effects are observed corresponding to the magic proton numbers. Clearly the Q-value and the asymmetry parameter affect the (*n*, 2*n*) cross sections.

The strong dependence of the (*n*, 2*n*) cross sections on the asymmetry parameter and the Q-value aroused the need to formulate the following empirical relation for the total cross section value at 14–15 MeV :

$$\sigma_{(n,2n)} = \pi R^{2_0} (A^{1/3} + \lambda\!\!\!^-)^2 \; [\exp Q \{ 0 \cdot 25 \xi - 0 \cdot 36 \xi^2 - \gamma \}] \quad (1)$$

For 14–15 MeV neutrons $\lambda\!\!\!^- = 1$ and with $R_0 = 1 \cdot 2f$, the geometrical cross section $\pi R_0{}^2(A^{1/3} + \lambda\!\!\!^-{}^2)$ becomes $45 \cdot 2\ (A^{1/3} + 1)^2$ and so relation (1) can be re-written as :

$$\sigma_{(n,2n)} = 45 \cdot 2 (A^{1/3} + 1)^2 \; [\exp Q \{ 0 \cdot 25 \xi - 0 \cdot 36 \xi^2 - \gamma \}] \quad (2)$$

where Q = Q-value of the (*n*, 2*n*) reaction

ξ = Asymmetry parameter

and γ is a constant which is different for different ranges of the asymmetry parameter as listed below :

$\gamma = 0 \cdot 36$ for $0 \leqslant \xi < 0 \cdot 040$

$\gamma = 0 \cdot 24$ for $0 \cdot 040 \leqslant \xi < 0 \cdot 063$

$\gamma = 0 \cdot 10$ for $0 \cdot 063 \leqslant \xi < 0 \cdot 087$

and

$\gamma = 0 \cdot 033$ for $\xi \geqslant 0 \cdot 087$

This empirical relation predicts the total (*n*, 2*n*) cross sections within 10% for all nuclei with a very few exceptions in the case of low ξ-values.

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SHORT PERIOD WAVES IN THE F2-REGION DURING MAGNETICALLY DISTURBED PERIOD

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THE acoustic waves in the F-region occur either due to natural sources[1-3] or due to artificial reasons[4,5]. The aim of this report is to present an evidence for the presence of short period waves around '1' minute in the F2-region of the ionosphere over Waltair. These waves are found to occur on magnetically disturbed days. This is the first time that such an observation is made.

The investigations are carried out by taking phase path measurements of F2-region echoes at vertical incidence on 5·6 MHz pulsed signal at Waltair (Geographic 17° 43′ N, 83° 18′ E, Geomag. 7° 24′ N). The experimental details and the method of analysis of the data are similar to those adopted by Reddy and Rao[6,7]. The positive slope of the fringes in the records illustrated in Fig. 1 indicates an increase in phase path and *vice versa*. The fringe pattern in the bottom part of the record corresponds to '*x*' magnetoionic component and the upper part relates to that of '*o*' as indicated. The local times are indicated.

The samples of phase path records shown in Fig. 1 from (*a*) to (*g*) are reproduced from the record of F2-region echo, obtained on 19–4–1974. Originally this record commenced at 1440 hrs. and the echo had both '*o*' and '*x*' components slightly resolved at a virtual height of about 315 km. Phase path variations between 1440–1520 hrs. are smooth and continuous with a few quasi-periodic oscillations of larger periods (due to regularly observed TIDs) superposed on a linearly increasing phase path. However during this interval, the sequence of short period oscillations is also indicated by just perturbing the smooth variattions as shown in sample (*a*). Around 1518 hrs. phase path variations (record not shown) have indicated a perturbation first on '*x*' and later in '*o*' component. Again a second perturbation [indicated by the movement of fringes parallel to record length shown with an arrow marked '*p*' in Fig. 1 (*b*)] appeared only on '*x*' component at about 1522 hrs. and after that, phase path variations exhibited the oscillations in an unusual way with short period reversals. This is a new phenomenon, not noticed during earlier observations. Samples (*c*), (*d*), (*e*), (*f*) show continuous series of these oscillations. The sequence of these oscillations continued upto 1542 hrs. and finally disappeared with a pair of two reversals between 1543 hrs. and 1548 hrs. as shown in sample (*g*).

