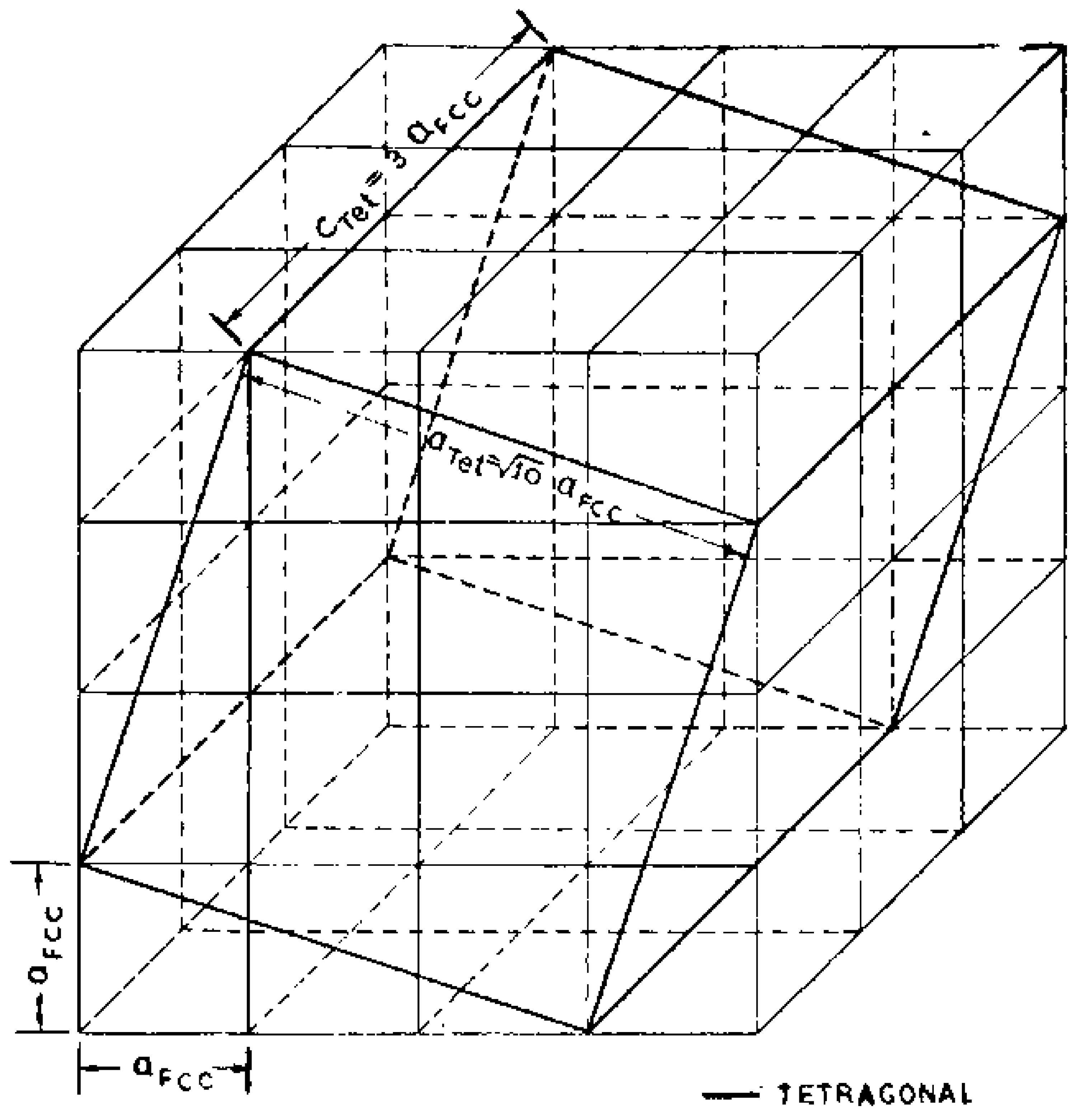

FIG. 1. Formation of the large tetragonal unit cell of the new Al-Ge phase with $a_{Tet} \simeq \sqrt{10}\, a_{FCC}$ and $c_{Tet} \simeq 3\, a_{FCC}$ from 30 unit cells of Al.

