Personality: Links to cancer, heart disease

The human mind and body are tied together in an extraordinarily complex fashion, but with what seems to be increasing regularity researchers report on the gradual unraveling of this Gordian knot. An ongoing study at Johns Hopkins University, for instance, suggests that certain psychological and personality factors may be precursors of some very physical conditions—cancer and heart attack.

Between 1946 and 1964, Caroline B. Thomas collected data on 1,337 medical students at Johns Hopkins. Complete physical examinations, psychological profiles and family histories were recorded. With yearly questionnaires, Thomas has kept track of these students and compiled physical and mental health dossiers on each. Through 1974, there had been 43 cases of cancer, 14 heart attacks, 38 reports of serious mental problems and 16 suicides. By correlating these facts with previously collected physical and personality findings, Thomas and her coworkers have come up with some interesting (if still tentative) conclusions.

Cancers tended to develop in people who were generally quiet, nonaggressive and emotionally contained. Such persons scored low on tests of anxiety, anger and depression. Many were lonely individuals who had not been very close to their parents. More than 30 percent of the cancer patients, for instance, had reported that their fathers were not companionable, understanding or warm. Less than 10 percent of the medical students who have not developed tumors reported this alienation from family.

The apparent link between personality traits and cancer is not entirely unsuspected. In the Aug. 8 SCIENCE Vernon Riley of the Northwest Research Foundation in Seattle, Wash., reported that stress can play an important role in the development of cancer in mice. Anxiety and fear caused by shipping and handling are stressors for mice. A strain of mice carrying a cancer virus developed cancers 92 percent of the time when they were exposed to moderate, chronic or intermittent stress. Similar mice protected from such stress developed cancers only seven percent of the time. Riley suggested that "the physiological effects of stress lead to an impairment of the host defense system, and thus a presumed increase in susceptibility to cancer." The loneliness, alienation and isolation that were part of the personalities of the cancer patients in Thomas' study could have been stressors that weakened their immune systems and led to increased susceptibility to cancer.

Thomas' study also suggests a link between personality traits and heart attacks. More than 100 of the students had high levels of blood cholesterol when first tested, but only 14 have had coronary attacks. This does not deny the link between cholesterol and heart attack, but it does indicate that other factors may be involved. Thomas has found that the coronary victims scored high in depression, anxiety and nervous tension. They tended to suffer from insomnia, were often tired in the mornings and had generally lower grades than did the other medical students. The high-cholesterol students who have not had heart attacks were typically calm individuals who were low in such things as anxiety, nervous tension and depression.

The Johns Hopkins study confirms the fact that doctors take their own lives at a rate three or four times higher than that of the general population in the United States. This may be due to several factors: the competitiveness of their profession, their familiarity with death and their easy access to the means of committing suicide. Those who did commit suicide and those who suffered from mental problems were in some ways similar to those who developed cancer. They had displayed negative attitudes toward their families, they were highly sensitive to stress and were often isolated or lonely types.

Although the complexities of the mind-body connection are far from being explained, it is long-range, prospective studies, like the one being conducted at Johns Hopkins, that will eventually help to untie this particular Gordian knot. □

Encephalitis cases: Six times normal

Cool autumn nights will bring more than just colored leaves this year: Plummeting temperatures in the next few weeks should wipe out the remaining mosquito populations in most areas and end an epidemic of encephalitis that has reached national proportions this summer.

The U.S. Public Health Service Center for Disease Control in Atlanta reports 655 cases this year, involving 41 deaths. That is about five times the number of cases in recent years, a CDC spokesman says. Most of the cases have been the relatively serious St. Louis encephalitis. Among the hardest hit have been southern states, especially Mississippi, Alabama, Texas and Tennessee and midwestern states, Illinois and Indiana. Although reports of new cases seem to be dropping off along with the temperatures, public health and mosquito abatement districts in hundreds of localities are stepping up their preventive programs.

