then doing research in Israel, about his discovery. Nathans's interest was sparked, and he suggested that restriction enzymes might be used as tools for cutting up DNA molecules and hence for learning all sorts of things about these molecules. In 1970 Nathans started using restriction enzymes to chop up cancer virus DNA molecules and to learn more about the DNA molecules' ability to cause cancer. For this work he has been awarded a Nobel.

Arber, Smith and Nathans, however, are sharing the Nobel Prize in Medicine not only for their specific restriction enzyme contributions, but also for the impact that their discoveries are having on the entire field of medical research. In other words, not only Nathans but numerous other investigators are now using restriction enzymes to map the genes of cancer viruses, to identify the genes responsible for the viruses' cancer-causing abilities and to investigate how these genes and the proteins they code for change normal cells into cancer cells. Restriction enzyme methodology is helping scientists analyze complex DNA molecules from human and other higher organisms — something that was tough if not impossible to do before — and thus providing valuable insights into healthy and diseased human genes. Restriction enzymes are allowing researchers to study the way that proteins recognize and interact with specific base sequences in DNA interactions that are important in gene regulation. And, most crucially, restriction enzymes have helped open up the field of recombinant DNA research by making it possible to snip a gene that codes for a particular protein out of a DNA molecule, to insert the gene into a plasmid, to place the plasmid in a bacterium, and to have the plasmid produce the protein coded for by the gene within the bacterium (SN: 3/8/75, p. 148).

Ironically, Nathans was one of the scientists who in 1974 urged that recombinant DNA researchers move with great caution. Arber, however, took the opposite stance. "You cannot slow down research," he insisted (SN: 11/2/74, p. 277). □

Economics: Decision-making behavior

Nearly 30 years ago, Herbert A. Simon used a little psychology to challenge traditional theories about how organizations and individuals behave. Last week, the Carnegie-Mellon professor, now studying human problem solving and artificial intelligence, was awarded the Nobel Prize in Economics for his novel ideas.

According to more conventional theory, businesses, organizations and individuals carefully make decisions to gain the most in long-term profits or satisfaction. Such behavior guarantees the economy will be in the best possible shape.

Simon's theory says such behavior is not possible. Individuals and organizations cannot know what decisions will maximize their profits or satisfaction and can only make the best choice for the immediate circumstances. Simon labeled such behavior "satisficing."

Satisficing is far from economic doctrine, according to Harvard University economist Harvey Leibenstein, but it is "important, innovative work." Simon's greatest influence has been with business schools, Leibenstein said, where his work with computer simulation of decision-making has made major changes. □

Chemistry: Energy for the cell

A cell's activities are powered by the energy released from the breakdown of molecules of adenosine triphosphate (ATP). ATP is manufactured for the cell by the mitochondria in a process called oxidative phosphorylation. In this process, the breakdown of sugars releases energy which then is transferred to ATP.

But *how* is the energy transferred? "A chemist likes to go from A to D via B and C, but in this case B and C, the chemistry of the reaction, are unknown," says University of Pennsylvania's Britton Chance.

Peter Mitchell of Glynn Laboratories, a small private company in Cornwall, England, received the Nobel Prize in Chemistry last week for his theory about B and C. But the recognition is not without controversy.

While other researchers have proposed a more strictly chemical means of trapping energy into ATP, Mitchell's theory, called chemiosmotic coupling, suggests a physical mechanism, which relies on a proton gradient. Some investigators, such as Chance and Patrick Storey of the University of Pennsylvania, postulate that reactions between high-energy chemical intermediates, possibly proteins carrying a high-energy phosphate group, pass the energy to ATP. Mitchell's theory, developed while he was at the University of Edinburgh, proposes that protons are transported across the mitochondrial membrane, creating an ion gradient. The potential energy created by the gradient is then transferred to ATP. Since Mitchell proposed his idea in 1961, the battle lines, though friendly, have been drawn.

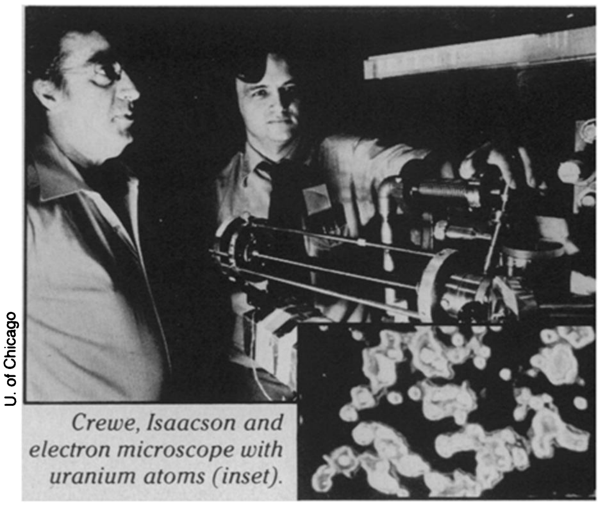
The results of recent experiments using mitochondria in solution with artificially created proton gradients, which showed that ATP formed, add strength to Mitchell's work, says Philip Feigelson of Columbia University. However, research by Chance and others disputes these findings.

Nevertheless, Chance says Mitchell's selection "speaks well for the committee to have the courage to indicate their opinion, in a unique way, that science is controversial. The choices on the roulette wheel are so manifold it is only just that it would stop in favor of someone who is so good a scientist." □

Atoms in nonliving color

The physicist S.A. Goudsmit used to give popular lectures on atomic physics, and a lady — peace, dear feminists, in Holland in those days she *was* a lady — a lady once asked him what color an electron was. Goudsmit being Goudsmit made a wisecrack about electrons being green and protons brown. Well, they might as well be, or any color fancy dictates. Electrons and protons are objects smaller than the wavelengths of visible light. They reflect none and therefore have no color, a concept that the lady, like most people, found difficult to take in.

Atoms are colorless for the same reason. They may emit colored light, but they do not reflect it. So an announcement that Albert V. Crewe and Michael S. Isaacson of the University of Chicago are making color movies of atoms leads one to wonder. It turns out that they are doing exactly what Goudsmit said, assigning colors at will to atoms of different elements.



U. of Chicago

Crewe, Isaacson and electron microscope with uranium atoms (inset).

Crewe and Isaacson use a transmission electron microscope to visualize atoms. The apparatus fires a beam of electrons at atoms deposited on a thin carbon film. The electrons scatter from the target atoms, and how they scatter can be translated into electrical currents that visualize the atoms. Until now it worked in black and white. Now they have added what is called false color to it: The imaging part of the system can now automatically apply pre-chosen color to a given image. The atoms of different densities have different reflectivities for electrons. Noting the varying reflectivities the apparatus applies different colors to the images of different atoms and clusters of atoms.

Thus atoms of one element can be distinguished from those of others and followed as they move around the carbon films, form crystals or combine with other elements in compounds. Crewe says a lot of basic physics and chemistry can be followed this way. □