Letters to the Editor

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MICROBAROGRAMS AND SEISMOGRAMS OF SUPERSONIC BANGS—3 APRIL 1960

The air-display staged at Bombay by the Indian Air Force on 3 April 1960, started and ended with two Hunter Jet-fighters breaking the sound barrier and thereby producing the typical "supersonic bangs". The track of the fighters when they produced the "bang" at the commencement of the display was almost directly over the Colaba Observatory, while the track at the end of the display was not so. The "supersonic bang" at the commencement caused large pressure fluctuations in the microbarogram and explosion-like effects in the seismograms of Colaba. These effects are described in the following paragraphs. The effects are also compared with those produced by the Dockyard explosions in the Bombay harbour on 14 April 1944, caused by fire in the ammunition ship, S. S. *Fort Stikine*.

2. *Microbarograms*—Fig. 1 is a reproduction of the relevant part of the barogram for 3 April 1960. At about 0842 IST, the pressure suddenly increased by 2·5 mb and almost instantaneously decreased by the same amount. Fig. 2 is a reproduction of the relevant part of the barogram for 14 April 1944, the day of the two explosions in the Bombay harbour. The increase in pressure due to the first explosion was 3·1 mb (0·09 inch), which was instantaneously followed by an even greater decrease of pressure of 6·8 mb (0·20 inch). For the second explosion, the increase in pressure was 3·1 mb (0·09 inch) followed instantaneously by a decrease of 4·8 mb (0·14 inch). In the case of the "supersonic bang", the increase and the decrease of pressure appear to be sensibly equal. The "supersonic bang" did not produce any noticeable effect on the barograms at Santacruz—nearly 20 km (13 miles) away from the arena of the display.

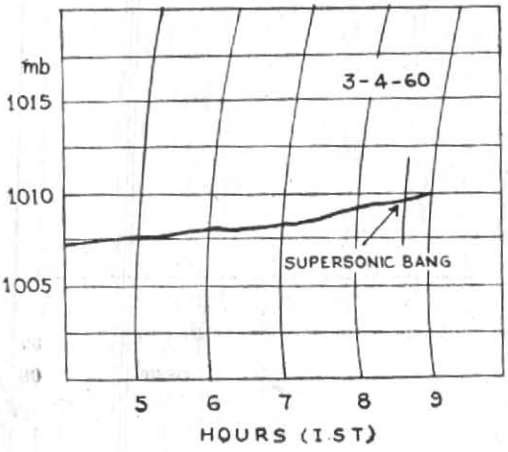

FIG. 1

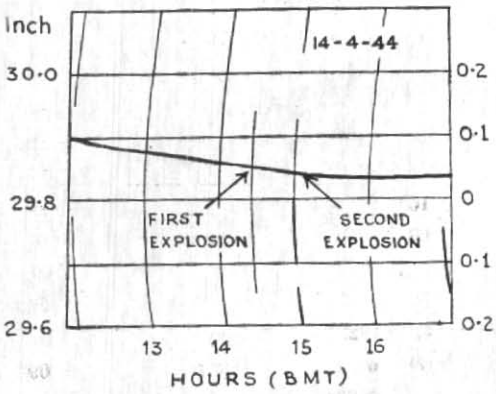

FIG 2

Fig. 1. Colaba microbarogram of 3 April 1960 showing the effects of "Supersonic bang"

Fig. 2. Colaba microbarogram of 14 April 1944 showing the effects of the two explosions in the Bombay Docks

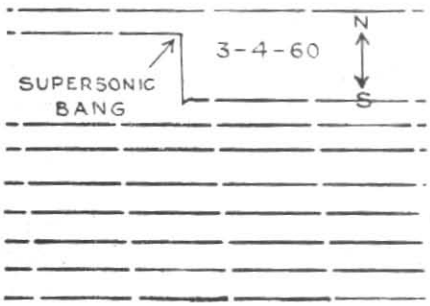

FIG. 3

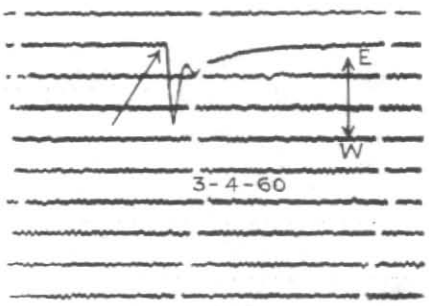

FIG. 3(a)

