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# **EQUIPMENT FOR RECORDING FEEDING, DRINKING, RUMINATION AND STANDING-LYING BEHAVIOUR OF CATTLE**

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## **1. INTRODUCTION**

In recent years, many studies have been initiated on the control of feed intake in ruminants. Fundamental questions in this field are what parts of the nervous system regulate the feeding responses and what intervening variables affect their state. To solve such questions, one must often know precisely the pattern of feed intake under various experimental conditions.

Feeding responses interact with other categories of behaviour. Therefore, data may also be needed about behavioral aspects other than feeding.

We have developed a device for automatic recording patterns of feeding, drinking, rumination and resting of cows which are housed separately. These behavioral patterns can be recorded simultaneously over periods of days or weeks.

In literature various systems of recording jaw movements have been described (DUCKWORTH and SHIRLAW, 1955; BALCH, 1958; PEARCE, 1965; KRZYWANEK, 1967). In this paper another technique is introduced, probably more suitable for longer recordings, and very simple and cheap.

The device for recording the pattern of feed intake is in many respects similar to the equipment described by SUZUKI et al. (1969). However, a special unit almost suppressing the interference, when the cow touches the manger, has been added.

The equipment which is described has been designed for two cows. Commercial recorders of a suitable capacity were chosen; other makes of recorder may well be suitable too.

## 2. TECHNICAL DESCRIPTION OF THE EQUIPMENT

The equipment consists of four main parts, each for one kind of behavioral trait that is to be recorded:

- (1) feeding;
- (2) drinking;
- (3) rumination;
- (4) standing-lying.

A Joens (Düsseldorf, Germany) six-channel galvanometer point recorder was used on which three different traits such as feeding, drinking and rumination of two cows can be recorded on one chart. For yes-no traits such as jaw movements and standing-lying, a ten-channel event recorder Goertz (Wien, Austria) Miniscript Z was used.

An electrical block diagram of the total equipment is shown in Fig. 1.

### 2.1. *Recording feeding behaviour*

To record the feed intake of a cow, the manger with the feed is continuously weighed by hanging up the manger on a load beam (Fig. 2).

The load beam (Philips, Eindhoven, type PR 6100/01HK) has a maximum load of 100 kg. The manger weighs 50 kg, so a maximum of 50 kg feed can be supplied.

The load beam transduces linearly the weight into an electrical tension that can be recorded when it has passed a low-pass filter, an amplifier and a calibration unit (Fig. 1).

The low-pass filter is essential to get quiet recording. When the cow eats, she continuously touches the manger and sharp electrical pulses with short rise times occur, making the recording unreadable. A well-dimensioned low-pass filter removes the short pulses and only the slow changes in weight of the manger are recorded.

In the calibration unit, the weight of the manger without feed can be electrically compensated and the full-scale deflection can be adjusted. An empty manger corresponds to the zero line of the graph paper and full-scale deflection can be chosen for 24 or 48 kg feed in the manger. The aggregate inaccuracy reached with the recordings was + or - 250 g for the 24 kg range and + or - 500 g for the 48 range. The sensitivity was 100 and 200 g.

By the experiment, one manger was attached to the ceiling and one manger was hung on a frame.

### 2.2. *Recording drinking behaviour*

The cast-iron drinking fountain of the cow is connected with a water tank which has a content of 70 litre. The water level in the tank is continuously measured by a capacitive water-level transducer developed by TFDL (Fig. 3).

The transducer consists of a stainless steel pipe 70 cm long, which forms the the first electrode of a capacitor. In the pipe, a Teflon-isolated copper thread is tensed as a second electrode.

