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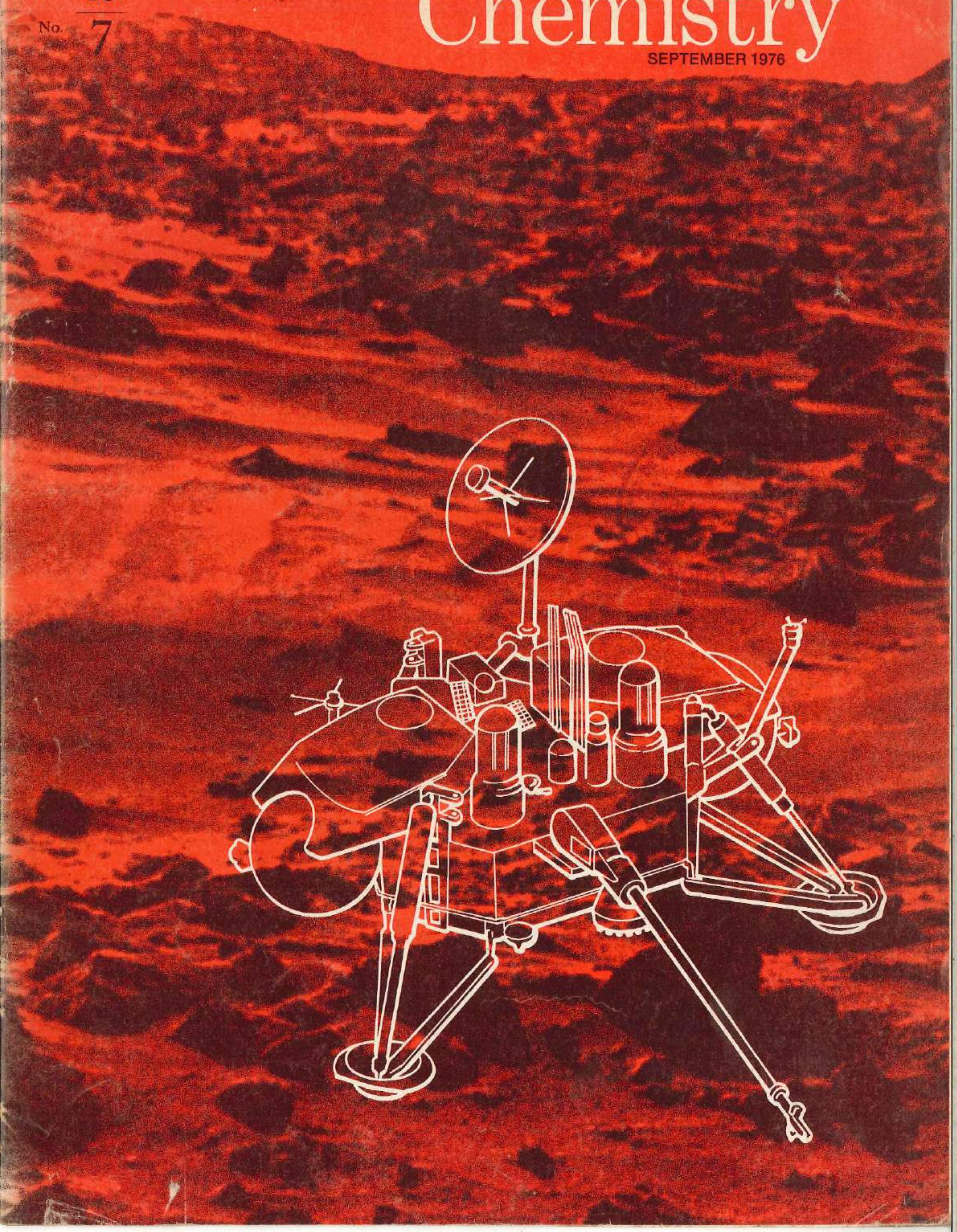