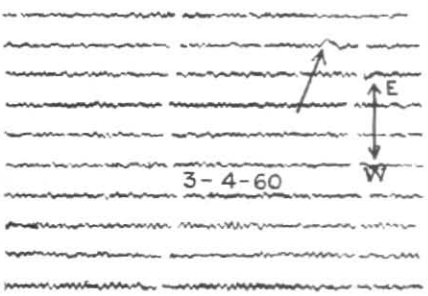

FIG. 3 (b)

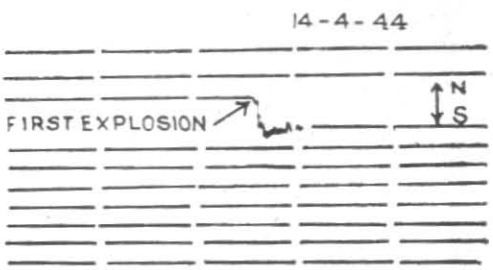

FIG. 4

Fig. 3. Colaba Milne-Shaw (N—S) seismogram of 3 April 1960 showing the effect of the "Supersonic bang"

Fig. 3(a). Colaba Sprengnether seismogram (E—W, over ground), showing the effect of the "Supersonic bang" and Fig. 3(b) when the instrument installed in the underground on 3 April 1960

Fig. 4. Colaba Milne-Shaw (N—S) seismogram of 14 April 1944 showing the effect of the first explosion in the Bombay Docks

TABLE 1

Seismograph	Component	Period for which constants apply	Pendulum free period (sec) T'	Static magnification V	Damping ratio ε	Paper speed (mm/min)
Milne-Shaw	N-S	April 1960	12	350	40:1	16
Sprengnether(2)	E-W	Do.	7	5000	2·2:1	30
Milne-Shaw	N-S	April 1944	12	250	28:1	16

3. *Seismograms*—The Milne-Shaw (N-S) Seismograph suffered a sudden jerk and the light speck got displaced suggesting ground movement towards the south at the first "supersonic bang". No such displacement was recorded by any of the E-W Component Seismographs (a Milne-Shaw and two Sprengnether instruments). However, these three E-W Seismographs did record effect similar to those usually recorded for local explosions. Fig. 3 is a reproduction of the relevant portion of the N-S Milne-Shaw record. All the seismograms have recorded the effect at $08^h\ 41^m\ 42^s$ IST on 3 April 1960. Relevant portions of the Sprengnether E-W records are reproduced in Figs. 3(a) and 3(b). The E-W Milne-Shaw Seismograph at Colaba is generally more prone to undergo a slight displacement at the commencement of an earthquake shock than the N-S instrument; in spite of this feature, that instrument (E-W) did not undergo any such displacement at the time of the "supersonic bang". Apparently, the flight of the aircraft along a nearly S-N direction had something to do with it. Fig. 4 shows the effect of the first Bombay Dock explosion of 14 April 1944, on the N-S Milne-Shaw seismogram at $16^h\ 06^m\ 31^s$ IST (war time).

Table 1 gives the constants of the seismographs.

4. The aircraft was not moving directly over Colaba Observatory when they gave the "supersonic bang" marking the end of the display. The microbarograph recorded only a very small kink in the pressure trace. The seismographs also recorded the effect at 0952 IST (Figs. 3 and 4), only to a relatively small extent.

During the rehearsals of the display, a "supersonic bang" was created on 1 April 1960, by breaking the sound barrier; this was distinctly heard at Colaba. The effects produced by this "bang" on the instrument of the Colaba Observatory were just perceptible and simultaneous among themselves; however, they were very feeble and would have been missed but for the observations of the prominent effect produced by the "bang" on 3 April 1960.

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