the tetragonal unit cell is formed by the stacking of three f.c.c. unit cells in all the three directions receives some support from the frequent occurrence of the number 3 or its multiples in indices (*hkl*) of the X-ray reflections from the new phase (Table I). Assuming 120 atoms per unit cell on the basis of the same close packing as in the f.c.c. structure the atomic volume works out to 17·03 Å^3 from the dimensions of the tetragonal cell. This value is almost identical with the extrapolated atomic volume (17·02 Å^3) for the Al-30 at.% Ge alloy[7] and further strengthens the suggested model for the unit cell of the new phase.

1. Anantharaman, T. R. and Ramachandra Rao, P., *Eastern Metals Review*, 1966, **19**, 141.
2. Pol Duwez, *ASM Trans. Qly.*, 1967, **60**, 607.
3. Predecki, P., Giessen, B. C. and Grant, N. J., *Trans. TMS-AIME*, 1965, **233**, 1438.
4. Pol Duwez and Willens, R. H., *Ibid.*, 1963, **227**, 362.
5. Anantharaman, T. R., Luo, H. L. and Klement, W. Jr., *Ibid.*, 1965, **233**, 2014.
6. Luo, H. L., Klement, W. Jr. and Anantharaman, T. R., *Trans. Ind. Inst. Metals*, 1965, **18**, 214.
7. Rudman, P. S., *Trans. TMS-AIME*, 1965, **233**, 864.

SOME PRESSURE OSCILLATIONS OBSERVED IN INDIA AND THEIR PROBABLE ASSOCIATION WITH THE CHINESE NUCLEAR TEST 1965

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INTRODUCTION

WELL-MARKED oscillations extending for more than four hours were observed in the microbarograph records on 15th May, 1965 at Okha (22° 29′ N. 69° 07′ E.) in Gujarat State. Some stations north of latitude 18° N. showed abrupt changes in the barograph traces as late as on 20th May, 1965. These suggested the possibility of propagation of pressure waves in the Indian latitudes as a result of the Chinese nuclear test during this period and led to detailed examination of the records of many stations in the neighbourhood. Figure 1 shows the stations whose barograph records were examined and which recorded significant impulses.

'ROUND-THE-WORLD' WAVES

Authentic reports about the exact time of explosion are not available. According to a special report[1] by Edward Neilan, the second blast was detonated at Lop Nor on 13th May, 1965, the actual time of explosion being not mentioned. Pressure waves can exist for long period without absorption and therefore it is not unlikely that the above pressure fluctuations recorded in India resulted from this explosion.

After the Russian nuclear tests at Novaya Zemlya in October, 1961, special observations at the Atomic Weapons Research Establishment, Essex,[2] with high sensitivity barographs showed clear signals of large amplitude 76 hours after the explosion. This was attributed to the waves being successively reflected at the antipodes with relatively little absorption or scattering. Similar studies at Sodankyla, Finland[3] after the same explosion showed microbarograph deflection 38 hours later and these were interpreted as due to "round-the-world waves" both in the forward and backward direction with mean velocity of 311 metres/sec. It was therefore considered worthwhile to examine the traces in the present case in order to see if the fluctuations were due to direct or 'round-the-world' waves after the Chinese explosion.

