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on farm

Evaluation of the Willis spay instrument

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Learning to use the Willis spay instrument

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SUMMARY: Surgical removal of the ovaries (spaying) is used in extensive beef cattle herds in northern Australia where it has an important role in increasing survival and turn-off value of female cattle. Currently, flank spaying is the predominant method used. It causes hide damage and carcase trim and is opposed by animal welfare groups because it is mainly done by lay persons without using anaesthesia. The Willis spay instrument is a simply designed, vaginal spaying device, widely used in North America to spay heifers. The technique requires the operator to have ovarian palpation skills. Compared to flank spaying of non-pregnant cattle, it potentially offers many benefits to the cattle industry in northern Australia. These include higher processing rates, minimal surgical complications, no hide damage or carcase trim, it avoids the need to use electroimmobilisers, and it is a more humane and aesthetically acceptable means of spaying. The findings of this pilot study, where the Willis spaying technique was successfully learned and applied by 3 different operators, on 40 Brahman cross heifers, support these claims.

Introduction

Background

Surgical removal of the ovaries (spaying) is commonly practised in extensive cattle herds in northern Australia. It is used to prevent the weight losses associated with pregnancy and lactation in situations where surplus females destined for slaughter cannot be kept separated from bulls. Flank spaying is the most common method used in Australia. It is usually performed via a 12 to 15 cm flank incision without local anaesthesia, on semi-domesticated cattle, in circumstances where a suitable surgical standard of hygiene is difficult to maintain. The procedure is performed by veterinarians and lay persons. Most spaying is done by lay persons, either travelling contractors or cattle station staff that do their own station's cattle. It is a relatively slow, tedious procedure (30 head per hr maximum). The large numbers of cattle usually mustered mean that rapid processing through yards is essential if cattle are to be returned quickly to grazing areas to avoid the costs of hand feeding and reduced production. Morbidity and mortality rates associated with flank spaying are variable depending on the training and experience of the operator and the physical stresses placed on the animals before and after the procedure.

It has been demonstrated repeatedly that spayed heifers do not grow as well as intact heifers, except when implanted with hormonal growth promotants (HGPs). HGPs cause spayed heifers to grow faster than intact heifers, even if the intact heifers have been treated with a HGP (Rupp and Hamilton 1995). However, the primary role of spaying in northern Australia is in maintaining a high level of female turn-off, the importance of reduced individual animal performance from spaying being secondary. Unless female turn-off is maintained at a high level, overstocking eventually causes land degradation and undernutrition and animal suffering may occur.

There are difficulties in turning off female cattle. On most stations, the dry winter mustering season from May to September is the only opportunity to collect and transport cattle. However, year-round mating systems and long periods of undernutrition during the seasonal dry winter period for pregnant and lactating females, allow too few to be in marketable condition during this period. Spaying removes the demands of pregnancy and lactation and ensures higher numbers of females are in marketable condition during this period. Also, a considerable bias exists against heifers for the live export feeder trade to south-east Asia, to the extent that they comprise less than 5% of the trade. Compared to steers, they grow more slowly, convert feed less efficiently, disturbs other cattle when in oestrus, and they become pregnant. The use of growth promotants and flank spaying on export feeder heifers, are attempts to overcome these problems, but damage to hides caused by flank spaying is a deterrent for buyers.

Animal welfare groups oppose traditional flank spaying because it is an invasive procedure without anaesthesia. They would prefer that it be done by veterinarians using local anaesthesia. The time and cost of travelling long distances to cattle properties in outback Australia, severely limits treatment of animals by veterinarians. Administering local anaesthesia would add time and cost to the procedure. It does not eliminate stress, and in rapid processing would not be given time to provide effective analgesia. The excitable temperament of semi-domesticated cattle prevalent in the north, necessitates good restraint for the flank operation to be performed successfully. This is often achieved with an electroimmobiliser, also opposed by animal welfare groups.

The Willis Spay Instrument

The Willis spay instrument[1] (WSI), a vaginal spaying instrument developed in the USA in the early 1980s, may offer a suitable alternative to flank spaying in northern Australia. Apparently, the WSI and the Kimberling-Rupp instrument, another vaginal spaying instrument, have largely replaced flank spaying of heifers in many areas of North America. This is apparently because they are quicker, simpler, less invasive, and more economical to use. The WSI is apparently preferred to the Kimberling-Rupp instrument because it is easier to learn and a simpler instrument to maintain.