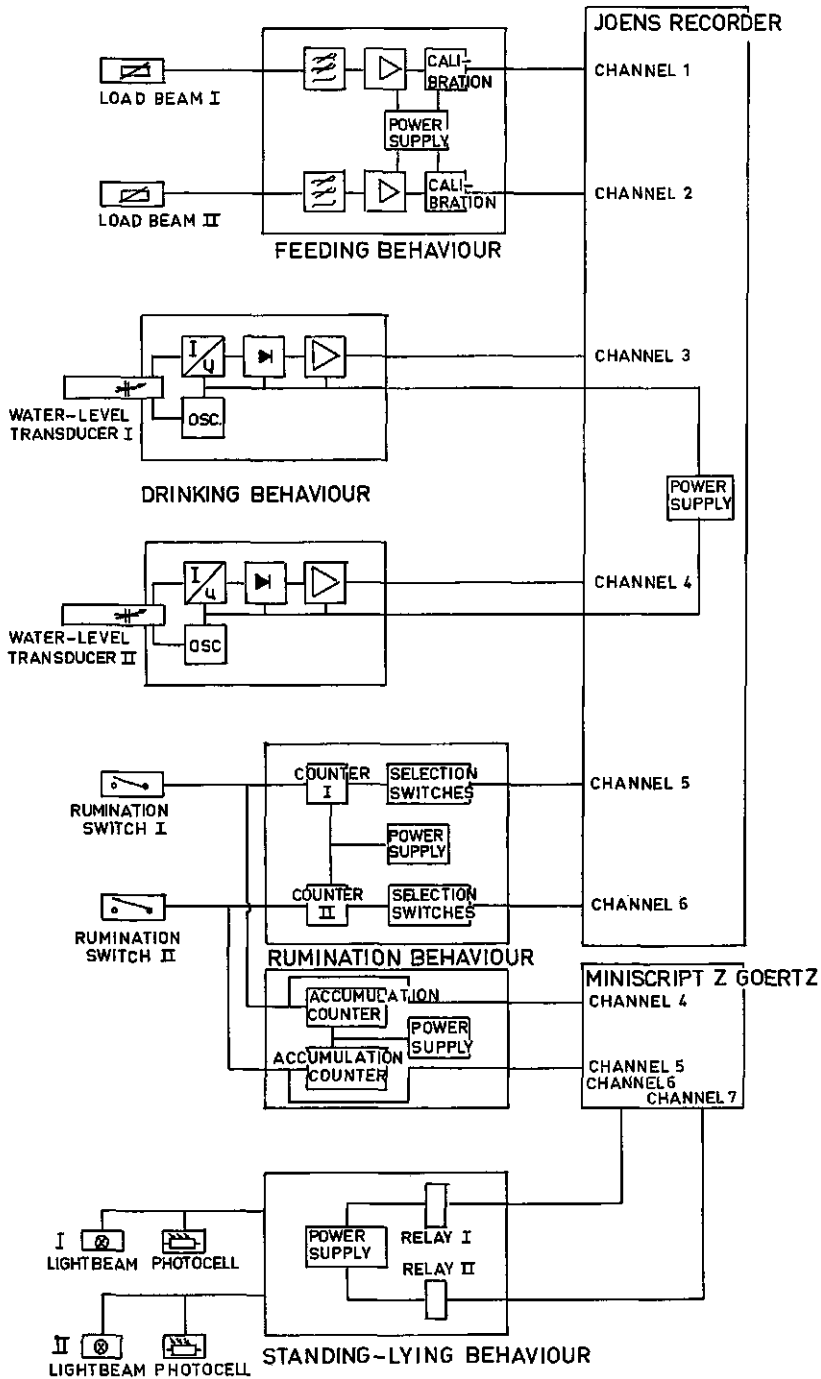


Fig. 1. Block diagram of the equipment for the behavioural recording of 2 cows.

