BIOLOGY

Sensitive plant shows its muscles

There are meat-eating plants, inch-tall plants with 30-foot taproots, and plants that smell like carrion. The list of intriguing plant adaptations is quite long, in fact, but thigmonasty surely leads it. *Thigmonasty?* This means, translated from scientific jargon to plain language, movement in response to pressure. The sensitive plant, *Mimosa pudica*, is probably the best exhibitor of thigmonasty.

Plant physiologists have for years probed the sensitive plant, hoping to learn why it folds up its slender, feathery leaves when touched and how the mechanism works. They have isolated the control function to the pulvini, small swollen regions at the bases of the leaf stems which change turgor pressure (distension by intercellular water) upon touch. A new study probes this control center even further and finds that its electrical behavior is remarkably like that of animal nerve and muscle cells.

Robert T. Balmer and Jeffrey G. Franks of the University of Wisconsin at Milwaukee report the study in the October PLANT PHYSIOLOGY. They hooked a sensitive plant to a modified myograph, an instrument usually used for testing animal muscle contractions, to test the contractile characteristics of the pulvinus at the base of a leaf. They measured the force of electrical stimulation versus reaction time, and calculated a constant value which, as it turns out, falls within the same range as the values for animal nerve and muscle cells. This adds evidence, they state, to the theory that the mechanisms for contractile movement in plant and animal tissues must be the same or nearly so. The similar values for animal muscles, contractile collagen and sensitive plant tissue "cannot be viewed as coincidence," they state, and the concept of a common mechanism at the molecular level is "quite acceptable." All that now remains is to find that common mechanism and accept it.

ATP: Right place at the right time

A fairly simple molecule, adenosine triphosphate (ATP), is the universal cellular fuel source. It stores energy in the form of phosphate bonds and releases the energy to power biochemical reactions. It is so basic to the life process that many biologists believe it existed well before true cells evolved. It was there, in other words, to power that same evolution.

Two biologists primarily interested in the biochemical origins of life have simulated what may have been the chemical and environmental conditions on the prehistoric earth and have created ATP in the absence of cells or nucleic acids. Ferencz Denes and Sidney W. Fox of the University of Miami Institute for Molecular and Cellular Evolution reported the ATP synthesis at a meeting of the American Chemical Society in Memphis.

The team combined pigmented proteinoids (protein-like polymers made by heating amino acids together), inorganic phosphate and adenosine monophosphate (AMP), the precursor to ATP. Other researchers had shown previously that AMP itself can be formed by the polymerization of simple molecules, hydrocyanic acid (HCN) and formaldehyde (HCHO). Fox and Denes combined the proteinoids, phosphate and AMP in an aqueous solution and exposed it to white and ultraviolet light such as that which irradiated the primitive earth.

The system yielded both high-energy ATP and inorganic polyphosphate, another energy carrier. Fox believes that some kind of minimal proto-cell may have existed before the evolution of DNA. He says this test-tube synthesis, using inorganic phosphate and AMP, demonstrates that DNA was not necessary for the evolution of ATP and that it could have existed to power the evolving cellular life processes.

PHYSICAL SCIENCES

From our reporter at the annual meeting of the Plasma Physics Division of the American Physical Society held last week in St. Petersburg, Fla.

Plasma physics and photon mass

Traditional electrodynamic theory regards the photon, the particle of light that embodies electromagnetic forces and conveys them from place to place, as being entirely without a rest mass. Every experiment so far is consistent with this. Nevertheless, one of the hardest things to prove in experimental physics is that something is exactly zero, and the photon could have an extremely tiny rest mass.

To speculate on such a thing is not merely idle activity. Nuclear and particle physicists have discovered forces whose intermediary particles do have rest masses. Such forces act only over short ranges, the range being inversely proportional to the mass of the intermediary particle. Thus if the photon actually has a small rest mass, electromagnetic forces do not extend their effect to infinity, as the classical theory holds. Such a result would work a profound theoretical and philosophical change in the nature of electromagnetism.

Because a photon's rest mass would be in any case extremely small, it would manifest itself only over large distances. A good place to check it is in the behavior of waves in astrophysical plasmas, large clouds of electrically charged particles.

From the behavior of cold plasma imbedded in the magnetic field generated by a flat sheet of electric current, Aaron Barnes of the NASA Ames Research Center deduces that if a photon mass exists, it can be no bigger than 3×10^{-54} grams. This puts it several orders of magnitude smaller than terrestrial experiments, and for the moment upholds the validity of classical electrodynamic theory.

Galactic clouds and star formations

Radio astronomy shows some seemingly inconsistent evidence about rotating gas clouds in the galaxy that are adjacent to ionized hydrogen. The overall motion of the clouds, deduced from Doppler shifts of the recorded spectral lines, indicates fairly slow rotation, whereas the widths of the lines would indicate supersonic motion.

M.M. Litvak of the Smithsonian Astrophysical Observatory's Center for Astrophysics proposes that the swift motions represent local turbulences in a cloud for which the overall rotation is slow. To explain this he introduces analogies to the theory of magnetic-field behavior in type II superconductors and to the formation of vortices in superfluid helium. He can then argue that filaments form in such clouds and twist themselves into vortex rings. This results in points of stagnation in the clouds where gravitational collapse could form new stars, he says.

Pulsars and earth-bound CTR

The atmosphere of a pulsar is supposed to be a plasma composed of electrons and positrons. A theory of the behavior of such a plasmasphere, developed by G. Cenacchi, Bruno Coppi and A. Taroni of the Italian Comitato Nazionale per L'Energia Nucleare at Bologna, proposes that such a plasmasphere forms itself into toroid-shaped regions that are carried around by the rotation of the neutron star that it surrounds. The behavior of the plasma in these toroids is similar, they find, to that of the plasma in toroidal devices on earth, such as the tokamaks of controlled fusion experiments. By starting from the equations for the terrestrial toroids, Cenacchi, Coppi and Taroni find that they can develop a complete theory for the behavior of the pulsar plasmasphere.