Barograph Oscillations

After eliminating the cases where the abrupt changes of trace can possibly be associated with weather phenomena or short marks, there were fifteen cases when the barographs recorded impulses which might have been caused by pressure waves (Figs. 2 and 3). These impulses were mostly well-marked oscillations, but in some cases they were kinks in the trace accompanied by significant pressure rise or fall. Similar faint traces have been observed in the pressure records after the test explosion over Japan. It was possible in ten of these cases, to explain the impulses as due to the arrival of the direct or "round-the-world" pressure waves. Details of these are given in Table I, together with the copies of the traces in Fig. 2. The velocity of propagation of the waves was calculated on the assumption that the explosion took place on the early morning of the 14th May, 1965, and the direct wave affected Nagpur on 14th May at 0355 IST (Fig. 2). The velocity of the waves varied in each case, the maximum and minimum values being 328 and 303 m/s. respectively. These figures are in agreement with the similar computation of velocities for the direct wave recorded at a number of stations in India, *viz.*, 304–322 m/s. after the Russian test explosion.[4] Minimum velocities of the order of 285–307 m/s. have been reported[5] in the case of waves from Hydrogen Bomb explosion over Japan. On the basis of these data, the actual time of the Chinese explosion is derived as 2023 GMT of 13th (0153 IST/14th) which is in agreement with the special report of the explosion mentioned earlier. A few of the press reports suggest a time of explosion of 0200 GMT/14th (1000 hrs. Peking time). This, however, appears doubtful since attempts to explain the arrival of direct waves or round-the-world