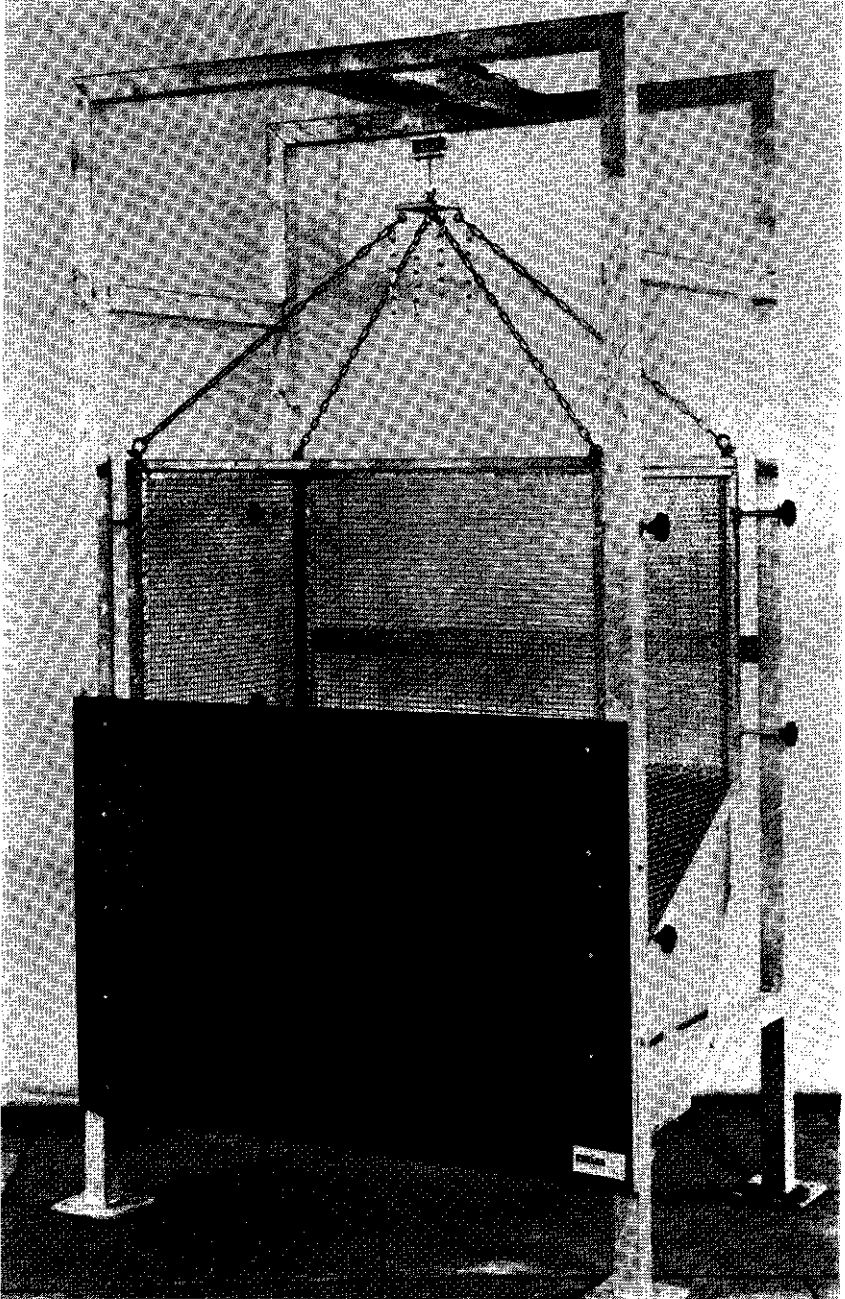


Fig. 2. Manger with feed hanging on a load beam. An opening was made in the wooden sheet, by trial and error, sufficiently large to allow the cow access to the manger.

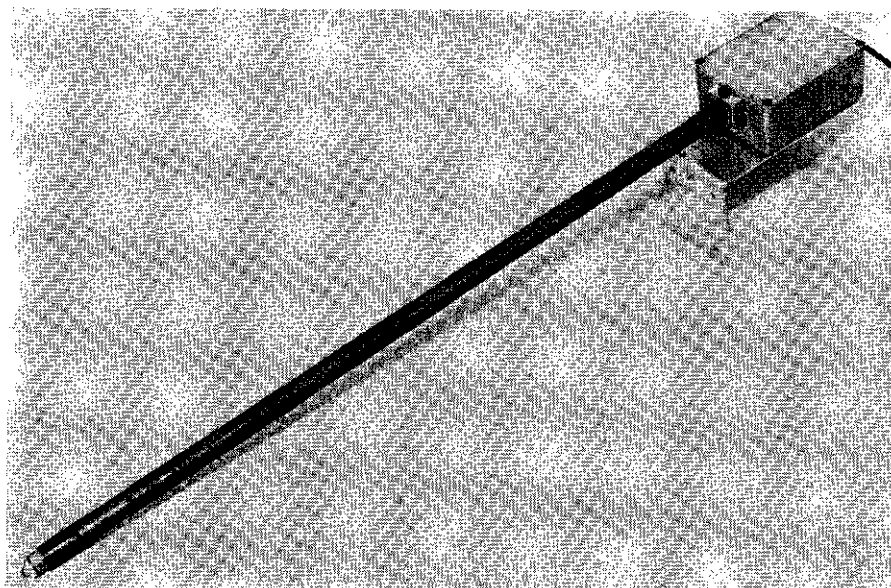


FIG. 3. Capacitive water-level transducer. The electronic oscillator and a pre-amplifier are built in the small box at the top of the transducer.

