OBSERVATION OF VLF NOISE SPECTRUM BY K-9M-19 ROCKET

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The natural radio noises in the ionosphere are very difficult to observe from the ground because of the shielding effects of the ionosphere. To examine the radio noise spectrum on VLF bands in the ionosphere, a sounding rocket, which was developed by the Sounding Rocket Group of Tokyo University, was used.

The observation of the radio noise spectrum on VLF bands in the ionosphere was carried out at 21.00 JST on August 10, 1966 using the sounding rocket Kappa 9M-19. The parameters of the rocket are shown in Table 1.

Table 1. Parameters of K-9M-19 Rocket

Diameter	(mm)	(lst stage)	420
Length	(m)	(total)	11.1
Weight	(kg)	(total)	1,500
No. of stages			2
Payload	(kg)		55
Altitude	(km)	(angle 80°)	350

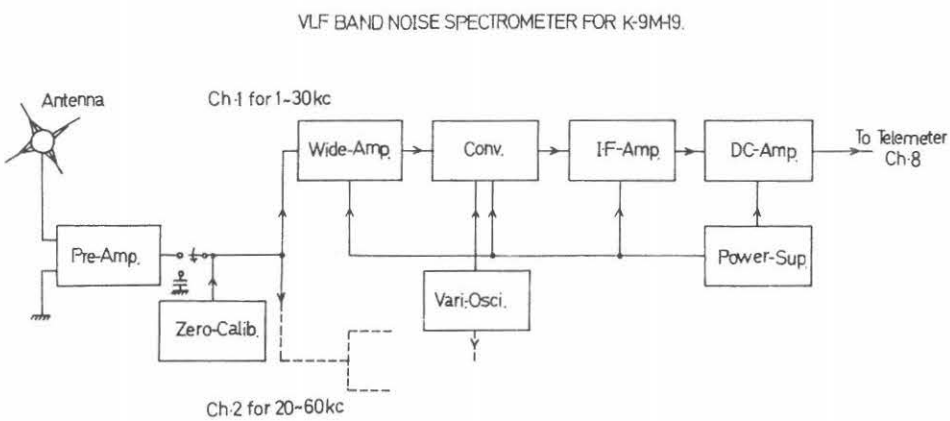

Fig. 1. The block diagram of the VLF noise spectrum receiver

To observe the amplitude-frequency spectrum, a swept-frequency method was used. The block diagram of the equipment is shown in Fig. 1, and its characteristics were as follows.

Frequency range	: 2—30 kc/s and 20—60 kc/s (2 channels)
Band-width	: 25 c/s
Total gain of receiver	: 100—110 db
Sweeping time	: 1 sec.
Antenna	: Umbrella ribs Type whip, 1 m long, 4 element

53 seconds after the firing, the nose cone was opened and the receiving whip antenna of 1 m long was extended on four sides. Then the measurement was carried out. The natural radio noise in the ionosphere was successfully observed throughout the flight. The results obtained from preliminary analysis are presented here.

