

ELECTROCARDIOGRAPHICAL STUDIES ON BOTTLE-NOSED DOLPHIN (*TRUSIOPS TRUNCATUS*)

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So far as the authors know, little studies on ECG of the whale have been reported. This paper deals with ECG of *Trusiops truncatus* which the authors had opportunity to obtain on July 18, 1957, when they were transported alive by trucks overland, from fishing-port Arari to Enoshima Aquarium in which they were to be reared.

The reason to study ECG of the whale is as follows. After the report on digitalis in 1932, Tokita and his collaborators published a paper on the mechanism of its effect on heart-rate in 1951 and 1952, a new aspect of the regulation mechanism of autonomic nerve. This stimulated the authors to begin studies in order to reveal the heart-rate regulation mechanism by collecting the ECG of laboratory animals and those in zoo, extending from mouse to elephant, rice-bird to crane, and killifish to common boa. In the course of the studies, the authors were afforded this opportunity.

CONDITION OF WHALE AND ECG-RECORDING

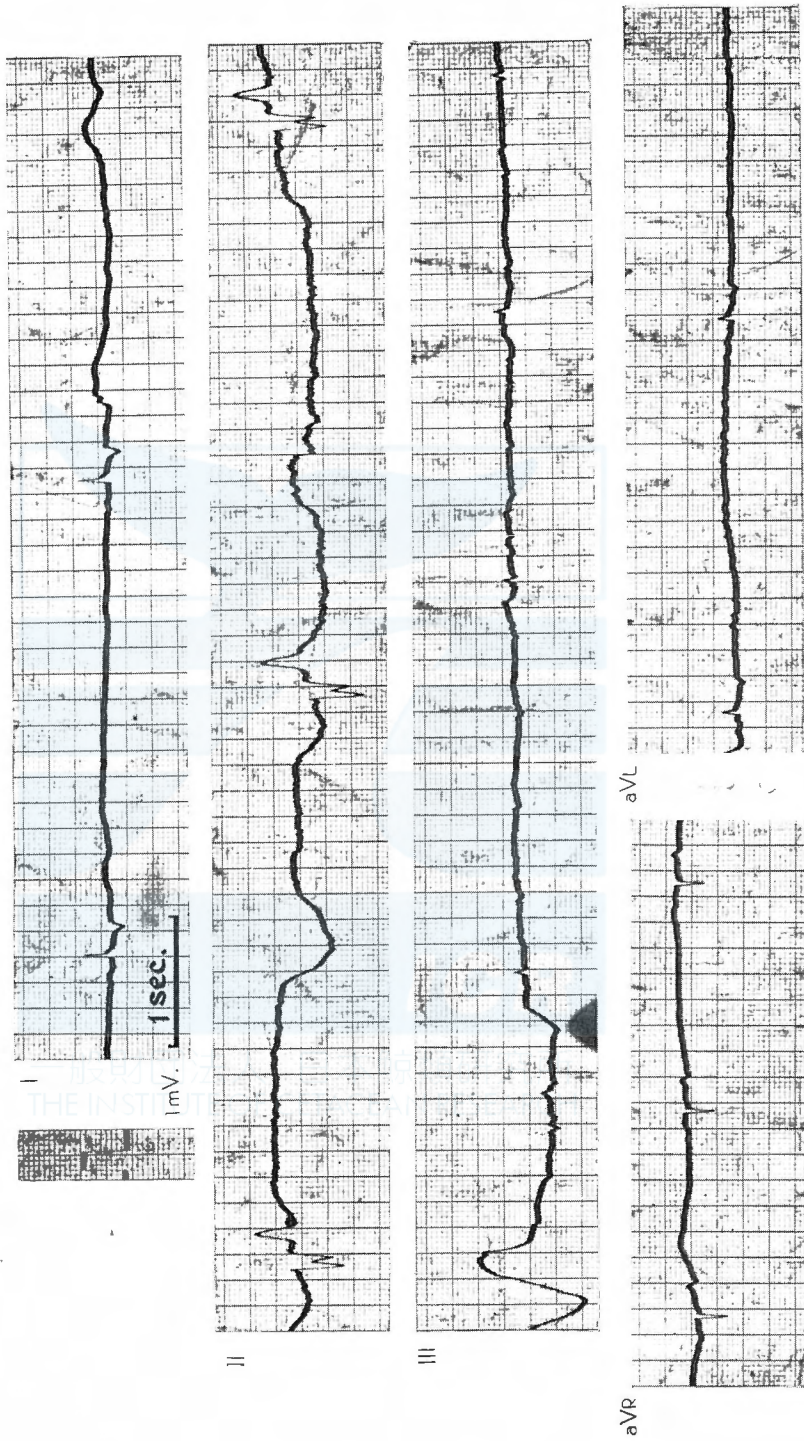
Before the transportation, *Trusiops* had been reared for two weeks to a month in Arari Bay with squids or fishes. ECG-recording was made at the port, immediately after they were loaded on auto-trucks, next at Mishima after 4 hours and finally at Enoshima after 8 hours. On the truck, one side of the animal body was immersed in sea-water contained in a canvas tank surrounded by ice-pillars, and the other side was covered with blanket moistened with the sea-water. The road passed through high grounds between Arari and Mishima, and through the Hakone Mountain, about 1,300 meters high between Mishima and Enoshima. Water temperature in the canvas tank was 23°C at Arari and 30°C at Mishima and Enoshima. Body-weight of *Trusiops* was 260 to 300 Kg, but an infant was 110 Kg. Unfortunately, one of the loaded died on the truck at Arari, but the other four reached safely to Enoshima and are still living.