The spaying technique is known as the Willis Dropped-Ovary Technique because the ovaries are dropped inside the abdomen. The animals do not continue to cycle although a small proportion (<5%) of ovariectomised heifers will show at least one behavioural oestrus. The evidence for this is provided by Garber *et al* (1990) where 54 heifers were spayed with the WSI. Only three heifers continued to cycle based on plasma progesterone results. At slaughter, one was found to be incompletely spayed, one had a necrotic ovary attached by adhesions to the ovarian mesentery, and one had a mild uterine infection with no ovarian tissue being found. Further evidence that the dropped ovaries do not continue to cause cycling is the study by Johnson *et al* (1987) where, after using the WSI, detached ovaries were found in only 7 of 15 heifers after 205 days and most were inactive (without growing follicles or corpora lutea). One ovary was attached to the rumen by a thin thread of tissue but the others were free in the abdomen.

[1] Willis Veterinary Supply, Presho, South Dakota, USA

Administering hormonal growth implants to spayed heifers may increase the proportion showing at least one post-procedural, behavioural oestrus, to greater than 75% (Garber *et al* 1990). However, incomplete severance of the ovaries might be a common cause of oestrus behaviour following spaying. Johnson *et al* (1987) found 7 of 15 flank spayed heifers, 11 of 15 heifers spayed with the Kimberling-Rupp instrument, and 2 of 15 heifers, spayed with the Willis spay instrument, had remnants of ovarian tissue *in situ*.

The WSI is a stainless steel rod about 48 cm long and 6 mm diameter (Figures 1 and 2). One end is bent to form a handle, the other is a flattened spear head with a tear drop shaped hole cut in it. The apex of the hole is sharpened to allow cutting of the ovarian attachments. The instrument is introduced into the vagina and placed against the anterior vaginal wall, dorsal to the cervix (Figure 3). The wall is pierced with the spear head end and the instrument enters the abdomen (Figure 4). Each ovary is placed into the instrument by rectal manipulation, severed by retracting the instrument, and dropped into the abdomen (Figures 5 to 10).

The Willis dropped-ovary technique potentially offers the quickest, simplest and least stressful means of spaying heifers in northern Australia. With this method of spaying, the hide is not damaged, and there is no carcase trim. Required restraint is minimal and not more than usually necessary for pregnancy testing or artificial insemination. There should be no need to use electroimmobilisers.

Traditional flank spaying can process about 20 to 30 heifers per hour with a good operator and good facilities. The WSI is apparently very fast in the hands of an experienced operator and rates of up to 50 per hr can be achieved although 30-40/hr would be average. The higher processing rates offered by the WSI would be very attractive in the north where large numbers of cattle are handled at any one time.

There are two published articles that examined morbidity and mortality rates associated with the use of the WSI. In the study by Garber *et al* (1990), 54 heifers with a mean bodyweight of 270 kg (standard error of the mean 15 kg) were spayed and no deaths or cases of excessive bleeding occurred. Clinical observation found mild discomfort with raised tail heads and arched backs for several hours after being spayed. In another study (Habermehl 1993) using heifers between 180 and 300 kg bodyweight, the morbidity rate was 2/522 (0.38%) and the mortality rate was 1/522 (0.19%). The cause of the deaths was not investigated. The 2 morbid animals were walking stiffly the day after the surgery. A few heifers exhibited mild stiffness and straining in the first 12 hr after surgery but this quickly subsided. In neither of the above studies was local anaesthetic or sedation used, nor was there mention of avoiding spaying animals in oestrus.

Habermehl (1993) also mentions data on 3400 ovariectomies with the WSI where 0.35% morbidity and 0.29% mortality occurred. Complications occurred during the learning phase or when operating at high processing rates. The cause of the deaths was not investigated.

The intentions of this study were to learn how to use the WSI and observe the cattle for complications. If successful, and adopted by the pastoral industries, the method has the potential to revolutionise pregnancy control in the northern cattle industry with very real benefit to the welfare of animals and the industry.

Materials and Methods

Prior to commencement of the main evaluation, the technique was rehearsed on reproductive tracts of 10 slaughtered females obtained from an abattoir.

