METRE AND DECAMETRE SOLAR RADIO BURSTS RECORDED DURING JULY 6-11, 1968

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THE period from July 6-11, 1968 has been very active with regard to solar radio emission in the metre and decametre wavelength region. We report here solar radio bursts and sudden cosmic noise absorption (SCNA) observed by a solar spectroscope (40–240 MHz) and a 21·3 MHz riometer at Ahmedabad. There were nearly 45 radio bursts of varying intensity and spectral types, out of which we report here some 27 bursts which have been recorded simultaneously on the solar spectroscope and the riometer.

Figures 1(*a*) and 1(*b*) show a complex radio event which occurred on July 6, 1968. (*a*) shows the SCNA on 21·3 MHz with two

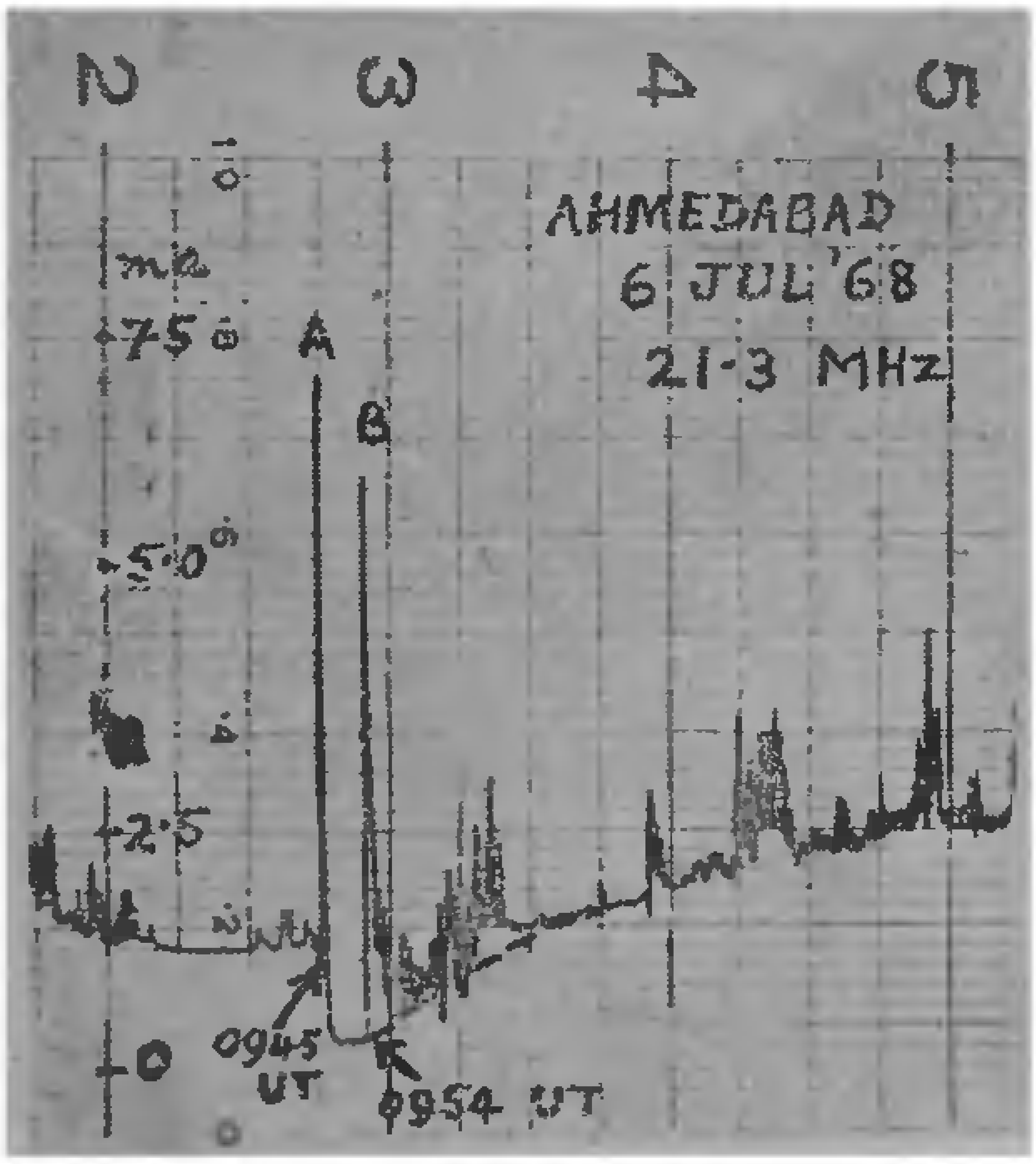

FIG. 1 (*a*). Cosmic radio noise record at 21·3 MHz showing SCNA and solar radio noise bursts on 6-7-1968.

