Following Persson, we assume an expression of the type

$$\frac{n_r}{n_o} = A\left[B - \left(\frac{r}{R}\right)^2\right] \quad (3)$$

where A and B are constants which can be determined from the boundary conditions, $n_r = n_R$ at $r = R$ and $n_r = n_0$ at $r = o$. n_R represents the observed particle density when the movable probe occupies the geometrical position of the wall. Equation (3) can then be written as

$$\frac{n_r}{n_0} = (1 - N)\left[\left(\frac{1}{1-N}\right) - \left(\frac{r}{R}\right)^2\right]$$

where $N = n_R/n_0$. For the present case $n_R = 1 \cdot 72 \times 10^9$ cm.$^{-3}$ and $n_o = 2 \cdot 88 \times 10^9$ cm.$^{-3}$, which gives the values of the constants as $A \doteq 0 \cdot 4$, $B = 2 \cdot 5$. Figure 1 (solid curve) gives the corresponding distribution. The Bessel function profile for the same experimental data is given in Fig. 2 (solid curve) which is calculated on the basis that $n_R \neq o$ but has the value observed with the help of the movable probe as mentioned above. Thus it can be seen from Figs. 1 and 2 that the observations appear to be capable of representation both by a parabolic distribution as well as by a Bessel function. This fact can be interpreted to mean that ionization is not restricted to only the high energy electrons ($\approx$ monoenergetic) coming from the cathode dark space. It appears therefore that the negative glow plasma investigated has a status intermediate between that of a positive column plasma and a negative glow beam plasma (where the parabolic distribution alone should be valid).