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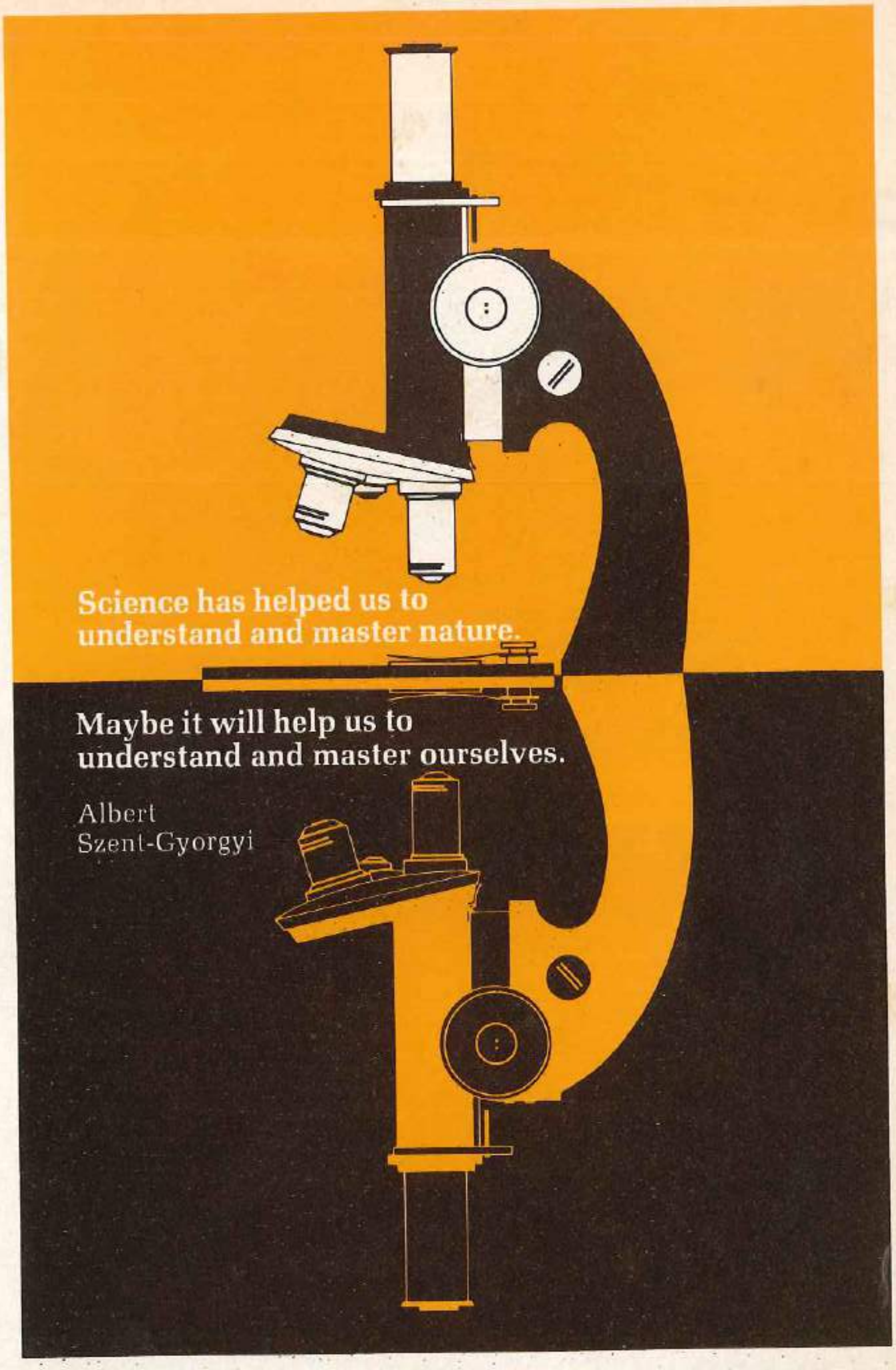

