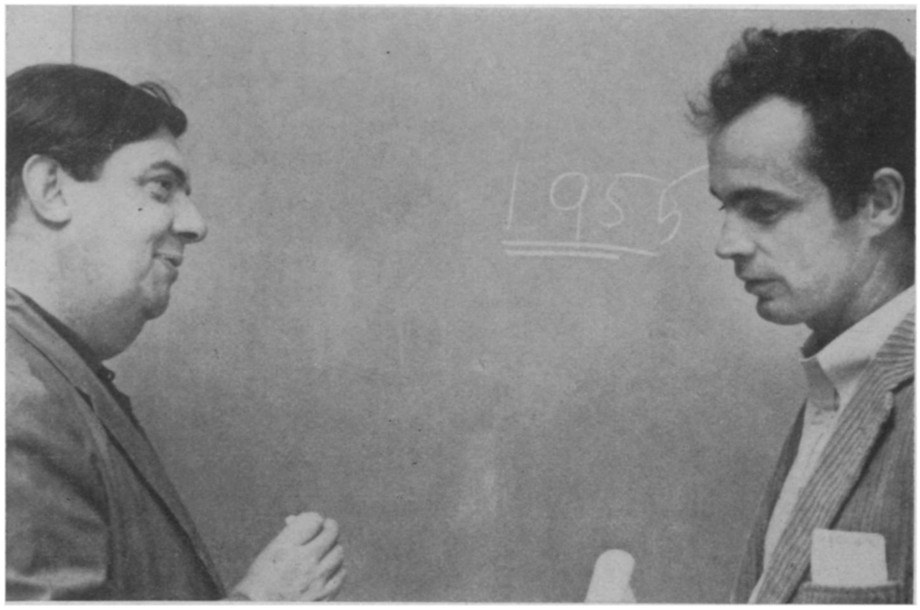
Chasing Seyfert Galaxies

Despite three days' effort, 100 astronomers couldn't agree on an explanation



Dave Acton

Drs. Burbidge (left) and Colgate conferring on Seyfert galaxies at Tucson.

In the early 1940's, the late Dr. Carl K. Seyfert, then at Harvard College Observatory, drew up a list of some 10 spiral galaxies having very small, intensely bright centers. These strange objects are now called Seyfert galaxies and constitute some two percent of all known spiral galaxies.

For 20 years, only a few astronomers paid any attention to Seyfert galaxies. But about five years ago interest in them quickened, sparked by the discovery of quasars, which are extremely intense sources of energy possibly located at extreme distances in space. Some astronomers wondered if there could be a link between quasars and Seyfert galaxies.

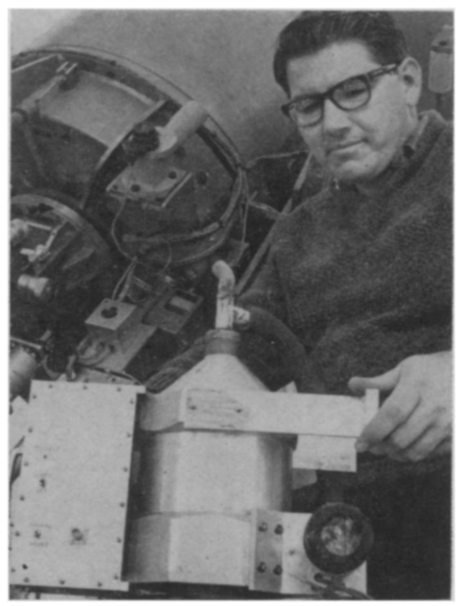
Last week at the University of Arizona in Tucson some 100 astronomers and astrophysicists from around the world spent three days discussing recent observations and theoretical explanations of Seyfert galaxies. They adjourned leaving the question of the relationship between quasars and Seyferts, if any, still open—with some believing there is a link, others holding that the two phenomena, although both puzzling, have no connection.

One tongue-in-cheek summation of the conference on Seyfert galaxies is that the 100 scientists spent three days proving that such objects do not exist; how could they, when they have so many different, seemingly unexplicable properties?

That they do exist, however, is without doubt and many recent optical and radio observations of these strange galaxies were reported. The general consensus was that the most important of these were made by Dr. Frank J. Low, a part-time professor at the University of Arizona's Lunar and Planetary Laboratory and also a part-time professor of space science at Rice University; he did his work jointly with Dr. D. E. Kleinman, also of Rice. Using a low temperature germanium bolometer of Dr. Low's invention, they measured the far infrared radiation of Seyfert galaxies, as well as a few quasars and the expanding remnants of the Crab Nebula supernova. Their observations showed that Seyfert galaxies have a luminosity in the infrared that bridges the differences between normal galaxies and more intense quasars.

The theoreticians have as yet no explanation for this, nor for such other, more esoteric factors as the broad emission line in the spectra of Seyferts first noted in the original list of 10, the high velocity motions of gas clouds within the objects, variations as high as one magnitude in the ultraviolet output on a time scale as short as 100 days, variations in radio output as well, or the emissions over a broad range of wavelengths.

One new theoretical explanation for the peculiar properties of Seyferts was offered by Dr. Sterling A. Colgate of the New Mexico Institute of Mining and Technology in Socorro. Dr. Colgate proposes that very massive stars, equivalent to about 50 suns, can form in an evolving galactic nucleus having an extremely high stellar density. These massive stars evolve into supernova quite rapidly (within a million years) at the rate of 10 a year, on an astronomical time scale in which the universe is considered to be about 10 billion years old.



Dave Acton

Dr. Low and his bolometer.