Capacitor changes due to the difference in dielectrical constant between water and air are rectilinear measured as a function of the water level. After amplifying and rectifying the signal, there is a calibration circuit with which one can adjust full-scale deflexion on the recorder for the full tank and zero when the tank is empty (Fig. 1).

Accuracy with the recording reached  $\pm$  or  $-0.5$  litre water.

### 2.3. *Recording rumination behaviour*

To record rumination, a leather halter is placed on the cow's head, with double straps under the jaw. Between these straps, a microswitch is constructed. When the cow opens her mouth the lower jaw presses on the switch and causes an electrical pulse. The signals can be recorded in two ways.

First every jaw movement can be recorded on the Miniscript event recorder. The second way, that has been developed, is to record rumination on the same chart as feeding and drinking. The electric pulses, due to rumination, are counted on the equipment in Fig. 4 for one minute. Only when the number of jaw movements per minute, preselected by a push-button, is reached in that minute, an electrical pulse is sent to the Joens recorder (Fig. 1).

Every minute the electro-mechanical counter is reset to zero.

When jaw movements do not reach the pre-selected number in a minute, they are not recorded.

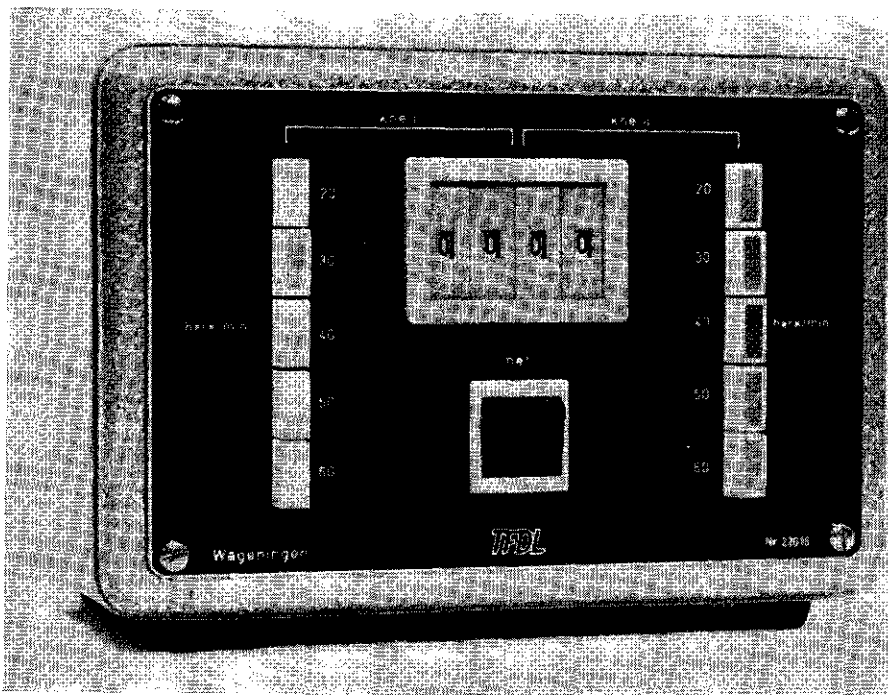


FIG. 4. Equipment for recording rumination behaviour of two cows. A minimum number of jaw movements per minute can be pre-selected.

#### 2.4. Recording standing-lying behaviour

When the cow is standing, a light beam shines between her legs, on a well positioned photocell on the wall (Fig. 1). The Miniscript recorder registers a deflexion.

When the cow is lying, the Miniscript recorder registers the zero line.

### 3. DISCUSSION OF THE RECORDED DATA

Recordings from the Joens recorder when a cow was eating concentrates, long hay and hay wafers are shown in Fig. 5. The chart shows clearly when the cow was eating or drinking and how much she consumed. The effect of touching the manger on the recording was very well reduced when the cow was eating concentrates or long hay. On hay wafers, however, she often rooted around in the feed mass and knocked the manger about. This caused much more vibration, which can be seen on the recording.