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ADVERTISING

Paul Kuntzler
National Science
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1742 Connecticut Ave.
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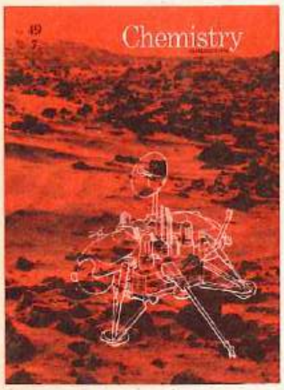
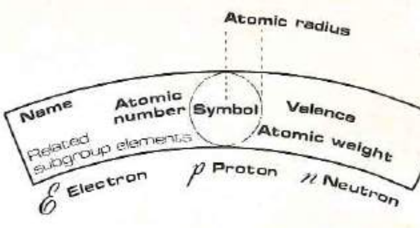


The Viking I lander module superimposed on a photograph of the Martian landscape. Is there life amidst the rocks and dunes? *See page 24*

Photograph, Courtesy of National Aeronautics and Space Administration



A NEWLY ARRANGED PERIODIC CHART

J. F. Hyde, Marco Island, FL 33937

The periodic chart shown on the following two pages retains all essential features of the Mendeleev chart. At the same time it brings all elements, including the various transition series, into a unified sequence without discontinuities. Thus, both structural and chemical relationships are clearly visualized.

Notation

The legend in the upper right margin shows the data included to characterize and compare properties of atoms for the chemical elements. Atomic weights are given for the naturally occurring elements, and mass numbers in *brackets* are given for the longest-lived isotopes of the synthetic elements. Note particularly those of the actinide series in the upper lobe of the figure.

Element symbols are enclosed in *circles,* the size of which represents the relative atomic radii. However, circles representing carbon, nitrogen, and oxygen are enlarged somewhat to accommodate the symbols. In the upper lobe, *broken-line circles* indicate lack of data on atomic radii. Elements beyond 105 are marked with *stars* to indicate that they have not yet been discovered.

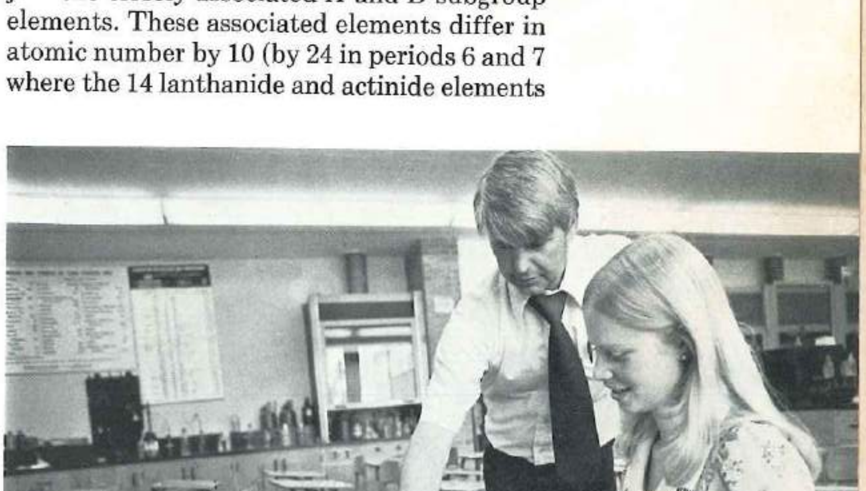
A *white bar* on the right extends out from the center of the chart just above the noble gas group to mark the major periods (principal quantum numbers and valence shells).

Roman numerals at the periphery of the chart indicate principal valence groups (as in Mendeleev's classical table) within both subgroups, *A* and *B*.

Also included is detailed distribution of electrons available for chemical bond formation in the orbital configurations of the valence shells, or quantum levels in the neutral atom.

