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TÍTULO: ON FOG FORMATION AT SÃO JOSÉ DOS CAMPOS

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ON FOG FORMATION AT SÃO JOSÉ DOS CAMPOS

by

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INTRODUCTION

São José dos Campos was blanketed by Fog or large extent on 20th July 1971, 27th July 1971 and 20th August 1971. Though the Fog formation is not uncommon, on these days the visibility was poor. The days are selected due to the fact that Radio Sonde Ascents taken at INPE are made available.

FOG

It is observed that stratus clouds are characteristic of the lower part of the atmosphere when a well developed temperature inversion or nearly isothermal layer exists there. If the air below is sufficiently moist, a stratus layer will form, its top at the base of inversion. For Fog formation the base of inversion must be at or close to the ground. Of course a Temperature inversion at or near to the ground suggests cooling from below and is therefore a characteristic of airmass that were originally warmer than the surface. The circumstances under which cooling of air at the surface in the presence of high moisture

content takes place give us the clue for Fog formation. Over tropical Oceans in Eastern parts in particular an inversion in Temperature namely Tradewind inversion is observed, situated usually at 3.0Km (Riehl 1954). But there is often a level above which the Relative Humidity drops to low values in spite of the Instability (thermal). This is shown by a sharp decrease in Relative Humidity above 800 mb. Considering the lapse rates we can treat the Tropical Atmosphere divided into a lower moist and an upper dry layer.

DATA

The surface weather chart of the day of Fog (20.07.71) is presented in Fig. 1. The values of Temperature and Relative Humidity are readfrom T-ϕ gram (Radio Sonde Ascent on 20.07.71, 27.07.71 and 20.08.71) and plotted in Fig. 2. To supplement the data the satellite picture of the day (20.07.71) is presented in Plate 1 (It must be noted that the picture is received after the Fog dissipated).

CLASSIFICATION

Willet (1928) made a classification of Fogs which Byers (1959) gave a modified form.

A - Air Mass Fogs	B - Frontal Fog
1 - Advection Fogs	1 - Pre-frontal Fog
2 - Radiation Fog	2 - Post-frontal
3 - Upslope Fog	3 - Front passage Fog

DISCUSSION

The Fog that was experienced at São José dos Campos can be classified as radiative fog with subtype being advection fog. This type of Fog is essentially a winter type phenomena like all radiation fogs occur only over land. It is formed due to long continued net loss of heat by radiation which is characteristic of continents. The inversion as applied to these fogs mean not only that the inversion extends through a deeper layer but also the type in which the vertical temperature curve may be isothermal or temperature may even slightly decrease with height, with an inversion at 100 - 600m above the ground. This land fog is probably due to the result of nightime radiational cooling of maritime air and nightime radiational cooling from the sharp upper level inversion of subtropical anticyclone, aids in the production of Fog.

FOG FORMATION BY RADIATIVE FLUX DIVERGENCE

An air parcel at temperature T in contact with the surface also having the same temperature exchanges radiation with the surface with no gain or loss of energy. It exchanges radiation with the atmosphere above with gain of energy because T is below the air temperature. Air parcel at a height, is warmer than the surface, exchanges radiation with the surface with net loss, and it exchanges with warmer atmosphere with net gain, so that there may be a height where the total net exchange vanishes. At a height when the air is much warmer than the surface, so loses energy by exchange with the surface while it gains slightly only by exchange with the atmosphere above. The conditions favourable for Fog formation by this process are high relative humidity and large

temperature gradient. And the heat losses per gram of moist air to the environment is given by the equation

$$\Delta H = C_p (T_2 - T_1) + L (m_2 - m_1) \text{ Joules/gram}$$

The second term on the right hand side of the equation represents the latent heat of condensation released during the fog formation.

C_p specific heat of dry air at constant pressure = 1.003 Joules $g^{-1}K_g^{-1}$.

T_1 and T_2 are temperatures in degree centigrade

M_1 and M_2 are specific humidities gm/kg.

L - latent heat of fusion = 334 Joules per gram

The values of ΔH are presented in Table 1.