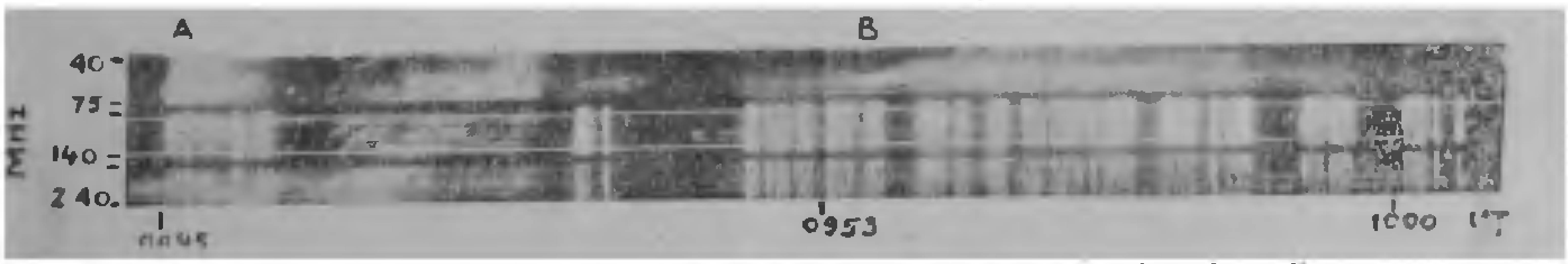

FIG. 1 (*b*). A dynamic spectrum of the radio burst obtained at the same time by solar radio spectroscope.

bursts denoted by A and B. (*b*) shows the dynamic spectrum of the radio burst. Burst A is seen to be fast drift type III followed within 2 minutes by a slow drift type II burst. Bursts B are continuum type IV which lasted for about 8 minutes. Figure 2 shows three ionograms at 09, 10 and 11 hr. UT on 6-7-1968. It can be seen that there is complete short wave fade-out at 10 hr. UT while at 09 and 11 hr. records appear normal.