All non-feeding pauses of 2 minutes or more are distinguishable on the chart from the Joens recorder. But for some vibration or for a very low feeding rate, it would be advisable to use a higher limit for a non-feeding pause, e.g. 4 minutes.

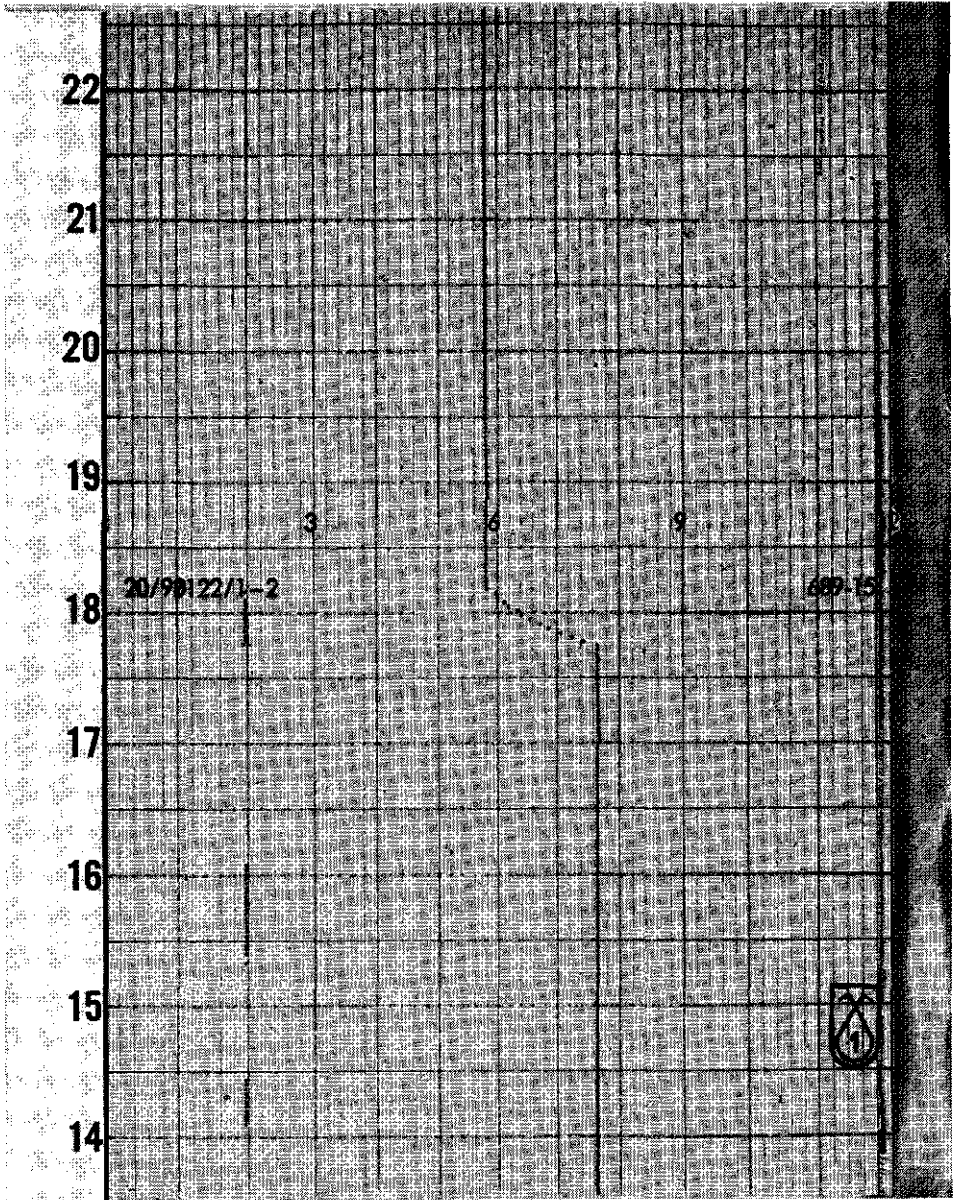


FIG. 5. Recordings from the Joens recorder, when a cow was eating concentrates (see above), long hay (see Fig. 5A, page 8) or hay wafers (see Fig. 5B, page 9). On the left of each recording is the record of rumination, in the middle eating and on the right drinking.

