say Administration officials, Nixon can withhold funds as he sees fit. In the 1971 fiscal year alone, the Administration impounded, or put into reserve, more than $12 billion appropriated by Congress.

Some of the money is not appropriated on a "yearly funding basis," so theoretically, the OMB could release the funds at a later date. However, say the opponents, when the funds are released, they are usually substracted from that year's budget request for the particular agency.

In response to the attack by Dr. Humphreys, NSF Director William D. McElroy, who himself has resigned effective next Feb. 1, issued a statement saying it would "be possible for the Foundation to offer a strong and well-balanced science education program in the fiscal year 1972 within the funds appropriated by Congress and allocated by OMB." □

CUT AT NASA POSSIBLE

Grand Tour, shuttle threatened

The National Aeronautics and Space Administration must submit its preliminary 1973 budget requests to the Office of Management and Budget (OMB) this month. In August, OMB gave the various Government agencies certain "guidelines" or budget levels acceptable for 1973, and the word is that NASA's may be as low as $3 billion for next year. If this turns out to be the ultimate figure, some observers say NASA may well be demoted to a "housekeeping level"—too large to be a "NACA" (the old agency, called the National Advisory Committee for Aeronautics) and too small to be a "NASA." Even at the same level of this year's budget, $3.3 billion, NASA would not be able to carry out the programs set forth in the 1972 budget.

The programs most vulnerable to such a cut include the unmanned Grand Tour of the outer planets, the Viking Mars landers, and the High-Energy Astronomical Observatory. On the manned side, the reusable shuttle would be felled.

Initially, NASA wanted to build a reusable booster and orbiter to replace all of the expendable hardware used for the last 12 years. This year, however, faced with the Administration's budget priorities, NASA has been considering a phased approach—building the reusable orbiter first and using expendable boosters until enough money is available (SN: 7/24/71, p. 56). But even to go ahead with this apporach, NASA would need a budget level above $3.3 billion.

The same type of situation exists with the Grand Tour. To do a first-class job of flying by all the outer planets when they are uniquely aligned during the latter part of this decade, NASA would like to use its TOPS spacecraft (Thermo-electric Outer Planet Spacecraft). The TOPS would have automatic self-repair capabilities to ensure the success of the nearly 4-billion-mile journey to Pluto. If the 1973 budget prohibits this, a Pioneer-type of spacecraft would have to be used. These less sophisticated craft would significantly reduce the complement of scientific instruments carried and have much smaller self-repair capabilities. □

PHOTOELECTRON SPECTROSCOPY

Studying electron behavior

Chemistry depends on what electrons do. Their motions, gains, losses and vibrations determine the nature of chemical bonds, chemical combinations and chemical changes.

One way to study the details of electron behavior is to knock electrons out of chemical substances, mainly with high-energy photons, and observe what happens. This subject, called photoelectron spectroscopy, is a "rather good example of the capricious way science used to proceed," says Dr. Kai Siegbahn of the University of Uppsala in Sweden. "Like a car with brakes and a gas pedal but no steering wheel it has followed a zig-zag path." The subject has an old history, but the last few years have seen developments that warranted the calling of an International Conference on Electron Spectroscopy, held last week at the Asilomar Conference Grounds in Pacific Grove, Calif.

The photoelectric effect has been known for decades, but the devices that use it, such as electric-eye doors, employ visible or nearly visible light to knock conduction electrons out of various solids. The thrust of the new developments in photoelectron spectroscopy is to use X-rays of various energies to spring more tightly bound electrons from atoms and molecules.

Such experimentation can aid theoretical chemists in developing a basic understanding of the behavior of electrons in, and the chemical structure of, complex chemical combinations.

More practically it can be used to analyze unknown samples for the elements in them. It can be used on smaller samples and with less destructive effect than other methods. For example, it has been used on minute samples of the substance called anomalous water and is responsible for a determination that anomalous water is not a polymer.

And to show that photoelectron spectroscopy is far from an ivory-tower subject, Dr. Thomas A. Carlson of Oak Ridge National Laboratory says that it has been used to determine how sulfur combines with air-pollution particles.

Photoelectron spectroscopy uses electromagnetic radiation of various energies including high-energy ultraviolet and soft X-rays. Dr. Carlson divides the experimental technique into two domains: using fairly low-energy radiation to dislodge electrons from the valence or outer shell of an atom and using higher energy X-rays to dislodge electrons from the inner, more tightly bound region.

In addition, there is a technique called the Auger effect (pronounced "oh-zhay") which uses electrons to cause a reaction in which an atom ultimately emits an electron. The Auger effect is of most use in studying solid surfaces since incoming electrons don't penetrate into the bulk of a sample anywhere near as far as photons do.

The outer or valence shell of an atom tends to belong to the substance as a whole. This is the region important in chemical bonding and molecular structure. One studies the behavior of these electrons, the orbits and vibrations they perform, to determine their effect on the nature of the chemical bonds, the binding energies and the chemical stability of the molecule that they belong to.

So far, says Dr. Carlson, such outer-shell studies have been done on a number of simple molecules. For the future he hopes to see more and more complicated molecules studied. It would be especially significant to work on complex organic molecules such as pesticides, to study homologous series of such molecules and determine the differences in the ways they may change, break down or persist in living tissue.

The inner-shell electrons are more closely bound to a particular atom. They feel chemical changes by alterations in the over-all electric field surrounding them. Here chemical shifts, changes in the way a given element combines with other substances, are studied.

Chemical-shift studies of the important elements carbon, nitrogen, oxygen and sulfur are less than half complete, and half the elements in the periodic table have not been touched. He sees much room for future work in this department.

Dr. Siegbahn, too, has a number of prescriptions for the future. Many have to do with more precise methods of determining data and with better modes of mathematical analysis including such things as on-line computers.

Another improvement Dr. Siegbahn hopes for is a way of studying liquids. Present methods do well with gases and solids but not liquids.

The use of two X-ray beams instead of one is yet another future possibility. One beam would excite the target molecule, the other would detach an electron. In this way molecular energy