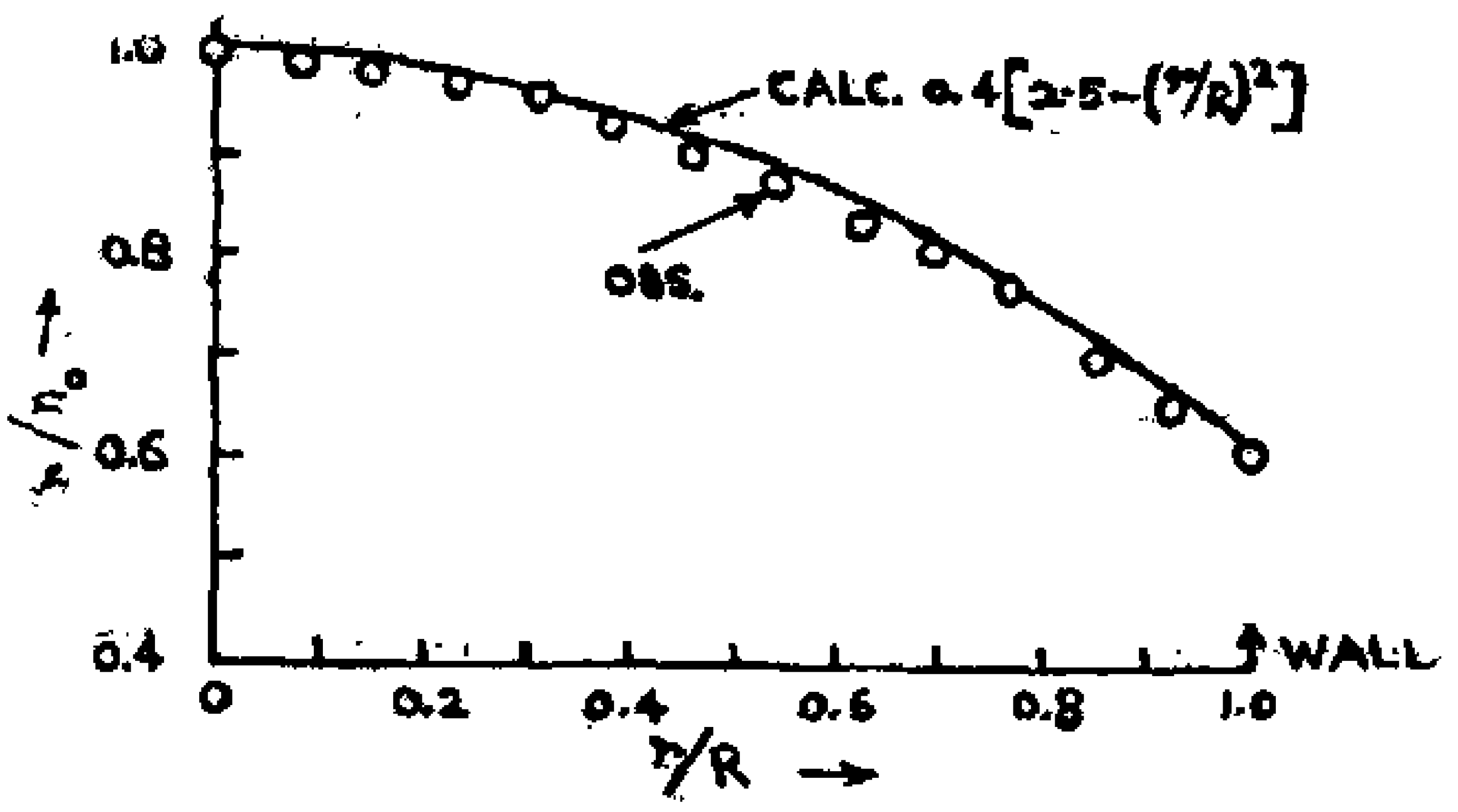

FIG. 1. Radial particle density profile in the negative glow neon plasma compared with parabolic function.

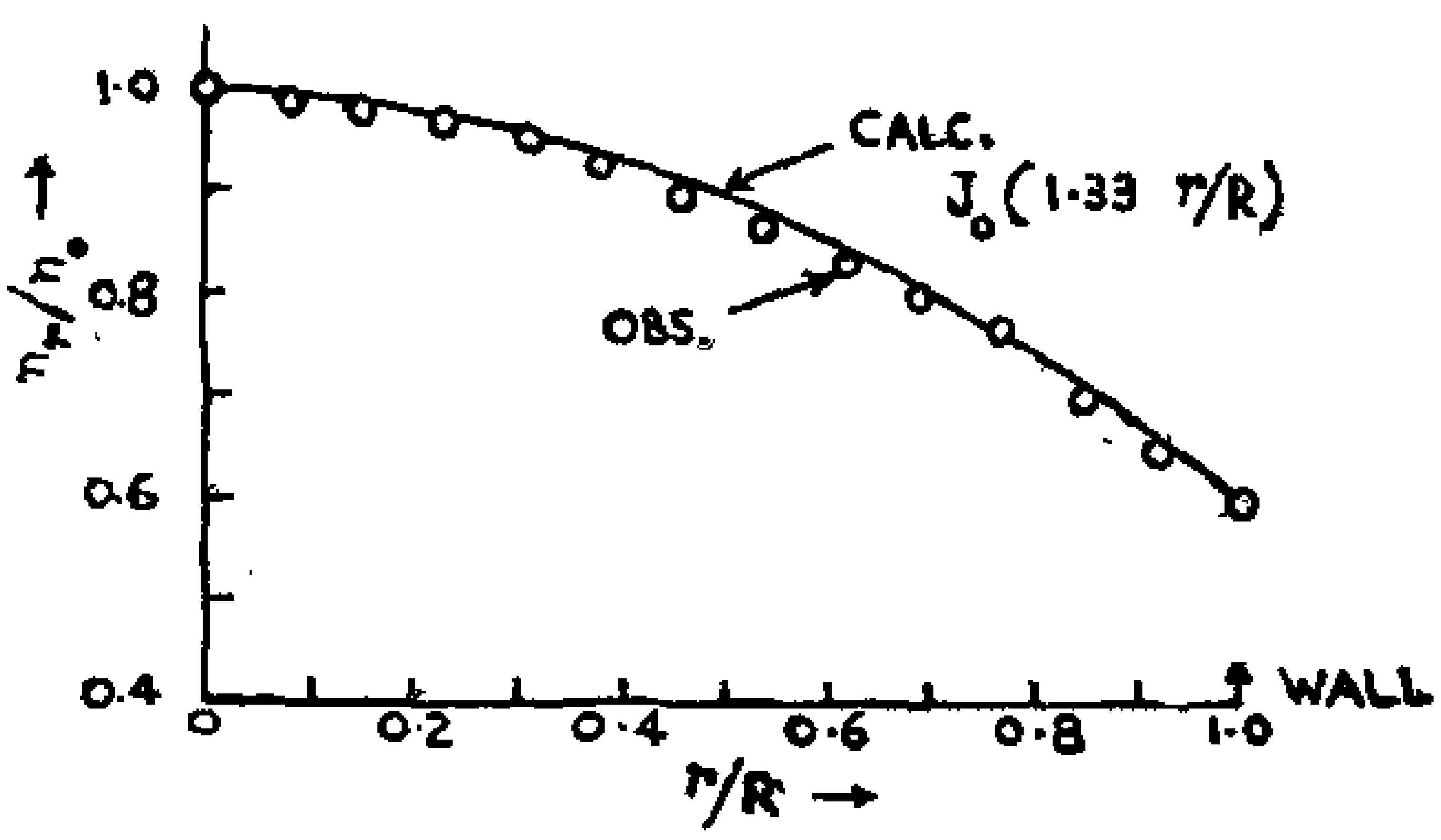

FIG. 2. Radial particle density profile in the negative glow neon plasma compared with Bessel function.