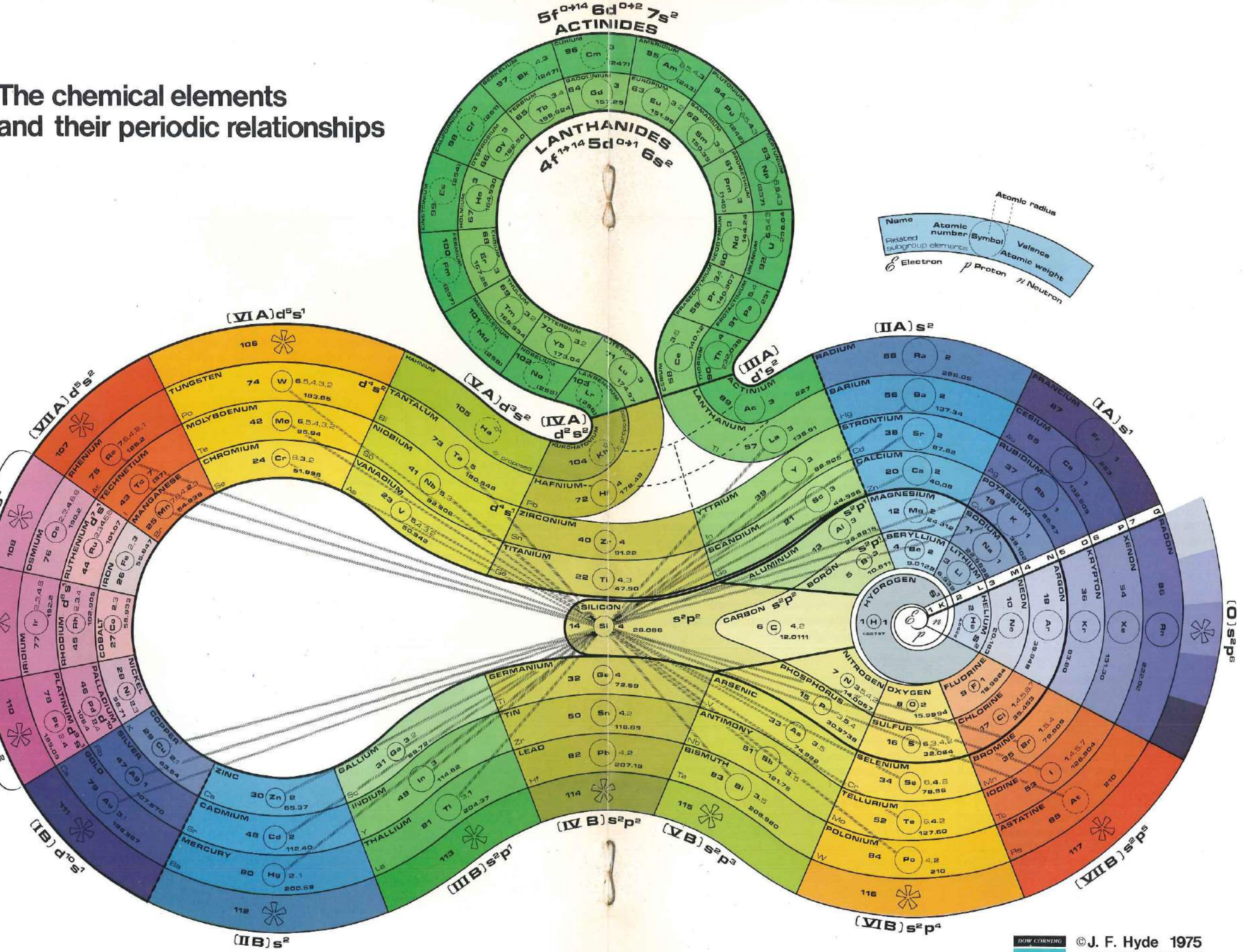
The *s, p, d,* and *f* designations are those customarily used in describing the orbital configurations available at different quantum levels, with the superscripts indicating the number and disposition of electrons present in the neutral atom.

Diagonal lines passing through the center of the figure, by coincidence the location of silicon, join the closely associated *A* and *B* subgroup elements. These associated elements differ in atomic number by 10 (by 24 in periods 6 and 7 where the 14 lanthanide and actinide elements



The Hyde periodic chart allows atoms to group together with like atoms. Not billed as a replacement but as a supplement, this chart shows the relationships in a new light based on current findings. The chart is especially helpful for beginning students. Here, Kay Jersey, Midland (Mich.) High School, and George Helvey, science department chairman, examine the chart that was developed by J. F. Hyde when he worked at the Dow Corning Corp.