A group of 13 Brahman cross heifers (group A), in forward store condition, and weighing between 210 and 318 kg (mean 278, se 8.0), were the first group spayed with the WSI. These heifers were observed for 72 hours for complications and then a second group of 27 Brahman cross heifers (group B), in backward store condition, and weighing between 171 and 250 kg (mean 212, se 3.9), were spayed with the WSI. These were also monitored for 72 hours for complications. This second group had been dehorned and treated for a moderate cattle tick infestation 3 weeks previously.

The heifers were individually identified by numbered eartags. All of the heifers were non-pregnant, having been kept separate from bulls, or injected with prostaglandins to cause abortion. The heifers were spayed alternately by the three authors who are veterinarians experienced at flank spaying, pregnancy testing and ovarian palpation. The heifers were restrained in a squeeze crush but were not squeezed tightly or head-baled. Each operator used epidural anaesthesia until at least 3 consecutive heifers were scored as being easy to average in difficulty to complete the ovariectomy. This caused all but one of the 13 heifers in group A to receive an epidural. Epidural anaesthesia (group A only) was induced by injecting 1 to 2 mL of lignocaine into the epidural space of the tail head vertebrae. This was intended to offer rectal relaxation, increased manipulation, and pain control. Once spayed, the spaying earmark, a 2.5 cm diameter hole, was cut with earmarking pliers into the nearside ear.

The technique used here closely followed the one of Habermehl (1993). The technique began with rectal palpation of the reproductive tract using a gloved hand coated with methycellulose obstetrical lubricant[2]. With one hand in the rectum, the vulvar lips and perineum were cleaned with water and then wiped with a dry paper towel (Figure 12). The instrument was passed through the vulvar lips which were parted by an assistant. It was then passed dorsally and cranially, manoeuvering past folds in the vaginal wall and avoiding the entrance to the urethra (Figure 13) Alternately flattening the vagina and pushing the cervix forward, using the wrist and finger tips of the hand in the rectum, assisted the passage of the instrument past the vaginal mucosal folds. The head of the instrument was placed 2 to 3 cm dorsal to the cervix where slight pressure was applied to keep it in place (Figures 3 and 14). With the instrument fixed in position the hand in the rectum was diverted away (upward and laterally) to reduce the risk of rectal penetration. The instrument was punched through the dorsal fornix and entered the peritoneal cavity (Figures 4 and 15). The instrument was then gently pushed forward until the handle rested against the vulvar lips. This served to free the head of the instrument from the vaginal serosa and positioned the head away from the area where rectal palpation of the ovaries resumed. One ovary was unfurled from its mesenteric attachments (mesosalpinx and mesovarium) and lifted onto the shaft of the instrument. While being held there, the instrument was drawn back until the ovary rode over the neck and dropped into the

[2] Obstetrical Lubricant, Ilium Veterinary Products, Smithfield, New South Wales, Australia

cutting hole. The instrument was rotated as necessary to facilitate this. After the ovary had passed through the cutting hole, the thumb and forefinger were placed either side of the head of the instrument, thereby fixing the ovary (Figures 7 and 8). Slow, steady retraction of the instrument cut the ovarian attachments and the ovary would fall away (Figures 9, 10 and 16). The procedure was repeated on the second ovary and the instrument withdrawn. Further rectal palpation was performed to confirm ovariectomy if there was any difficulty in cutting, and the hand in the rectum was withdrawn. The instrument was then wiped and washed free of faecal material and placed in a 20 L plastic drum containing a solution of 0.05% chlorhexidine[3]. A drum with a 6.5 cm diameter pour hole was used instead of an open bucket to minimise dust contamination (Figure 11).

Prophylactic long acting penicillin[4] (procaine penicillin G 150 mg/mL, benzathine penicillin 112.5 mg/mL) was administered intramuscularly at a dose rate of 3 to 5 mL per 50 kg liveweight to all heifers immediately after surgery.

Measurements included liveweight, duration of surgery (from the time of the hand entering the rectum until removal of the instrument from the vagina), degree of surgical difficulty (very difficult, difficult, average, easy, very easy), packed cell volume (PCV)[5] 24 hr after surgery, morbidity (such as inappetence, lethargy, stiff gait, prolonged recumbency or excessive straining) and mortality. Rectal temperature was measured 24 hr after surgery in group A. In group B it was measured immediately prior to surgery and again 24 hr. postsurgery for comparison. The vulval mucous membranes were examined for evidence of anaemia at 24 h post-surgery.