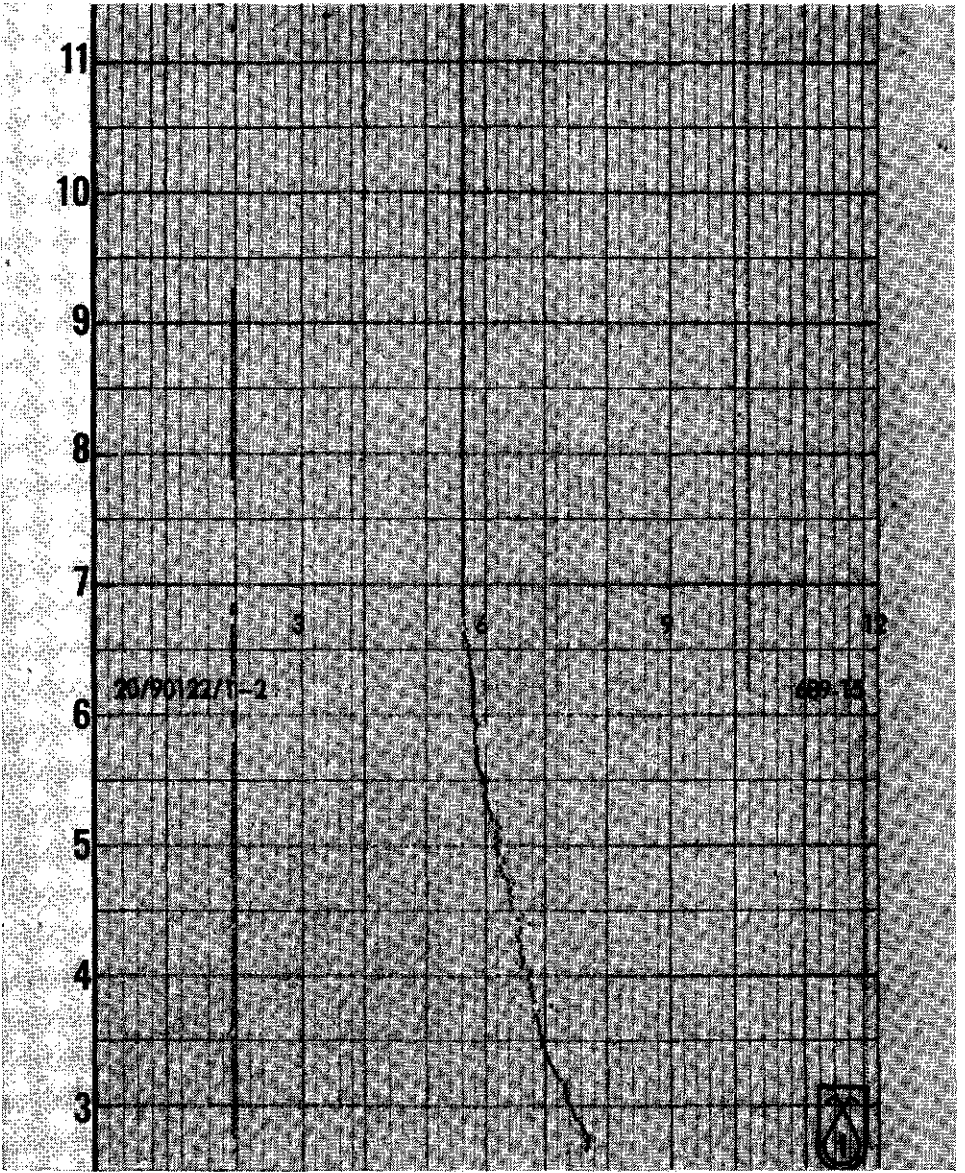


Fig. 5A.