To induce ECG, electrodes (Injection needle) were implanted into the body at the spots corresponding to those of the human body, or the

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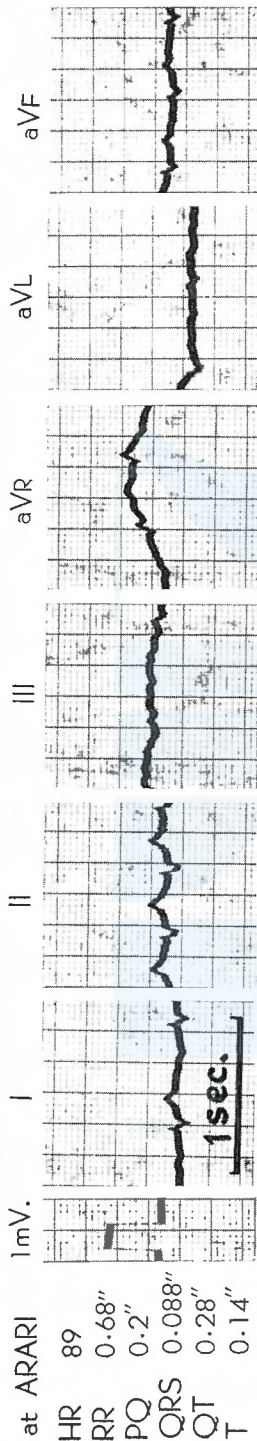
** Ryuta Ito, Sukeaki Nishimuta, Yoshinori Kawasaki Naoyoshi Nakamura, Kozo Saito, Sho Isogai and Yasuo Ogawa.