The surgery was done slowly and carefully with no attempt to hurry except in nervous heifers which were likely to move excessively. The emphasis was on quiet handling of the heifers, careful surgical technique, and applying a high standard of hygiene to minimise complications.

Rectal palpation of the reproductive tract occurred at 21 days post-surgery in group A and 19 days post-surgery in group B. This was performed to determine if post-surgical adhesions had developed and to confirm that ovariectomy had occurred. All 13 heifers were available from group A, but only 24 heifers were available from the original 27 in group B. This was because 2 were sacrificed and one was not able to be mustered.

Results

During the procedure, most of the heifers (>90%) stood quietly except for a few that had a nervous temperament. Few (<10%) showed signs of discomfort during the surgery. The part of the procedure that caused most reaction was when the ear marking pliers were used to cut the spay mark in the ear.

A distinctive "thop" sound was often produced when the vaginal wall was penetrated. Sometimes, considerable force was required to achieve penetration. It was noticed that few heifers flinched in response to this. Best results for achieving vaginal wall penetration were when the spear head of the instrument was positioned 2 to 3 cm above the dorsal

[3] Hibitane Concentrate 5%, ICI Australia, Melbourne, Victoria, Australia
[4] Norocillin L.A. Injection, Heriot Agvet Pty Ltd, Rowville, Victoria, Australia
[5] PCVs were measured directly from the 10 mL vacutainer tubes containing the unclotted blood samples after centrifugation for 10 min at 4000 rpm.

fornix. To complete the procedure successfully required basic ovarian palpation skills sufficient to pick up and free the ovaries from its mesenteric attachments (the mesosalpinx and mesovarium) and to manipulate them onto the shaft of the WSI. Unless the head of the WSI was free of the vaginal subserosa, and the ovary free of its mesenteric attachments, the ovary would not drop through the cutting hole. The other impediments which slowed the procedure most, were difficulty in penetrating the vaginal wall, and difficulty locating one or both ovaries after the instrument was in place. The frequency of these and other impediments are listed in Table 1.

Tables 2 and 3 present the measurements and comments recorded for the heifers in groups A and B, respectively.

Severing the ovaries was surprisingly easy and could be achieved by a slow backwards pull on the instrument with no jerking required. As the ovarian attachments were being cut, a grating feeling was apparent.

One of the operators' first attempt with the WSI on a group A heifer was stopped at 15 min with neither ovary being severed. However, the heifer was successfully spayed by the same operator at a second attempt about 2 hr later after other heifers had provided more practice. The ovaries were removed in less than 2 minutes and the degree of difficulty was scored as very easy.

One heifer in group B was not able to be spayed despite 2 attempts about 2 hr apart. One ovary was removed at the first attempt. At the second attempt, bleeding from the rectal mucosa occurred and the operation was stopped.

The duration of surgery for the group A heifers which were successfully spayed, ranged from 1min 30 s to 15 min with a median time of 5 min 15 s. For the group B heifers, surgery time ranged from 1min 22 s to 11 min with a median time of 3 min 20 s.

In group A, 3 heifers (23%) were scored as difficult or very difficult, 5 (38%) as average and 5 (38%) as easy or very easy, whilst in group B, 4 heifers (15%) were scored as difficult and one (4%) as very difficult, 13 (48%) as average and 9 (33%) as easy or very easy.

The absence of epidural anaesthesia in group B did not increase the difficulty of the procedure. There was no difficulty in performing rectal palpation on the smaller heifers.

No heifers in groups A or B were observed to be showing signs of discomfort or sickness after spaying, and none died.

All animals in both groups had pink vulval mucous membranes 24 hr post-surgery and showed no evidence of weakness. Packed cell volumes from blood samples taken 24 hr post surgery were in the normal range (25 to 48) for all except 2 heifers in group A. These 2 heifers had PCVs of 49 and 52.

The heifers in group B generally had lower PCVs and with a greater range than group A (Table 3).