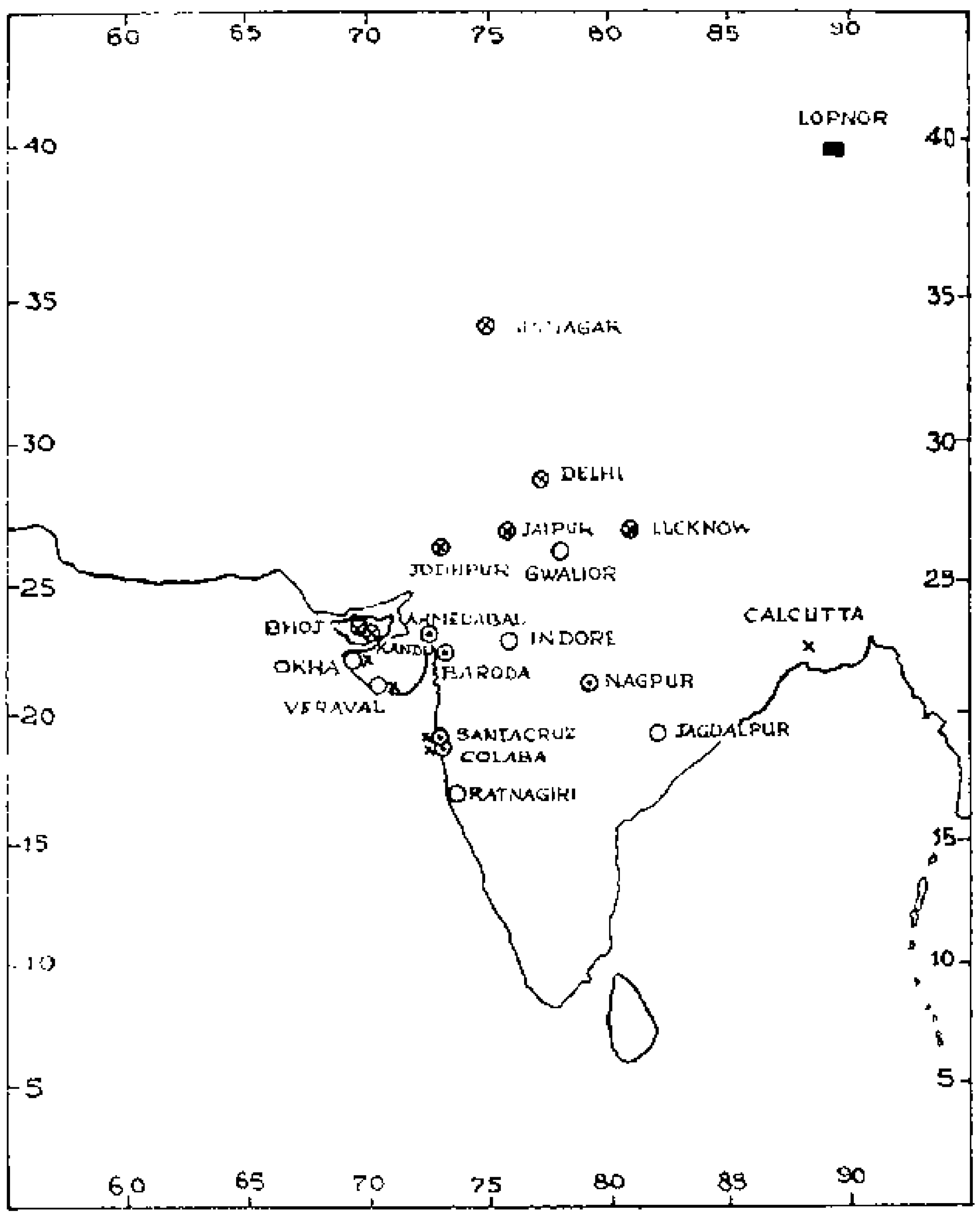

FIG. 1. ⊙ Barograms showed impulses due to direct or "Round-the-World Wave". ⊗ Barograms showed impulses which could be associated weather phenomena, short marks, etc. × Barograms whose impulses could not be interpreted. O Barograms examined but did not show any abnormal features.

Table I

Sl. No.	Station		Lat. °N.	Long. °E.	Distance from LOPNOR in km.	Date and time (in GMT) of arrival of wave	Velocity m/s.	Maximum amplitude mb. (approx.)	Type of wave*
1	Nagpur	..	2109	7907	2300	13 2225	318·9	0·7	Direct
2	Okha	..	2229	6907	2740	15 0445	320·2	1·3	1st round-the world in backward direction
3	Colaba	..	1854	7249	2770	16 1425	324·8	0·5	2nd round-the-world in backward direction
4	Santacruz	..	1906	7251	2750	16 1432	324·7	1·0	do.
5	Ahmedabad	..	2302	7235	2460	16 1753	329·6	0·7	2nd round-the-world forward wave
6	Veraval	..	2054	7022	2770	16 2145	313·4	0·8	do.
7	Baroda	..	2218	7315	2500	16 2355	302·8	0·5	do.
8	Ahmedabad	..	2302	7235	2460	19 1350	318·3	1·4	3rd round-the-world in forward direction
9	Baroda	..	2218	7315	2500	19 1711	320·6	0·8	4th round-the-world in backward direction
10	Veraval	..	2054	7022	2770	19 1930	315·8	0·5	do.

* Forward wave is assumed as the one travelling southwards from Lopnor to India whereas the wave moving in the opposite direction is taken as the backward wave.

waves made on the assumption that the explosion took place at 02 GMT/14th lead to abnormal velocities of the order of 350–400 m/s. in many cases.