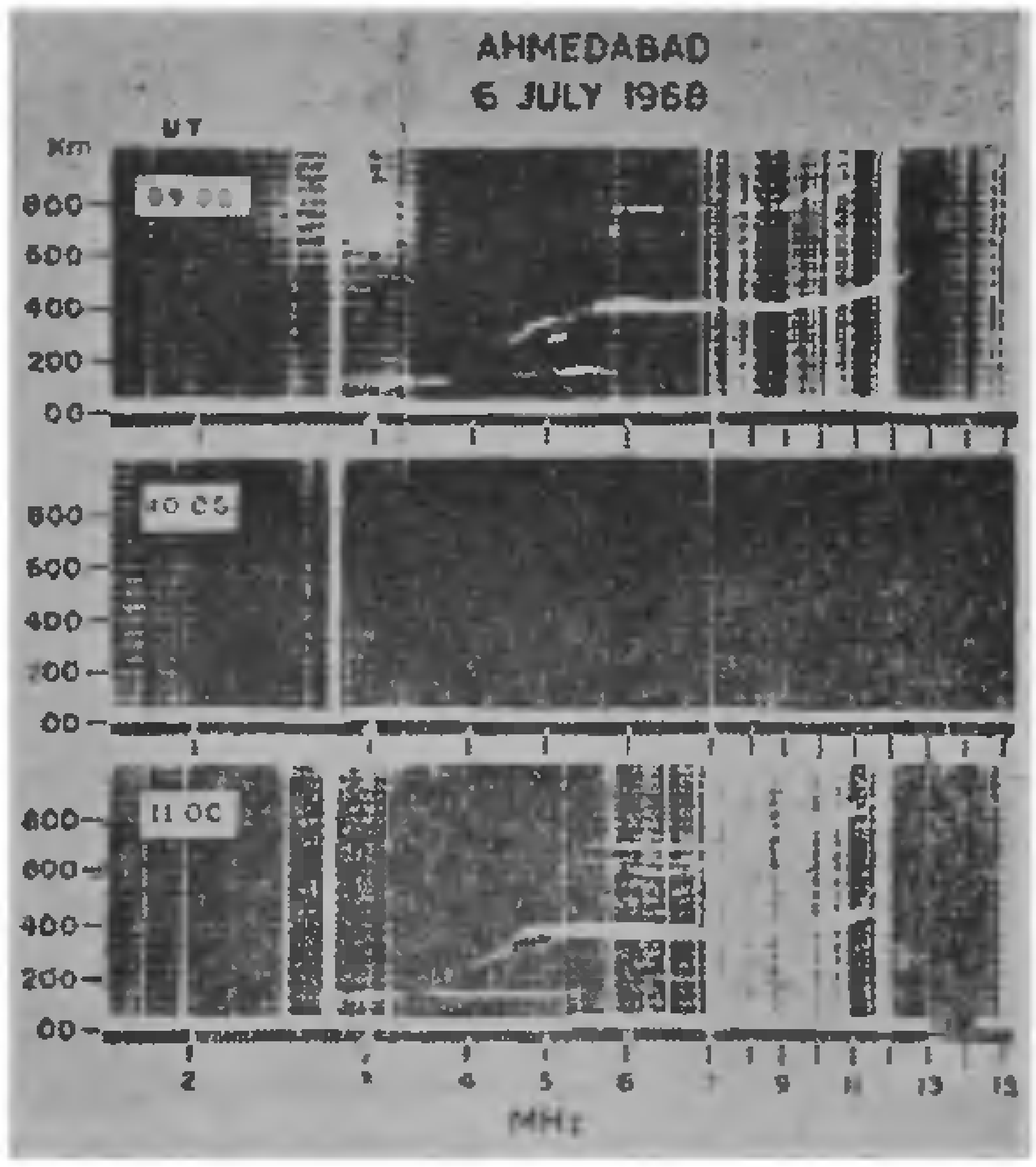

FIG. 2. Ionograms showing the short wave fade-out during the solar event and the normal records about one hour before and after the event.

We have shown in Fig. 3 one more example of a very strong radio burst which occurred on July 9, 1968. The starting frequency of the type III-type V burst is about 140 MHz. The burst has become much stronger and longer in duration at the lower frequency end. The 21·3 MHz riometer record shows at the same time a strong radio burst which has exceeded the chart range.

In Table I we have listed the 27 bursts giving solar radio flux intensities in watts

