EXPERIMENTAL BOVINE TRAUMATIC GASTRITIS

by

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I. INTRODUCTION

A. Introductory Statements

The problem of traumatic gastritis in the bovine arises because of the indifferent manner of prehension, mastication and deglutition of the animal, together with the peculiar anatomical arrangement of the gastric apparatus. Because of these predisposing factors the bovine has always been troubled with foreign bodies being ingested, penetrating the gastric wall and creating various degrees of peritonitis. With the advancement of animal husbandry has come the increasing tendency to maintain cattle under stable conditions and on dry feeds for longer periods during the year. This fact, coupled with the mechanization of agriculture and consequent increase in metallic debris, seems to be causing an increasing number of deaths due to traumatic gastritis each year.

The annual death loss is but a part of the loss suffered by the cattle industry. A number of the affected animals survive, but are so affected that they no longer are profitable because of poor lactation, poor weight gains, or loss of reproductive ability.

Thus, the veterinarian seems to be confronted with an increasing number of traumatic gastritis cases each year.

His problem is twofold: accurate diganosis and the establishment of a judicious treatment.

Satisfactory treatment can be predicated only upon an accurate diagnosis. In recent years surgical removal of the foreign bodies has been increasingly popular among veterinarians. It seems to be the concensus that favorable outcomes are especially dependent upon early diagnosis.

Fundamental, then, to the prudent handling of this condition is the early and accurate diagnosis.

In an effort to further clarify the clinical syndrome of this condition in the early stages, ten healthy cows were made available for study by the Iowa State College Veterinary Clinic. These animals were maintained under circumstances very similar to actual field conditions during the entire course of the experiment.

B. Review of Literature

A review of the literature indicates that traumatic gastritis is becoming recognized as one of the most important diseases of cattle. Maddy (1954) reported on the incidence of perforation of the bovine reticulum on 44,000 cattle slaughtered. He states that veterinarians with considerable large animal experience who are now engaged in meat inspection are surprised at the frequency of such lesions. He states that they frequently comment that had they known the actual high incidence of perforation of the reticulum by foreign bodies, they would have handled many cases of bovine indigestion differently. His report showed that 20.9 per cent of the beef cows and 79.6 per cent of the dairy cows showed reticular adhesions. This report was amplified by Bardoulat et al (1950) who estimate that foreign bodies are the cause of 80 per cent or more of the digestive troubles of the bovine. A lower figure is estimated by other authors.

Because of the relative frequency of traumatic gastritis, many authors have described what they consider to be the clinical syndrome of the disease. The bulk of the literature, however, deals with reports on the diagnosis and treatment of field cases. Many such reports (Eber, 1906; Smith and

Rawson, 1953; Bosshart, 1926; Bardwell, 1927; Gibbons, 1932; Hansen, 1953) have contributed valuable information regarding the many manifestations that the disease may assume. The symptoms reported by each author indicated much similarity of findings. However, the importance and constancy of certain clinical features were interpreted differently and in certain instances a feature considered by one author to be of great diagnostic significance was not mentioned by other authors.

Since these reports were on field cases there was the possibility that some discrepancy in the findings was the result of unidentified secondary conditions. While informative autopsy reports were given to verify the diagnosis in some instances, there were frequently animals which did survive and for which the diagnosis could never positively be confirmed.

Gibbons (1932) listed the clinical findings present on fifty field cases as follows: soreness on percussion, 36; anorexia, 27; sudden decrease in milk flow, 21; decreased peristalsis, 19; poor condition, 12; history of previous attacks, 8; arched back, 6; grunting, 12; stiffness, 5; trembling, 4; vomiting, 1.

Krichels (1877) reports saliva dribbling from the mouth. Holterbach (1906) reports occasional gagging or vomiting with

the expulsion of either blood or food through the mouth and nose. Holterbach (1906) reports blood having been discharged with the feces. Aghion (1943) saw symptoms of colic after feeding. Neidiger (1917) found albuminuria in 29 out of 33 cows with traumatic gastritis. Dougherty (1939), Matteson et al (1953) and Arthur (1946) demonstrated neutrophile leucocytosis in the circulating blood. Friedberger and Frohner (1895) report that as a rule chronic typanitis is the most salient symptom.

Liegeois (1949) reports that the respirations are accelerated and of the costal type.

Bosshart (1926) reports that pressure on the spine from both sides, or picking up the skin over it, may bring out groaning. He also reports trembling of the posterior scapular muscles in the majority of his cases.

Bardwell and Udall (1927) report that in almost every case there is trembling of the muscles over the left side back of the elbow, occasionally over the rumen, and rarely over both sides. They also state that the evacuations are normal or suppressed.

Smith and Rawson (1952) reported on the diagnostic value of an electronic metal detector, whereas Churchill (1950) believes it is of little diagnostic value since pieces of

metal are frequently present on the floor of the reticulum without causing injury.

Hansen (1953) states that the most significant symptom is the pain over the xyphoid which he reports present in 90 per cent of his cases. Ketonuria was reported as common by Udall (1950).

Although the symptomatology on field cases is often conflicting, there appears to have been very little controlled experimentation in an effort to clarify the clinical syndrome. Hutyra and Marek (1917) in an effort to determine the time required to produce penetration of a foreign body after ingestion, introduced some nails, ten centimeters long and pointed at both ends, through a stomach tube. One animal showed symptoms after twenty-four hours, the other only after four days.

Dougherty (1939) used three cows with rumen fistulae to insert foreign bodies through the wall of the reticulum in order to study the hemocytological changes. His report was enlightening but the cows could not be considered as normal.

II. METHOD OF PROCEDURE

Ten healthy cows were used in this experiment. They were selected to represent variations in size, age, temperament, stage of pregnancy, lactation and conformation.

A piece of baling wire three and one-half inches long and another two and one-half inches long were sharpened on one end. The other end was made into a loop one-half inch in diameter to prevent the wires from escaping through the reticulum. One eight-penny nail, well sharpened, was included. These three objects were enclosed in a gelatin capsule especially fashioned to contain their lengths. Inert powder was used to fill the capsule to give it additional weight. (See photograph No. 1) The administration was made with a balling gun.

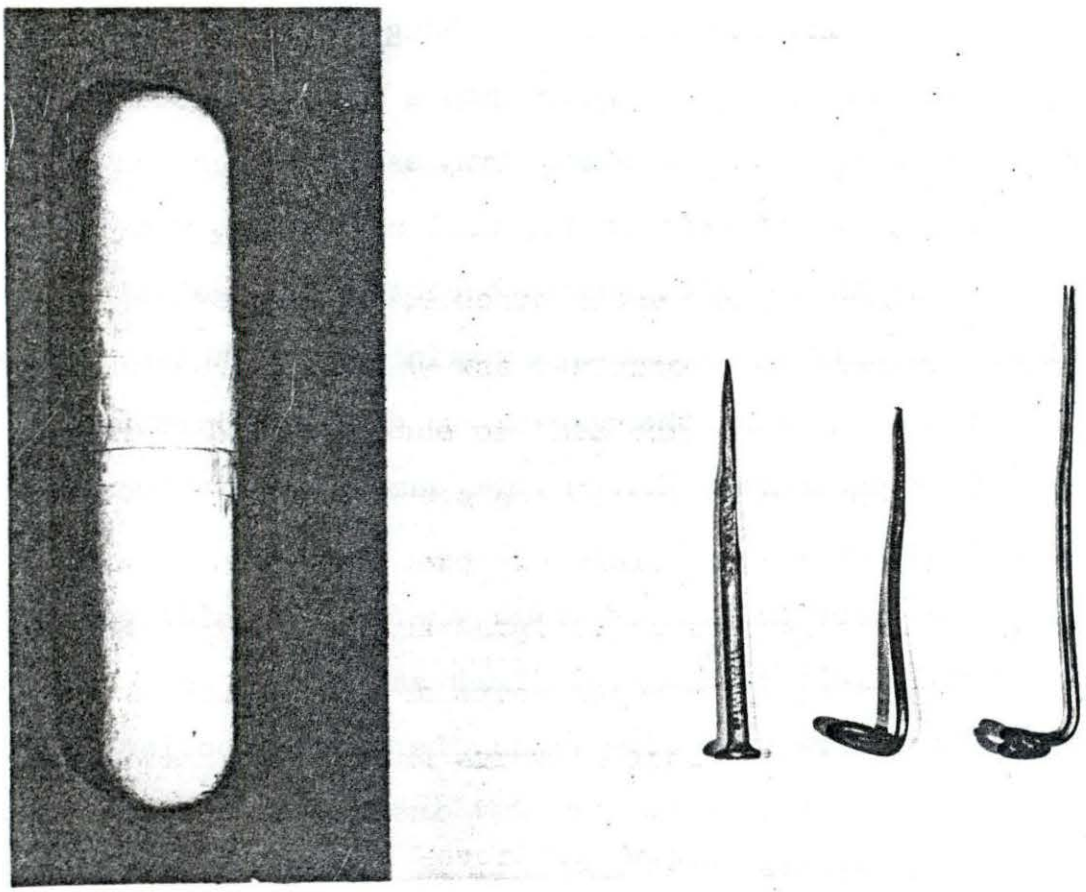
The cows were maintained under what was considered fairly normal field conditions. Each animal was kept in a stanchion in the regular line until the foreign bodies were administered. At this time, in most instances, they were removed to box stalls.

Each animal was identified by breed, weight, temperament, age and neck chain.

For a period of three weeks each animal was regularly

Photograph 1.

Gelatin capsule and the three foreign bodies it contained.



examined prior to administration of the foreign bodies. These findings were recorded and used to represent the animal in normal condition. It was found that the information obtained over the three week period was excessive and did not show sufficient daily variation to warrant the inclusion of that amount of time in this report. Consequently only the four days preceding the administration of the foreign bodies are included. During this time the examinations were made twice daily. After the foreign bodies were ingested the examination of certain features was made five times daily, until after the outcome seemed apparent, and then twice daily for two days.

Approximately 48 hours after the initial symptoms were detected a rumenotomy was performed to remove the foreign bodies. The technique of this surgery was varied, and the rate of recovery of the animal and subsequent appearance of the surgical wound were recorded. It was intended that an evaluation of various surgical techniques would result.

On the graphs an arrow is used to indicate the onset of symptoms and a second arrow to indicate the time of surgery.

A. Recording Temperatures

The temperatures recorded were obtained by inserting the thermometer into the rectum. It was left in place three to five minutes. In order to facilitate introduction of the

thermometer through the anal sphincter and to reduce the discomfiture to the animal a lubricant was first used to moisten the thermometer. The type of thermometer used was the half-minute, blunt nosed type with a magnifying scale.

This procedure was the first part of the examination in each instance on each animal, in order to disturb the animal as little as possible before the recording was made. However, reclining animals were urged to their feet and at least a few minutes were allowed to elapse to reduce the effect of that exertion on the temperature. It was decided that for the purpose of uniformity all temperatures recorded would be of standing animals.

The schedule was arranged so that no recordings were made immediately after the animals had been fed.

When the introduction of the thermometer stimulated the discharge of feces, about five minutes were allowed to elapse before the thermometer was re-inserted.

When abnormal readings were encountered the procedure was repeated two or three times to verify the accuracy of the reading.

B. Recording the Heart Rate

The rate of the heart beat was recorded by using a stethoscope applied over the heart on the left chest wall.

The animal was approached slowly and handled gently to avoid disturbance to the heart rate. When the chest piece of the stethoscope was in place, several minutes were permitted to elapse before the recording was started. Usually the number of beats per minute for several minutes was recorded to insure a typical number of heart beats in one minute.

The procedure was altered somewhat according to the temperament of the individual. In making the examination on two of the animals it was necessary to spend considerable time waiting for the cardiac rate to quiet to that point where it seemed not to be influenced by psychological stimulation.

The stethoscopic examination of the heart was also used in order that any abnormalities of the heart action that became apparent in the course of the illness could be recorded. It developed, however, that no disturbance other than rate was perceptible to the investigator so no data concerning cardiac deterioration are included in this study.

C. Recording the Respiratory Rate

The respiratory rate was ascertained by noting the excursions of the ribs and the abdominal wall. In each instance the recording was made on the standing animal and before any other phases of the examination were conducted that might psychologically stimulate the respiratory rate.

In each instance the recording was not begun until the animal had become accustomed to the presence of the clinician and was not sniffing or snorting to disturb the rate. The respirations were counted for several minutes and then the average respiration per minute was recorded.

An attempt was made in each instance to detect abnormalities in either the rhythm or the character of the respirations. There seemed in this investigation to be no significant disturbance in either of these features so the data concerning those two factors are not included in this report.

The schedule of recording the respiratory rate was arranged in such a manner that no examination was made immediately after the animal had been fed.

It was found impossible to make all recordings when the animal was not ruminating and yet maintain a regular schedule. To deliberately disturb her enough so that she would cease ruminating seemed to result in a psychological stimulation of the respiratory rate. To wait until she had finished ruminating distorted the regularity of the examination.

D. Recording the Blood Studies

1. Collection of the blood sample

Blood samples were obtained by venipuncture of the jugular vein. Ten cc. of blood were withdrawn into a glass tube

containing 20 mg. or dry potassium exalate. The tube was immediately stoppered and inverted several times to insure mixing of the anticoagulant. A sharp, sterile, 14 gauge bleeding needle was used for the puncturing. The first samples were drawn from the anterior part of the jugular vein and each succeeding puncture was moved posteriorly enough to avoid any traumatized tissue. The veins on either side of the neck were used alternately. The area was prepared for venipuncture by rubbing the skin and hair coat with 70 per cent ethyl alcohol.

2. Leucocyte count

The leucocyte counts were made on a double Neubauer "Bright-Line" counting chamber. The tube containing the oxalated blood was inverted several times in the laboratory when preparing to fill the pipette.. The white pipette was filled with a column of blood to the 0.5 mark. The excess blood was wiped from the tip of the pipette and acetic acid diluting fluid was used to fill the pipette to the 11 mark. Meanwhile, the pipette was being rotated to mix the contents. An electric vibrator was used to insure a uniform mixture in the pipette.

In filling the counting chamber, a few drops of fluid were discarded from the capillary bore to remove the unmixed fluid. Both sides of the counting chamber were filled. Each

of the four corner squares of 1 sq. mm. in area and 1 mm. in depth was counted. Therefore, four-tenths cmm. was counted and since the dilution in the pipette was one to twenty, the total leucocytes in the four squares were multiplied by fifty. This figure represented the white blood cells per cubic millimeter. The average count from the two sides was recorded.

3. The differential leucocyte count

A drop of blood was thinly smeared and quickly dried on a slide. Methylene blue and eosin were used to stain the slides.

For the purpose of this study it was considered sufficient to classify the neutrophiles only as being segmented or non-segmented. Since it was determined to present each facet of the examination separately it was thought that if these values were presented on a percentage basis a more accurate evaluation of them would be obtained.

As a rule, a total of 100 leucocytes was classified for each determination.

While the eosinophile count was made regularly, an analysis failed to reveal any changes of significance in this study, so that these figures will not be included in the report.

E. Recording the Character of the Aortic Pulse

At first an attempt was made to evaluate the character of the pulse by use of the superficially palpable median or coccygeal arteries. On certain of the animals, however, the pulse was so faint that no determination of the quality could be made. It was decided then to examine the aortic pulse per rectum. It was feared that this procedure might cause reflex stimulation of the pulse, so the rate was not recorded. The stethoscopic examination of the heart was used instead, and before the rectal examination was made.

A rubber sleeve was used by the clinician and a lubricant was liberally applied. This procedure was carried out in as gentle a manner as possible and it was thought that very little if any disturbance in the character of the pulse resulted from this procedure.

This examination was made twice per day at regular times. It was thought that more frequent examinations might result in tissue irritation.

Through this examination any disturbance in rhythm was also to be recorded. It developed, however, that there was no peculiarity of rhythm identified and these negative data were discarded.

F. Recording the Rate of Rumen Movements

The rate of ruminal contractions was determined by palpation of the rumen with the tips of the fingers pressed firmly into the middle third of the left para lumbar fossa.

