TABLE I
Means, variances, heritability and genetic advance in two crosses

<table>
<thead>
<tr>
<th>Generation</th>
<th>N</th>
<th>Mean (X)</th>
<th>Variance (V)</th>
<th>Heritability (h²)</th>
<th>Genetic advance (A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>P₁ (Tainan-3)</td>
<td>45</td>
<td>0.143</td>
<td>0.00561</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P₂ (IR-8)</td>
<td>51</td>
<td>0.169</td>
<td>0.00282</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P₃ (Basmati-370)</td>
<td>45</td>
<td>0.176</td>
<td>0.00657</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P₁×P₂ (F₂)</td>
<td>96</td>
<td>0.220</td>
<td>0.00058</td>
<td>50-000</td>
<td>0.029</td>
</tr>
<tr>
<td>(F₂ population)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P₂×P₃ (F₂)</td>
<td>92</td>
<td>0.245</td>
<td>0.00058</td>
<td>47-530</td>
<td>0.027</td>
</tr>
</tbody>
</table>

The formula \( \frac{\text{V}_{F₂} - \text{VE}}{\text{V}_{F₂}} \) was used for the calculation of heritability in broad sense wherein, \( \text{V}_{F₂} = \text{variance of } F₂ \text{ population} \) and \( \text{VE} = \frac{\text{V}_{F₁} + \text{V}_{F₂}}{2} \). The non-fixable components of variation and the genotype environment interactions have not been removed from the \( F₂ \) variance. The data clearly indicate that in both the crosses studied, there is considerable evidence for additive and cumulative gene action for the DBC values (Fig. 1). This is expected, since very diverse parents have been crossed in either case. A large number of genes must be responsible for the determination of 'DBC' values since moderate heritability estimates have been obtained. It is, however, remarkable that the two estimates are almost alike. The genetic advance calculated indicates that \( F₃ \) lines derived from the 5% top \( F₂ \) selections would be 0.03 units higher than the mean of \( F₂ \).

The heritability estimates in the present study compare fairly well with similar studies done in wheat, soybean and other crops. With larger population at hand, it should be possible to breed for high DBC value which in turn would result in genetic advance for protein content and quality.

FIG. 1. Distribution of \( F₂ \) population of two crosses in rice for DBC value.

We are highly thankful to Dr. M. S. Swaminathan for his keen interest in the work and kindly going through the manuscript.

5. —, ibid., 1962, 54, 203.

RATE COEFFICIENT FOR TWO-BODY N-ATOMS RECOMBINATION

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The recombination of N-atoms is important in many phenomena. During discharge through nitrogen, N₂ molecules are excited, ionized and/or dissociated. The dissociated N-atoms afterwards recombine and produce active nitrogen. Again, in the upper atmosphere, N-atoms are produced by dissociation of N₂ molecules by solar ultraviolet rays. On reacting with constituent particles of the atmosphere—atoms, molecules, ions and electrons—they produce certain upper atmospheric phenomena. Data for two-body recombination of N-atoms recombination are not available. In this note, two-body recombination of N-atoms is
studied photometrically by the flow method. By assuming the recombination of \( N \)-atoms at the walls of the experimental system (pyrex glass), the rate coefficient of \( N \)-atoms recombination is estimated at a pressure of 100 \( \mu \) of Hg and at a temperature of 295°K.

Experimental arrangement is shown in Fig. 1. It consisted of a pyrex glass tube 115 cm. long, 2.5 cm. in diameter and having six side tubes, spaced equally along the tube and closed at the ends by quartz windows. Tank nitrogen was introduced into the tube through a Hoke needle valve. Pressures at the ends of the tube were measured with N.R.C. thermocouple gauges. \( N_2 \) was then activated by means of a discharge produced by a magnetron oscillator (Raytheon Microtherm, Model CMD-4) operating at a frequency of 2450 Mc/s. and giving a maximum power output of 100 watts. Active nitrogen glow was produced which filled up whole of the experimental tube. Through the side tubes the intensities of the afterglow were measured with a photomultiplier tube (RCA 1P21) and an ultraselective microammeter (RCA Model WV 4B). High voltages to the photomultiplier tube were supplied by Baird Atomic Super-stable Power Supply (Model 312 A). The observed intensities at the different side tubes are given in Table I.