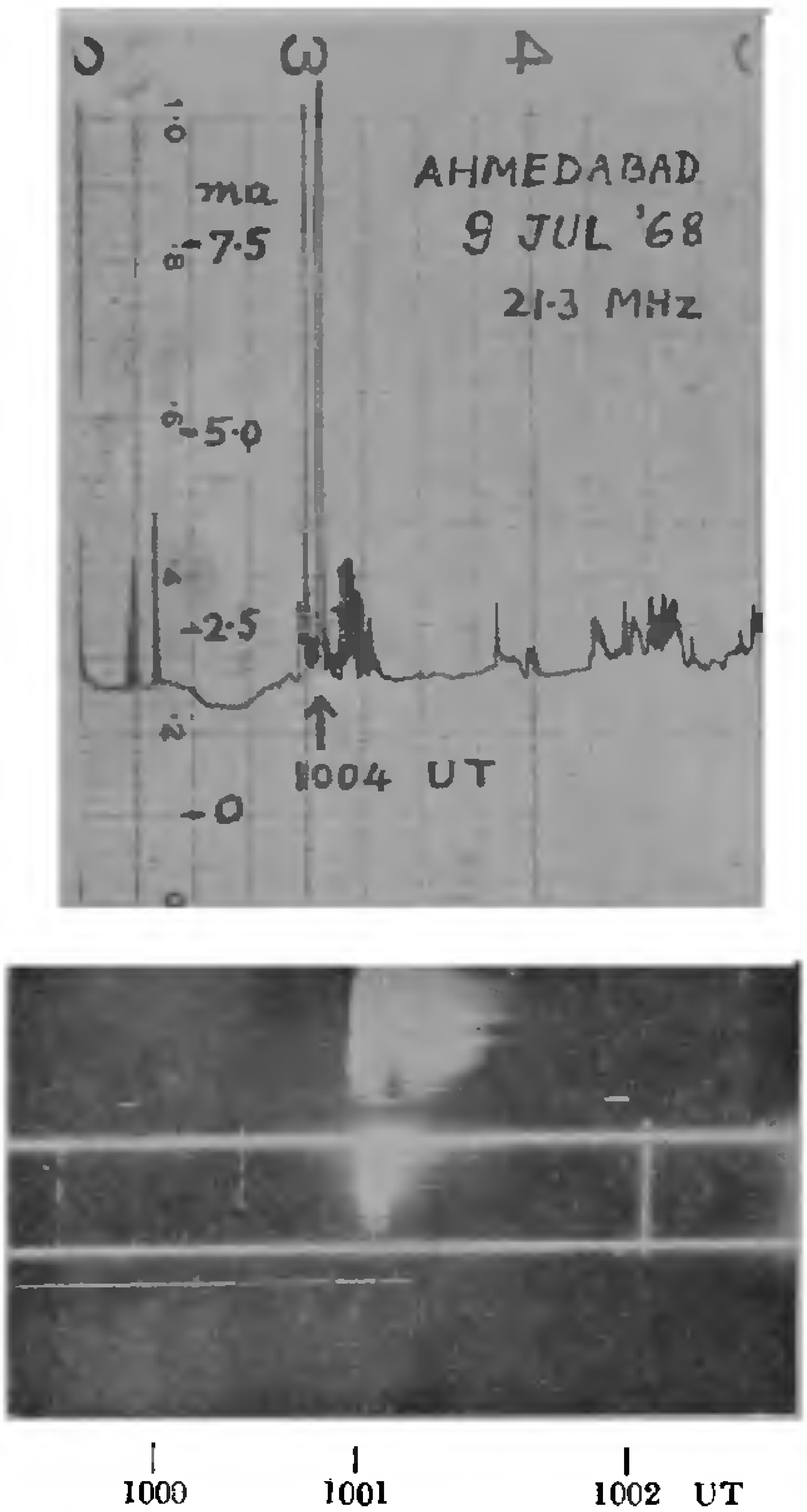

FIG. 3. Another example of a solar radio noise burst on the cosmic radio noise at 21·3 MHz on 9-7-1968 and corresponding type III-type V burst on solar radio spectroscope.

metre^2 (Hz)$^{-1}$ as calculated from the riometer data and the spectral types as observed on the solar radio spectroscope. In the last column, we have given the approximate starting frequencies of the bursts as obtained from the spectrograms. The burst intensities have been corrected for the solar zenith angle and the flux density of source is calculated by[1]

$$S = \frac{2kT_S \cdot \Omega_S}{\lambda^2}$$

where

k = the Boltzmann constant $= 1 \cdot 38 \times 10^{-23}$ joules/degree K. T_S = the apparent disk temperature of the sun. Ω_s = the mean solid angle in steradian subtended by the photosphere of the sun at the antenna. λ = the operating wavelength = 14·1 metres.

TABLE I

Date	Time UT	Equivalent Antenna Temp. °K. $\times 10^4$ at 21·3 MHz.	Power flux $w m^{-2}$ (Hz)$^{-1} \times 10^{-21}$ at 21·3 MHz	Type of burst	Starting frequency of burst MHz
6-7-1968	0945	5·5	2·6	III	240
	0953	4·4	2·1	IV	..
7-7-1968	0759	2·0	0·9	III	140
	0931	0·8	0·4	III	140
8-7-1968	0651-53	3·7	1·7	III	130
	0730	3·8	1·8	III-V	125
	0736	3·8	1·8	III-V	130
	0742	4·9	2·3	III-V	170
9-7-1968	0614	3·9	1·8	III	135
	0912	1·2	0·6	III	125
	1001	7·4	3·5	III-V	130
10-7-1968	0415	2·0	0·9	III	100
	0615	1·1	0·5	III	100
	0618	2·2	1·0	III	75
	0621-22	2·6	1·2	III	75
	0644	3·4	1·6	III	75
	0648	2·0	0·9	III	75
	0727	3·3	1·6	III-V	220
	0745	3·5	1·7	III-V	240
	0909	1·2	0·6	III	140
	0933	1·3	0·6	III	200
11-7-1968	0454-59	1·2	0·5	III group	75
	0508-09	0·7	0·3	III	75
	0548	0·3	1·3	III-V	130
	0553	0·2	0·9	III	130
	0903	0·1	0·7	III-V	140
	1134	3·6	1·7	III-V	130