Here again, the animal was approached slowly and stroked a few minutes to permit her to become accustomed to the contact of the clinician's hands. The pressure by the fingers was increased gradually to overcome the natural resistance of the abdominal wall. In this manner the contractions of the rumen wall were detected easily and the number of such contractions occurring in a five minute period was recorded. This examination was discontinued after the surgery had been performed because of the presence of the incision wound in the para lumbar fossa.

G. Recording the Character of the Rumen Contractions

The information regarding the strength of the contractions of the rumen was obtained in the preceding examination and by palpation of the rumen wall per rectum at the time of examining the aortic pulse.

A deviation from the normal resiliency of the rumen wall and a weakening of the force of contractions were recorded. The rumen showing normal tone and strength of contractions was indicated as "strong". The rumen that indicated slight

reduction in either quality was recorded as "good". Further deterioration was indicated as "fair", or as "weak".

H. Recording the Amount of Feces

The feces voided from each animal were weighed twice per day at intervals. It was difficult to consistently keep the feces free from bedding material saturated with urine for a twelve hour period so it was thought that approximate figures were sufficient for the purpose of this study. Therefore, estimations by volume were used alternately with spot checks by weight at various times. Extreme variations were weighed.

I. Recording the Character of the Feces

Since all of the cows used in this study received identical grain and hay, the character of the feces was similar in every animal at the beginning of the experiment. The feces that barely held contour when dropped were considered as normal and were recorded as "normal". In no instance was there any increase in the fluidity of the stools so that all disturbances were in the form of progressively firmer feces. When they became slightly drier they were recorded as "firm". Those that were voided as a mass of wafer-like segments and showed an excessive amount of mucous covering were identified as "hard". When only individual equine-like pellets covered with mucous were passed, the term "pellets" was used.

J. Recording the Amount of Grain Consumed

Every animal was given four pounds of grain twice per day. The normal animal consumed this amount greedily. When the appetite for grain was disturbed so that some of all remained in the manger for a period of two hours after feeding the remaining grain was deducted from the amount fed to give the amount consumed.

When the foreign bodies were administered the animals were moved to an isolated stall so that there would be no neighboring cows to steal the grain.

K. Recording the Amount of Hay Consumed

Since, at the beginning all of the animals were in stanchions and feeding from a non-partitioned manger it was not possible to calculate exactly the amount of hay consumed. Therefore only approximations were made. The weight of a bale of hay was established and the amount of coarse residue was deducted from the amount fed. An effort was made to discount any hay stolen by the neighboring cows. It was recognized that this procedure left much to be desired in accuracy but it was thought that the approximations would be similar to those obtained under field conditions and it was toward that end that this study was conducted.

L. Recording the Amount of Milk Produced

The amount of milk obtained from each cow twice per day was recorded. The scale was adjusted to compensate for the weight of the pail and the amount of milk was automatically computed.

M. Recording the Pain over the Xyphoid Cartilage

This examination was conducted by the clinician, kneeling or squatting at the right shoulder of the cow. A stethoscope was used, with the chest piece being held firmly against the trachea of the cow by the clinician's right hand. When the stethoscope was adjusted so that the regular rush of air through the trachea could be heard, the left fist was placed against the skin just posterior to the animal's xyphoid cartilage. At first, pressure was applied by lifting the fist and raising the abdominal wall in a slow and gentle manner. This procedure was repeated over the surrounding area to include a space of twelve inches in diameter. This was done lightly at first for two reasons -- to accustom the cow to this procedure so that she would not wince just as a result of being startled, and to detect individuals that showed severe enough pain to cause a reaction from even the slight and gradual pressure of the fist. If this procedure caused the animal to grunt or "catch her breath" the pain was considered to be severe and was recorded as "severe".

When no positive reaction was obtained by this test, the procedure was repeated, but when the fist had indented the abdominal wall as far as possible the fist was suddenly withdrawn, permitting the viscera to drop down into its normal position. When the reaction in the stethoscope was positive this was indicated as "marked". When a negative response was obtained, the process was repeated but the fist was thrust suddenly and deeply into the abdominal wall over the same area. When this elicited a positive reaction, it was recorded as "moderate". When a reaction was obtained only occasionally by the last procedure but could not be consistently repeated, the indication "slight" was used.

When the procedure was conducted in this manner none of the normal animals gave a positive response and the indication "0" was used for entirely negative findings. In transposing these recordings to Fig. 3, negative findings were not designated.

N. Recording the Reflex Sensitivity

In this examination an ordinary writing pencil, seven inches in length, was sharpened to a blunt point. The tip of the pencil was rested against the skin, with only the weight of the pencil bearing on the point. The hand was used only to maintain the pencil loosely in a perpendicular

position. The area examined began at a plane drawn through the anterior border of the proximal end of the scapula and extended posteriorly to the middle of the para lumbar fossa. The pencil was brought to bear at points two inches apart beginning first with a line about three inches lateral to the spinous processes. The process was repeated on lines two inches apart, progressing laterally until a line about eighteen inches down on the ribs was reached. This was then repeated on the opposite side of the animal. If more than half of the area examined resulted in persistent twitching of the skin, the indication "severe" was used. If an area less than fifty per cent of the examined surface evidenced persistent twitching, the indication "marked" was used. When over half of the area showed momentary twitching, which promptly disappeared even though the pressure of the pencil was maintained, "moderate" was given as an index. If less than half of the area gave such a response, "slight" was used. When the procedure conducted in this manner resulted in no reaction, the word "none" was recorded.

O. Recording the Height of the Thoracic Spine

A device was used for this purpose that was specifically constructed for measuring the wither height of horses. It consisted of a wooden cross arm, about two feet in length, that was lightly rested upon the spine. This cross arm was

movable on a vertical standard. The upright standard was rested on the floor and the cross arm was raised or lowered to the proper position to rest lightly on the back of the animal. The measurements were then read from the calibrations on the standard. The reading was made at a point about six inches posterior to the dorsal tips of the scapulae.

To obtain accurate measurements it was necessary to be certain that no bedding was beneath the animal's feet or beneath the standard.

P. Use of the Metal Detector

At the beginning of the experiment each cow was examined with a metal detector. This device would register a deflection up to sixty points. Some animals had a sufficient amount of ferrous metal in the reticulum to cause the instrument to register its maximum. Others were positive but to a lesser degree. Only two failed to show any reaction whatsoever.

After the foreign bodies were administered, the metal detector was applied beneath the reticulum twice daily, and increases were considered to indicate the arrival of the administered metal into the reticulum. When the rumenotomy was performed, metal that had previously been in the reticulum was removed along with the experimental objects. The

complete removal of the ferrous metal was insured by the use of a magnet carried into the reticulum and carefully moved over the reticular mucosa. This metallic debris was weighed and recorded. It was thought that in this way the sensitiveness of the metal detector could be evaluated. After the surgery the device was again used to determine whether or not any reaction remained.

Q. Examination of Urine Samples

An examination of the urine was made regularly to determine any changes in the pH and to record the appearance of ketones and albumin. At the conclusion of the experiment it was apparent that nothing of significance had resulted from the urine studies so they are not included in this report.

III. RESULTS

The results were first organized into tables as the study was concluded for each animal. It was thought that only in this manner could the slight changes be accurately reported. It soon became apparent, however, that the number of readings was excessive and the resulting tables contained too many figures to permit an easy evaluation of the findings.

The recordings were then transposed onto graphs. It is recognized that slight variations are not easily perceived in graphic representation. It was thought, however, that the graphs were more satisfactory in representing the findings in a complete perspective.

Each complete vertical line marks the conclusion of one day. The readings on the normal days were taken at 8 A.M. and 4 P.M.. The point at which foreign bodies were administered is indicated by a heavier vertical line. The left hand arrow indicates the onset of symptoms and the right hand arrow the time of surgery.

Fig. 1. The loss of appetite for grain was complete at some point in every animal. This disturbance was present at the very onset of the disease in every animal except one, (No. 27) which consumed two normal meals before the disturbance in the appetite for grain appeared.

From the beginning of illness until surgery was performed, a total of 44 grain feedings were offered. Of these, only in four instances was the grain consumed in a normal manner. By the time of the rumenotomy there seemed to be a tendency for the grain consumption to begin to return to normal. If this was true the surgery did not seem to interfere, since in every animal the findings on the last day of the study revealed a return to normal.

Only three animals showed a complete refusal to eat over a period including more than three consecutive feedings. Thus it would seem that even though an affected animal returned to normal grain consumption, it might prove to be transitory and would not necessarily indicate the beginning of recovery.

FIG. I GRAIN CONSUMED.

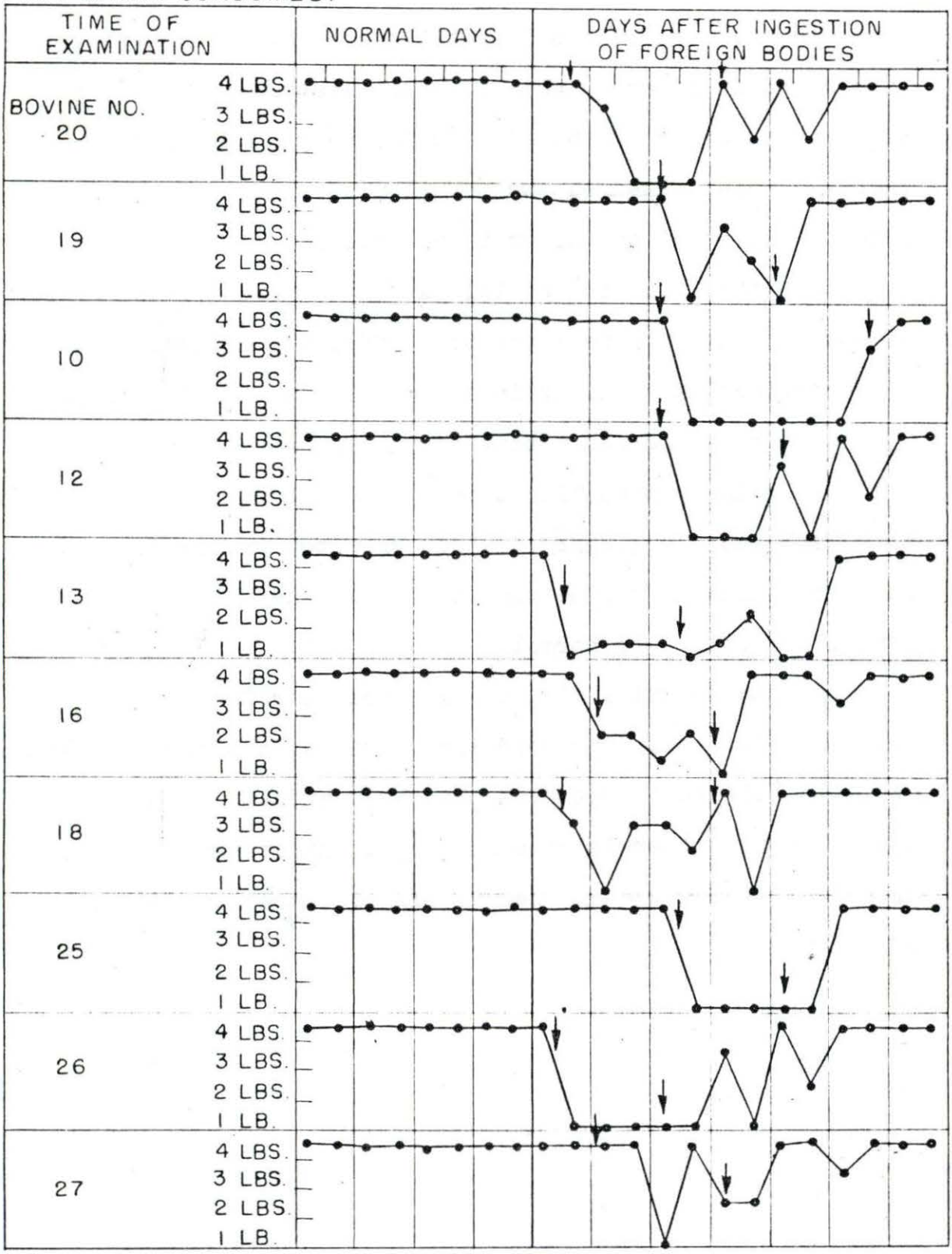


Fig. 2. The disturbance in hay consumption was not as apparent as the disturbance in grain consumption. While in each instance there was a reduction during the period of illness, in one animal (No. 20) the disturbance was negligible and in no instance was the disturbance marked. In general, there was a tendency for the appetite for hay to fluctuate widely during the period of illness. Four animals had apparently returned to normal in this respect by the time the study was discontinued.

While there was definitely demonstrated some deterioration in the appetite for hay, it would seem that the disturbance was frequently so slight and transitory that this feature might easily be misinterpreted on a field case. It was surprising to the investigator that this part of the appetite showed so little abnormality in the presence of the concurrent febrile reactions.

FIG. 2 HAY CONSUMED.

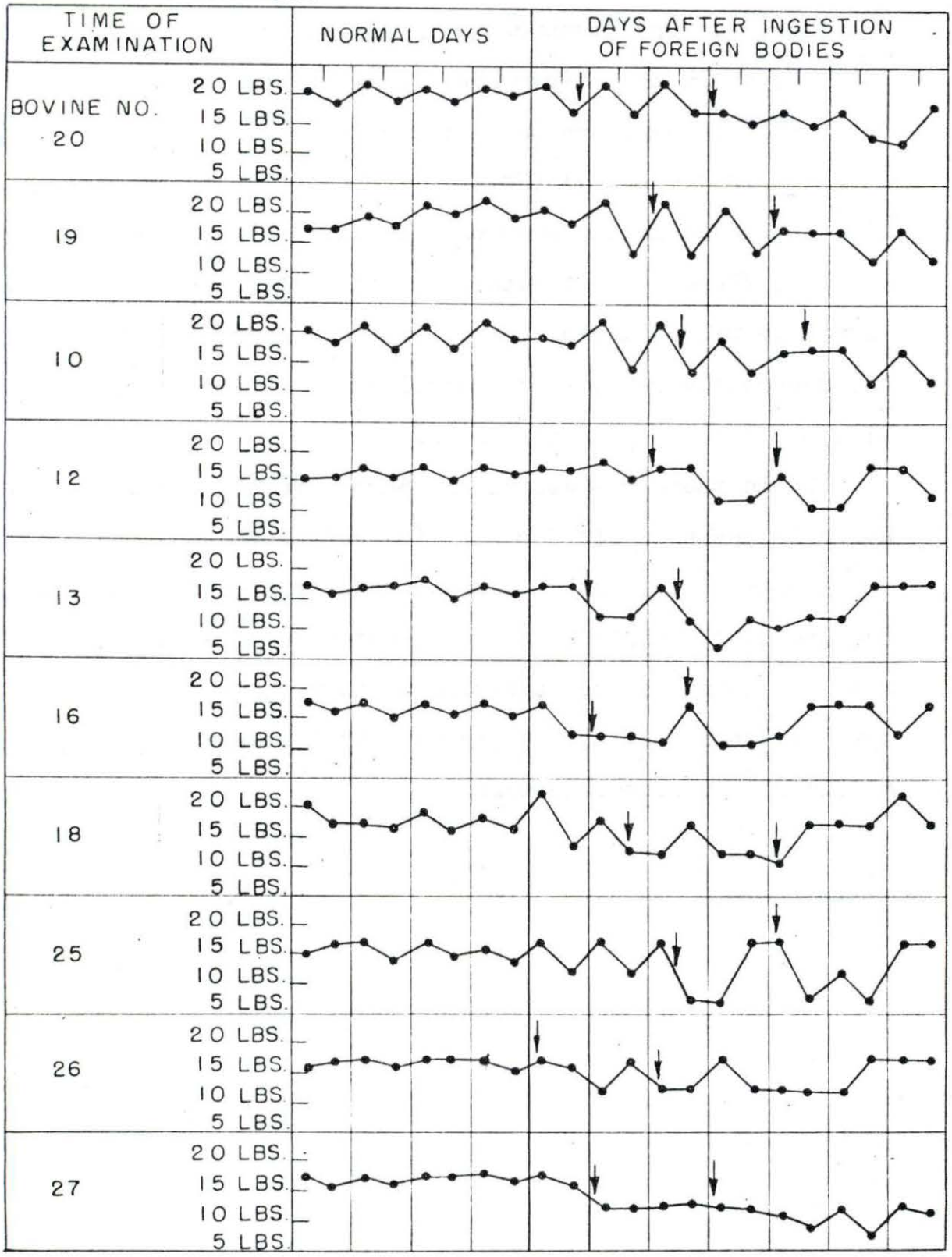


Fig. 3. The sensitivity over the xyphoid cartilage was consistently found to be an early development in the course of the disease. In every instance, the first examination following the development of symptoms demonstrated pain in that area, although there were differences in degree.