Rectal temperatures were generally high with 2 heifers in group A, and 5 heifers in group B, having temperatures greater than 39.5°C, 24 hr after surgery. However, 7 heifers in group B showed rectal temperatures greater than 39.5°C prior to surgery. Four of the 5 heifers in group B with rectal temperatures greater than 39.5°C at 24 hr after surgery had

higher rectal temperatures before the surgery. The ambient temperature ranged from 32 °C to 40 °C between 06.30 am and 09.30 am when the rectal temperatures were measured. Maximum daily temperatures over this period ranged from 44 °C to 48 °C.

Two heifers in group B showing low PCVs were euthanased and autopsied 48 hr after surgery. One animal with a PCV of 26 taken at 24 hr post surgery had a 200 mL blood clot in the ventral abdomen (Figures 21 and 22). Another with a PCV of 27 at 24 hr post surgery, had two blood clots totalling 1.2L (Figures 23 and 24). One clot was located in the ventral abdomen and the other near the pelvic inlet. These heifers had PCVs of 27 and 28 respectively, in blood samples collected immediately after being killed. In both heifers, ovariectomy was complete and no remnants of ovarian tissue were attached to the uterus. The sites in the vaginal wall where penetration occurred were small and contracted and difficult to locate (Figures 17 and 18). Very slight bruising and haemorrhage revealed their location. They would have posed no danger in allowing prolapse of intestines to occur. There was also no evidence of localised septic peritonitis around the penetration sites in the vaginal wall or around the pelvic canal and uterus (Figures 25 and 26).

One heifer in group A and one heifer in group B, thought to have been spayed successfully, were found to have one ovary *in situ* when palpated at 21 d and 19 d, respectively.

Two heifers in group A had adhesions, and 7 heifers in group B, had adhesions involving the uterus. None of the adhesions appeared to involve the rectum or bladder. One heifer in group B had extensive adhesions surrounding the entire uterus. This was the heifer in which there were 2 unsuccessful spaying attempts. This heifer had not been noticed to be sick and had been eating, ruminating and defecating normally. However she had been slow to walk when mustered and was in noticably poorer condition compared to other heifers in group B at the time of palpation. This heifer was recorded as morbid.

Another heifer in group B had extensive adhesions of the uterus to the pelvic floor but was alert, active, and in good condition. The 7 other heifers had minor, localised adhesions, mostly affecting the right uterine horn or oviduct.

Eight heifers had small, hard, lumps or thickenings in the mesovarium or mesosalpinx that were probably scar tissue but could have been remnants of a partly severed ovary.

Discussion

Three operators with no previous experience with the technique were able to learn the basic skill and become confident with the technique after spaying 13 or 14 non-pregnant heifers each. At least 29 and probably 37 of the forty heifers were successfully spayed, 32 of them without difficulty. Signs of discomfort displayed by the heifers during and after the surgery were almost negligible. Fever and anaemia were absent 24 hr after the surgery. One heifer was identified retrospectively as morbid and no heifers died.

Examination of reproductive tracts at slaughter would be necessary to determine if the lumps and thickenings palpated at the site of ovarian detachment in the 8 heifers, were ovarian remnants or scar tissue. In the 2 supposedly spayed heifers, later found to have an ovary still attached, operator fatigue and inexperience were probably contributory.

The extensive adhesions in 2 of the heifers are of some concern. The adhesions might be from one or a number of causes. These include infection introduced from the vagina, infection from faecal contamination of the head or shaft of the WSI, organisation of clotted blood following haemorrhage from the site of ovariectomy, tissue trauma from rectal manipulation or movement of the instrument, or tissue irritation from the chlorhexidine used to disinfect the instrument. The degree of difficulty of the procedure, the duration of the procedure, or the operator, had no obvious association with the presence or extent of adhesions. There is however, a slight trend showing that the quicker, easier procedures, tended to be spared of adhesions.

The heifers in group B had lower PCVs than group A, probably as a consequence of being infested with ticks and dehorned, 3 weeks previously. Some of the heifers were still suffering continuous intermittent bleeding from dehorning at the time of spaying. Their poorer body condition may also have contributed to the low PCVs.

The high rectal temperatures prior to surgery, compared to 24 hr after surgery, in the group B heifers, suggest that the high environmental temperatures were causing hyperthermia rather than fever from illness being present.