ECG
No. 1 Whale, dead 20 min. after, July 18, 1957



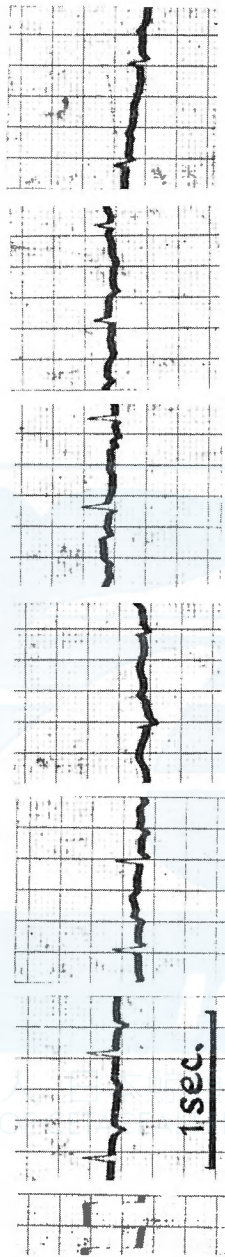
ECG

No. 2 Whale, July 18, 1957



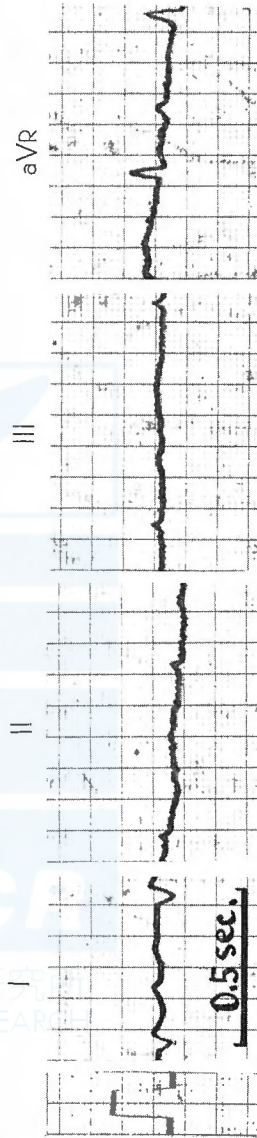
at MISHIMA

HR	89
RR	0.68"
PQ	0.22"
QRS	0.06"
QT	0.24"
T	0.07"

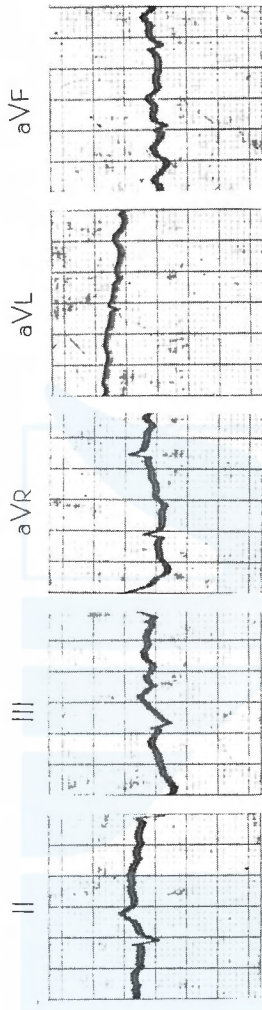


at ENOSHIMA

HR	125
RR	0.48"
PQ	0.2"
QRS	0.12"
QT	0.24"
T	0.07"

