The present work synthesises for the first time a vast amount of experimental information latent in the optical potentials for deuterons (2 to 80 MeV), tritons (20 MeV), helions (4 to 217 MeV), alpha particles (10 to 172 MeV) and lithium-6 (12 to 156 MeV). Volume integrals of the absorptive part of optical potentials for these projectiles over the target mass range 12 to 208 have been computed and systematically analysed. It has been shown that the volume integrals per target-projectile nucleon pair increases with increase of energy and saturates to a value in the neighborhood of 100 MeV fm$^3$ at higher energies for all the projectiles.

Systematics of these absorptive volume integrals with respect to energy and target mass have been found in the form

$$J_1 = J_{10} \left[ 1 - \exp \left( -\alpha E_{cm} \right) \right]$$  \hspace{1cm} (6.1)

and

$$J_{10} = \left[ J_{100} + \gamma_{TP} J_{11} \right] \left[ 1 + K A_T^{-1/3} \right]$$  \hspace{1cm} (6.2)

$$\gamma_{TP} = \left( \frac{N_P - Z_F}{A_F} \right) \left( \frac{N_T - Z_T}{A_T} \right)$$  \hspace{1cm} (6.3)

where the projectile and target are represented by $(N_P, Z_P, A_P)$ and $(N_T, Z_T, A_T)$. The parameter $\alpha$ evaluated
are shown in Table 5.3 for the different projectiles.

The energy parameter $\propto$ decreases with projectile mass and seems to obey the relation $A_F \propto = \text{constant}$ and also seems to agree with the value for nucleons.

The mass number systematics contains the isoscalar contribution $J_{100}$ and isovector contribution $J_{11}$, and the proportion of volume and surface form factor contributions to the absorptive volume integrals. The values for these contributions for the different particles have been listed in Table 5.3. There seems to be a uniformity in these strengths for all the particles within errors. For $^6\text{Li}$, the contribution seems to be essentially from the surface. The data for $^3\text{He}$ and triton show the splitting due to the isovector component as expected. There is a general decrease in $J_1$ with respect to projectile mass due to Pauli blocking effects.

Based upon these findings, the following global formula is presented for all the particles.

\begin{align*}
J_1 &= J_{10} \left[ 1 - \exp \left( - \frac{0.2}{A_F} E_{\text{cm}} \right) \right] \quad \text{(6.4)} \\
J_{10} &= \left\{ \frac{41}{1 + \exp(A_F - 5.2)} + 274A_T^{-1/3} \right\} \\
&\quad - \frac{T_F}{T_P} \left\{ 120(1 + 6A_T^{-1/3}) \right\} \quad \text{(6.5)}
\end{align*}
where $\mathcal{J}_{TP}$ is given by the relation (6.3) above. The predictions of this empirical formula compares very well with the experimental data.

The findings of this work corroborate that the saturation effects of the imaginary volume integral $J_I$ and its near constancy is a general phenomena for all projectiles studied and is a universal property of effective nucleon-nucleon interaction. This fact, together with the systematics of $J_I$ remain to be explained by microscopic theories.