The entire lot of animals was examined 47 times between the onset of symptoms and surgery. In these examinations eleven gave marked reactions, 12 moderate, 16 slight, and eight no reaction. Only one of the negative reactions was recorded, except at the very outset of the disease.

This would seem to be a very significant finding because of its constancy and because of the limited number of conditions with which this disturbance is likely to be associated.

FIG. 3 SENSITIVITY OVER THE XYPHOID CARTILAGE.

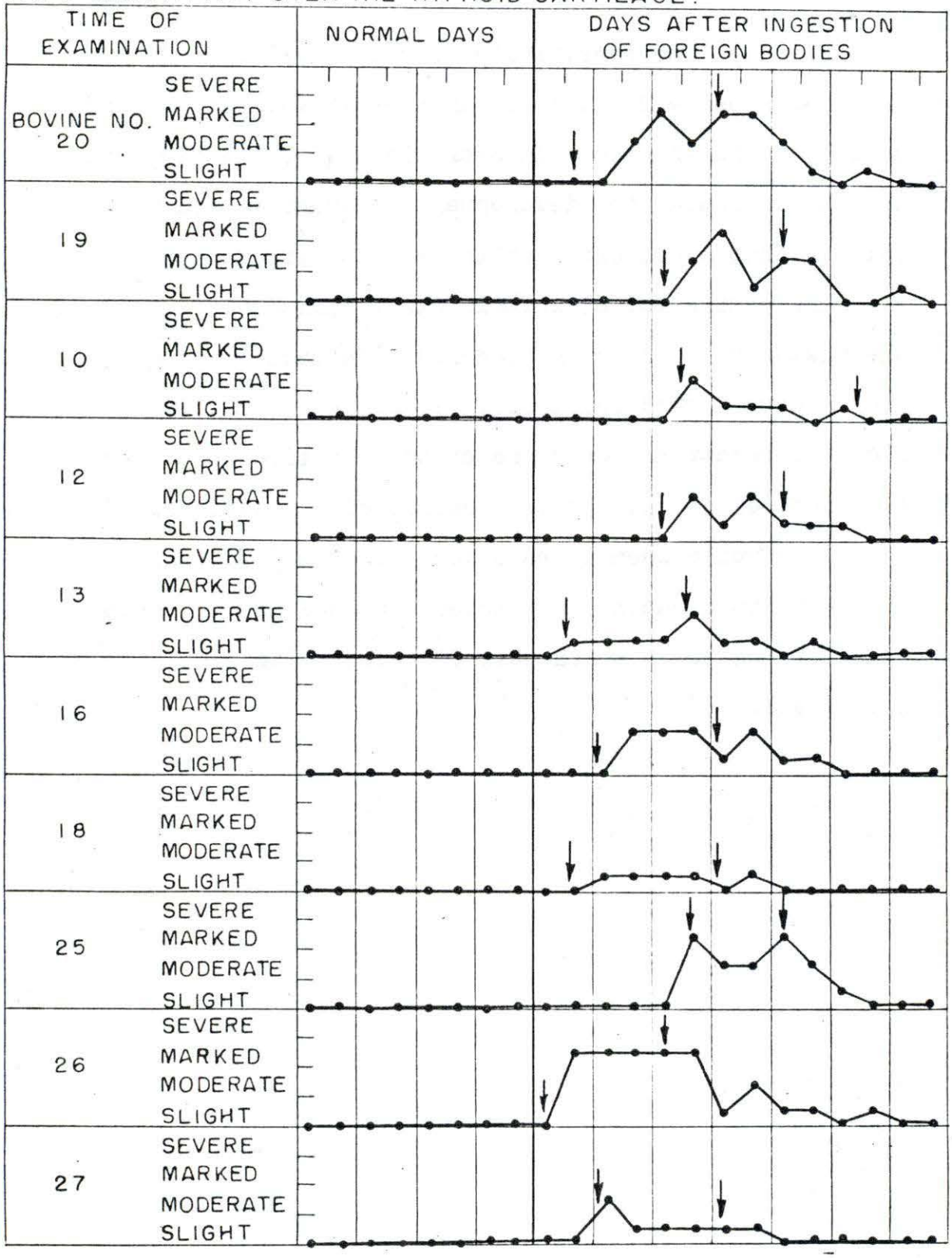


Fig. 4. The strength of the aortic pulse was disturbed in every animal except one (No. 18), in which no abnormality was detected at any time. Several others showed only slight disturbances. Of the 47 examinations made during the period between the onset of illness and the surgery, 17 readings were recorded as weak and none was found that was considered as feeble. It was thought that had this condition been permitted to extend over a longer period of time, the deterioration of the strength of the pulse might, at least in some individuals, become more pronounced.

In itself this feature does not seem to be of striking importance. An examination of the other features, however, reveals that many of them show frequent transitory returns to normal. It might be possible, even in the absence of other febrile manifestations, to detect a weakened pulse which might suggest that the other apparently normal findings should be viewed critically.

FIG. 4 STRENGTH OF AORTIC PULSE

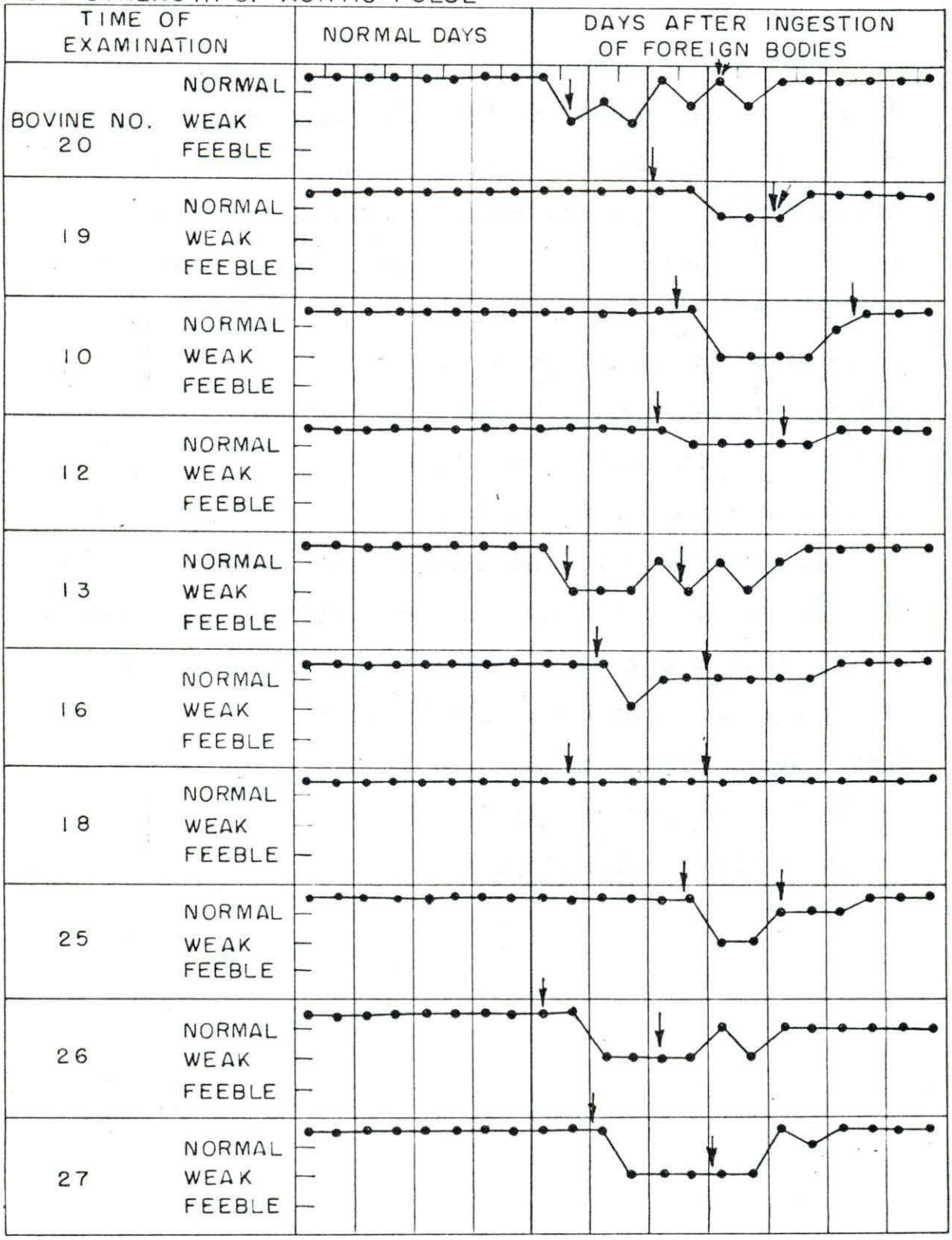


Fig. 5. The height of the thoracic spine was found to increase somewhat on certain of the animals. The most marked reaction was demonstrated by No. 26, which showed a maximum rise of three and one-half inches. Five cows showed no rise, or a negligible rise, prior to surgery.

Only three animals demonstrated any rise greater than two inches. There seemed to be a tendency for the surgery to cause a rise in the thoracic vertebrae for a time.

It seemed to the investigator that a rise of less than one inch was not readily apparent by inspection alone. Consequently, in examining a strange animal, only elevations of the spine a distance of one inch or more would be likely to be detected and peculiarities in the conformation of different animals might cause even this amount of rise to be difficult to determine.

Of the 47 examinations made between the first symptoms and the time of surgery, only 13 readings were more than an inch above normal. This would indicate that though the presence of the humped spine would be of significance, the absence of this abnormality would have limited significance.

FIG. 5 HEIGHT OF THORACIC SPINE.

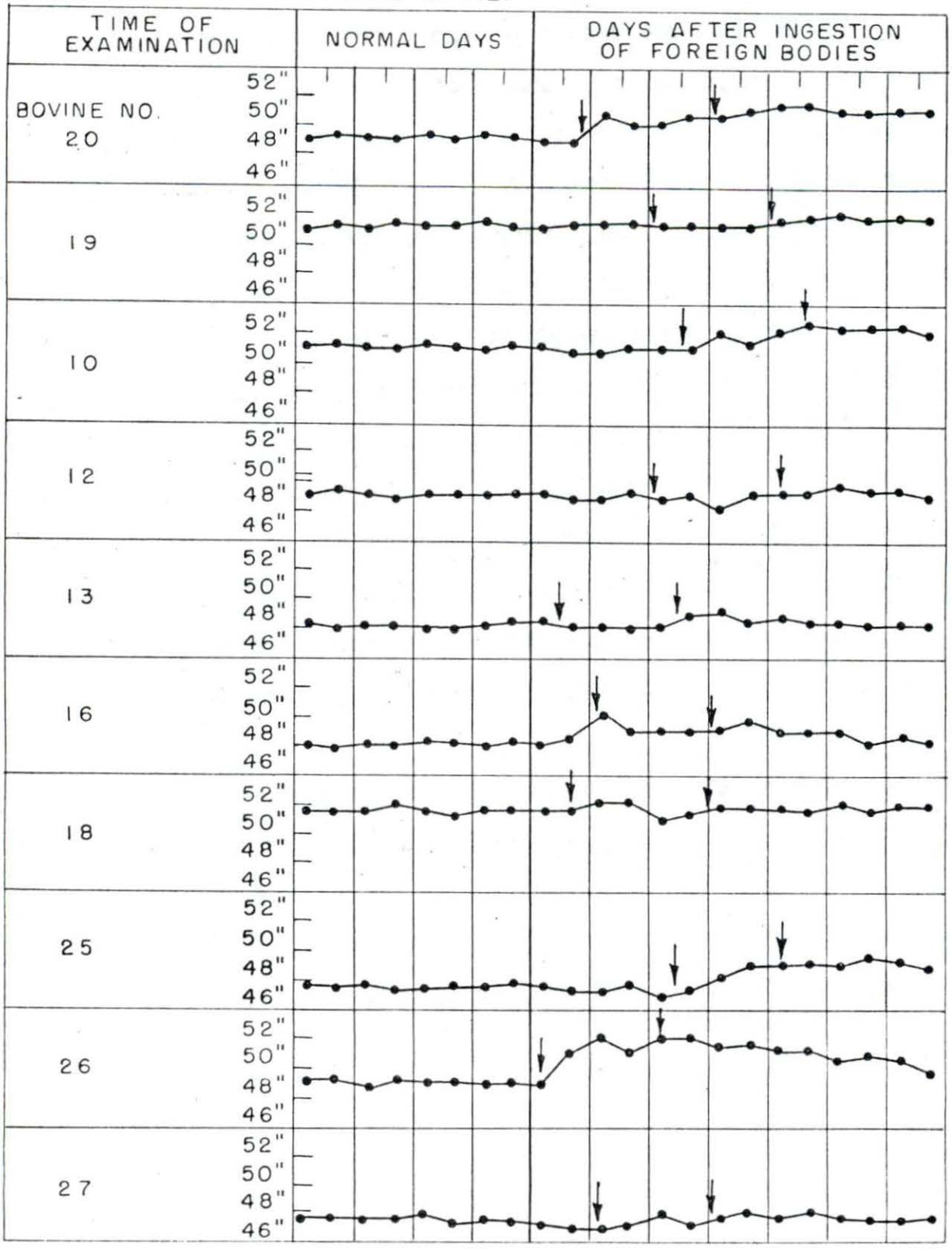


Fig. 6. The examination of the reflex sensitivity was conducted to determine whether or not the inflammatory reaction of the reticulum and adjacent structures would cause a hyperirritability to the skin over the dorsal part of the thorax. The results were entirely negative, with the only change being a marked decrease in the sensitivity on one cow (No. 13) and a similar decrease on another (No. 16) after the surgery.

There was a great variation in the response given to this test by normal animals. There were certain variations from one examination to the next in a given animal but the variation among individuals was especially distinct. From this data it would seem that this diagnostic feature has no value to the clinician but the results have been included to demonstrate the individual variations among normal animals.

It is recognized that had the disease process been permitted to develop further, this investigation might result in different findings.