TABLE I

Details of the four events in which short period waves are observed on phase path records during magnetically disturbed days

Date of event	Time of occurrence in hours LT. (LT = UT + 5·5 hours)	Maximum value of 3 hourly magnetic indices occurred during or neighbouring interval of the event		Sum of magnetic indices of the day	
		K_p	K	K_p	K
22-3-1974	1355-1410	6	5	36+	30
18-4-1974	1330-1430	6	6	38+	31
19-4-1974	1520-1550	6	5	35+	30
21-4-1974	1400-1545	6	4	35−	27

K—Values obtained from the nearest Magnetic Observatory, Alibag (Geomagnetic 9·5° N).
K_p —Values published in the Solar Geophysical Data.

By observing the similarity of the corresponding reversals on '*o*' and '*x*' components in various samples of Fig. 1, it can be seen that they occur earlier on '*x*' component than '*o*' by a few seconds. Information from magnetic data (K_p values) indicated that 19-4-1974 was one of the five most magnetically disturbed days with a moderate activity all through the day and with a maximum K_p value at 6.

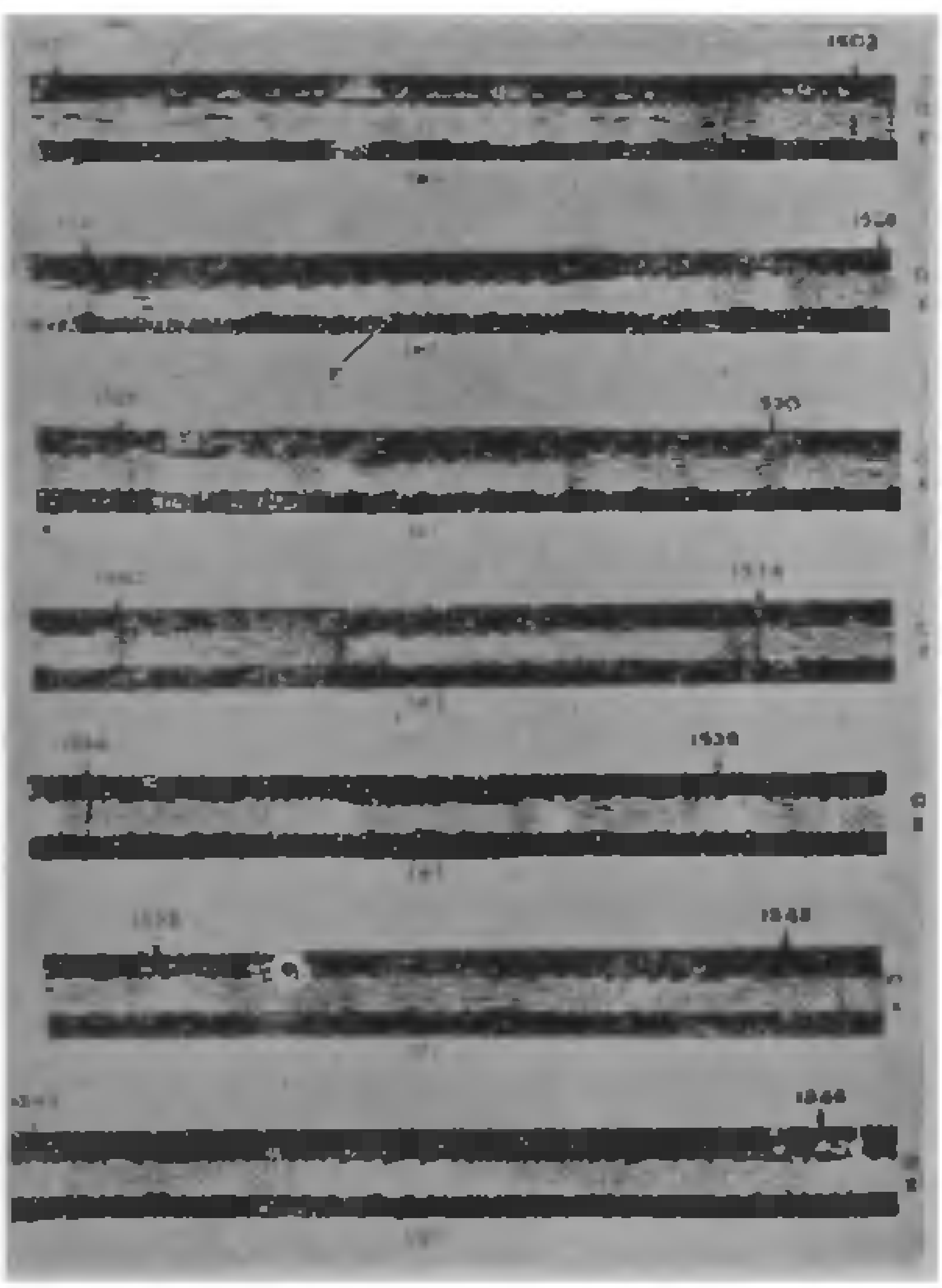

FIG. 1. Phase path variations of F2-region echo on 5·6 MHz taken on 19-4-1974 showing short period oscillations.