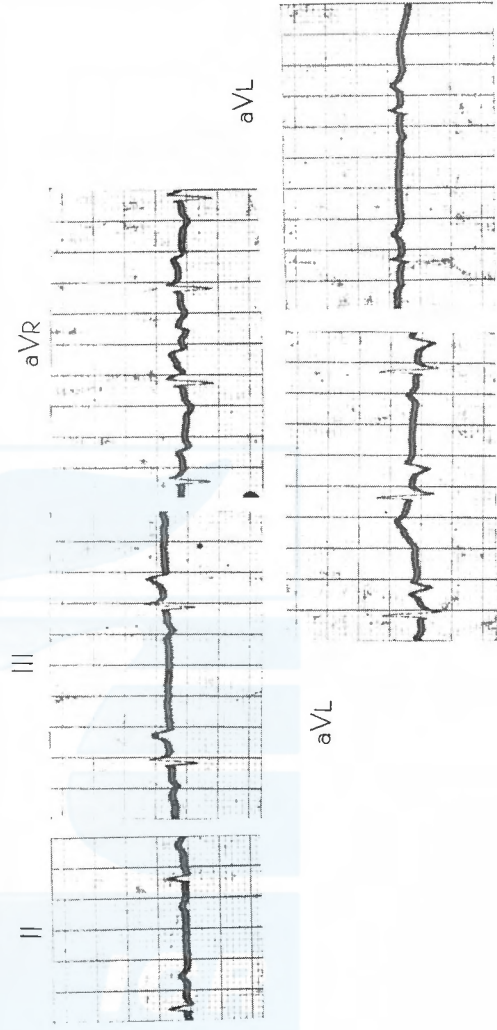


ECG
 No. 3 Whale, July 18, 1957



at ARARI

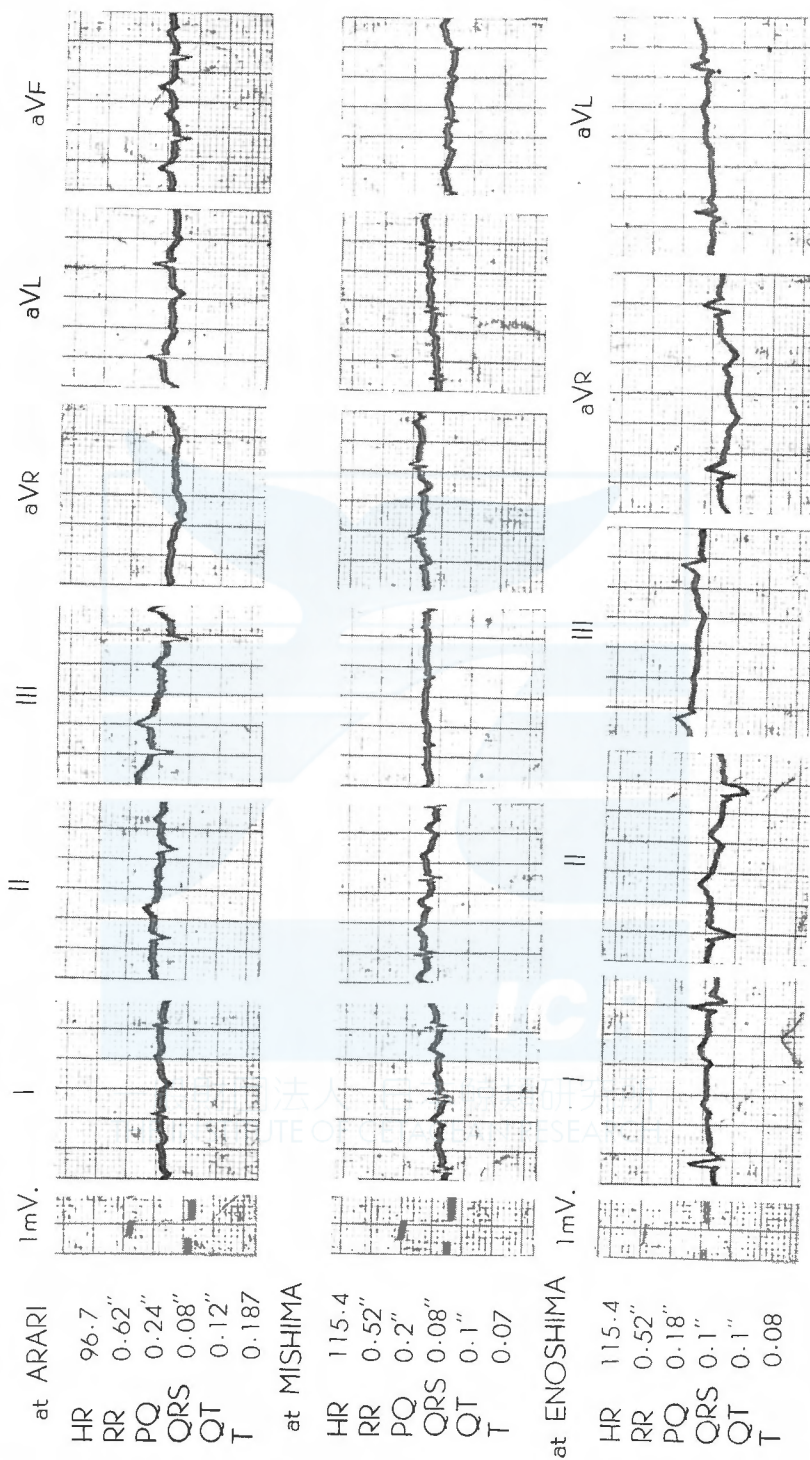
HR 79
 RR 0.76"
 PQ 0.2"
 QRS 0.056"
 QT 0.24"
 T 0.068"



at MISHIMA

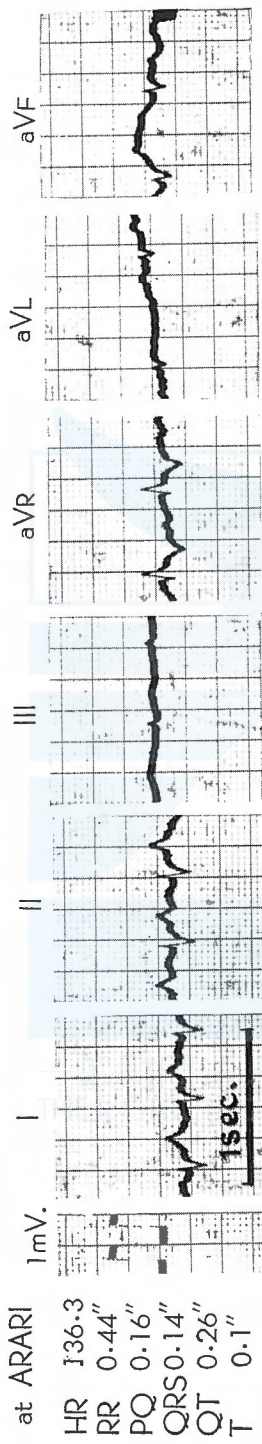
HR 65
 RR 0.92"
 PQ 0.18"
 QRS 0.10"
 QT 0.3"
 T 0.14"