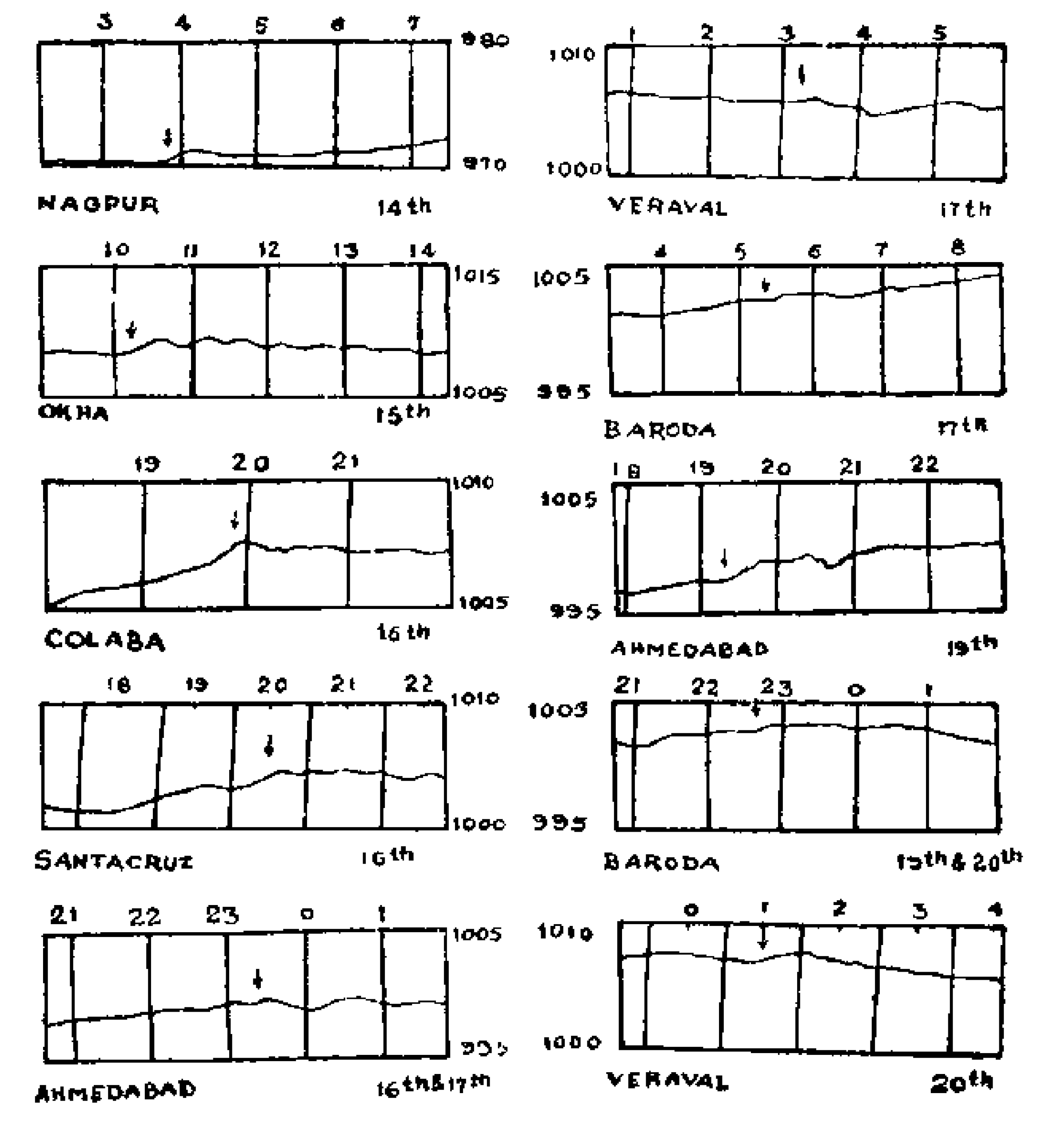

FIG. 2. Barograms showing impulses due to direct and round-the-world waves. Time of records in IST.

In the present examination, very high accuracy is not claimed on account of the fact that the clocks at different stations had not been exactly synchronised. The sensitivity of the instruments at different stations may not also be very high. To some extent, the non-registration of the impulses at some of the stations located nearer the site of explosion might have been due to the low sensitivity of the barographs there. While the impulses registered at the stations can be attributed to successive 'round-the-world' waves, these stations have not been affected by the direct waves except in the case of Nagpur. Further, the direct wave or 'round-the-world' waves could not explain a few remaining cases of impulses recorded on the barographs during this period (Fig. 3). It is likely that the large mountain barrier, *viz.*, the Himalayan ranges lying between the test site and these stations have damped the direct pressure waves in some unknown manner. Comparatively lesser orographic features off the coast of Japan have caused a decrease in the amplitude of the waves after the Hydrogen Bomb blasts.[5] It is necessary to obtain more precise data regarding the time, nature and intensity of explosion before any detailed analysis of the wave propagation caused by this explosion can be undertaken. Even so the limited information available and the internal consistency that apparently exists between the ten cases cited