The 1.2 L blood clot found in the abdomen of one of the sacrificed heifers is of concern. This volume of clot probably equates to 3 to 4 L of blood. In heifers already suffering blood loss from dehorning, haemonchosis or ticks, this amount of blood may be critical. Stress factors such as hyperthermia from high environmental temperatures, and overexertion in poor temperament animals, probably contribute significantly to internal bleeding. Deaths from anaemia in flank spayed heifers and cows have been attributed to these 2 factors. Pregnancy must also be a risk factor for internal bleeding because of the increased blood supply to the uterus and ovaries. The presence of a 200 mL blood clot in the other sacrificed heifer, shows that internal bleeding can be minimal.

However, the risk of excessive internal bleeding after spaying with the WSI would be no greater than with flank spaying and probably less. This is because the common method of flank spaying in northern Australia uses an ovariotome[6] containing partly enclosed scalpel blades which are very sharp. The cutting edge of the WSI is not as sharp, and the ovary is severed more by a combination of tearing and cutting, than cutting alone. Superior haemostasis should be achieved by the increased vasoconstriction and clotting caused by the greater microtrauma created with the blunter instrument.

The absence of epidural anaesthesia made no noticeable difference to the degree of difficulty of the surgery, or the level of discomfort of the heifers. Epidural anaesthesia is not used routinely for this procedure in North America, nor is it used for training (Norman Habermehl, personal communication). This would suggest that it not be made a recommended or mandatory additional procedure when the WSI is used in Australia.

It was felt that the impediments that slowed the procedure (Table 1) could be overcome with practice. The technique does require good restraint to minimise movement of nervous and excited patients. A kick gate is essential. Care should be taken to prevent entry of air into the rectum. An experienced proponent and teacher of the technique suggested that practice on up to 400 heifers would be required before rates of 30 to 40 an hr might be

[6] Spaymate, DLC Australia Pty Ltd, Werribee, Victoria, Australia

achieved, but some gifted operators might take only 10 to 20 animals to become highly skilled (Norman Habermehl, personal communication).

Most cattle veterinarians and some lay persons with basic ovarian palpation skills would have little difficulty in learning the technique. The critical skill required is probably freeing the ovary from the mesovarium and mesosalpinx, to allow it to drop into the "key hole" of the WSI.

It was felt that the practice on the abattoir specimens greatly assisted our rapid learning on live animals. It is recommended that similar experience should be obtained by other trainees. A very clear and detailed understanding of the technique should be obtained from someone experienced with the technique. This is essential. There are very real dangers of penetrating the rectum with the WSI if the hand in the rectum is not diverted out of the way when the vaginal wall is penetrated.

We also recommend in the interests of animal welfare that learning takes place on quiet well restrained animals with an experienced operator present. In animals demonstrating excessive movement or poor temperament, the procedure should be stopped and and the animal released. Hot conditions should be avoided, and the procedure should be stopped if rectal bleeding occurs or if the operator becomes fatigued. To avoid critical anaemia developing, which may occur from internal bleeding, the animals should be free of parasites that might be causing blood loss, and should not have been radically dehorned within the previous 6 weeks. Because the adhesions may have been caused by infection and may have been exacerbated by the inexperience of the operators, it is also recommended that heifers used for training receive prophylactic antibiotics.

In North America, 180 kg is the generally accepted lower limit for liveweight of heifers to be spayed with the WSI. This is because rectal palpation becomes more difficult at lower weights (Charles Willis, personal communication).We successfully spayed 3 heifers of 180 to 184 kg liveweight that were in backward store condition, and a heifer of 210 kg liveweight in forward store condition. There was no difficulty performing the rectal palpation part of the procedure. Sometimes, large groups of small, prepubertal heifers, are submitted for spaying in northern Australia. A large proportion of these may not be large enough to be spayed successfully with the WSI. A lower limit of liveweight or frame size will need to be established for the technique in *Bos indicus* and *Bos indicus-Bos taurus* cross cattle prevalent in the north.

Our experience with the Willis spay instrument demonstrates that it may have a major application in the northern cattle industry. The method has the potential to replace flank spaying as the predominant spaying method for non-pregnant heifers that are not too small for rectal palpation. Early pregnant heifers, up to about $2^1/_2$ months gestation, could possibly be spayed with the WSI, but more advanced pregnancies would have to be managed using abortifacients or flank spaying, or be left to calve. The low morbidity, zero mortality, and the lack of discomfort displayed during and after spaying, gives us confidence that this is a safe and humane procedure when performed properly. The technique has the potential to be a very fast operation. The processing rates of 30 to 50 head per hr mentioned by Habermehl (1993) would probably be reasonable target rates for northern Australian conditions with experienced operators not limited by poor facilities or shortage of labour to assist.