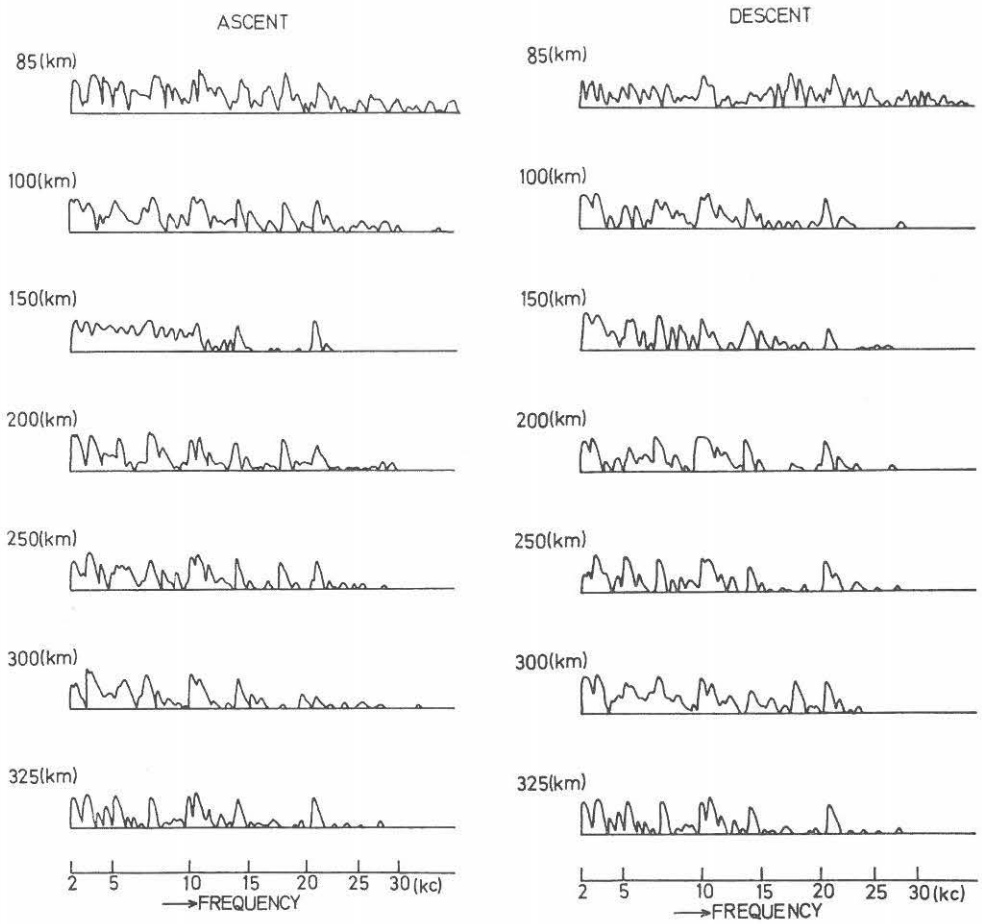

Fig. 2. An example of the amplitude-frequency spectrum of radio noises from 2 to 30 kc/s in the ionosphere

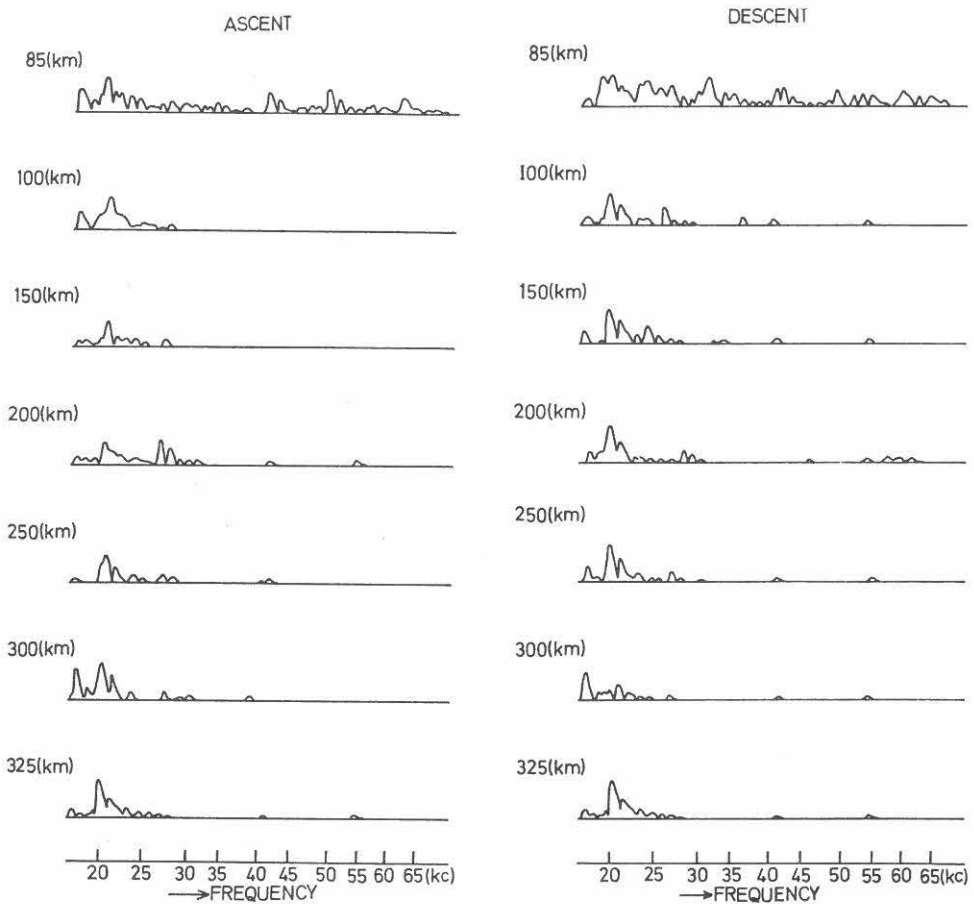

Fig. 3. An example of the amplitude-frequency spectrum of radio noises from 20 to 60 kc/s in the ionosphere

The amplitude-frequency spectrum of radio noises from 2 to 30 kc/s and from 20 to 60 kc/s at several altitudes are shown in Figs. 2 and 3, respectively. It can be seen that the radio noises over 20 kc/s which had been transmitted from the ground, suddenly decreased, due to absorption by the ionosphere when the rocket rushed into the lower side of the ionosphere. All the records show that in the ionosphere, the lower the frequency, the higer the level of radio noises.