FIG. 6 REFLEX SENSITIVITY

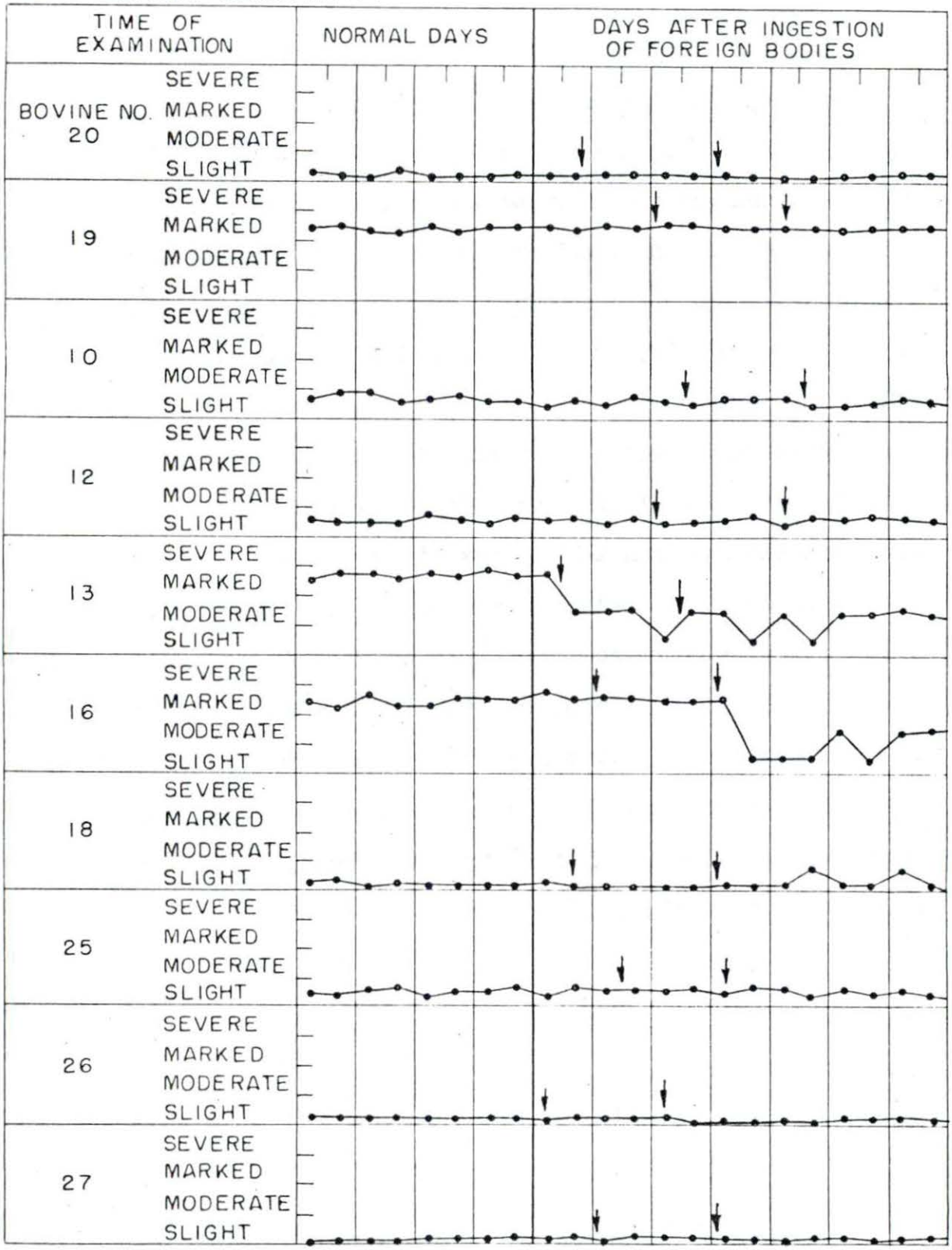


Fig. 7. The rate of rumen movements was depressed in certain of the animals during the progress of the disease. In five of the cows the disturbance was quite distinct. One animal (No. 16) did not show any recognizable disturbance in this feature. The other four animals demonstrated a tendency toward a slower rate but often the disturbance was slight and with frequent returns to normal limits.

Quite a wide range of readings was demonstrated in the examinations of the normal animals. Since a few of the normal rates were recorded as being only five movements in five minutes, it would seem necessary that the rate be markedly decreased in disease to give assurance that the rate was pathologically low. Thus, the disclosure of a reduced rate on a single examination would have limited significance. However, the tendency toward slower movements was quite apparent and this phase of the examination would seem to be worthwhile in diagnosing traumatic gastritis, although a normal rate would seem not to preclude the possibility of that condition.

FIG. 7 RUMEN MOVEMENTS IN 5 MINUTES.

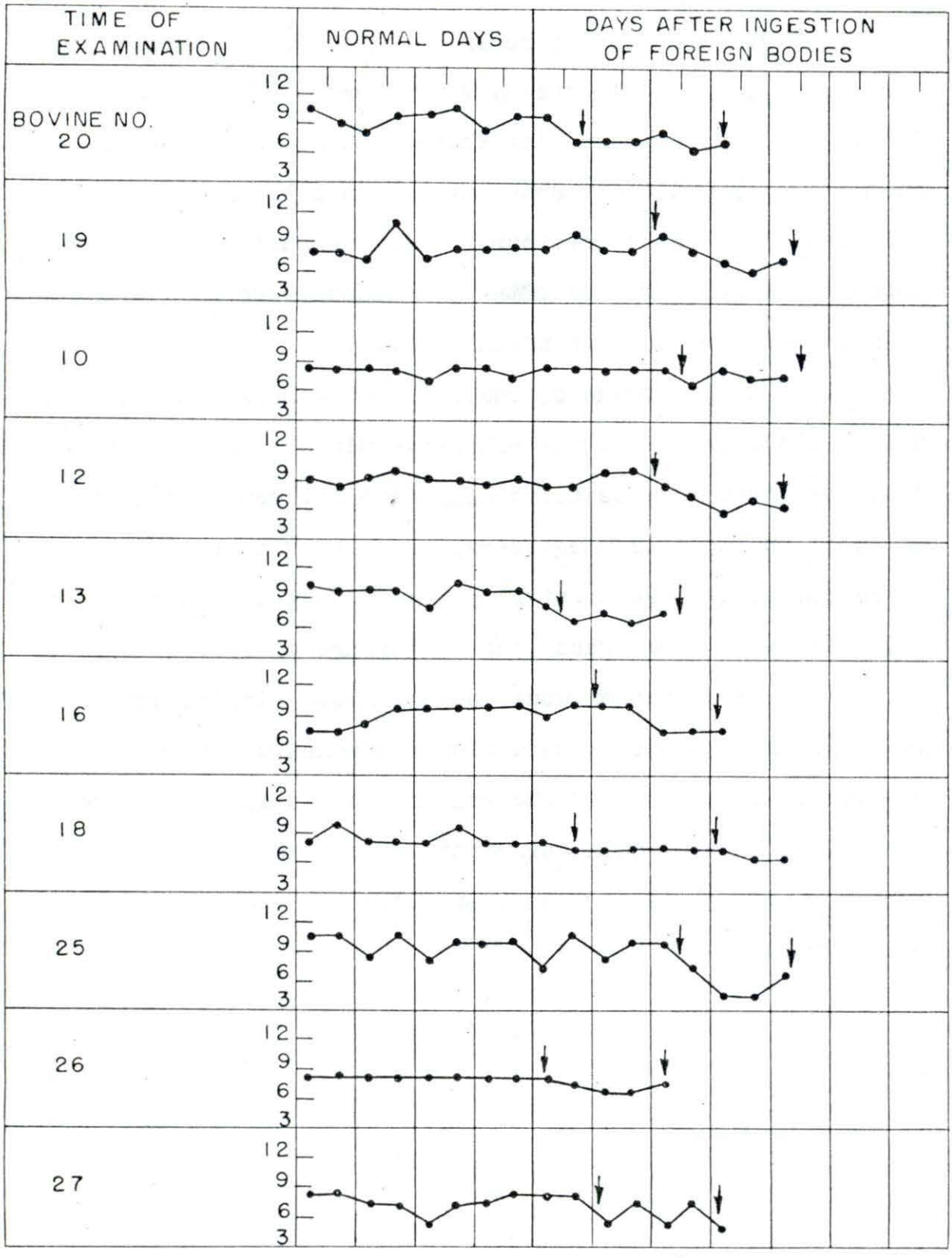


Fig. 8. The study of the strength of rumenal contractions disclosed a very pronounced and constant disturbance. The weakened contractions were present almost immediately at the onset of the illness and remained abnormally weak in each animal throughout the illness. There seemed to be no indication of a return to normal up to the time of surgery. There were no normal readings after the disturbance developed.

It would seem that in examining the rumen activity, the weakened contractions would be of greater diagnostic significance than the rate of those contractions. In comparing this graph with the one concerned with the rate of rumen contractions (Fig. 7) it is demonstrated that even though the rate may be normal the contractions may be considerably weakened.

FIG. 8 STRENGTH OF RUMEN CONTRACTIONS

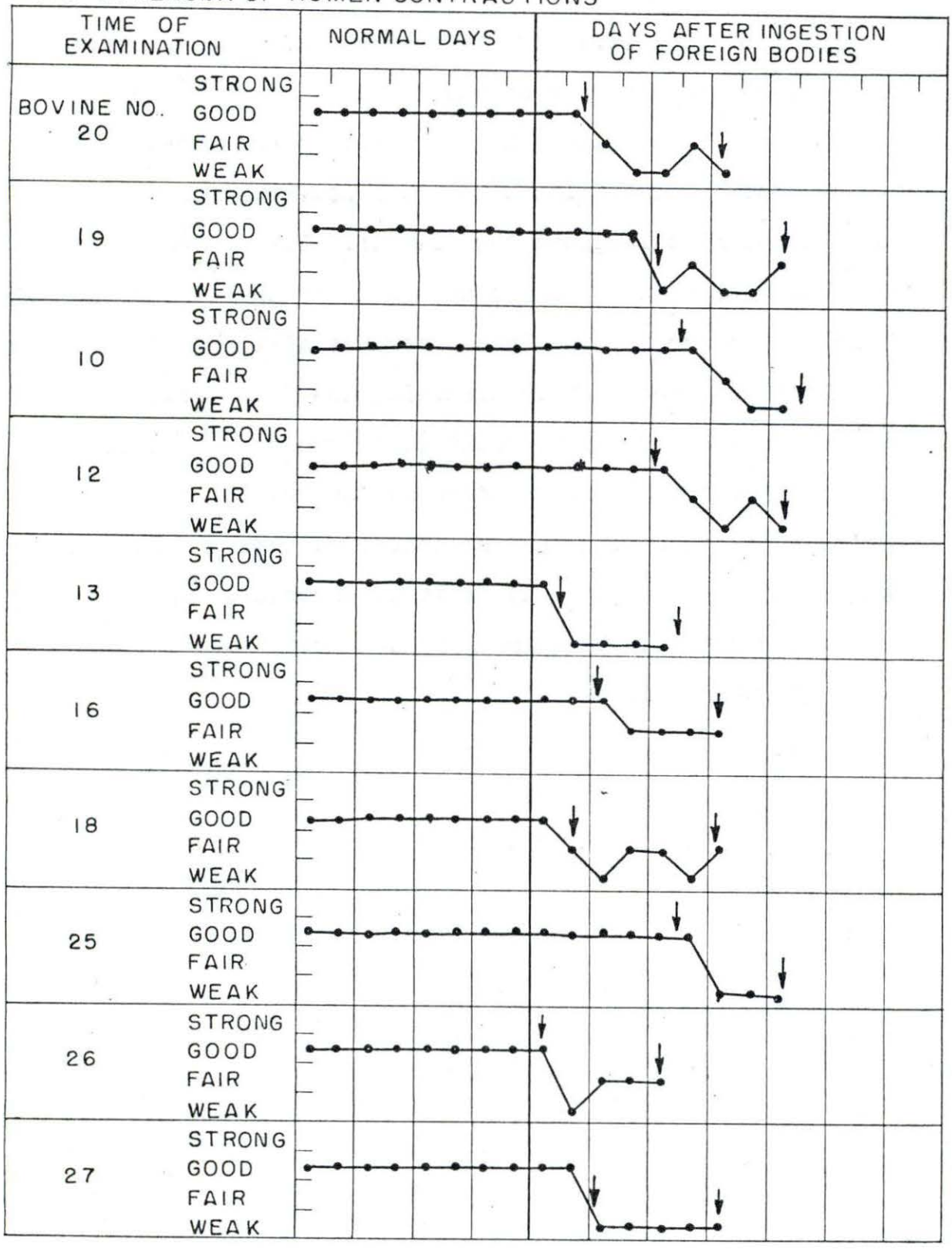


Fig. 9. In the five lactating cows it was revealed that a prompt decline in milk flow coincided with the onset of the disease.

Once the milk flow was depressed there were no normal amounts given throughout the balance of the study period. Two animals (Nos. 19 and 13) were producing only small quantities at the beginning of the experiment. With the development of the illness their milk flow became negligible and by the time the experiment was terminated they were considered to be dry.

Of the three cows (Nos. 20, 16 and 25) that were in heavier production, there was a partial return to normal about one week after the study was concluded.

It would seem that an examination of the volume of milk flow is a simple and significant feature in the diagnosis of traumatic gastritis. Since it is a disturbance that would readily be detected by the owner of a lactating dairy cow, this history might be commonly included in the owner's complaint.

FIG. 9 MILK PRODUCED.

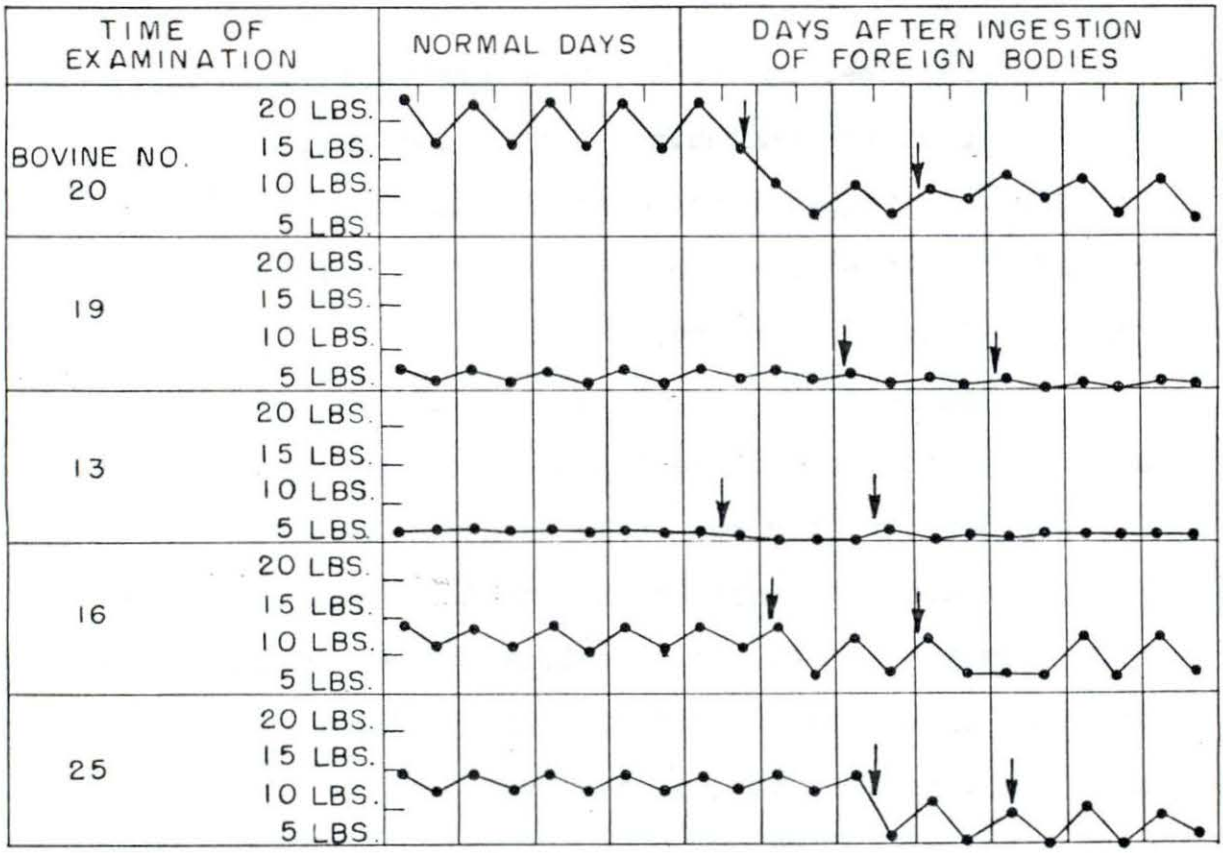


Fig. 10. Each animal showed some suppression of fecal evacuation as a part of the syndrome. Two animals, however, (Nos. 18 and 25) were only slightly disturbed. There seemed to be no definite pattern regarding the period in which the disturbance was most marked. There seemed to be a slight tendency for the amount to become somewhat more scant as the disease progressed.

In view of the fact that no animal was entirely free from this symptom it would seem that this feature would be a diagnostic aid on stabled animals that would not be apparent in pastured or yarded animals.

The return to normal did not seem to be retarded by the surgical operation and most animals were discharging fairly normal amounts of feces by the time the experiment was terminated.

FIG. 10 AMOUNT OF FECES.

