THE D-AND F-BLOCK ELEMENTS
INTRODUCTION OF D-BLOCK ELEMENTS

- THE ACTINOIDS

ACTINOIDS (5f - SERIES):

The actinoids encompass the fourteen elements from Th to Lr. These elements are characterized by radioactivity, with the earlier members exhibiting relatively long half-lives, while the latter ones have half-life values ranging from a day to 3 minutes for lawrencium (Z = 103).

Electronic Configuration: The electronic configuration of all actinoids is generally believed to be $7s^2$ with variable occupancy of the 5f and 6d subshells. The fourteen electrons are formally added to 5f, with the exception of thorium (Z = 90). From protactinium (Pa) onward, the 5f orbitals are complete by element 103. Irregularities in the electronic configuration of actinoids, akin to those in lanthanoids, are linked to the stabilities of the f^o, f^7, and f^{14} occupancies of the 5f orbitals. Consequently, the configurations of Am and Cm are [Rn] $5f^7\,7s^2$ and [Rn] $5f^7 6d^{17} 7s^2$.

Ionic Sizes: Similar to lanthanoids, a gradual decrease in the size of atoms or M^{3+} ions across the series is observed in actinoids. This phenomenon is termed the actinoids contraction, akin to the lanthanoids contraction. However, the contraction is more significant from one element to the next in this series due to poor shielding by 5f electrons.

Oxidation States: Actinoids exhibit a broader range of oxidation states, partly attributed to the comparable energies of the 5f, 6d, and 7s levels. In general, actinoids tend to show a +3-oxidation state. Elements in the first half of the series frequently display higher oxidation states. For instance, the maximum oxidation state increases from +4 in Th to +5, +6, and +7 in Pa, U, and Np, respectively, but decreases in succeeding elements. Similar to lanthanoids, actinoids have more compounds in the +3 state than in the +4 state. However, both +3 and +4 ions have a tendency to undergo hydrolysis.

GENERAL CHARACTERISTICS AND COMPARISION WITH LANTHANOIDS:

1. Actinoid metals exhibit a silvery-white appearance but showcase diverse structures, stemming from irregularities in metallic radii that surpass those observed in lanthanoids.
2. Actinoids, known for their high reactivity, particularly when subdivided, undergo reactions such as boiling water, resulting in a combination of oxide and hydride. These metals readily form compounds with most metals at moderate temperatures. While hydrochloric acid attacks all metals, nitric acid has a slight effect due to the development of protective oxide layers. Alkalies, however, do not elicit any response.
3. The chemistry of lanthanoids reveals that the ionization enthalpies of early actinoids, though not precisely determined, are expected to be lower than those of early lanthanoids. This expectation arises from the logical assumption that as 5f orbitals begin to fill, they penetrate less into the inner electron core. Consequently, the 5f electrons experience more effective shielding from the nuclear charge compared to the 4f electrons in corresponding lanthanoids. This reduced hold on outer electrons makes them more available for bonding in actinoids.

Note: The lanthanoids contraction is more important because the chemistry of elements succeeding the actinoids are much less known at the present time.

USES OF ACTINOIDS:

1. Thorium finds application in atomic reactors and cancer treatment. Additionally, its salts play a role in the production of incandescent gas mantles.
2. Uranium serves as a nuclear fuel and its salts contribute to various industries, including glass (for providing a green color), textiles, ceramics, and pharmaceuticals.
3. Plutonium serves a dual purpose, functioning as a fuel for atomic reactors and playing a crucial role in the production of atomic bombs.