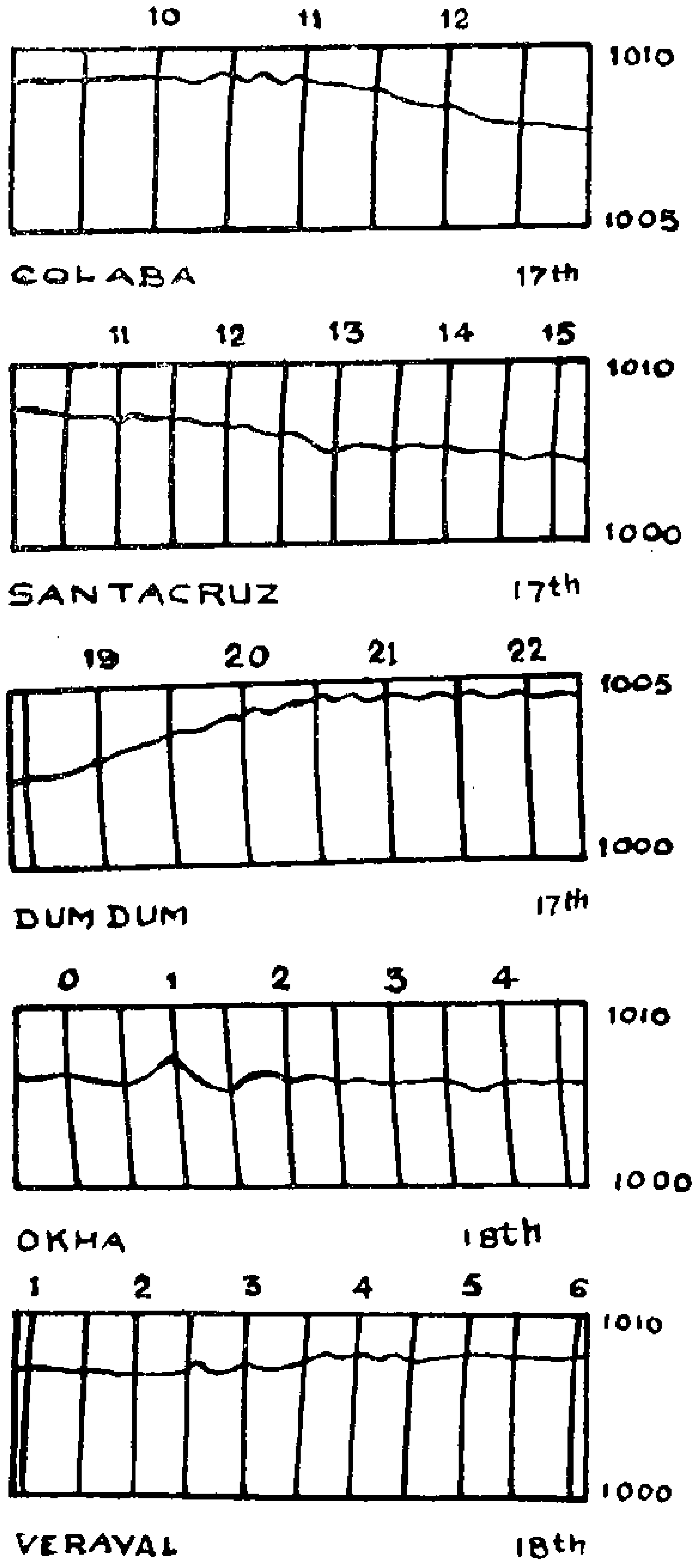

FIG. 3. Unexplained wave patterns.

strongly suggest that direct as well as 'round-the-world' pressure waves following the Chinese nuclear explosion are responsible for the observed impulses on the microbarograms over India.

ACKNOWLEDGEMENT

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1. Edward Neilan, *The Sunday Standard*, Bombay Edition, 4th July 1965.