Now the equivalent antenna temperature T_A is given by

$$T_A = \frac{\Omega_S}{\Omega_A} \cdot T_S$$

where

Ω_A = the antenna beamwidth = 0·3 steradian in our case of a broadside collinear array having 4 × 4 half-wave dipoles, $\Omega_S = 6 \cdot 8 \times 10^{-5}$ steradians, and T_A = 5800 IR, where I = the noise diode current in amperes, R = the load of the noise diode in ohms which is 1000 ohms in our riometer. The post detector integration time constant for increasing noise signal is of the order of one minute. Therefore the peak intensities of the radio bursts calculated here give the lower limit to the flux values.

It can be seen from Table I that the flux density of the solar bursts is of the order of 10^{-21} watts/m^2(Hz)$^{-1}$ which has varied within a factor between 0·5 and 3·5. As compared with the quiet sun flux at 21·0 MHz, this intensity is about 1000 times more powerful.[2] A detailed study of these events is in progress and will be reported elsewhere.

ACKNOWLEDGEMENT

Financial support for this work has come from Department of Atomic Energy, Government of India. Thanks are due to M/s. Bansidhar and N. S. Nirman for help in maintaining the equipments.

1. Kundu, M. R., *Solar Radio Astronomy*, Interscience Publishers, New York, 1965, p. 68.
2. Smerd, S. F., *Annals of the IGY*, 1964*a*, p. 34.

SYNTHESIS OF BENZOCHROMENES AND RELATED COMPOUNDS

Part I. 5 : 6 and 7 : 8 Benzochromanones and Benzocoumarins

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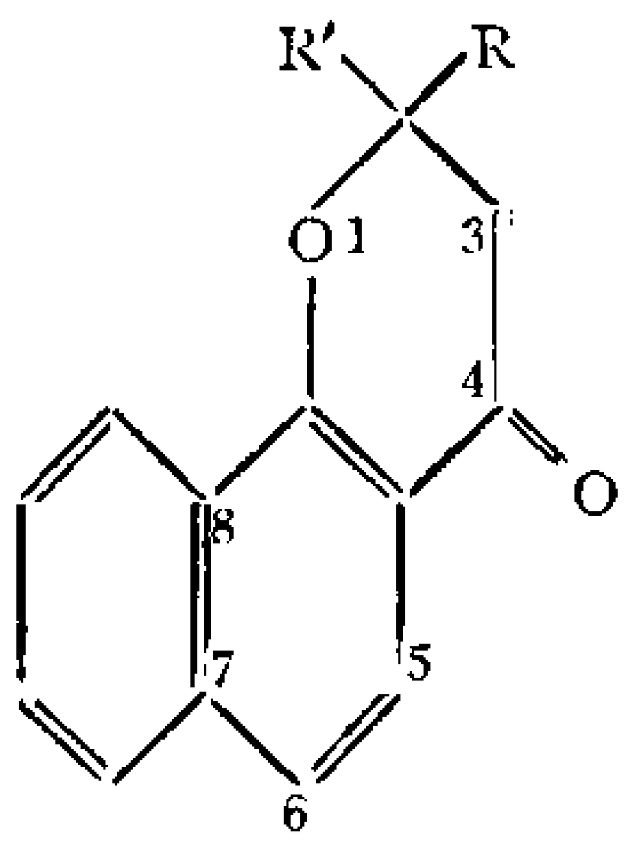
DURING our study of the naturally occurring fungicides belonging to the class of benzochromenes, methods of syntheses of 5 : 6 and 7 : 8 benzochromanones were critically examined. Among several methods,[1–8] the condensation of α- and β-naphthols with substituted crotonic acids offers a facile method. Such a condensation between polyhydric phenols and crotonic acids was already effected using $SbCl_3$, $ZnCl_2$ or $SnCl_2$,[3,4] P_2O_5,[5] polyphosphoric acid[6] or $AlCl_3$.[7] Alternatively, the phenolic esters of crotonic acids were subjected to Fries migration using $AlCl_3$[7] or HF[8] to yield the chromanones.

