CONDUTION :- Let us consider the conduction phenomenon which is due to transport of Energy. in this case the temperature and hence the energy varies from layer to layer and it is the energy 'E' which is transferred from one layer to another, when one proceeds according to 'η' phenomenon the total transfer of energy per unit area is given by.

$$-\frac{1}{3} n \bar{c} \lambda \frac{d\bar{E}}{dz} \quad \text{------} (1)$$

and this should be equated to the flow of energy across unit area.

$$-JK \frac{dT}{dz} \quad \text{Thus}$$

$$-JK \frac{dT}{dz} = -\frac{1}{3} n \bar{c} \lambda \frac{d\vec{E}}{dz} \cdot \frac{dT}{dT}$$

$$\text{as } K = \frac{1}{3} n \bar{c} \lambda \frac{d\bar{E}}{dT} \frac{1}{J} = \frac{1}{3} n \bar{c} \lambda \cdot m c_v = \eta c_v \quad \text{------} (2)$$

when c_v the sp-heat is expressed in heat units, for $d\bar{E} = J m c_v dT$ The above relation is however found to be at variance with experimental results.

Chapman and Enskog following Maxwell's method discussed rigorously the transport of energy by spherically symmetrical (monatomic) molecules.

and showed that energy is transported at 5/2 times the rate given by the expression(1). This result is found to be in accordance with experiments. For the general case of any molecule we may put.

$$\frac{K}{\eta c_v} = \epsilon \quad \text{--- (3)}$$

it is difficult to determine ϵ for polyatomic molecules since their energy is partly due to translational motion and partly to internal motions. Eucken has suggested that in the case of polyatomic gases the transport of other forms of energy may be given by (2) while that of the translational energy is given by Chapman's results. With this assumption he found an expression for ϵ. Let the total number of degrees of freedom of the molecule be $3+\beta$ where 'β' denotes the number due to causes other than translation. Then the expression for the transport of energy becomes:

$$\frac{\eta}{m}\left[\frac{5}{2}\frac{d\bar{E}_1}{dT} + \frac{d\bar{E}'}{dT}\right]\frac{dT}{dz}$$

$\bar{E}_1$ being the translational energy and $\bar{E}'$ the energy of other types. As earlier if this expression is equated to $Jk\frac{dT}{dz}$ we have

$$JK \frac{dT}{dz} = n/m \left[5/2 \frac{d\bar{E}}{dT} + \frac{d\bar{E}'}{dT} \right] \frac{dT}{dz}$$

as $$K/m = \frac{1}{Jm} \left[\frac{d\bar{E}}{dT} + \frac{d\bar{E}'}{dT} \right]$$

However the law of equipartition reveals

$$\frac{d\bar{E}}{dT} = 3/2\, k \; ; \; \frac{d\bar{E}'}{dT} = \frac{\beta}{2} k$$

with the help of these 4 result

$$\frac{K}{\eta} \left[\frac{5}{2} \cdot \frac{3}{2} + \frac{\beta}{2} \right] \frac{k}{Jm}$$

further from the law of equipartition

$$C_v = \frac{3+\beta}{2} \frac{k}{Jm} \; ; \; C_p = \frac{5+\beta}{2} \frac{k}{Jm}$$ thus

$$\gamma = 1 + \frac{2}{3+\beta}$$

$$C_v = \frac{k}{Jm(\gamma - 1)}$$

Making the substution for β and K/m in (I) yields :

$$\frac{K}{\eta C_v} = \epsilon = \frac{1}{4}(9\gamma - 5)$$

Hence for monatimic gases $\epsilon = 2.5$
for diatomic gase $\epsilon = 1.9$ etc

Since $K = \epsilon \eta C$ and the Variation of C_v is small K's Vaniation with temperatures and Pressure follows In general the Same Course as the η Variation. Thus K like 'η' is independent of Pressure. This was verifide Experimentally by Stefan and others. This law however fails at Very high and at very low Pressures as in the Case of viscosity. At extrememely low Pressures the Conductivity decreases. As In the Case of Viscosity the Conductivity of all gasses increases more rapidly than the $\sqrt{T}$