ECG
No. 4 Whale, July 18, 1957



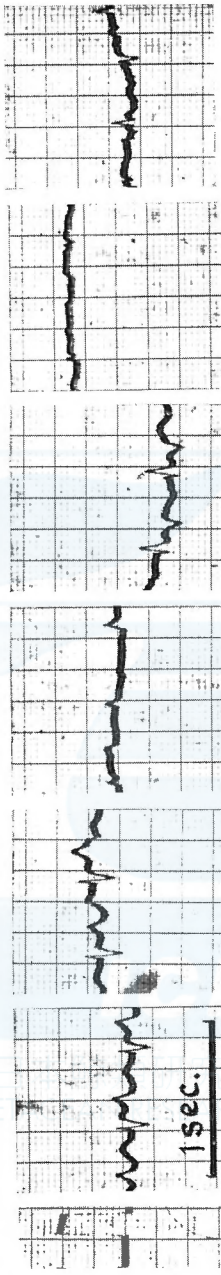
ECG

No. 5 Whale, July 18, 1957



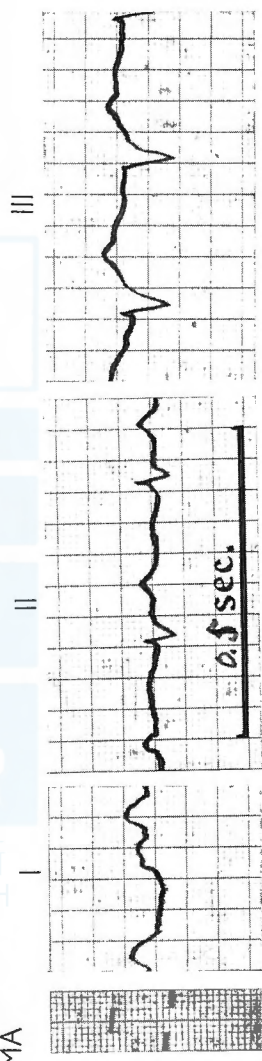
HR 136.3
 RR 0.44"
 PQ 0.16"
 QRS 0.14"
 QT 0.26"
 T 0.1"

at MISHIMA



HR 120
 RR 0.5"
 PQ 0.2"
 QRS 0.08"
 QT 0.28"
 T 0.14"

at ENOSHIMA



HR 125
 RR 0.48"

metalplate-electrodes were attached to these spots without implanting.

RESULTS

1) Heart-rate. The heart-rate of four Trusiops ranged 81 to 137 per minute and even after transportation, increasing in the course of time in two cases and decreasing in other two.

2) Details of ECG. Equal to other animals, the beats were regular except in the one which died, and *P*, *QRS* and *T* were observed. Proportions of *RR* to other parts did not differ from those of other animals. *T* was relatively low similar to a large animal such as elephant. In one case, *T* was normal at Arari, reversed at Mishima and recovered at Enoshima. In a second, *T* was normal at Arari, but reversed slightly at Mishima. But irrespective of these changes, they swam lively in Enoshima Aquarium and they are still alive. In the case which died, arrhythmia, markedly reversed *T* and disrupted *R* were observed.

3) Respiration. The rate was 1.5 to 4 per minute in the Aquarium in which they could swim voluntarily. But on the truck, it ranged 4 to 7 per minute and not regular during transportation.

DISCUSSION AND SUMMARY

As described above, average heart-rate was 100 per minute. This was unexpectedly rapid. The first problem is whether this rate was normal or not. Although this record was done under unusual conditions, in other words, although aquatic animals were investigated on land under intensive stress, the heart-rate did not change markedly and details of ECG were not influenced exceedingly. From these results, it can be remarked that $\pm 20\%$ of this average would be the normal range of heart-rate for bottlenosed dolphin. The difference between that of adult and infant seemed small.

Low voltage of *T* is equal to that of a large animal such as elephant (for example, Indila in Ueno zoo, Tokyo). Reversal of *T* would be the sign of shock as is seen in human, because the one which died showed the sign of reversal in significant grade, but that of other cases was slight and might have recovered after they were released into the Aquarium.

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