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X-RAY ANALYSIS OF IMPERFECTIONS IN DEFORMED RHODIUM

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BROADENING of X-ray powder reflections from cold-worked rhodium was first analysed by Brindley and Rindley[1] and the conclusion drawn that lattice strain alone contributes to the observed broadening. No further attempt has, however, been made in the last two decades to examine the possible incidence of stacking faults on deforming rhodium and to separate quantitatively the contributions due to domain size and lattice strain. The present note deals with an accurate determination of deformation stacking faults in cold-worked rhodium powder and an evaluation therefrom of the values of domain size and lattice strain.

High-purity (> 99·99%) rhodium powder was deformed at room temperature for an hour in a mechanical pulveriser and was then pressed in the form of briquettes for mounting in a Philips X-ray Diffractometer. Line profiles of the (111), (200), (311) and (222) reflections were recorded from such briquettes at a scanning rate of 1/8° per minute and a time constant of 4 seconds. The briquette was then annealed in vacuum and the same line profiles recorded

TABLE I

Analysis of X-ray line broadening in cold-worked rhodium powder. Results corrected for stacking faults

($a = 1 \cdot 9 \times 10^{-3}$)

Reflection	$2\theta°$	$b \times 10^3$ rad.	$b_{corr.} \times 10^3$ rad.	$B \times 10^3$ rad.	$\beta_S \times 10^3$ rad.	$\epsilon_S \times 10^3$	η_S Å	$\beta_{AC} \times 10^3$ rad.	$\epsilon_{AC} \times 10^3$	η_{AC} (Å)	$\beta_{WB} \times 10^3$ rad.	$\epsilon_{WB} \times 10^3$	η_{WB} (Å)
111	20·53	1·52	1·66	3·79	2·13	1·39	772	3·06	2·04	537	3·40	2·27	484
200	23·68	1·57	1·82	4·81	2·99	1·69	561	4·12	2·32	409	4·45	2·51	378
311	42·20	3·17	3·35	8·34	4·99	1·38	416	7·00	1·93	297	7·64	2·11	272
222	44·55	3·40	3·58	9·86	6·28	1·59	344	8·56	2·17	252	9·18	2·33	235
Mean value		..	..	..	..	1·51	523	..	2·11	374	..	2·30	342
Percentage mean deviation ftom mean value					..	8·4	27·0	..	6·1	26·6	..	5·0	25·9

under identical experimental conditions to characterise instrumental broadening.

The location of the α_1 peaks and the determination of the integral breadth of the cold-worked and annealed profiles was done by the method suggested by Anantharaman and Christian.[2] The deformation stacking fault parameter (α) was determined by the change in separation of the (111) and (200) reflections according to the equation.[3]

$$\Delta\, (2\theta°_{200} - 2\theta°_{111}) = -\frac{45\sqrt{3}\alpha}{\pi^2}\,(\tan\theta_{200} + \tfrac{1}{2}\tan\theta_{111}). \qquad (1)$$

A very small value of α, *viz.*, $1 \cdot 9 \times 10^{-3}$, was found in cold-worked rhodium powder.

The breadths (β_f) due to deformation faulting for each of the hexagonal components of any particular f.c.c. reflection could be computed[4] from the α value. The fault breadths of each of the components were compounded separately with the instrumental breadth (b) by the parabolic equation[5] to obtain the individual breadths of the components broadened by faulting. Neglecting the small peak shifts of the individual components, the desired fault-corrected instrumental breadth ($b_{corr.}$) was thereby obtained[6] from the individual breadths of the components broadened by faulting and their corresponding fractional intensities.