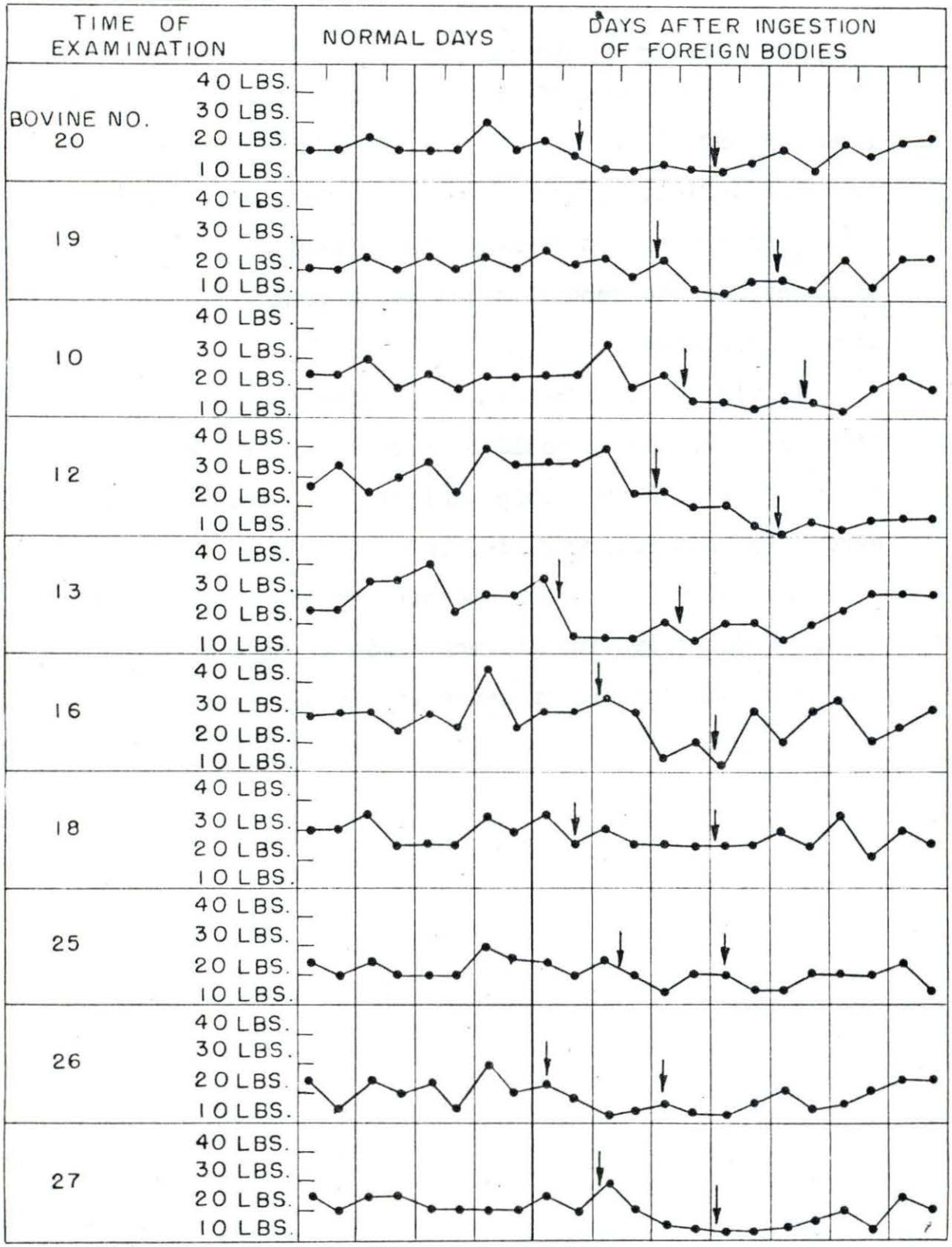


Fig. 11. The alterations that developed in the character of the feces during the illness seemed to be one of the more striking features.

Of the 42 examinations of the feces that were made between the onset of symptoms and the surgery, only four times were the feces recorded as being normal.

On the other hand, only seven times were they identified as being extremely hard. This would indicate that the most common finding would be a moderate increase in the firmness of the stools.

It had been intended that this part of the study would include the inspection for color changes of the feces, the presence of blood in the feces, or any abnormal odor of the feces. It developed, however, that these findings were entirely negative.

There was an increase in the amount of mucous excreted with the feces. This amount seemed to increase in direct proportion to the hardness of the feces so that in those evacuations that were recorded as "firm" there was only a barely perceptible increase in mucous. When the feces were hard there was always a definite increase in the amount and when small hard equine-like pellets were passed there was frequently an equal amount of mucous discharged.

FIG. II CHARACTER OF FECES.

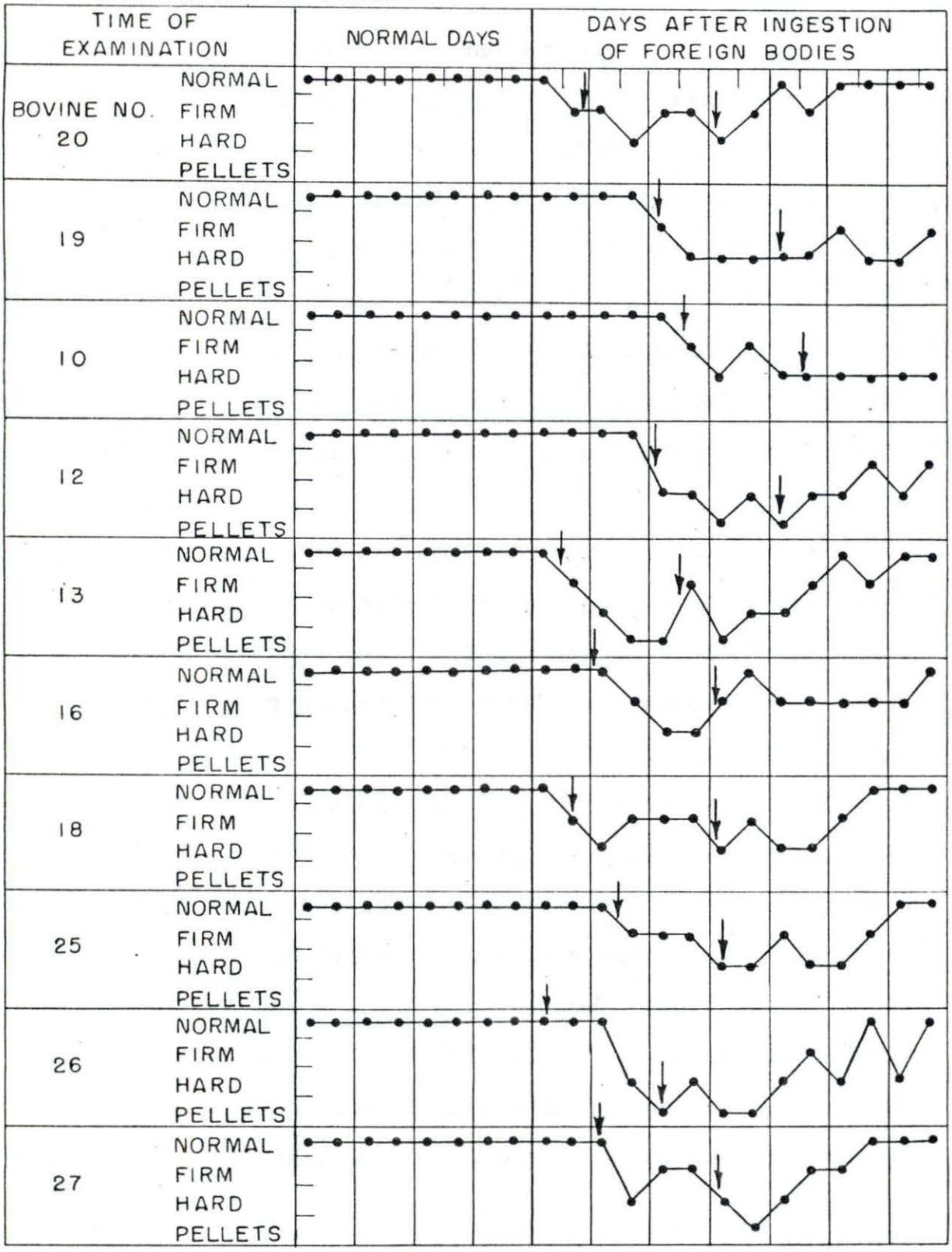


Fig. 12. In each animal there was a marked temperature rise early in the course of the disease. The marked rise tended to subside by the time of surgery and there were often wide variations recorded over a period of a few hours. There was a total of 113 temperature recordings made between the onset of symptoms and the time of surgery. Of this number 17 per cent were within the established normal range. There were only three animals that did not have at least one reading within the normal range during that time.

These results would seem to indicate that a temperature rise would be of considerable diagnostic significance and that a higher temperature is more likely to be found soon after perforation. It would also seem that a normal temperature in the presence of other suspicious findings should not preclude the possiblity of traumatic gastritis. The value of a subsequent temperaturing is demonstrated.

The surgery seemed to cause no significant temperature reaction.

FIG. 12 TEMPERATURE RECORDINGS

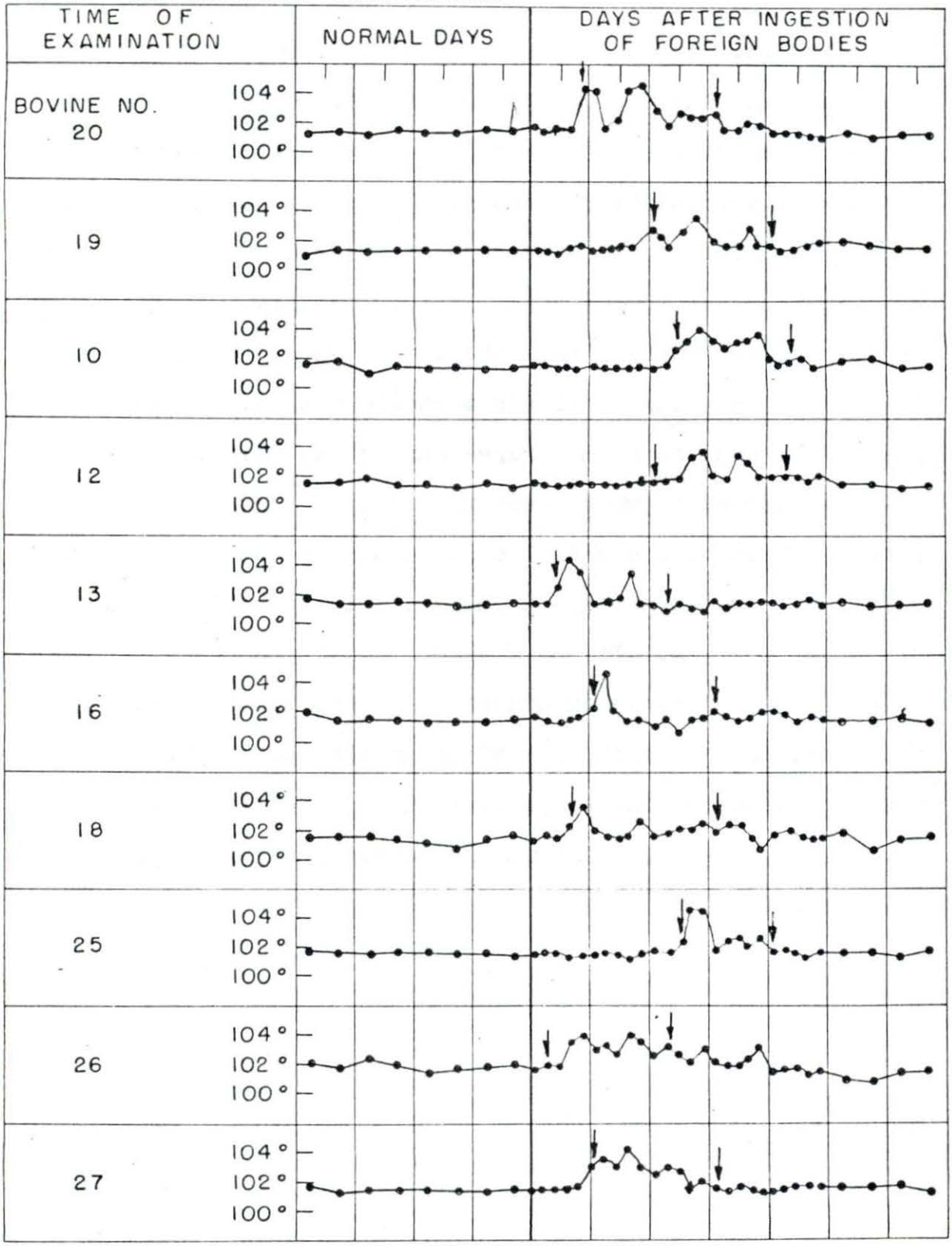


Fig. 13. The perforation of the reticulum was attended by a tendency for the animal to show an accelerated heart rate. The normal rates established, however, showed a great variation and it was not always clear what should be considered as being within the normal range. After the perforation the variations seemed to occur more rapidly. In six of the animals the increase in rate was among the first symptoms, but in three (Nos. 20, 12, 25) the significant rise came later. Two cows (Nos. 19 and 27) reached only one point above their highest normal reading, whereas the maximum increase was the sixteen-point rise shown by No. 26.

The average of the readings for the four normal days on all ten animals was 63. The average of the highest points reached during illness was only 70.

Since most animals showed an increase in the averages after the onset of symptoms it would seem that this factor is of diagnostic significance. On the other hand, the wide variations in the normal animal, and the frequent temporary return to normal in the sick animal, require some reservation in assessing the significance of the heart rate, especially if limited to one examination.

FIG. 13 HEART RATE

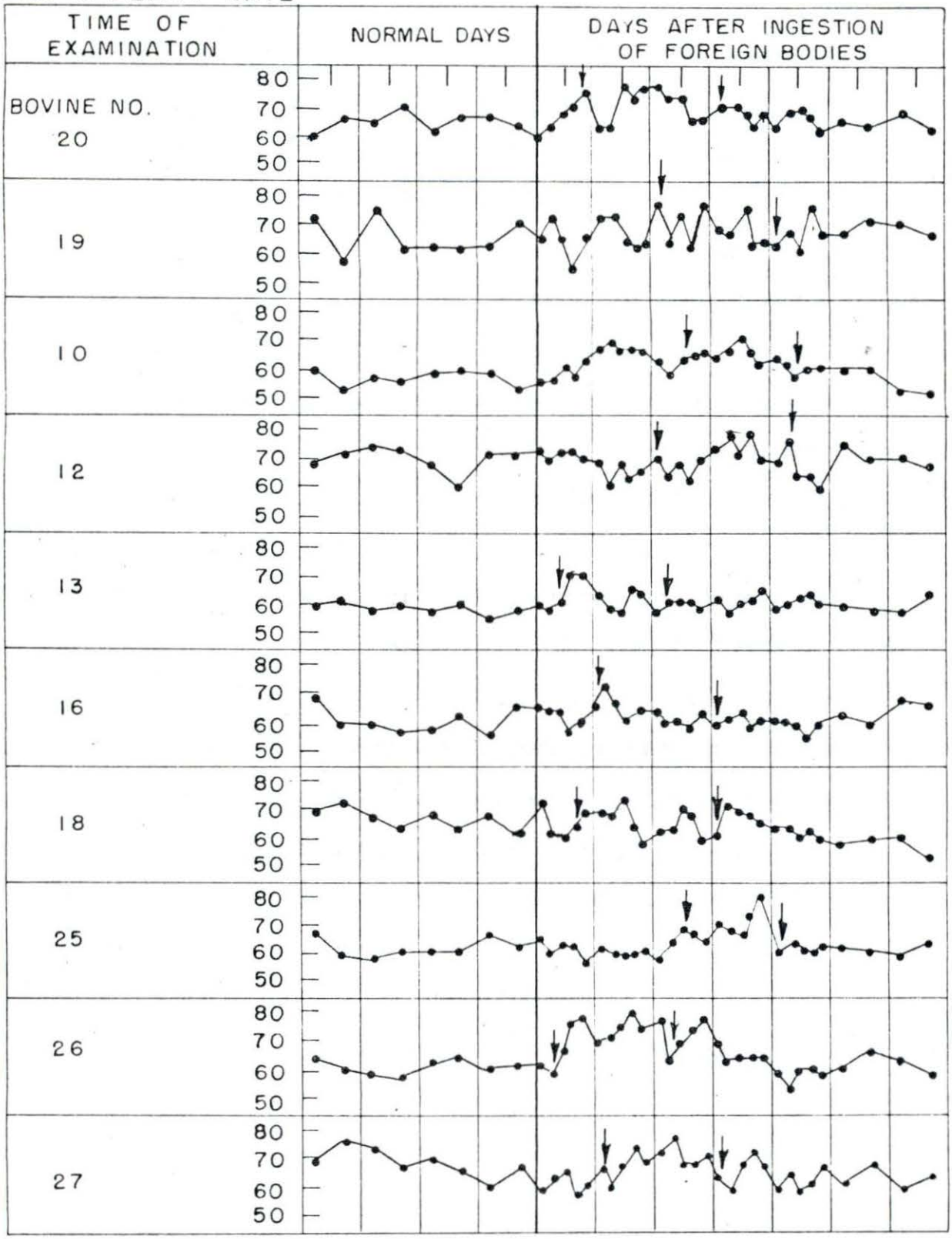


Fig. 14. From an overall standpoint there was a tendency for the respiratory rate to increase as a part of the febrile reaction. This tendency was not constant and one cow (No. 18) actually showed a three point higher normal respiratory rate than any shown during her illness. Two others (Nos. 12 and 25) only equaled their highest normal reading. The greatest rise over the highest normal was twelve points by one animal (No. 13).

