energy if the organic molecules are right where the energy is produced, and these are the locations where the organic molecules tend to be trapped."

Cyril Ponnamperuma of the Laboratory of Chemical Evolution at the University of Maryland says, "It's an interesting and rather unusual observation." However, he says there are numerous energy pathways postulated that promote polymerization. The finding will be of value if it leads to understanding the selection and ordering of particular amino acids and their isomers. So far he has seen little or no evidence of such selectivity in clays.

Scientists interested in molecular evolution are not the only ones excited by the finding. Lawless calls the discovery "a major find in a very old field. Clay scientists are absolutely intrigued." □