In the current investigation, α- and β-naphthols were condensed with β : β-dimethyl acrylic acid and crotonic acid in presence of $SbCl_3$, $ZnCl_2$ and polyphosphoric acid to secure 7 : 8 and 5 : 6 benzochromanones (I, II). The optimum conditions with $SbCl_3$ and $ZnCl_2$ were found to be heating at 140–50° for 1–2 hr., while with polyphosphoric acid, heating on a water-bath for 1 hr. would be sufficient. The latter reagent caused exclusive formation of benzochromanones (I, II) in good yields (upto 70%). But, $SbCl_3$ and $ZnCl_2$ furnished them only in low yields (12–30%). The results are summarised in Table I.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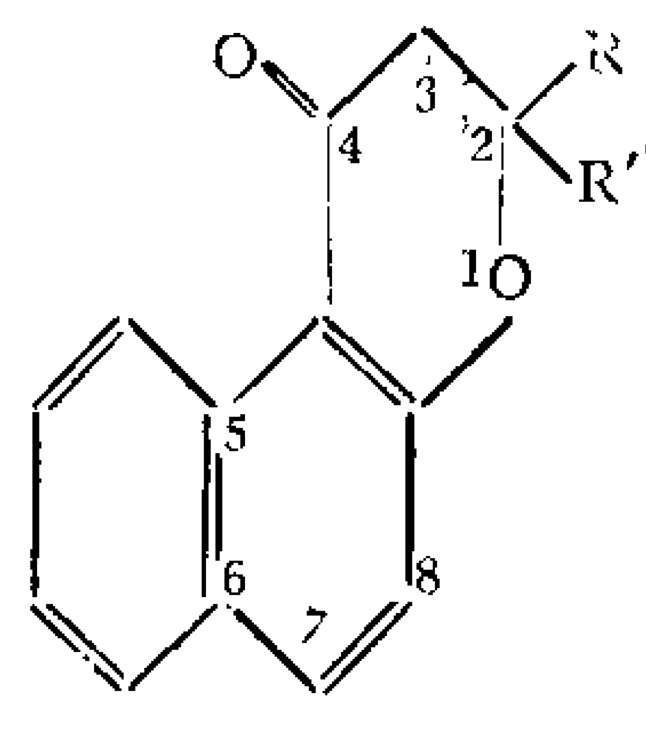
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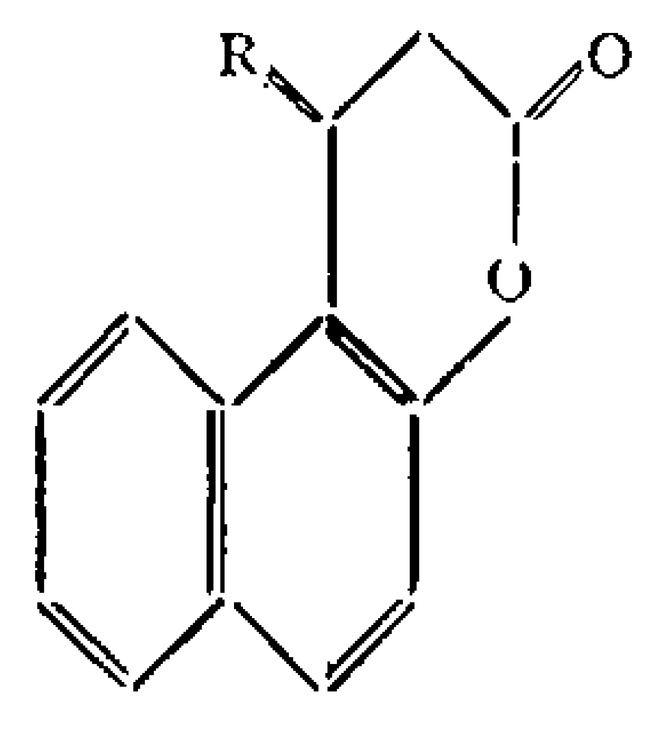
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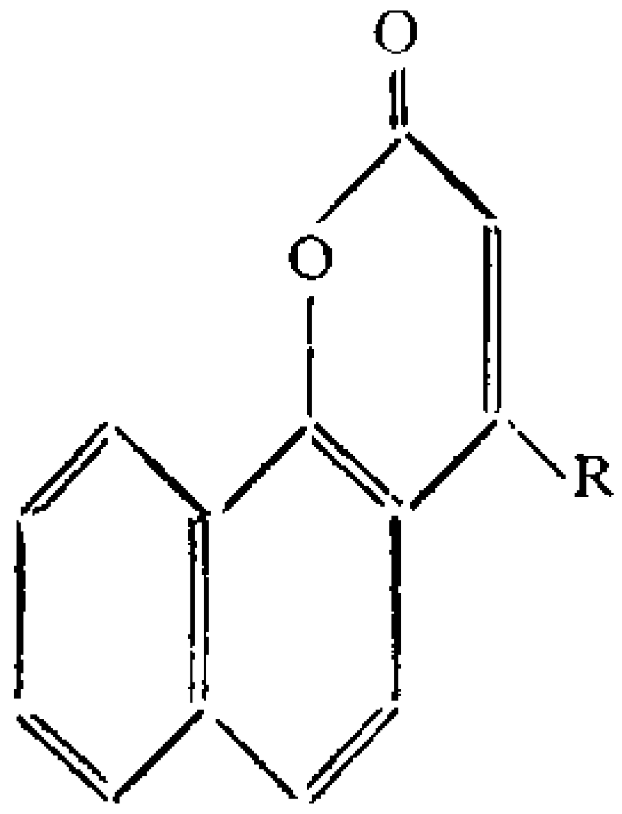
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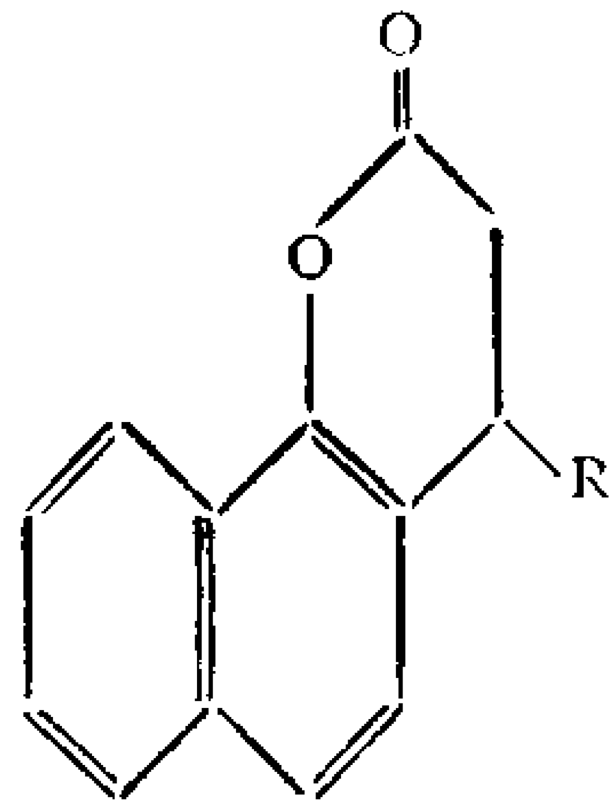
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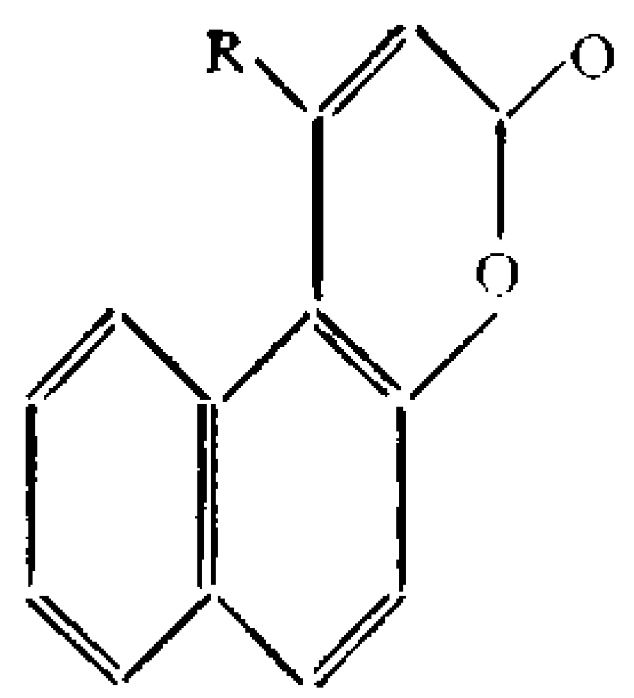
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