St. Louis encephalitis (also known as sleeping sickness) is, like the other forms of that disease, a mosquito-borne viral inflammation of the brain. The virus is harbored in common bird species, often sparrows and blackbirds, is picked up by mosquitoes and transferred to humans through mosquito bites. The symptoms include stiff neck, headaches, vomiting, drowsiness, fever and in severest cases, coma and death. The very elderly and the very young are most susceptible. "Most of us wouldn't even notice if we'd been bitten," the CDC spokesman says. There is no specific treatment for the viral infection; physicians are limited to treating the symptoms of the disease and hoping the body's immune system will overcome the infection when it occurs.

Prevention on the community level involves destroying mosquito populations, specifically members of the genus *Culex*, carriers of St. Louis encephalitis. Standing water is drained when possible, and low-lying areas are sprayed with insecticides, most often Malathion. Besides stepped-up spraying efforts by individual communities (particularly those in hard-hit states), public health scientists are testing for the presence of the encephalitis virus in local bird populations. There is no national mosquito-abatement system, and CDC does not have a complete national picture of current preventive efforts, but spraying and testing efforts have definitely intensified.

Prevention on a personal level involves the draining of standing water around one's house or yard and checking to make sure screens and windows are tightly fitted. Mosquitoes come out to bite around dusk, and people in areas where encephalitis cases have been reported, particularly the very old and very young, are advised to wear long sleeves and perhaps mosquito repellant, during those hours, the CDC spokesman says. □

Weighing in Vela X-1

Weighing a star is a complicated business, but a necessary one for astrophysicists. The masses of different kinds of stars are important inputs to theories about their behavior. This is especially true in what might be called astrophysical eschatology, the science of the last stages of stellar life. Whether a dying star becomes a white dwarf, a neutron star or a black hole depends strongly on its mass.

The mass of one such stellar end point, the supposed neutron star called Vela X-1, has now been determined by three astrophysicists at the Massachusetts Institute of Technology, Paul C. Joss, Saul A. Rappaport and Jeffrey McClintock. It is a doubly interesting contribution, because the amount determined, 1.7 times the sun's mass, would set some new constraints on the theorizing about conditions inside such bodies.

The first necessity for determining the

mass of a star is that it should be in a binary system. Newton's laws of gravitation will yield equations that can be used to find the mass provided the star is in a close gravitational relation with another, and a star standing alone is not.

About half the stars in the sky are in binary or multiple systems, but X-ray emitters are a rare breed, and their statistics are not so cozy. About 100 stellar X-ray emitters have been found in our galaxy, but among them are only eight known binary systems. Each of these appears to consist of a collapsed star (the X-ray emitter) and a more or less normal optical star orbiting around each other.

The second requirement for determining mass is that there be some way of finding out the star's orbital motion. Luckily Vela X-1 emits X-rays in pulses. As the star moves in its orbit, alternately receding from the earth and advancing toward it, the frequency of the pulses will undergo an apparent change, a Doppler shift. From the Doppler shift the astrophysicists could tell the X-ray source's speed in orbit, and that datum allows them to set up a relation between the masses of the two bodies.

That, however, as any student of Algebra I knows, is not enough. To solve for two unknowns, the two masses, you need two equations. By a third piece of good fortune, the second equation became available. It proved possible to measure the Doppler shift in the light of the X-ray star's companion and make an independent determination of its orbital motion. With the two equations the two unknowns could be determined.

The X-ray source turns out to be a highly compacted, ultradense body, which has 1.7 times the sun's mass though it is only about 16 kilometers in diameter. The density of such a thing, the MIT astrophysicists calculate, is comparable to that of a pea that weighs a billion tons. The visible companion star has about 20 solar masses and 30 times the sun's diameter.

The determined mass for the neutron star is at or slightly above the upper limit that most theories assign for neutron stars (which would be about 1.65) almost into the range proper to black holes. Yet the pulsations indicate that Vela X-1 is not a black hole; theory knows no way for a black hole to pulse.