Although the stable was equipped with thermostatically controlled exhaust fans, the humidity seemed to vary considerably and it was noted that when the humidity was high the respirations were accelerated in the normal animals to practically the same degree as in an animal showing a febrile reaction.

Since many barns are subjected to even greater changes in temperature and humidity, it would seem that in field cases an increase in the respiratory rate should always be considered in the light of external conditions.

FIG. 14 RESPIRATORY RATE (PER MINUTE)

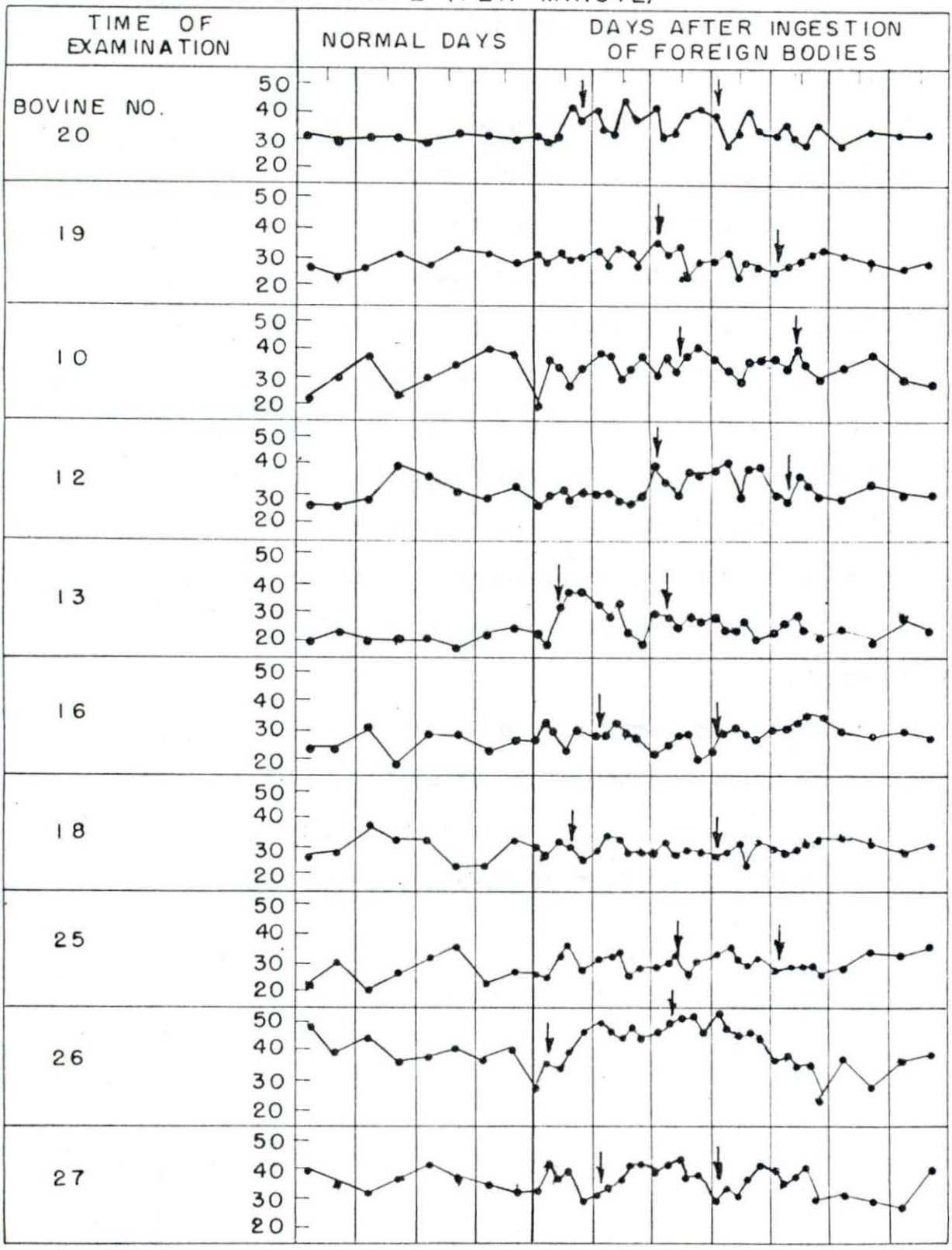


Fig. 15. In every instance the development of the disease was accompanied by a rise in the total leucocyte count. While not necessarily the first manifestation, it usually occurred within a few hours after the first symptoms appeared.

In each instance the rise was to a significant degree. The average normal reading for all animals was 8,200. The average of the highest points reached by all ten animals was 13,380.

After the first sixteen hours from the onset of symptoms there were no readings below the highest normal for each individual up to the time of surgery, except for No. 12 in which the last two readings were within normal limits, and No. 26 in which the last reading was normal.

By the time the rumenotomy was performed there seemed to be a tendency, in most instances, for the count to be receding toward normal. This seems to indicate that a normal leucocyte count in the presence of other symptoms might suggest either the very early stages, or that at least two or three days had elapsed from the time of penetration.

While cow No. 25 showed a definite increase over her normal reading, her normal readings were only an average of 5,170. Consequently, during her febrile stage the highest point was only about equal to the normal readings on the

other animals.

This would suggest that some apparently normal animals show an abnormal leucocyte count and some reservation must be used in interpreting a disturbed count under field conditions.

FIG. 15 TOTAL LEUCOCYTE COUNT (PER CMM.)

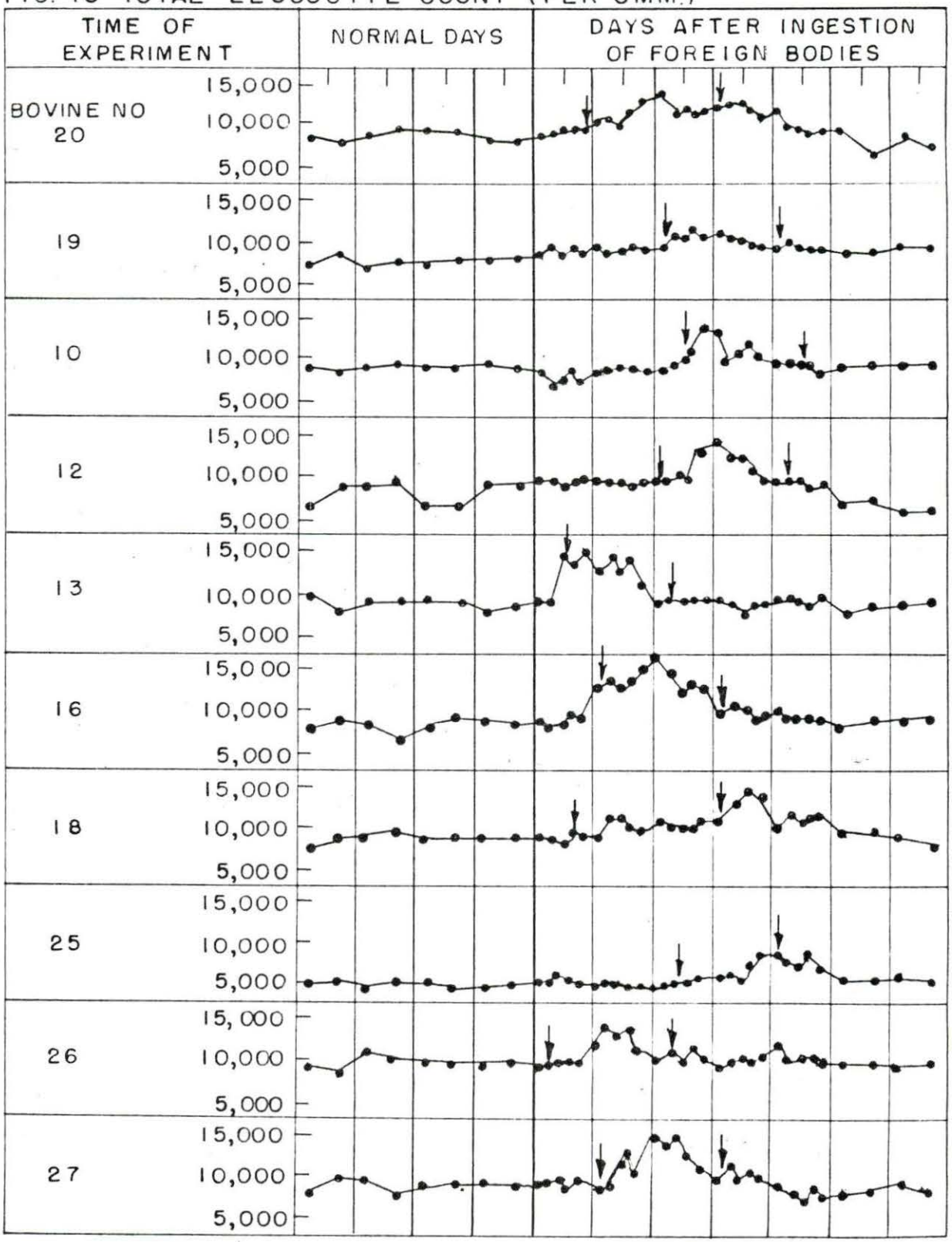


Fig. 16. The increase in the percentage of the leucocytes that were segmented neutrophiles was a consistent finding in every animal. It was noteworthy that this percentage increase often developed before any increase in the total leucocyte count. This apparently was possible because of a concurrent lymphocytopenia.

A significant rise developed within 12 hours from the initial symptoms in all animals except two (Nos. 25 and 27). These two showed a rise on the second day. The general tendency was for the readings to remain above normal for a time even after the surgery was performed.

Thus, it would seem that it would be difficult to establish from this form of inquiry whether the perforation had just occurred or was of several days' standing. However, the persistent increase should be of considerable significance in establishing the diagnosis.

FIG. 16 SEGMENTED NEUTROPHILES (PER CENT)

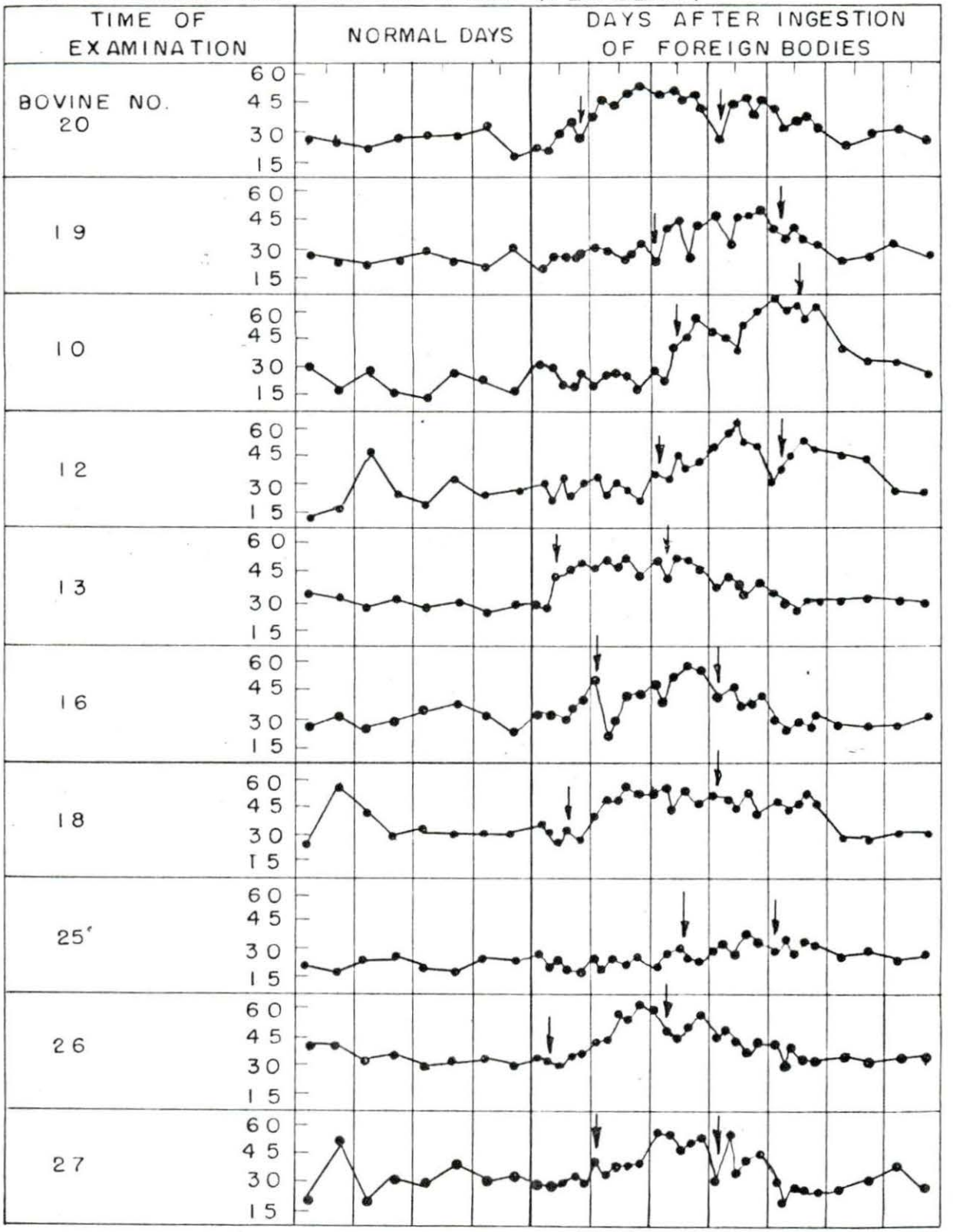


Fig. 17. The increased percentage of stab cells in the total leucocyte count was quite a consistent disturbance in each animal. The average of the normal readings of all animals was 5.8 per cent. The animal showing the greatest increase over the average normal was No. 16, which showed a 30 point increase. The least difference was from cow No. 10 which showed only a 4 point increase.

It was noteworthy that in certain instances when the total leucocyte count seemed to be within normal limits, the presence of an abnormally large percentage of stab cells could be relied upon to indicate the presence of infection.

The increase usually developed early in the course of the disease and tended to persist for a time even after surgery was completed. The surgery itself seemed to result in no definite disturbance in these findings.