The chemical elements and their periodic relationships



appear). The related A and B subgroup elements are also recognizable by having the same colors.

Colors also indicate the relative acid (red) and basic (blue) character of compounds such as oxides or hydrides of the atoms, whether or not they become involved as a cation, anion, or more complex molecular species. Deepening color extending out from the center indicates increasing metallic character.

The A and B subgroups are also separated horizontally through the center of the configuration by the noble gases, hydrogen, carbon, silicon, and the group VIII elements, none of which belong to either subgroup.

A *heavy line* and spacing enclose the elements of periods 1, 2, and 3, which are central in the right lobe. This accentuates their importance. They are prototypes for the chemical behavior of the related subgroup elements and, with the exception of iron, they contain 10 of the most abundant elements in the universe. These include carbon and silicon, which suggests the high stability of these two elements during nuclear synthesis in the sun and stars. Also, depending on atoms with which carbon and silicon are combined, the elements of periods 1, 2, and 3 can show either acidic or basic behavior and can form complex polymers essential to our environment and even to life itself.

The *heavy line* separating argon and krypton has further significance because it separates krypton, xenon, and radon into a triad. These elements, formerly thought to be inert, are now known to combine chemically with fluorine. Founded on chemical and physical properties, such triads are recognizable among other groups of elements, even the alkaline earths.

Hydrogen's central position emphasizes its importance. It is the primordial building block for all other elements synthesized in the sun and stars. The location shows clearly its relationship to other elements, both metals and nonmetals, with which it can react and serve either as an anion or part of a cation, for example, $H_3O^+ClO_4^-$.

Hyphenated lines mark off the transition elements in which the d orbitals of the previous quantum level begin to receive electrons with the stepwise increase in nuclear charge (atomic number) until a full complement of 10 is reached. Group VIII, the iron, cobalt, nickel series, appears as a type of transition series within a transition series.

A heavy line marks off the lanthanide and actinide series in which, in a similar way, the f orbitals of the previous quantum level receive electrons with increasing nuclear charge until a full complement of 14 is acquired.

Subgroups *A* and *B*

In published literature, subgroups A and B are sometimes reversed. In this periodic chart, classic designations are retained because chemical evidence shows systematic variations between chemical properties of both subgroups and elements of periods 2 and 3. This classic designation places subgroup A, which includes transitional elements, at the top of the chart where melting points are high.

Electronic Distributions

The detailed distribution of valence electrons in the orbital configurations indicated around the periphery for each group is that used by R. T. Sanderson (*Chemistry*, October 1974, page 29) and shows the modern insights into structure–property relationships. Some discrepancies appear, however, because each element in the periodic chart has some uniqueness which sets it apart from a general group pattern. For example, hybridized orbitals occur for the first time with boron and aluminum, for which the structure designation is s^2p^1, whereas d^1s^2 is the designation for the elements of subgroup IIIA. Similar deviations occur in niobium, tungsten, ruthenium, rhodium, palladium, and platinum, and are so indicated.

Also, differences in electronic structure must occur in transition elements and their compounds where electrons in the next inner shell become involved in chemical bond formation. Thus differences in electronic structure reflect the environment under which the structures are determined and may represent only one of several possible configurations.

These electronic structure differences are important in many oxidation-reduction reactions and are the source of color where resonance frequencies between structures are in the range of visible light.

Man-Made Elements

Those chemical and physical properties presently known about the transuranium elements justify the indicated relationships with the lanthanide series. Two recent additions to the periodic chart, elements 104 and 105, have not been named officially. However, kurchatovium and hahnium, respectively, have been proposed. Elements beyond 105 are shown largely for the sake of symmetry to end the ribbon near its starting point. The possibility of synthesizing such elements is remote but, should that happen, their chemical properties would probably follow this pattern. More information on this topic probably will appear in the future. Just recently, traces of elements 116, 124, and 126 were discovered in Madagascan mica (see page 26).