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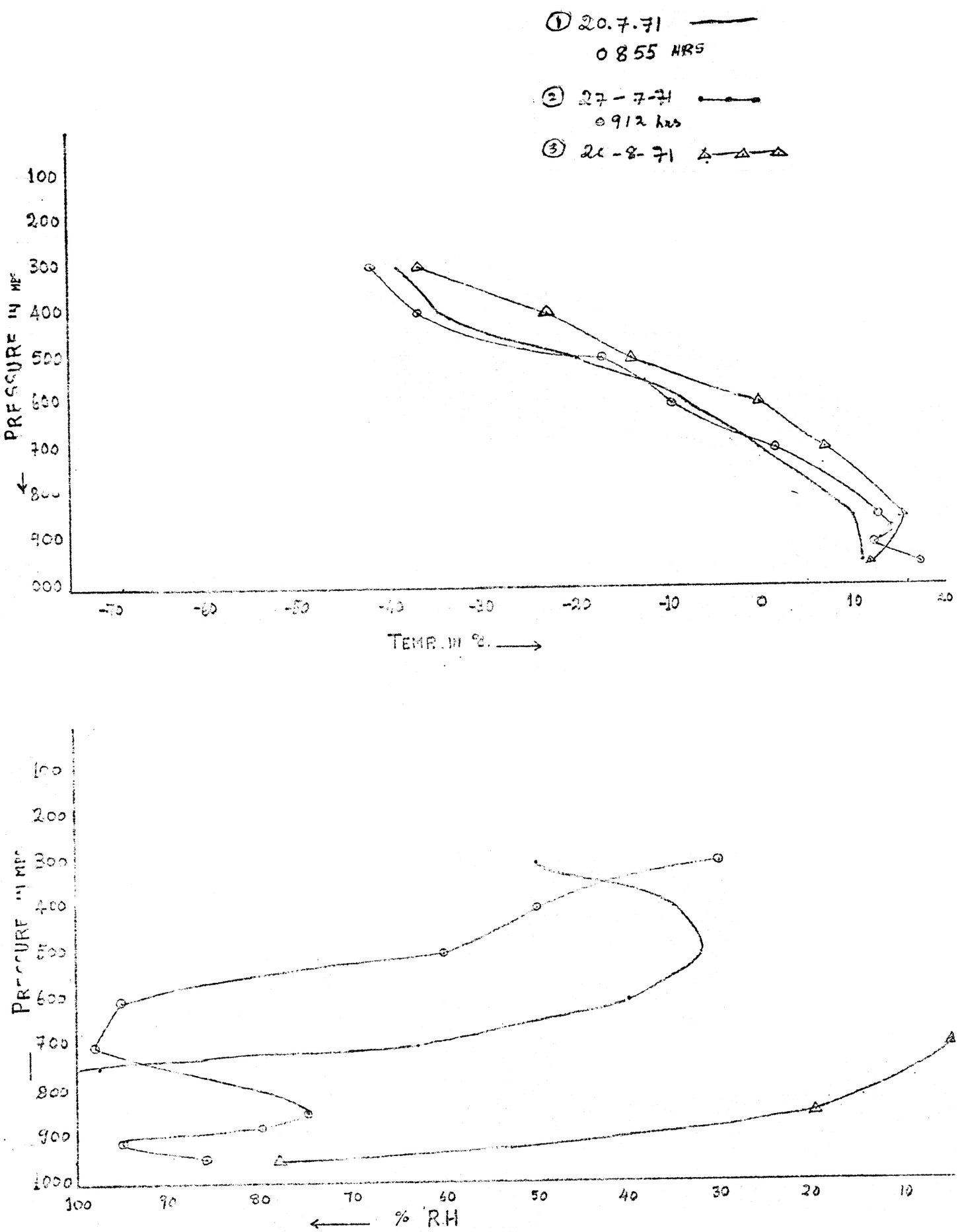
REFERENCES:

1. Byers H. R., 1959 General Meteorology, Mc Graw Hill P480
2. Kraus H., 1958 Berichte Deutschen Wetterdinestes nº 48
3. Reihl H. 1954 Tropical Meteorology, Mc Graw Hill, P_{43}
4. Willet H. 1928 Monthly Weather Rev. 56, P_{435}

TABLE 1

DATE	PRESSURE (mb)	TEMPERATURE ^{o}C	RELATIVE HUMIDITY %	DEW POINT	SPECIFIC HUMIDITY m	HEAT LOSS J/gm $\Delta H = C_p(T_2 - T_1) + L(m_2 - m_1)$
	1000	- 15.8	100	15.0	10.831 g kg^{-1}	
	949.7	- 10.8	100	11.0	8.746	134.4 Joules/gm
20.7.71	850	- 10.0	100	10.0	9.146	
	700	- 0.2	63	- 2.8	4.737	
	947.2	17.0	86	15.4	11.411	
	910	12.0	95	11.6	9.237	
27.7.71	880	14.0	80	12.0	9.879	202.4 J/gm
	850	12.6	75	9,8	9.146	
	700	1.8	97	2.0	6.352	
	951.3	11.8	78	10.2	8.174	
	850	15.1	20	4.9	6.470	337.4 J/gm
20.8.71	700	7.0	0/	- 4.4	4.071	

'The difference in values in the last columm is attributed to the different intensities of Fog which in turn depend on the lower atmospheric conditions.