Dr. Geoffrey R. Burbidge of the University of California, San Diego, at

La Jolla, Calif., promptly dubbed this explanation the Colgate Effect, and agreed that it should be considered along with three or four other theories of Seyfert radiation at wavelengths from radio to ultraviolet, including electron synchrotron emission and proton synchrotron emission.

If Seyferts and quasars are related, what astronomers may be seeing could be likened to a bomb explosion on earth, with the galaxies looking so very different because they are caught at various stages: a time-stopped photograph of galactic evolution with most of the pictures missing.

One additional explanation for the variations of radiation in very short times in both Seyferts and quasars is that some unknown force is at work. Just as there are phenomena, not all understood, that effect earth in a few seconds or less (microseisms) and the sun in a few minutes or hours (surges or flares), there may be equally mysterious forces at work in galaxies with time scales of a few months or years, such as those observed in Seyferts. ◇

CHROMOSOMAL RNA

Key to cell specialization described

Every cell that possesses a nucleus also has a complete set of genes for the organism of which it is part. This interesting state of affairs, somehow, does not result in biological anarchy.

Yet if every function controlled by the genes was performed by every cell, there truly would be anarchy. That liver cells function as liver cells and not as leukocytes is a fundamental of life.

The fundamental is not necessarily simple. Much effort has gone toward uncovering the mechanism whereby each cell performs as a specialist. Dr. Mark Ptashne of Harvard University, speaking at last week's Biophysical Society meeting in Pittsburgh, reported on a tide of research into gene function repression at the bacterial level.

Genetic experiments some time ago showed that there are groups of genes controlled by the products of other genes called regulators. The latter produce substances called repressors, which neutralize the protein-forming activities of the genes under their control. Dr. Ptashne reports that the action of repressors, which are medium-to-large-sized proteins, is due to tight binding of these proteins to the strand of deoxyribonucleic acid (DNA) bearing the genes they control. For each group of genes the bacterium synthesizes a unique repressor protein.

This system works well in a bacterium, which has relatively only a few genes. But it would be unwieldy in higher organisms; in fact, their reliance on the system may explain why bacteria have risen no higher on the evolutionary scale. At the same time, Dr. James Bonner of California Institute of Technology reported a substance in the chromosomes of higher organisms which apparently performs the same function as the cumbersome bacterial system of repression. Dr. Bonner calls the substance chromosomal ribonucleic acid (RNA). This form of RNA, he says, is responsible for the specificity of the repressant action of certain proteins.

DNA is found in the nucleus and consists of long strands of sub-units, called nucleotides, hooked together. In nearly every instance the DNA occurs as a double strand wound into a helix. Genes are defined as sites along these strands which are capable of initiating a process leading to the biosynthesis of proteins. Each gene can start the ball rolling for one specific protein. It does so by acting as a template for the formation of messenger RNA.

The messenger RNA, a kind of mold of the gene site on the DNA strand, migrates into the cell's cytoplasm and becomes attached to an organelle called a ribosome.

At the surface of the ribosome systhesis of protein takes place. There the messenger RNA is deciphered by the ribosome as a record of the genetic information.

Dr. Bonner notes that only 5 to 15 percent of the DNA of a cell is available for transcription, however. The rest seems to have been switched off and does not form messenger RNA. Responsible for this repressed state are the histones, a group of proteins found in the nucleus associated with DNA. These histones are capable of bonding firmly to the gene sites, thereby occupying the space that otherwise would have been occupied by the messenger RNA as it was being synthesized.

The problem that researchers ran into was the lack of specificity of the small group of histones. When extracted from cells, DNA partly associated with histones is capable of synthesizing a certain population of messenger RNA's. If the histone association is undone chemically, however, and the histones are then left on their own to rebond with the DNA they were taken from, they do so at random. The same mixture then produces an entirely different selection of messenger RNA's.

In the presence of chromosomal RNA from the same cell, Dr. Bonner reports, the histones all fall back in line the way they were before. Furthermore, chromosomal RNA and its histones from one organ will act on DNA from another, so that the latter is made to produce the same messenger RNA series that the first organ does. It appears that chromosomal RNA is the sole determinant of what activity a cell will undertake out of the spectrum of activity allowed by the full gene package.

Evolutionarily the advantage of the RNA-histone system is that its working tools, the histones, are so non-specific and interchangeable. In fact they vary little from tissue to tissue and even organism to organism.

SIXTH HEART TRANSPLANT

Indian team unsuccessful

It was after midnight on Friday, Feb. 16, when 19-year-old Lalita Balkrishna, was brought into the King Edward Memorial Hospital in Bombay, India, scarcely alive after a fall from a train.

The young woman's heart was transplanted into the chest of an ailing farmer named Bodhan Chitan, who had no chance of survival because of cardiomyopathy, a weakening of the heart muscle peculiar to India and Africa.

Dr. P. K. Sen, chief of a team of 45 doctors, nurses and technicians, said the operation was technically successful, but death came three hours later from a lung infection.

The young woman had had an operation on her brain in an effort to correct injuries received in the fall, but she died soon after surgery. A heart-lung machine kept blood circulating through her heart to keep it viable while surgeons prepared the farmer for the transplant.

Dr. Sen, who is highly respected by heart surgeons in the U.S., had issued a call for a heart to be salvaged after a possible accident. Chitan had been ill for a number of months and it became evident that he could not survive without another heart.

No electric shock was necessary to get the heart to start beating again after the transplant, and it functioned satisfactorily until his death.

This marked the sixth human heart transplant in history, and the first to be performed outside the Union of South Africa and the United States.

All of the six patients are now dead except Dr. Philip Blaiberg, who received the heart of a young man in Capetown's Groote Schuur Hospital, and was still making satisfactory progress 50 days after his transplant.

(See special transplant section: pages 213 to 221.)