"The mere fact that you have a neutron star as massive as this places constraints on the physics of these objects," Joss says. Theorists suggest that much of the energy of the sea of particles in a neutron star is converted into new particles. This behavior would lower the interparticle repulsive forces and lead to lower mass estimates than it seems Vela X-1 has. Still, as Joss points out: "At densities greater than that of an atomic nucleus there is no direct information about how matter behaves." So the theorists have a number of options to go back to the drawing board with. □

Opto-sonic hologram: 3-D views of organs

Baum and Stroke/Science

Hologram of cyst would be 3-D by laser.

Medical researchers have long sought new ways of examining interior structures of the body, both healthy and abnormal, particularly in view of the potential dangers of X-ray exposure. One of the most widely used of these tools has been ultrasonography, a technique for creating images from reflected high-frequency sound waves (SN: 12/25/71, p. 424). But, like an X-ray, a sonogram is a two-dimensional image. The problem has been to find a way of creating such images in three dimensions, so that an investigator can measure the extent of, for example, a cyst in all directions.

Such a technique has now been reported by two New York researchers, Gilbert Baum of the Albert Einstein College of Medicine in the Bronx and George W. Stroke of the State University of New York at Stony Brook, in the Sept. 19 SCIENCE. Not too surprisingly, the key is holography, a method for creating three-dimensional images on a flat piece of film using diffraction patterns created and viewed with a coherent, or directionally aligned, beam of energy. The technique, however, is less obvious.

Clear three-dimensional "sound images" have heretofore been made largely by putting two-dimensional sonograms from parallel planes of the organ under study onto glass plates, and looking through the resultant "sandwich." The opaque sections of each plate, however, cast shadows on the plates beneath, so that a sandwich of more than a few plates becomes uselessly murky. Another approach is acoustic holography, but, says Stroke, it suffers from blurring caused by depth scattering when sound waves are reflected from soft tissue.

The method of Baum and Stroke combines both sonic and optical techniques, beginning with a series of conventional, two-dimensional sonograms made of adjacent planes. Since these do not depend on coherent energy, they can each resolve a plane as little as a half-millimeter thick. Then a conventional, optical hologram is made of the first sonogram on a piece of film. Next the first sonogram is replaced in the holograph's laser beam with the second, displaced by the same distance as the separation of the planes of the original sonograms. It is photographed on the same piece of film, which has been displaced by the same distance. This procedure is repeated for all the sonograms, which then appear simultaneously, with their original separation, when the film is viewed by laser light, and without the shadows of the glass sandwich.

Stroke says further research is necessary to determine the technique's range of applications, which might extend beyond medicine to such areas as metallurgy. □

Has a heavy lepton been discovered?

Lepton means something light in weight (from the Greek *leptos*), and the particles called leptons are the lightest known to physics: the electron, the muon and the neutrino associated with each of them. Heavy leptons would seem to be a logical contradiction, but their existence is predicted in some of the latest theories of particle physics, the unified field theories that link electromagnetism and the weak subatomic interaction in a single framework. In the Sept. 8 PHYSICAL REVIEW LETTERS, three theorists from Harvard University, A. De Rújula, Howard Georgi and S.L. Glashow propose that such things have been discovered, although the experimenters involved think not.

The experiment was done in a mine in India by M.R. Krishnaswamy and collaborators from the Tata Institute of Fundamental Research in Bombay. They were looking for neutrino interactions, but they found a significant number of events that yielded double tracks quite uncharacteristic of neutrino processes. Krishnaswamy and his group proposed that the double tracks come from the decay of a new heavy particle produced in the rock around the mine by neutrinos.

The Harvard theorists do not accept this. They say the double tracks are produced by decay of neutral heavy leptons. The neutral heavy leptons are produced in the upper atmosphere by decay of charged heavy leptons (plus or minus), which in their turn are produced by the cosmic rays. The neutrals last long enough to reach the mine, incidentally, because they decay under the governance of an interaction weaker than the usual weak interaction, possibly the super-weak force that has been proposed to account for certain other leptonic anomalies.

The proposed heavy leptons would have masses about two billion electron-volts. This is 20 times the mass of the heaviest known leptons (muons at 106 million electron-volts) and a little more than twice that of a proton. The heaviest known elementary particles of any class now run to about four billion electron-volts. □