① 20.7.71
0855 HRS
② 27-7-71
0912 hrs
③ 26-8-71
PRESSURE IN MB
100
200
300
400
500
600
700
800
900
000
-70
-60
-50
-40
-30
-20
-10
0
10
20
TEMP. IN °C.

PRESSURE IN MB
100
200
300
400
500
600
700
800
900
1000
100
90
80
70
60
50
40
30
20
10
% R.H

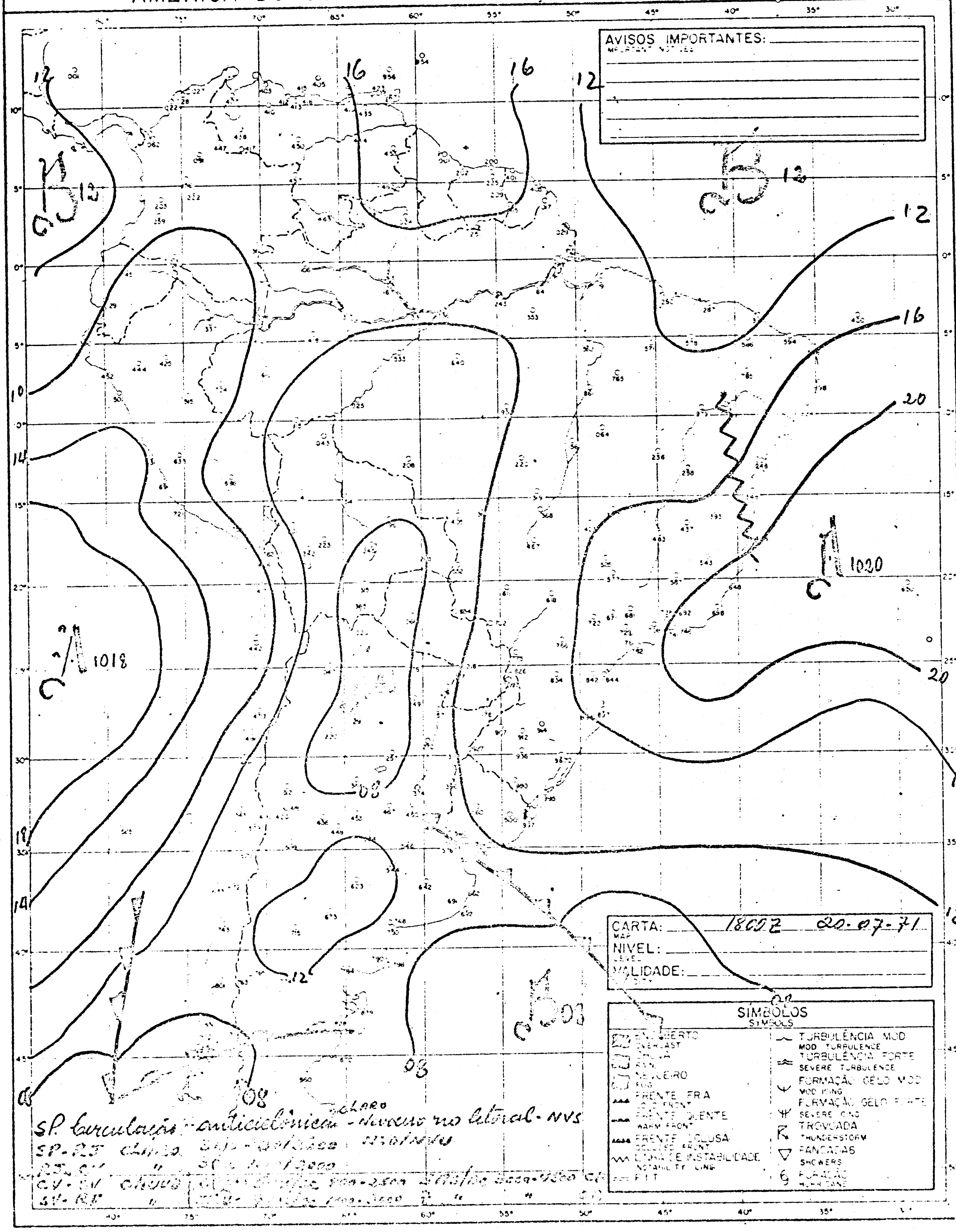