As the \( N \)-atoms produced by the microwave discharge in \( N_2 \) move down the experimental tube, they recombine by the following processes:

1. Surface recombination
   \[ N + N \rightarrow N_2^* + S. \] (1)
2. Three-body recombination
   \[ N + N + M \rightarrow N_2^* + M. \] (2)
3. Two-body recombination
   \[ N + N \rightarrow N_2^*. \] (3)

Since the experiment was carried out at a pressure of 100 \( \mu \) of Hg, the rate of loss of \( N \)-atoms due to the three-body recombination is very small and is therefore neglected. Hence the rate of loss of \( N \)-atoms is given by

\[ \frac{dn}{dt} = K_1n + K_2n^2 \] (4)

where
- \( n \)—\( N \)-atoms concentration,
- \( K_1 \)—two-body rate coefficient for recombination of \( N \)-atoms,
- \( K_2 \)—surface recombination coefficient of \( N \)-atoms on pyrex glass and is given by:

\[ K_2 = \frac{S\gamma}{4V} \] (5)

where
- \( S \)—surface area of the tube,
- \( \gamma \)—average velocity of nitrogen atoms,
- \( \gamma \)—catalytic recombination efficiency of \( N \)-atoms at the glass surface,
\[ = 2 \times 10^{-5} \] (2-4)
- \( V \)—volume of the tube.

Integrating equation (4), we obtain

\[ n = n_0K_2\left( e^{K_2t} \left( K_1 + K_2n_0 \right) - K_2n_0 \right)^{-1}. \] (6)

Since the pressure readings at the two ends of the reaction tube were almost the same, an essentially uniform distribution of atoms and molecules existed throughout the tube. At 100 \( \mu \) pressure and 295°K, the number of nitrogen molecules is \( 3 \times 10^{15} \) per cc and assuming 1.0% dissociation of \( N_2 \) molecules by the microwave discharge, \( N \)-atoms concentration is \( 6.55 \times 10^{18} \) per cc. Obtaining \( \nu \) at 295°K from
kinetic theory

\[ \dot{v} = \left( \frac{8 KT}{m n} \right)^{\frac{1}{2}} \]  

(7)

and substituting values of other factors in the expression for \( K_s \), one obtains \( K_s = 0.534 \text{ sec.}^{-1} \).

The gas was pumped from the reaction tube at the rate of \( 1.29 \times 10^2 \text{ cm}^3 \text{ sec.}^{-1} \) sec. at 100 \( \mu \text{ of Hg}. \) Hence, 1 cm. distance along the experimental tube is covered in \( 3.81 \times 10^{-3} \text{ sec.} \). Utilizing this value the concentration of N-atoms at the different side tubes are then determined. The intensities at the side tubes are calculated from the relation

\[ I = k n (K_s + K_p n) \]  

(8)

and are given in the left column of the table. It is seen that the observed intensities agree well for \( K_s = 8 \times 10^{-13} \text{ cm}^3 \text{ sec.}^{-1} \).

From Table I it will be seen that the intensity at the first window is larger than what is expected. It may be mentioned that the intensity peak drifts down the experimental tube as the pressure is increased and may be due to traces of secondary afterglow, namely, ‘Pink Afterglow’. However, earlier workers reported that such afterglow is observed only when highly purified nitrogen is used.

![Table I](image)

*Corrected for dark current of the photomultiplier tube.

* The degree of dissociation varies mainly with the power of the oscillator which causes discharge. Its value ranges between 1-6%. As the power in the present case is low, the lowest value is assumed.


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**THE MEGATECTONICS OF CONTINENTS AND OCEANS**

As a result of development of palaeomagnetism in the last two decades, and also of improved techniques for accurate measurements of this fossil record of geomagnetism in rock samples, there has arisen a revival of interest in the hypothesis of continental drift which remained almost a discarded subject in the forties. The recent findings of “Ocean floor spreading” have added interest to the subject of global tectonics.

The book under review is the outcome of lectures given at a symposium on matters relating to continental drift, at Rutgers University in the summer of 1966. There are 12 chapters in the book and each chapter gives a bibliography of references at the end. There are 81 figures and a useful index.

The fundamentals of palaeomagnetic methods are described by David Collinson, Tuzo Wilson and Robert Dietz each outlines aspects of the development of the theory of sea floor spreading and its many implications. Three regions of special interest in the continental drift theory are reviewed in the three chapters: “Crustal Deformation in the Western United States”, by James Gilluly; “Tectonics and Geophysics of Eastern North America”, by Philip B. King; and “The Mediterranean, Ophiolites, and Continental Drift”, by John C. Maxwell. The chapter on “Developments in Seismology and Geochronology” is contributed by Leon Knopoff. Adrian Scheidegger examines the large-scale tectonic stress field of the crust.

Aeromagnetic surveys used in exploration for petroleum also provide data for research in basement tectonics. James Affleck presents three results of such studies which bear on continental drift and polar wander. Paul Lyons contributes another basement tectonics study suggesting that large-scale crustal movements are confined to lateral displacements along faults.

Finally, in two recently invited papers for the book Kenneth S. Deffeyes discusses a proposed model for the area of generation of new crust, and R. K. Olsson outlines the impact of palaeomagnetic dating and sea floor spreading on advances in biostratigraphy.

Thus the book provides a collective account of our present knowledge on global tectonics since the palaeomagnetic breakthrough in the mid-fifties.

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