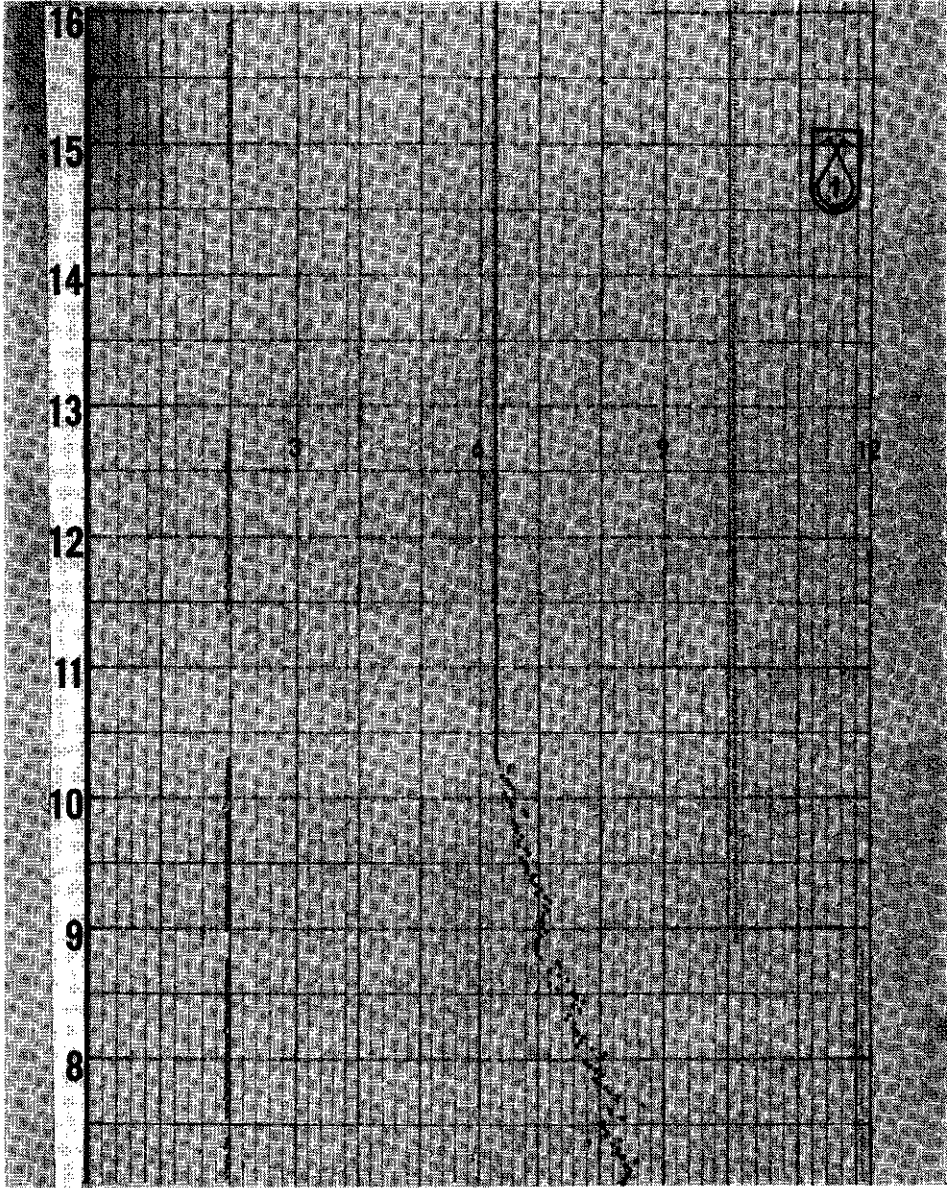


Fig. 5B.

Records of jaw movements during non-feeding pauses generally indicate rumination periods. Jaw movements due to grooming or licking objects in the surrounding did usually not reach the preselected number per minute and, if they did, it was not for more than one or a few minutes. Rumination usually lasts much longer.

A more detailed recording of rumination was obtained from the Miniscript recorder. This behaviour can easily be distinguished on the recorder charts because it involves a much more regular pattern of jaw movements than feeding or licking (Fig. 6).

At the lowest chart speed, separate cycles within the rumination periods could be distinguished. At the highest speed, even the separate jaw movements within the cycles are visible. If one is not interested in these details of rumination, it would be sufficient to use only the recording from the Joens recorder.

#### 4. FINAL REMARKS

For our technique the cows were tied. If the cows are loose, the recording of rumination and standing-lying would have to be omitted. Alternatively a wireless telemetric system should be used, at least for rumination.

A leather halter with a microswitch is a simple way of recording rumination. However, an accurate recording is only possible when the straps of the halter are correct in length. For this, the technical staff carrying out the experiments must be experienced.