FIG. 2

BRASIL
PREVISÃO DE ÁREA PARA VÔO
FLIGHT AREA FORECAST
AMÉRICA DO SUL

PREPARADA PELO CENTRO METEOROLÓGICO DE: ____
ISSUED BY METEOROLOGICAL OFFICE AT

HORA: *1200 Z* TCG / TIME GMT DATA: *21-07-71* / DATE

PREVISOR: ____ / FORECASTER



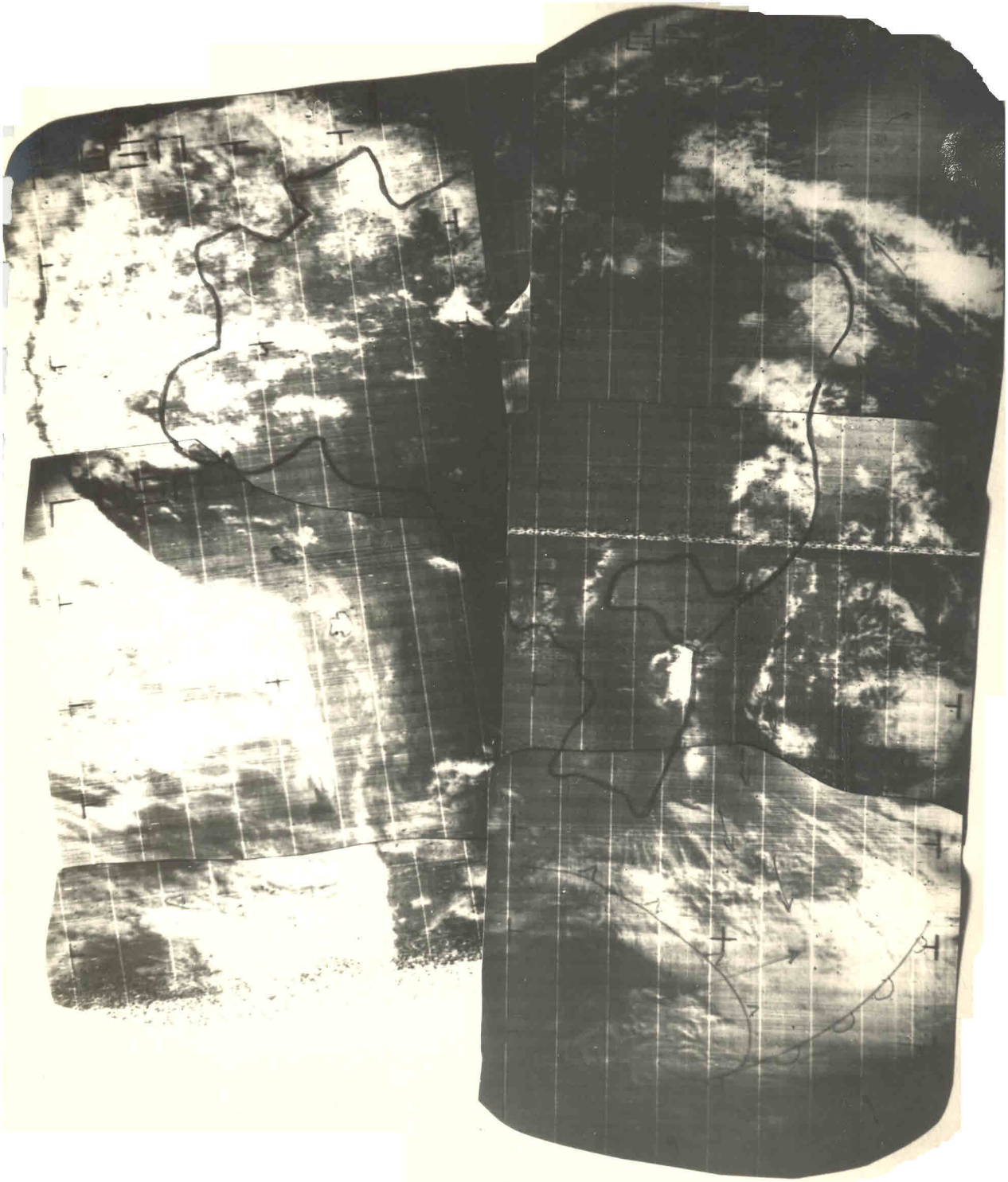


PLATE 1