2. Carpenter, E. W., Harwood, G. and Whiteside, T., *Nature*, 1961, **192** (4805). 857.
3. Rose, G., Oksman, J. and Kataja, E., *Nature*, 1961, No. 4808, p. 1173.
4. Rao, K. V. and Ananthakrishnan, R., *Ind. Jour. Met. Geoph.*, July 1962, **13**, 383.
5. Japan Society for the Promotion of Science, Tokyo, *Research in the Effect and Influences of the Nuclear Bomb Test Explosion*, 1955, **1**, 1 to 7 & 91 to 115. (i) "Effect of atomic explosion on the atmosphere and sea," by Yasuo Miyate. (ii) "The microbarograph oscillations produced by explosion of H_2 bomb," by R. Yamamoto. (iii) "Preliminary report on the atmospheric pressure oscillations due to H bomb explosion."

EFFICIENCY OF ENERGY CAPTURE BY THE GRASSLAND VEGETATION AT VARANASI

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WITH the growing interest in recent years on the evaluation of productivity in various natural and man-modified ecosystems, much emphasis has been laid on the efficiency with which the energy is trapped, accumulated and dissipated at different trophic levels. The first step in the process of energy flow within an ecosystem is the capture of solar energy by green plants. The productivity potential of different ecosystems depends much on the efficiency with which the vegetation accumulates this energy in the net primary production. Although data on energy relations of a number of temperate ecosystems have been published,[1-6] so far no information is available regarding the terrestrial systems in India.

The present study was conducted with three types of grasslands situated within the campus of the Banaras Hindu University (25° 20′ N. latitude 83° 1′ E. longitude). These grasslands are graded according to the intensity of herbage removal as least disturbed, moderately disturbed and over disturbed.[7] Net aboveground community production was evaluated through monthly harvests and by summing up the positive differences in the plant biomass in different periods.[7] Underground plant biomass was evaluated through monoliths and net production was computed by the difference method.[8] Energy content of the aboveground and underground plant material was estimated with the help of a Bomb calorimeter during June 1968.[9] The calorific values were calculated on the basis of ash-free dry weight in order to avoid the variation between organic samples of various types and the error due to pollution with dense, non-combustible materials as argued by Ovington and Lawrence.[5]

The energy content varies from 4018·8 to 4356·6 gram cal./g. ash-free dry weight in the aboveground parts of the herbage and from 4528·1 to 4770·4 g.cal./g. in the underground parts. The average values based on six samples of aboveground herbage and three samples of underground plant material come to 4150·23 g.cal./g. and 4648·06 g.cal./g. respectively. Ovington and Lawrence[5] have reported the following calorific values for maize field, prairie, savanna, and oakwood ecosystems in Minnesota: 4525, 4827, 4817 and 4865 g.cal./g. respectively. Thus, the energy content in the herbage of our grasslands seems to be a little lower than that of temperate vegetation. In alpine plants, Hadley and Bliss[10] have reported higher calorific values for shoots (4557–5648 g.cal./g.) as compared to underground parts (4405–4996 g.cal./g.). In our grasslands the situation is reverse.

On the basis of the calorific values and the net dry matter production, the net primary community production in different grasslands has been computed in terms of energy and the values for the same are set in Table I. From Table I it is apparent that most of the net annual energy accumulation is accrued during the period 23rd June to 30th September, which, therefore, constitutes the grand period of growth. The new underground growth during post-monsoon period could not be measured because it is very meagre as compared to the decomposition and disappearance of the carry over from the monsoon period. Evidently, therefore, more thorough sampling gadgets and procedure have to be used in future studies.

The amounts of energy in the primary net production when expressed as percentages of half of the total solar radiation received during the period represent the efficiency of energy capture. Here only half of the incident radiation is considered because approximately 50% of the total radiation (that in the ultra-violet and infra-red portions of the spectrum) is not usable by plants in photosynthesis.[11,12] No data on incident solar radiation are available at Varanasi, but at Allahabad, which is situated very near to this area on almost the