FIG. 17 NON-SEGMENTED NEUTROPHILES (PER CENT)

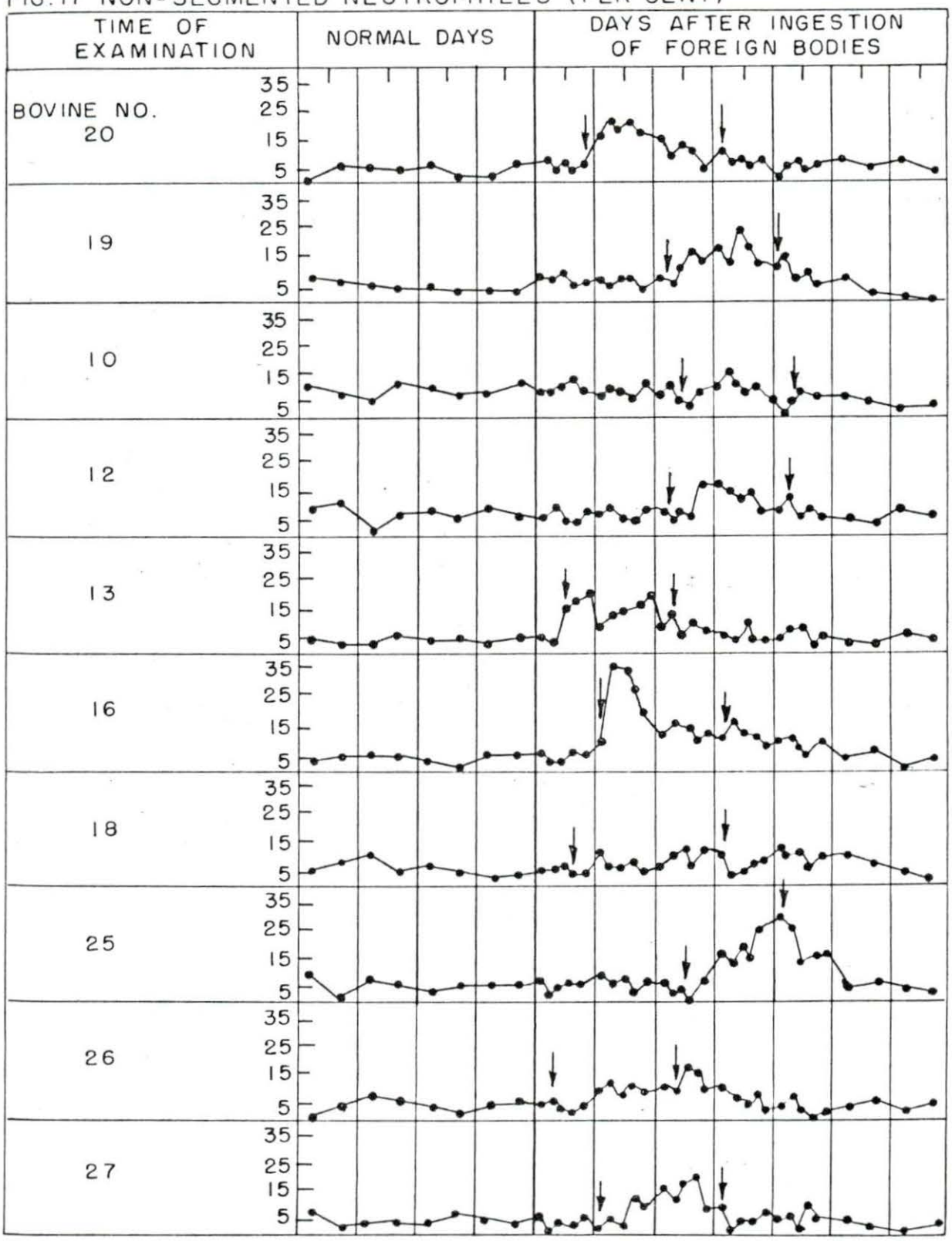


Fig. 18. To establish the average normal readings the first readings of all animals were averaged, the second normal readings were averaged, and the process was continued to establish for each type of examination the average readings for the first five days.

It was determined that the onset of symptoms developed, on the average, eighteen hours after the ingestion of the foreign bodies. To establish the average reaction of the group, the first readings after the apparent onset of symptoms were averaged, the second readings for each animal were averaged, and so on until the entire post-operative observation period was covered.

It was found that surgery was performed on an average of 48 hours after the onset of symptoms, so the graph was prepared accordingly. This was done so that, for example, the ninth examination after the beginning of illness represents the average ninth reading for each animal after onset.

The resulting graph presents a somewhat different aspect than the individual charts. The individual charts demonstrated fluctuations from one reading to the next in many of the features. However, the averages show the general trend without the marked fluctuations. It was also seen on the individual graphs that certain of the diagnostic features would develop early in most animals but somewhat

later in a few. This graph of averages, on the other hand, does not show such peculiarities but represents the stage at which the majority of the animals showed reactions.

Consequently, this graph does not necessarily represent the course that an individual animal is likely to take, but, rather, represents the general trend to which the majority of animals are likely to conform.

The temperature reaction indicates a very significant feature, the average reading being above normal for nearly three days. The highest point was reached within eight hours from the onset and then began a gradual return to normal. This fact may be of significance in determining the stage of the disease.

The heart rate began to accelerate with the onset of symptoms and continued to increase for a period of twenty four hours, at which time it began to subside although it remained above normal until the time of surgery. It was interesting to note that this feature did not conform closely to the temperature rise in time and degree even though both features are part of a febrile reaction.

The respiratory rate definitely increased during the period of illness. The increase was not great, however, and since the individual normal animals showed such wide variations it would seem that an occasional examination of

the respiratory rate would be of only limited diagnostic value.

The total leucocyte count began to increase immediately with the onset of symptoms and continued to rise for a period of twenty four hours. It remained near this high point for about six hours and then began to decline. The first twenty four hour period of the decline was marked, but there then was a tendency to level off at a slightly above normal reading for the duration of the study. The surgery may have been a factor in preventing the return to normal, although even before surgery the tendency was suggested.

The percentage of segmented neutrophiles followed a pattern very similar to the total leucocyte count, although the highest readings came twelve hours later in the course of the disease and the decline came more slowly. The return to normal limits did seem to have been completed within the period of study, however.

The percentage of non-segmented neutrophiles increased, in a general manner, in direct proportion to the total count and to the percentage of segmented neutrophiles. The return to normal developed slightly earlier than the other two features and then dropped slightly below normal for the last two days of the study.

In view of the reactions demonstrated by these three features of blood study it would seem that they should be considered as quite consistent and significant findings associated with traumatic reticulitis. Since each of these readings was subject to variations and even occasional returns to near normal on individual animals, it would seem that all three features should be routinely examined. Even though one feature might be within normal limits at a particular time, it is likely that one or both of the others would disclose a significant disturbance.

The amount of grain consumed indicates that an evaluation of the appetite is a significant and simple part of the examination. This disturbance began with a marked decrease in the appetite for grain which persisted, on the average, until a day after surgery. After the appetite began to improve it was marked by occasional lags and apparently was only returning to normal at the time the study was terminated.

The hay consumed during the illness was somewhat less than the normal daily consumption. The decrease was slight, however, and under normal field conditions such a slight disturbance might be difficult to detect. This would indicate that an animal receiving only hay and no grain might seem to have a normal appetite and that this feature might easily be misleading.

An increased sensitivity of the area over and around the xyphoid cartilage was present, on the average, within the first few hours of the onset. From this point there was a gradual decline over a period of four days until the sensitivity was again normal. Had the foreign bodies not been removed it is probable that this early return to normal would not have occurred, although there was a definite indication that the sensations were becoming less severe by the time of surgery.

The character of the aortic pulse was disturbed to a slight degree in that, on the average, there was a decrease in the strength of the pulse wave coincident with the development of the other symptoms. This disturbance persisted for four days. However, on the average, the disturbance was not great, and while the weakness was sufficiently pronounced to be easily recognized in a few animals, it could not be considered as being among the most reliable clinical findings.

The height of the thoracic spine on individual animals showed variation from day to day but the average of the group demonstrated a one inch rise occurring within twelve hours and then persisting throughout the period of study. From this we might interpret that the elevation of the spinous processes of the thoracic vertebrae is a quite constant feature although the degree may not be marked.

The examination of the reflex sensitivity of the animals indicated a definite decrease in two individuals. In none was there an increase. The average findings represent a disturbance so slight that this diagnostic feature would seem to be of limited significance.

The rate of rumen movements showed considerable variation among the normal readings. This rate was promptly slowed with the beginning of symptoms and became progressively slower for the following twenty four hours. Even though there were wide deviations in the normal readings the overall average indicates that there is likely to be a sufficient disturbance associated with the disease to be of diagnostic significance.

The strength of rumen contractions was disturbed in nearly direct proportion to the disturbance in rate. Certain individuals showed readings in which only one of these two features was definitely abnormal but it appears that, on the average, the deviation from normal is likely to be concurrent in the two features.

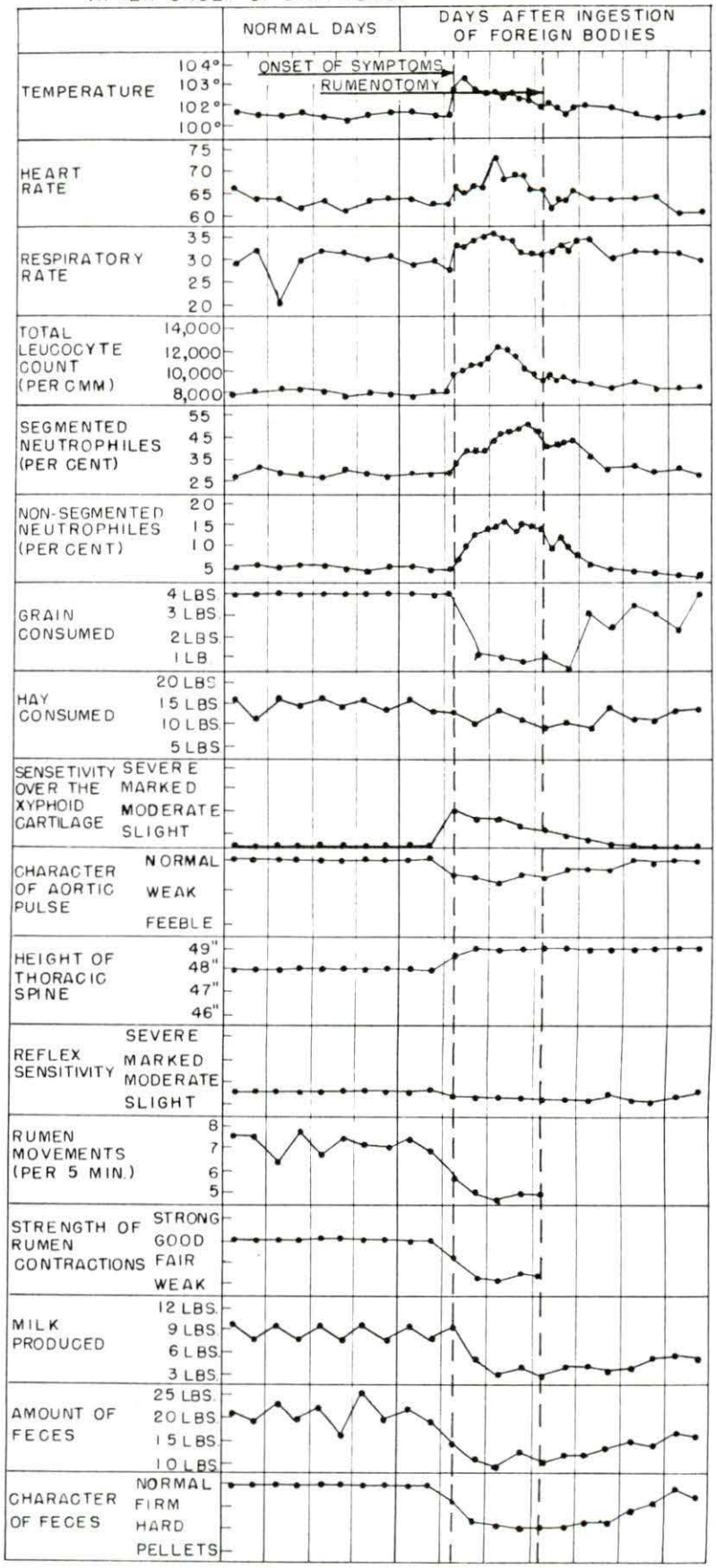
The amount of milk produced was promptly diminished with the advent of illness. Only five animals were lactating at the time of the experiment, but each of these individuals was similarly affected. Within twenty four hours the lowest point was reached and by the time the study was

completed the volume of the averages had made only a partial return to normal. This would appear to be a valuable clinical feature in the lactating animal that is not available in the examination of the dry cow.

The amount of feces excreted was diminished early in the disease and remained below the normal limits throughout the period of study. Although there was considerable variation in the amount excreted by the normal animal, the average decrease was sufficiently marked to indicate that this should be a quite consistent disturbance.

The character of the feces was altered much in proportion to their amount. The smaller the amount the more abnormal the consistency. While certain individuals at times discharged only small, hard, equine-like pellets the average animal evacuated larger, but abnormally hard masses for a period of five days after the onset of symptoms.

FIG. 18 AVERAGE NORMAL READINGS AND AVERAGE READINGS AFTER ONSET OF SYMPTOMS.



IV. DISCUSSION

In this study ten healthy adult cows were used in an attempt to create, in each traumatic reticulitis. At the beginning of the experiment each animal was examined regularly twice per day for four days. At the end of this time sharpened foreign bodies were administered to the animal per orum. Then the regular examinations were continued and the findings recorded until there was evidence of traumatic gastritis. When the disease had persisted approximately 48 hours the foreign bodies were removed surgically and the study was continued until the outcome seemed apparent.

The purposes of this experiment were: 1. to attempt to evaluate the significance of the symptoms usually associated with the disease, 2. to search for abnormal changes that would indicate the stage of the disease, 3. to identify any clinical features that had not yet been reported relative to the condition, 4. to ascertain the results of surgical removal of the offending foreign bodies after a delay of approximately 48 hours.

The results from these ten animals indicated that there are frequently variations in the clinical picture among different animals and even in one animal at examinations only a few hours apart. On the other hand, there was a remarkable

uniformity in the symptoms evident in the group, and in their general trend throughout the disease.

Certain of the features would show an occasional return to normal during the disease. Because of this it would seem that the diagnosis should be based upon the composite findings rather than on any given symptom.

The temperature was found to be elevated most of the time, but did show occasional returns to normal. Merriman (1953) reports seeing the temperature, when checked every two hours for eight hours, go from 100.8 to 104.5 and back to 101.5. The heart and respiratory rates demonstrated a tendency to accelerate during the disease but were less consistent than the temperature rise. Liegeois (1949) said respirations are accelerated and of the costal type. Also, the readings on the normal animals varied to such an extent as to make it difficult to be certain what readings should be considered as abnormal.

The blood studies were significant from both a negative and positive standpoint. The blood examinations included hemoglobin determinations, erythrocyte counts, total leucocyte counts, and differential leucocyte counts. Of these studies only the total leucocyte count and the percentages of segmented and non-segmented neutrophiles showed distinct changes consistently in the course of study. Concurrent

with these changes was a relative decrease in lymphocytes. This response by the blood conforms with Shillings (1929) description of hemocytological changes in the presence of an inflammatory tissue reaction.

It might be mentioned that even after the author had run a large number of these blood counts there were occasionally readings that seemed entirely out of proportion. In these instances the procedure would be repeated on another blood sample. Had this not been done the results would not have conformed to a pattern as well as reported. This factor must be considered when blood studies are applied to field cases in which the examination is frequently limited to one sample. The total leucocyte count during the course of the disease was usually between 10,000 and 15,000 per cmm. This supports the report of Arther (1946) who found that in ten field cases the leucocyte count varied between 7,300 and 12,000. His lower counts were probably the result of readings taken at later stages of the disease, after the inflammatory process had subsided. Apparently the later stages are often accompanied by a decline in the total leucocyte count. This tendency was demonstrated even before the surgery in this study.

Dougherty, (1939) working on three cows with rumen fistulae, inserted foreign bodies through the reticular wall and then studied the hemocytological changes. He

reported that blood changes occurred within four to six hours after the foreign bodies were inserted, but tended to return to normal limits within a few days.