The events of these short period oscillations are seen in about four occasions. The details of these events and the maximum value of 3 hourly magnetic indices (which occurred either within the interval or neighbouring interval of the observed event) are presented in Table. I. From this table it can be inferred that the observed short period oscillations occurred consistently around 1400-1500 hrs. Their appearance is not noticed in the records obtained during the other part of the respective days given in Table I.

The time period between the midpoints of the corresponding reversals are measured and twice the value of this gives the period of the disturbance causing the oscillations at the reflecting height. The frequently observed periods are found to range between 50-80 seconds. This range of periods fall within the short period range of expected acoustic waves in the F-region (Fig. 9 of Georges[3]). For all of these events the occurrence of the disturbance is seen first on '*x*' component and later on '*o*'. These time delays range between 10-20 seconds and at certain parts of the record time, delays less than 10 seconds are also noticed. These low values of time delays suggest that the observed short period oscillations are caused by disturbances travelling faster than the normally observed TIDs[7] (Travelling Ionospheric Disturbances). This is a possibility in the case of acoustic waves. Hence it suggests that the observed short period oscillations are caused by the propagation of acoustic waves on these occasions.

From the available information there is no evidence to believe that the observed short period waves are caused by any source of the type mentioned by earlier workers such as tropospheric storms[2,3], earth quakes[1], nuclear detonations[4,5], etc. Hence it is felt that the only source associated with the observed oscillations are connected with the increased magnetic activity in view of the information indicated in Table I.

Existence of infrasonic waves at auroral latitudes at times of polar magnetic substorms is well understood[5]. Appearance of such waves at equatorial region is not noticed previously. From the observations discussed here one point to be stressed is that the occurrence of the events around local noon is in accordance with the occurrence of the geomagnetic activity effect on thermospheric density which is also maximum during local noon at the equatorial region at times of magnetic storms[9]. Possibility for the local generation of shorter period disturbances has been suggested by Hines[10] in explaining the greater speed disturbances at times of high magnetic activity. In view of this the present observations might be a representative one from a low latitude station like Waltair. However more number of similar observations from equatorial stations may lead to better understanding of these events.

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STUDIES ON THE CMC OF ANIONIC SURFACTANTS IN THE PRESENCE OF NONIONIC SURFACTANTS

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ABSTRACT

The effect of four non ionic surfactants, *viz.*, Tween 20 and 40, Nonidet P 40 and Nonex 501 on the CMC of three ionic surfactants, *viz.*, sulphonated phenyl stearic acid (SPSA), sulphonated tolyl stearic acid (STSA) and sulphonated xylyl s earic acid (SXSA) has been studied. Tha shift in the CMC of the ionic surfactants caused by the addition of nonionic surfactants has been interpreted on the basis of mixed micelle formation.

INTRODUCTION

SURFACE active agents are often mixed together to impart special properties (such as higher foaming power) to the resulting formulations, which find wide applications in industry[1]. The changes in the CMC of the resulting formulations give valuable information regarding their properties. A large amount of work has been carried out on the change of CMC of ionic surfactants as a function of the amounts of various additives. However, the effect of nonionic surfactants on the micellisation of anionic surfactants has received less attention. Studies have therefore been carried out on the effect of four nonionic surfactants, *viz.*, Tween 20 and 40, Nonidet P 40 and Nonex 501 on the CMC of three alkyl aryl sulphonates, *viz.*, sulphonated phenyl stearic acid (SPSA), sulphonated tolyl stearic acid (STSA) and sulphonated xylyl stearic acid (SXSA).

EXPERIMENTAL

The anionic surfactants, sulphonated phenyl-, tolyl-, and xylyl stearic acids were prepared by the method of Stirton *et al.*[2]. Nonionic surfactants, *viz*, Tween 20, Tween 40, Nonidet P 40 and Nonex 501 were BDH products. Surface tension *vs* concentration curves were plotted for each one of these surfactants as a criterion of purity. All the surfactants used showed sharp breaks in these plots which indicated their purity and homogeneity. The solutions of sulphonated aryl stearic acids (SPSA, STSA and SXSA) were prepared in double distilled water and their strengths determined by tit ating pH metrically against standard KOH. The nonionic surfactants were dissolved in double distilled water and the solutions allowed to stand overnight to attain equilibrium.

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