Further, the law professor predicted a scanning device that could go farther—and actually read the letter inside without the bother of opening the envelope. (Washington experts in the field later acknowledged this could be done, but that steaming open the envelope was quicker and surer, especially with folded letters.)

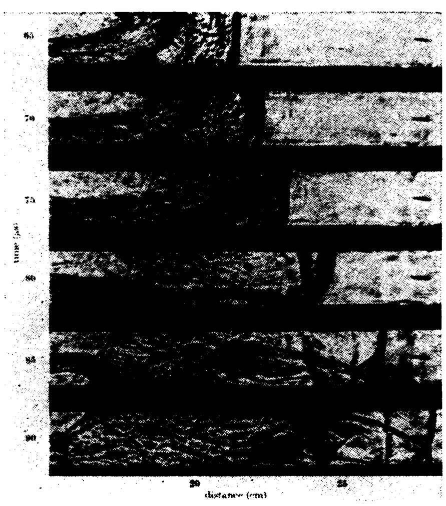
Any such data center, Miller predicted, would quickly develop branches around the country, and be more or less open to eavesdroppers along its telephone lines or microwave circuits. He recommended that any such transmissions be scrambled.

Eventually, he said, it may be proved that computers themselves give off some clue to what is going on inside them, and that their secrets could be garnered from such emissions.

Explosion Photographed

Laser photographs made with pulses of light one-billionth of a second long have shown for the first time exactly what happens when a gas explodes in an open-ended tube. The experiments may lead, among other applications, to higher power for rocket engines.

Dr. A. K. Oppenheim of the University of California, Berkeley, said the photographs taken in the experiment showed that explosions take place in four stages, the most important being



Royal Society

Explosion within an explosion.

an "explosion within the explosion" which happens in front of the advancing flame of the burning gas.

When the gas—hydrogen and oxygen in this experiment—is ignited, the flame is preceded by a number of shock waves which move along the length of the tube. If the gas is pumped into the tube fast enough, the shock waves pile up and merge, and the flame also backs up and becomes turbulent. This turbulence is the second stage of the explosion. The third stage takes place when the merged shock waves, under high pressure, become hot enough to set off a secondary explosion, ahead of the first flame. This second explosion, in the fourth stage, sends its own shock waves back into the first explosion causing tremendous pressures within the tube.

Dr. Oppenheim, reporting to the Research Applications Conference of the Air Force Office of Aerospace Research in Washington, said that most rocket engines operate in the first stage of explosion, where the shock waves reach the end of the rocket without merging. Advanced high-power rockets, such as the Saturn, operate in the second stage, where the flame has become turbulent. This is done by pumping the burning gasses into the thrust chamber faster, thus getting more burning and more power. If the gasses go into the chamber too fast, though, the third and fourth stages are reached and the rocket is likely to explode.

Dr. Oppenheim said, however, that a study of the phenomenon of secondary explosion, through pictures such as he took, should make it possible to use the higher power range of the third and fourth stages to make more powerful rockets.

Magnetic Plastics In the Offing

A new series of polymer plastics, which among other things are magnetic, act like metals and semiconductors, and withstand temperatures up to 1,000 degrees F, are within reach as a result of research by Dr. Manuel Ballester of the University of Barcelona, Spain. Dr. Ballester reported his findings to the Research Applications Conference in Washington last week.

Most plastics are large molecules made up of carbon and hydrogen atoms. These atoms combine chemically in many different shapes—rings, chains, and combinations of the two. The shape of the molecule determines its physical and chemical characteristics.

What Dr. Ballester has done is substitute a chlorine atom for each hydrogen atom in a number of complex molecules. This was difficult because chlorine atoms are about eight times bigger than hydrogen atoms, and could not be fitted together as easily. Once formed, however, the carbon-chlorine molecules showed amazing strength and resistance to other chemicals. And some forms, called free-radical chlorocarbons, can be magnetized.

The magnetic properties of the newly discovered materials depend on the way carbon combines with other atoms to form molecules. Atoms combine by sharing electrons with other atoms, and atoms differ in the number of electrons they can share. Carbon can share four electrons, hydrogen can share one. Chlorine, although it is bigger and has more electrons than hydrogen, can also share only one electron.

Although carbon usually combines with other atoms so that all four of its shareable electrons—called valences—are used up, some compounds of hydrogen and carbon have been formed in which the carbon shares only three electrons. These are called free radicals. The compounds are very unstable, however, because the free electron combines quickly with oxygen and many other materials and a new substance is formed.

Free radical compounds of carbon and chlorine can also be formed. Like the hydrogen-carbon molecules, they have carbon atoms which share only three electrons and have a fourth free. These free radicals are very stable, because the large chlorine atoms shield the free electron from outside reagents so that it can't combine with them.

The magnetic property of the new molecule is a result of that shielded free electron. Magnetism can be induced in a material by causing a number of its electrons to spin in the same direction, and the free electrons can be made to do just that.

The free electron may also be used to carry current, or to make the plastic act as a semiconductor, Dr. Ballester says. Other chlorocarbons might be used to form unusual electric fields, or to store electrons or electrical charges.

Einstein Award Winner

Dr. Marshall N. Rosenbluth, 40-year-old physics professor who will leave his post at the University of California in San Diego to join the Institute for Advanced Study next fall, has been named winner of the Albert Einstein Award for 1967.

Dr. Rosenbluth is a theoretical physicist who has made outstanding contributions to such fields as high energy nuclear physics, thermonuclear weapons and controlled fusion power.

He received his B.S. from Harvard in 1944 and his Ph.D. from the University of Chicago in 1949.

While he was an instructor in physics at Stanford University in 1950, Dr. Rosenbluth developed a formula describing how high energy electrons are scattered by protons, a theory that has been vertified at all electron energy levels used in scattering experiments.

At the Los Alamos Scientific Laboratory in the early 1950's, Dr. Rosenbluth, with Dr. Conrad Longmire, was responsible for the planning and detailed calculations that led to the first