The pure diffraction broadening (β) due only to domain size and lattice strain was obtained from the observed integral breadth (B) by making use of each of the following relations derived by Scherrer,[7] Anantharaman and Christian[5] and Warren and Biscoe[8] on the assumption of Cauchy, intermediate and Gaussian profiles respectively :

$$\beta_S = B - b_{corr.} \qquad (2)$$

$$\beta_{AC} = B - \frac{b^2_{corr.}}{B} \qquad (3)$$

$$\beta_{WB} = B^2 - b^2_{corr.} \qquad (4)$$

The domain size (η) and lattice strain (ϵ) values were obtained by the following well-known relations to check the preponderance of one effect over the other :

$$\eta = \frac{\lambda}{\beta\cos\theta} \qquad (5)$$

$$\epsilon = \tfrac{1}{4}\,\beta\cot\theta. \qquad (6)$$

The separation of domain size and lattice strain values was done by graphical methods[9-10] assuming line profiles to be Cauchy or Gaussian functions respectively and also by the analytical method due to Rao and Anantharaman.[11]

The domain size and lattice strain values obtained from equations (2), (3) and (4) are given in Table I. The domain size values after separation by graphical methods were 1250 Å and 1000 Å, while a value of 1130 Å was arrived at by the analytical method. Corresponding values for lattice strain were found to be $1 \cdot 50 \times 10^{-3}$, $1 \cdot 95 \times 10^{-3}$ and $2 \cdot 09 \times 10^{-3}$ respectively. The very large value (well above 1000 Å) for domain size indicates that broadening due to domain size effect is negligible or very small and isotropic lattice strain is the main contributor to the broadening besides deformation stacking faults ($\alpha = 0 \cdot 002$). This result is thus in general agreement with that reported much earlier by Brindley and Rindley.[1]

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RADIOCARBON DATES OF SAMPLES FROM SOUTHERN NEOLITHIC SITES

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In this paper we present radiocarbon dates of samples from Sangankallu, Hallur, Bainapalli and T. Narasipur. Samples from Utnur (Agrawal *et al.*, 1964) and Tekklakota (Agrawal *et al.*, 1965) were reported earlier. From these, a tentative chronology of the Southern Neolithic seems to emerge, though more samples are needed to confirm it. A brief discussion of the results is given below.

Two dates in years B.P. (before present) are given for each sample: the first one is based on carbon-14 half-life of 5568 years; the other —within brackets—is based on the half-life value of 5730 years. For changing them to A.D./B.C. scale, 1950 A.D. should be used as reference year. For intercomparisons dates based on the same half-life should be used.

Samples were manually cleaned to get rid of rootlets and other extraneous matter. Soil-carbonates in the sample were removed by 1% HCl treatment. Relatively harder charcoal samples alone were given NaOH treatment to remove humic acid. Gas proportional counters were used to count methane synthesised from the samples. For modern reference 95% activity of N.B.S. oxalic acid was taken as standard. Techniques employed have been described in detail earlier (Kusumgar *et al.*, 1963; Agrawal *et al.*, 1965).

General Discussion*

Although the age determinations made so far for the Neolithic of the South are not numerous, they already reveal cetain salient features of this culture (Agrawal, 1966). We have several dates for the period *ca.* 2100–1100 B.C. If we include the extreme dates of samples TF-573, 2905 ± 100, and BM-54, 4250 ± 155 (Barker and Mackey, 1960), the maximum time spread for this Neolithic Culture can be bracketed within *ca.* 2300–900 B.C. The three Hallur samples (TF-570, –573, –575) date the overlap phase with iron using megalithic people. This shows that for about 1,400 years the neolithic economy continued without any drastic change, although slow changes are perceptible. Whereas early neolithic at Piklihal (Allchin, 1960) and Utnur (Allchin, 1961) is completely free of any metal, copper artifacts are associated with the earliest neolithic phase at Tekklakota (Nagaraj Rao, 1965). The rusticated A_1 ware, which is an upper neolithic trait, occurs in Phase I at Tekklakota. A detailed comparative study of the wares of all the excavated sites would undoubtedly reveal the slow evolution even in neolithic pattern of life. In later sites more specialisation in society and trade should be discernible in the cultural assemblage.

If one plots the sites (with their C^{14} dates) latitudinally, there is a faint indication of a migratory pattern from north to south, as suspected by Sankalia also. This can be confirmed only by a larger number of measurements and more precise data about the cultural horizons of the samples.

Very interesting—though only three so far—are the dates for the end of the neolithic and the beginning of megalithic. Iron and Black-and-Red ware using megalithic folks are appearing in the South with the beginning of the first millennium B.C. Is it a migration to or from the Doab in view of very early megalithic there—in case the two are connected. The relation between the pre-P.G. Ware black-and-red ware and the pre-Iron Megaliths of Doab is worth pursuing.

* C^{14} dates based on $\tau_{1/2}$ = 5370 years have been used for discussion.

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