The high total white count was the result of an increased number of neutrophiles. Their increase was only partly offset by a concurrent lymphocytopenia. The proportion of nearly twice the number of lymphocytes to neutrophiles on the normal animal tended to reverse itself during the course of the disease. Both Dougherty and Arthur reported that the neutrophilia was due largely to an increase in non-segmented neutrophiles. In the current report there was an increase in the percentage of non-segmented neutrophiles, although the increase was considerably less than that reported by the two previous investigators. In the current report the non-segmented neutrophiles constituted 5 to 35 per cent of the total count during the illness. Arthur reported that the unsegmented neutrophiles varied from 8 to 38 per cent and Dougherty reported them as constituting as much as 85 per cent. This discrepancy may be the result of different opinions by individuals as to what should be considered as a non-segmented cell. Fitz-Hugh (1932) reports that in separating mature from immature cells the distinction should be based on cytoplasmic as well as nuclear morphology.

According to Coffin (1953) the values obtained in this classification will vary greatly with the individual examiner

since the factor of personal decision plays a serious part in the classification of young cells. It is therefore necessary for each examiner to establish his own standards of calssification or attempt to correlate his findings with those of other workers.

The disturbance in appetite proved to be a significant feature associated with the disease. It was found that the appetite for grain was considerably more sensitive than the appetite for hay. Both of these features would be significant in the examination of a field case. In the light of these findings, an animal showing no disturbance in grain consumption would not conform to the behavior demonstrated by these experimental animals with traumatic gastritis, and an animal on a "strictly hay" ration might show little loss of appetite even though suffering from the disease.

It was found that a weakening of the aortic pulse frequently accompanied the febrile period. This feature would seem to be of value in confirming a diagnosis but was not marked or consistent enough to justify considering it as being of primary significance.

The development of a tenderness in the area of the xyphoid cartilage seems to be a factor of great diagnostic significance. It is important because it was a nearly constant feature in the early stage of the disease and it

would seem to be especially important as a differentiating feature to distinguish between traumatic gastritis and other diseases showing similar febrile and digestive disturbances. Hansen (1953) reports that in his experience the only other conditions that can produce a similar reaction are pleuritis, and peritonitis from other causes, which he states can be easily differentiated from traumatic gastritis.

Since a reaction to this examination is not always pronounced it would seem wise for a clinician to be familiar with the test on a number of normal animals so that he would be able to identify even slight manifestations of pain from this procedure. It is the opinion of this investigator that a positive reaction to this form of clinical inquiry is the most nearly pathognomonic of traumatic gastritis.

Certain of the animals demonstrated a definite kyphosis during the course of the disease. Often, however, the rise of the spine was negligible or appeared only transitorily. Since this is not a constant feature, and since kyphosis occurs in other diseases, this cannot be considered as being of primary importance. Its presence in company with other typical symptoms would have substantiating value, however.

The milk secretion was suppressed immediately with the onset of symptoms. While this feature is of limited significance in differential diagnosis, it is an easily accessible

symptom that should be expected to be present in most cases of early traumatic gastritis. It has been observed by the author, in the field, that this symptom enables the dairyman to detect traumatic gastritis in a lactating dairy cow much earlier than in the dry cows or nurse cows.

The fecal evacuations were studied in order to detect any significant changes in the amount or character of the feces. The findings indicated that a decrease in the amount and an increase in firmness are associated with traumatic gastritis. This tendency developed early in the course of the disease and remained fairly constant throughout the illness. As the fecal evacuations became harder there was a coincident increase in the amount of mucous excreted with the feces. In no instance was there any evidence of the feces becoming softer. Neither was any observable blood passed with the feces, as was reported by Holterbach (1906) and Friedberger and Fröhner (1895).

The information recorded concerning the rumen activity disclosed a slight suppression of the rate of contractions. This disturbance, however, was not as pronounced as might be expected in view of the febrile reaction. The strength of the rumen contractions, on the other hand, was severely depressed. Thus it would seem that in examining the function of the rumen it is of greater significance to ascertain the tonus of the rumen wall than the rate of its contractions.

While conducting this part of the examination the investigator made a special point of searching for any signs of tympany. Bosshart (1926) and Hutyra and Marek (1917) report tympany as being common, and Friedberger and Fröhner (1895) state that, as a rule, chronic tympanitis is the salient symptom. Hutyra et al (1938) includes in the characteristic symptoms a rumbling and whistling sound heard over the rumen. In this investigation there was no evidence of an excessive accumulation of gas in the rumen. It has been previously observed by the author that atony of the rumen in an animal on dry feed, as these were, is unlikely to result in bloat. However, animals on succulent, especially legume, pasture tend to develop tympanitis with even a slight disturbance in rumen motility. This would indicate that, in examining for traumatic gastritis, the absence of rumen tympany might be expected in animals on dry feed.

Friedberger and Fröhner (1895) reported commonly observing colics with stamping, and kicking at the abdomen. They reported that at times these troubles simulate the symptoms of invagination. Aghion(1943) also states that tympanitis plays a leading part in the symptomatology. Other authors make no mention of this behavior. No colicy symptoms

were observed in the experimental animals even though they were under nearly constant inspection.

The examinations for an increase in the sensitivity over the dorsal thorax were negative with the exception that the two animals showing the greatest amount of depression showed a loss in the sensitivity over that area.

Hansen (1953) reports that squeezing on the back directly dorsal to the reticulum will often elicit a grunt from an animal with traumatic gastritis. Bosshart (1926) states that pressure upon the spine from both sides, or picking up the skin over it, may bring out groaning. This procedure was repeated at regular intervals on the experimental animals. It was noted that this process caused no reaction from certain of the normal animals but severe discomfiture to some. With the advent of illness the same responses were given by each animal as they had given prior to illness.

The urine was regularly examined for changes in pH, the presence of albumin, and the presence of ketones. These findings were entirely negative with the exception that one cow showed a positive ketone reaction occasionally, both before and after illness. These findings are contrary to the results given by Meidiger (1917), who found albuminuria in 29 out of 33 cows with traumatic gastritis.

Bosshart (1926) reports that trembling of the posterior

scapular muscles had been noticed in the larger part of his cases. Bardwell and Udall (1927) state that in almost every case they had observed there was trembling of the muscles over the left side back of the elbow, occasionally over the rumen, and rarely over both sides. Gibbons (1932) reports that four out of 50 affected animals showed this symptom. There seems little doubt but that this feature may be associated with traumatic gastritis. Since none of the experimental animals demonstrated this manifestation it is assumed that it is not a very constant symptom.

Maddy (1954) reports frequent swallowing to be a significant sign of traumatic gastritis. This behavior was not detected on any of the experimental animals. Three animals, however, did show excessive salivation for approximately the first 36 hours of illness.

It was also seen that these same three animals held the head in an extended position, giving the impression of suffering from internal pain.

At the beginning of the experiment the animals were maintained in steel stanchions and on a concrete floor. They had not moved from these stanchions for 60 - 90 days. When the foreign bodies were administered they were removed to box stalls where they could be more closely observed and where abnormalities in movement could be more easily detected.

It seemed, however, that the long period without exercise caused a certain amount of stiffness to be shown when the animals were permitted to move about. Consequently, no data were recorded concerning disturbances in gait since the normal gait could not be considered typical. There was, however, no grunting associated with movement heard at any time, although Matteson et al (1953) reports this to be a major symptom.

Holterbach (1906) reports that the affection exceptionally begins with gagging or vomiting through the mouth and nose. This was not evidenced by any of the experimental cows, although the author has encountered this behavior occasionally in field cases of traumatic gastritis.

In viewing the results of this experiment from an overall perspective it seems evident that the findings substantiate many of the reports on the symptomatology of field cases. Certain of the findings are quite contrary to descriptions of such field cases. The author feels that this is true because of certain instances of mistaken diagnosis on field cases and because a number of the field cases are studied in more advanced stages of the disease. It is hoped that this study has helped to clarify the syndrome of the early stages. It is further hoped that this type of controlled work might be pursued further by other investigators. While a distinct pattern seems to have evolved from this work, the number of

animals is too small to permit speculation about the numerical probability of the various manifestations.

Since the veterinarian encounters advanced cases as well as the early ones, it would seem very worthwhile for this procedure to be repeated but with the surgery postponed for perhaps a week or two. It would also seem of value to conduct this type of experiment using straight foreign bodies that would not necessarily be retained partly within the reticulum. If sufficient work were conducted covering these various aspects, it would seem that the probable pattern of traumatic gastritis in its various manifestations could be fairly well outlined.

Although this experiment was conducted primarily to study symptoms, a brief discussion of the surgical removal of the foreign bodies seems in order.

The site for invading the rumen was the left paralumbar fossa, after the manner first described by Obich (1863). The paravertebral injection of two per cent procaine was employed for anesthesia in three animals. In two of these the resultant anesthesia was good. In the third animal it was necessary to infiltrate the proposed line of incision in addition to the paravertebral injections. In the other animals only local infiltration was used and the anesthesia was good, although large amounts (250 cc) of two per cent procaine were used.

Several methods were used to anchor the rumen before an incision in its wall was made. On two animals the rumen was simply grasped with forceps, drawn to the outside and held in position by assistants. This procedure was the quickest and was satisfactory. Its limitations lie largely in the requirement of reliable assistants.

On two animals the rumen retractor first described by Michael and McKinley (1954) was used. This instrument consists of an aluminum ring with a rubber ring attached to its inner circumference. To the rubber ring, a series of hooks is attached, the hooks being sharpened and turned in such a manner as to facilitate their insertion into the margins of the incision in the rumen. In both instances this procedure was attended by the escape of a small amount of rumen content into the peritoneal cavity. This was the author's first experience with the device, which may have been a factor in the difficulty.

On two cows, four stay sutures through the muscularis of the rumen were held under tension by assistants. This was effective but again the presence of competent assistants was required.

On the remaining four animals the operator worked entirely alone, and the rumen wall was anchored to the adjacent skin by seven stay sutures. In the opinion of the author

this would be the most practical procedure for a veterinarian in the field. Besides facilitating the operation without help, it was attended by the rapid formation of a blood clot which effectively sealed the space between the rumen and the peritoneal cavity. Unless the rumen was firmly anchored to the body wall this clot, formed by seeping blood, did not effectively develop. A shroud with a hoop was used on each animal.

Of the 30 foreign bodies that were administered, 25 were found in the reticulum, three in the anterior dorsal sac of the rumen, and two on the floor of the rumen proper. Of the 25 that were located in the reticulum, 19 were puncturing the reticulum. Of these, six were found to be only partially implanted or stitched through the plicae. The remaining 13 had passed as far through the reticular wall as was possible. It happened that each cow had at least one complete perforation. It was interesting to note that the nails seemed to cause the least trouble. Of the ten administered, five remained in the rumen. Of the nails in the reticulum, one was stitched through the plicae, while the others were free on the floor of the reticulum. Of the pieces of baling wire there seemed to be no distinction between the longer and shorter lengths.

The rumen incision was closed with two rows of continuous

infolding sutures of No.3 catgut. The incision in the abdominal wall was closed in several different manners for a comparison of healing properties.

On two animals, six figure eight sutures including the skin musculature and peritoneum were used. Both of these resulted in sufficient healing to permit the removal of the stitches in seven days. No abscesses developed, although the wound edges had not been held in good apposition and sections of the wound edges necrosed and the wound was not haired over for some time.

On two animals the peritoneum was closed with catgut and the muscle layers were closed in the same manner. Then interrupted tension sutures were used on the skin. These skin sutures were removed on the tenth day but the wounds were slow to heal and abcessed. These animals both showed bare patches of skin over the incision three months later. These two animals demonstrated the poorest healing.

The remaining six animals were handled alike. The peritoneum was closed separately and the muscle layers were closed together. Then a continuous lock stitch was used on the skin. Care was taken to bring the skin edges in apposition without excessive tension. Five per cent sulfathiazole ointment was applied to the wound and the entire wound was covered by a strip of gauze four inches wide. This was held

in position by collodion around the edges. Primary union resulted in each of these animals. The stitches were removed on the sixth day. One cow calved on the ninth day after surgery with no assistance and with no disturbance to the wound.

Every animal made a complete recovery following surgery. These ten experimental animals were in a herd of 18 that were to have rumenotomies as a part of the surgery course. Eight had been operated before the experiment was undertaken. Of these 18 head, every animal was marketed at the conclusion of the school year. Although the butcher buyer was informed of the history of these animals, there was no indication of abnormality and they were bought not subject to examination. Because of the simplicity and lack of reaction to the surgery, Gentile (1951) urged that an exploratory laparotomy be included as a diagnostic procedure on questionable cases.

From these results it would seem that if surgical removal of the foreign bodies is effected early in the course of the disease, before secondary complications have developed and before the restorative properties of the body are lost, there is good assurance that the recovery will be satisfactory. This speculation is substantiated by the report of Ryan (1947) of 100 per cent recovery on 40 rumenotomies. The author has recorded 119 rumenotomies in the field in which there were 115

recoveries, two cases of mistaken diagnosis, and two in which the foreign bodies were not recovered.

Before the foreign bodies were administered, two animals were negative to the examination with the electronic metal detector. Two were positive to the maximum degree registered by the device, while the remaining six were positive but to a lesser degree.

After administration of the foreign bodies all of the eight cows that had not shown the maximum reaction, showed a marked rise within 12 hours. This was taken to indicate that at least one of the metal articles had arrived in the reticulum.

After the rumenotomy the metal removed from the reticulum, exclusive of the experimental objects, was weighed. It was found that the two animals apparently negative at the beginning of the experiment had one Gm. and one-half Gm. respectively. This consisted of metal shavings and was apparently not sufficient to register on the metal detector. Of the six animals that had given a partial reaction there were 9, 9.5, 8, 2.5, 8 and 4 Gms. removed. The two animals that had given the maximum reaction had 13 Gms. and 14 Gms., including a total of 12 wires and nails from one to four inches in length.

Each of the experimental wires was found to weigh three

Gms. Since one cow was positive with 2.5 Gms. it would seem that one piece of baling wire 3.5 inches long could be detected by the device. It is also demonstrated that a positive reaction to a metal detector has limited diagnostic value.

V. CONCLUSIONS

From the observations made in this study, the following general conclusions may be made:

1. Sharpened foreign bodies when administered to cows are likely to result in traumatic gastritis within three days.

2. The symptoms of traumatic gastritis tend to subside after the initial 48 to 72 hours.

3. Every diagnostic feature has some tendency to fluctuate, thus making a second examination of value if the first is inconclusive.

4. There are no pathognomonic symptoms of the disease. Careful systematic examinations and observations of the complicated clinical picture may be necessary to arrive at accurate diagnosis.

5. The most reliable of the many possible clinical manifestations of early traumatic gastritis would seem to be an elevated temperature, a neutrophilia, a disturbed appetite for grain, pain in the area of the xyphoid cartilage, a suppression of milk flow in the lactating animal, atony of the rumen, and constipation.

6. It would seem that the most important clinical manifestation that would aid in a differential diagnosis is the presence of pain in the area of the xyphoid cartilage,

since most of the other consistent symptoms are present with other common febrile disturbances.

7. The symptoms presented by the experimental animals were more moderate than those usually reported on field cases. This indicates that field cases of traumatic gastritis which demonstrate mild symptoms may frequently be overlooked.

8. If surgical removal of the foreign bodies is accomplished within approximately 48 hours from the onset of symptoms it is possible to anticipate nearly 100 per cent recovery.

VI. SUMMARY

Traumatic gastritis was experimentally created in ten cows. They were frequently examined at regular intervals. The purpose was to evaluate the merit of the many symptoms that have been reported to accompany the disease in field cases as well as to permit close inspection for previously unreported symptoms. After the animals showed symptoms for approximately 48 hours the foreign bodies were removed. It was hoped that the results of this surgery would give prognostic information about the value of early surgery in traumatic gastritis.

In general the syndrome was that of a moderate febrile reaction with neutrophilia and mild indigestion, and was marked by many exacerbations of symptoms. Pain in the area of the perforation was quite consistently demonstrated. The symptomatology was most pronounced in the initial 36 hours and was apparently beginning to subside by the time of surgery.

In general it was found that the clinical syndrome of the experimental animals was less pronounced than that commonly described in field cases. This suggests that animals giving less spectacular manifestations may be overlooked in the field.

The rumenotomies resulted in prompt recovery of the animals. It was mentioned that this surgery was also performed.

experimentally on eight additional animals that did not have gastric perforations. Healing and recovery was prompt on all 18 cows, which would indicate that if a rumenotomy is performed early, before the body is devitalized, it should be possible to expect excellent results.

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