or,
$$ k_e = A \cdot e^{Q/RT}, $$
where $A = \text{const}.$

So,
$$ k_e^{1/2} = A \cdot e^{Q/2RT} $$

By combining eqns. (1)-(4), we get,
$$ \frac{dp}{dt} = K \cdot \frac{T^{\frac{3}{4}} \cdot e^{Q/3RT}}{t^{\frac{1}{2}}} $$

This equation explains the occurrence of $-ve$ activation energy, because at a certain range of temperature, the variation of $T^{\frac{3}{4}}$ is negligible in comparison with the variation of the exponential term; and as $T$ increases, $-\frac{dp}{dt}$ decreases. Hence the rate has a $-ve$ temp. coeff. and appears to have a $-ve$ activation energy of magnitude $Q/2.$ The following calculation will show the predominance of the $e^{Q/2RT}$ term over $T^{\frac{3}{4}}$ term.

For constant $t$ and $K$, and $Q = 4$ kcal/mole:

<table>
<thead>
<tr>
<th>$T^\circ K$</th>
<th>$T^{\frac{3}{4}}$</th>
<th>$e^{Q/3RT}$</th>
<th>$-\frac{dp}{dt}$ (For $t = 1, K = 1$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>300</td>
<td>70.5</td>
<td>30.5</td>
<td>$2000$</td>
</tr>
<tr>
<td>400</td>
<td>88.9</td>
<td>12</td>
<td>$1068$</td>
</tr>
<tr>
<td>500</td>
<td>102.5</td>
<td>7.6</td>
<td>$820$</td>
</tr>
</tbody>
</table>

In our case, all the above conditions have been observed:
1. Initial pressure for adsorption is 12.32 cm.
2. Surface area of the sample is only 11 m$^2$/g, hence pore radius should be small.
3. Rapid equilibrium—it is established within 2-3 hrs.
4. Heat of adsorption is very small, only 1-2 kcal/mole.
5. Expt. has been conducted in a constant volume apparatus.

Figure 1 gives the plot of $-\frac{dp}{dt}$ vs. $1/t^{\frac{1}{2}}$ for our sample at 98$^\circ$ C, 167$^\circ$ C, 253$^\circ$ C.

![Figure 1](image)

In view of the graphical evaluation of $-\frac{dp}{dt}$ values, the agreement can be described as fair. As is expected, the slope of the plots (const. x $e^{Q/3RT}$) increases as temperature decreases. But at higher temperatures the plots have one break, the slope of the 2nd stage being smaller than that of the first. Moreover, the break in the plots appears in the region where the corresponding Elovich plots show discontinuities. The change in slope is evidently due to change in $Q$, other factors remaining constant. The heat of adsorption in the 2nd stage ($Q_2$) is not only greater than $Q_1$ (slope is higher) but also $Q_2 \gg RT$ and the change in $T$ has little influence in changing the slope in the 2nd stage at different temperatures.

Hence, this equation may be used to test whether the Knudsen diffusion is rate-controlling or not, and if the pore radius of the sample is in motion, this may be used as an indirect method for the evaluation of heat of adsorption, $Q$, from the slope of $-\frac{dp}{dt}$ vs. $1/t^{\frac{1}{2}}$ plots.

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**CYCLIC CHANGES IN PERIPHERAL PLASMA PROGESTERONE IN BUFFALO HEIFERS**

In cow with silent heat Dobrowolski and coworkers observed significantly lower levels of blood progesterone at all stages of the oestrous cycle. No such study has been reported in buffalo. The investigation was undertaken to determine the peripheral plasma progesterone levels in buffalo heifers during the various phases of oestrous cycle as incidence of silent heat in this species is quite high during summer.

The study was carried out during June-July, 1976 with 9 Murrah buffalo heifers 3-4 years of age and average weight 325 ± 25 kg. The animals were checked for heat twice daily at 8 A.M. and 4 P.M. using vasectomized bull. Jugular venous blood was collected in heparinised tubes, which were immediately centrifuged and plasma stored at $-15^\circ$ C. Progesterone was determined by the competitive protein binding assay as described by Murphy. The efficiency value of the method was 82%.

All the buffalo heifers were in "silent" heat with no apparent symptoms of oestrus. On rectal palpation of the genitals, mucus discharge invariably came out. Corpus luteum (CL) could only be detected in 6 animals at 10th and 15th day of the service; 3 heifers...
repeated heat with a cycle length of 23 ± 1.5 days and one heifer became pregnant.

The average plasma progesterone levels (ng/ml) of the 5 cycling buffalo heifers on day 0, 3, 5, 10, 15 and 21 of the oestrous cycle (day 0 = day of heat) were < 0·10, 0·11, 0·10, 0·24, 0·24 and 0·17 respectively. The progesterone levels in one heifer which conceived were 0·22, 0·36, 0·60, 0·84, 1·96 and 2·54 ng/ml. The 3 heifers in which heat was non-ovulatory the values were < 0·1 ng/ml at all intervals.

In cows, the average plasma progesterone concentration (ng/ml) during the oestrous cycle has been reported to be lowest at oestrus (0·2 to 2·0) which remain low for a period of 2 to 4 days, increase to maximum values (5·9 to 9·0) at about day 21 and again register a decline during the pre-oestrous period to nadir values of < 1·5 kg. It is obvious that in buffalo heifers much lower values of plasma progesterone could be obtained at all stages of the cycle as compared to cow, although its temporal pattern remain similar in the two species. During early pregnancy in cows, up to first 14 days the mean levels of plasma progesterone remained similar to normal cycles, which then declined in cyclic animals but not in those which became pregnant. In the buffalo heifer which conceived, higher levels of progesterone were obtained at all stages of the oestrous cycle.

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November 12, 1976.


AGE OF KALPATTA GRANITE, KERALA STATE

The Kalpatta granite, a medium to coarse-grained biotite granite, occurs among the Pro-cambrian crystalline rocks in the Calicut District, Keral State. Studies on the granite and the associated country rocks in and around Kalpatta (11° 36' 15"; 76° 5' 5"), located on the south-western margin of the granite body, throw light on its age and relation with the associated biotite hornblende gneisses.

A penetrative megascopic foliation (S1) is characteristic of both the granite as well as the associated gneisses. While S1 in the gneisses is defined by planar preferential alignment of biotite flakes and hornblende grains, in the granite it is after biotite flakes. S1 foliation is axial surface type with respect to the earliest recognisable folds (F) in the gneisses. The appearance of S1 in these rocks is a significant deformational event indicative of the accompanying metamorphic peak and can therefore be used as a time-marker for establishing the age relation between the granite and the gneisses.

Charnockites and granulites occurring as occasional lenses in the gneisses carry imprints of polymetamorphism. Grains having a pyroxene core with a hornblende or biotite rim are common in these lenses. Obviously a lower grade amphibolite facies metamorphism has been printed on an earlier granulite facies assemblage. Since the penetrative axial surface foliation (S1) is after biotite and hornblende, its development marks the peak of the retrograde amphibolite facies metamorphism in time.

The granite is traversed by pegmatitic and aplitic veins of two age groups. The early aplite veins bear evidences of metamorphic recrystallisation as they have developed S1 foliation after biotite. S1 traces in the granite run uninterruptedly through these aplites, cutting across vein boundaries. The early pegmatitic veins, though free from megascopic foliation, have been strongly boudinaged and in some cases the pegmatitic material has even flowed parallel to S1 in granite (Fig. 1). This shows that while the incompetent

![Fig. 1. A boudinaged pegmatite vein. Note flowage of pegmatitic material parallel to S1 in granite](image-url)