#### SUMMARY

Equipment was developed allowing continuous recording of feed intake, drinking, jaw movements, and standing or lying. The system largely suppress interference from knocking of the manger in the record of feed intake. All traits of two cows could be recorded on one chart. Examples show how the recording can be interpreted.

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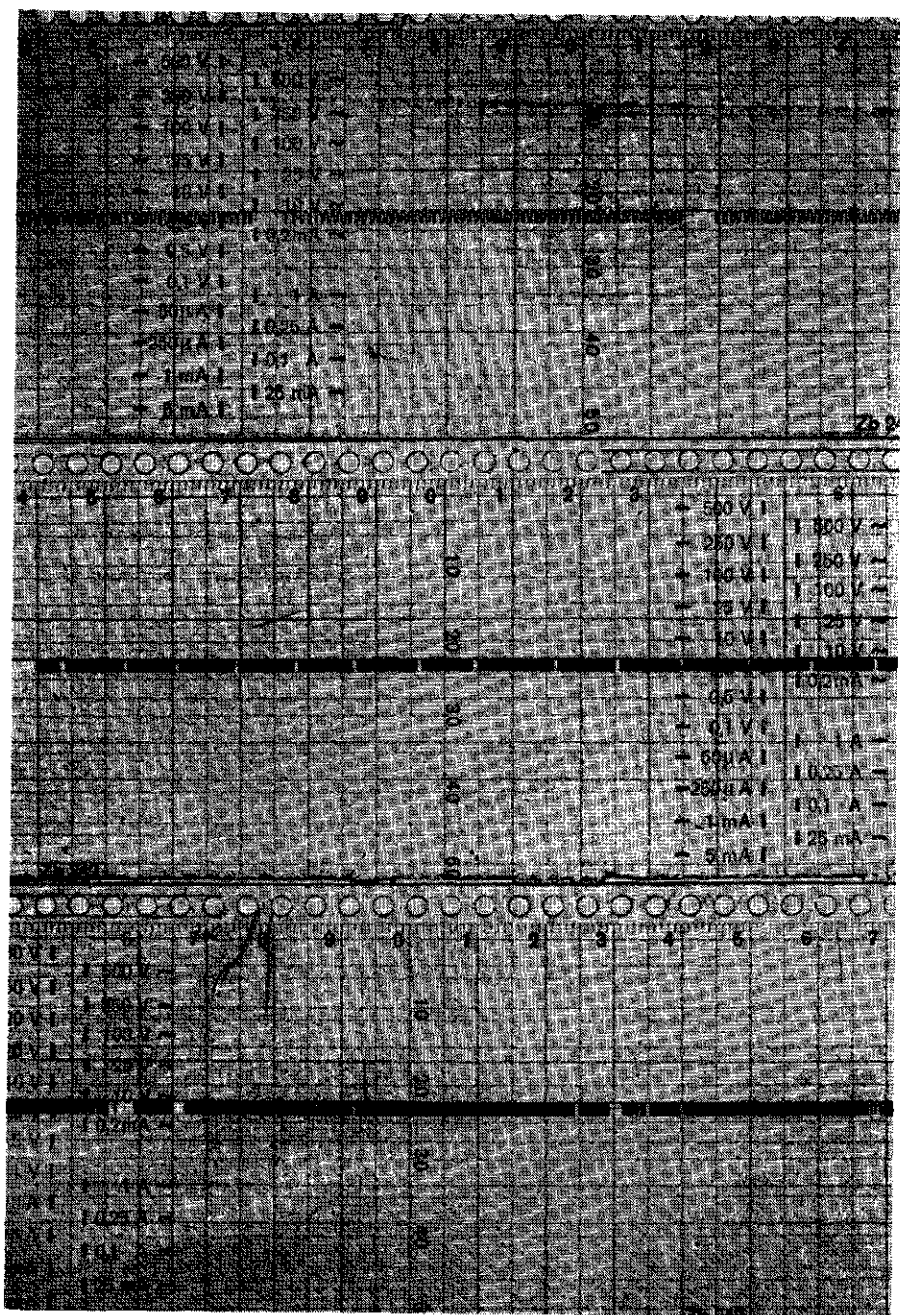


FIG. 6. Recordings from the Miniscript recorder. At the top, rumination recorded with a paper speed of 6 cm/s; in the middle with a paper speed of 1 cm/s; at the bottom, a recording of non-rumination jaw movements.

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