An interesting result is that the discrete noises were observed in the ionosphere at frequencies of about 2, 3, 5, 7, 11, 14, 18, 21, 40 and 55 kc/s. The intensity variations at 4, 10 and 21 kc/s against the altitude are shown in Figs. 4, 5, and 6, respectively. It may be considered that most of these discrete noises were atmospherics and VLF signals from the ground, but some of these noises seem to be due to the unknown seem causes. It is a future problem to know what sort of noises they are.

At the altitude from 140 to 160 km, noises spreading over some frequency bandwidth were observed at the ascending phase. These are likely to be diffused whistlers.

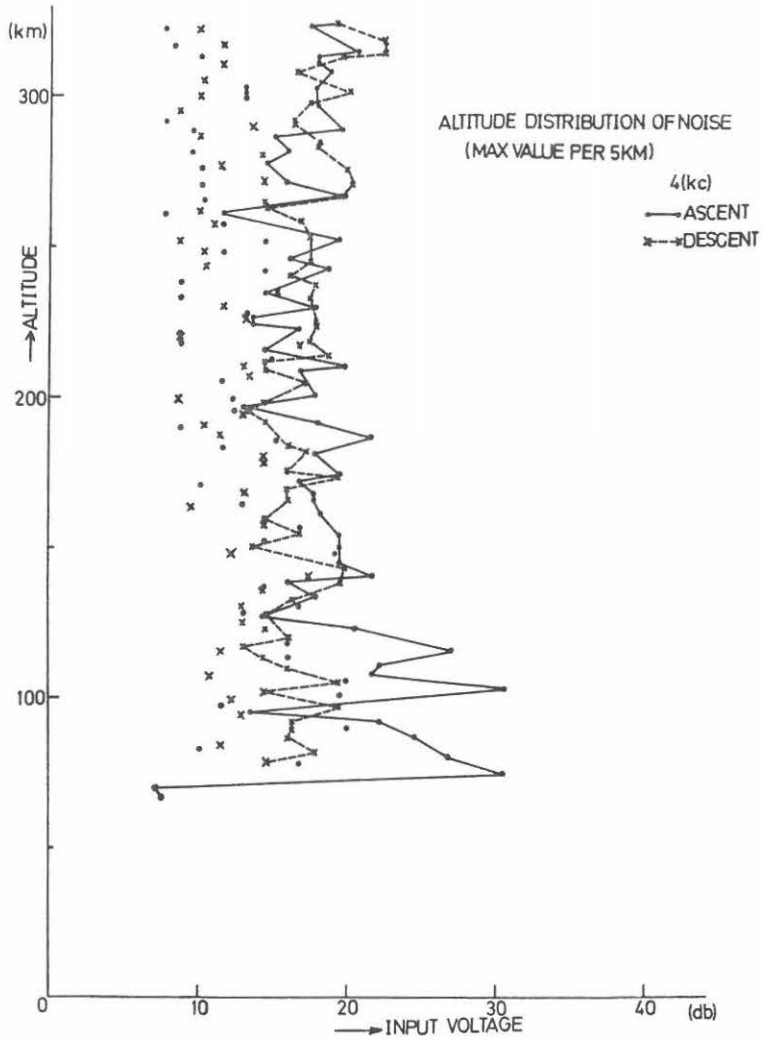

Fig. 4. The altitude distribution of radio noise on 4 kc/s

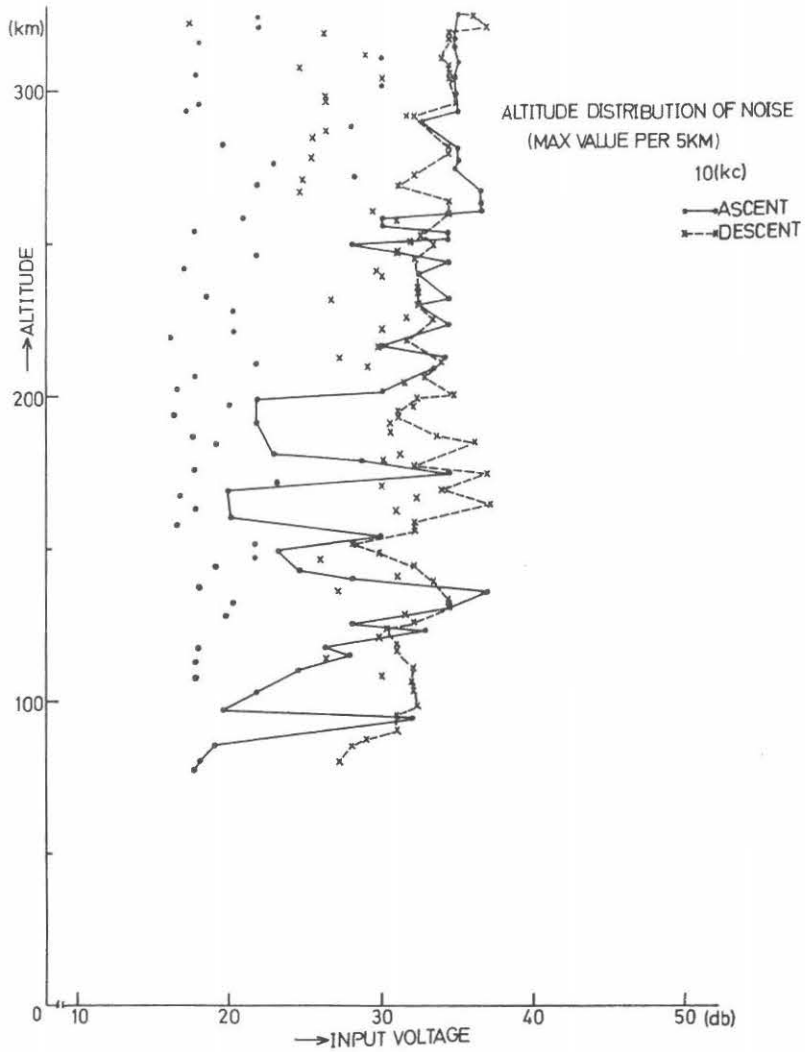

Fig. 5. The altitude distribution of radio noise on 10 kc/s

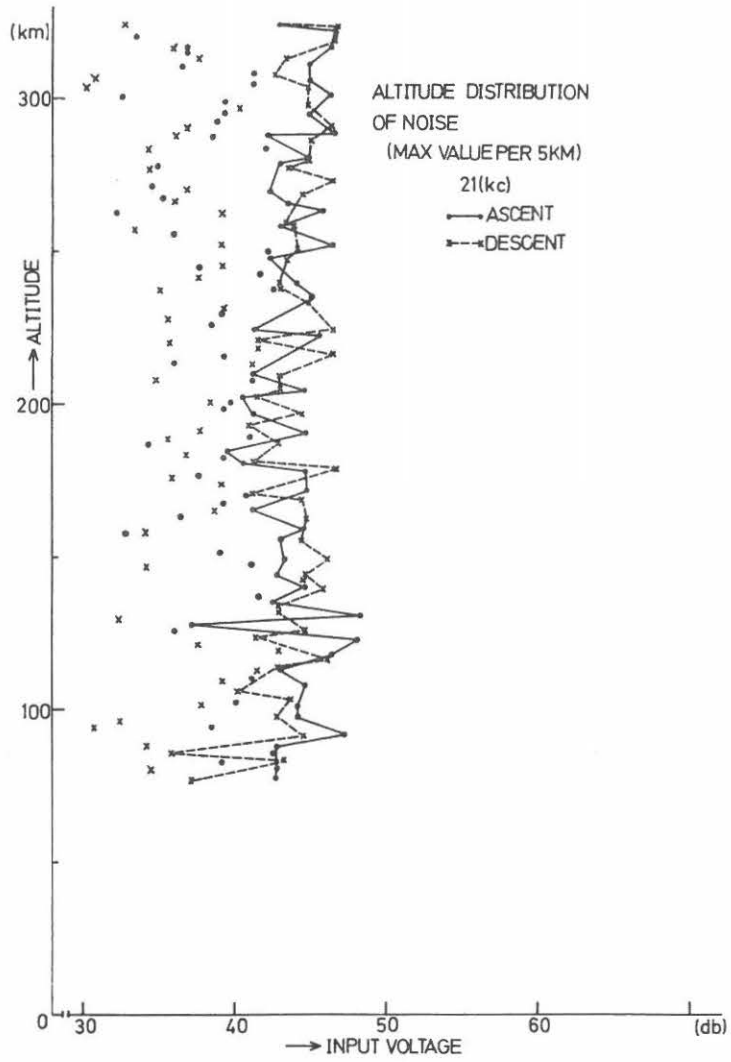

Fig. 6. The altitude distribution of radio noise on 21 kc/s