Further trials under commercial field conditions in northern Australia, using skilled operators, would be desirable. Skilled operators would hopefully reduce the numbers affected by post-operative adhesions, and consistently achieve complete, bilateral ovariectomy. Heifers spayed with the WSI should be compared with flank spayed heifers and intact, non-pregnant heifers. The cause of morbidity and mortalities under commercial conditions would need to be defined, and follow up examinations at slaughter are needed to confirm that ovariectomy has been successful.

The development of simply administered hormonal implants to control pregnancy should be our long term goal. This would avoid the need to surgically spay altogether. The WSI is potentially a major advance in the interim, until this goal is achieved.

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Table 1

The number of impediments encountered in 40 heifers by 3 veterinarians learning to use the Willis spay instrument

Impediment	Number of occasions
Difficulty locating ovary	7
Obstructing mesentery	7
Difficulty penetrating vaginal wall	4
Excessive animal movement	4
Difficulty severing ovary	2
Head of WSI caught in vaginal folds	3
Pneumorectum	2

Table 2

Measurements in 13 heifers in group A, spayed with the Willis spay instrument

No	Weight (kg)	Surgery time (min)	Difficulty+	Comments	Operator*	Rectal temperature	Packed Cell Volume %
1	269	3	3	difficulty penetrating vaginal wall	TJ2	39.64	47
2	318	6	3	difficulty severing ovary	PL3	39.19	44
3	291	15	3	animal moved excessively	MB2	39.07	48
4	288	15	1	membrane obstructing	PL1	39.4	52
5	305	3	2		PL4	38.88	48
6	311	11	1	difficulty in locating ovaries	MB1	39.49	43
7	272	6	2	difficulty locating very small left ovary	TJ3	39.25	46
8	250	5	3	membrane obstructing	PL2	39.03	45
9	295	2	4		MB3	39.18	47
10	261	5	3		TJ1	39.29	45
11	279	1.5	5		MB4	39.09	45
12	266	2	5	membrane obstructing	TJ4	39.78	49
13	210	1.5	5	no epidural, no flinching observed	TJ5	39.48	48

* TJ, PL and MB are the authors' initials, the numbers indicate the sequence of heifers spayed

+ 1-very difficult, 2-difficult, 3-average, 4-easy, 5-very easy

Table 3

Measurements in 27 heifers in group B, spayed with the Willis Spay Instrument

No	Weight (kg)	Operator*	Surgery time (min.sec)	Difficulty+	Comments	Rectal temperature at time of spaying	Rectal temperature 24 h after spaying	Packed Cell Volume at 24 h post spaying
1	220	MB6	3.20	3		39.36	39.85	40
2	234	TJ8	4.30	3	caught in vaginal folds/membrane obstructing	39.49	38.87	42
3	200	TJ9	3.10	4	difficulty finding left ovary/caught in vaginal folds	40.78	39.99	37
4	196	TJ1	1.40	3	difficulty severing ovary	39.34	39.26	34
5	221	MB1	2.12	3		39.29	39.46	34
6	220	PL3	1.51	4		38.95	39.13	27
7	171	PL2	10.00	1	could not find left ovary/heifer moved excessively	38.99	38.87	28
8	184	PL5	2.50	3		40.15	39.58	46
9	217	TJ2	4.30	3	caught in vaginal folds	39.76	39.25	31
10	242	TJ7	4.10	3	difficulty locating ovary	40.47	40.05	45
11	242	MB5	6.24	3	membrane obstructing/pneumorectum	38.99	39.35	37
12	184	PL4	1.30	5		39.10	39.34	35
13	222	MB8	11.00	2	difficulty penetrating vagina/ membrane obstructing	39.26	39.34	31
14	232	PL1	1.30	5		38.53	39.05	39
15	250	PL9	5.00	3	adhesions of left ovary made it difficult	39.23	38.56	36
16	196	MB7	10.00	3	heifer moved excessively/difficulty locating ovaries	39.61	39.17	39
17	210	PL7	5.40	3	membrane obstructing	39.57	38.90	39
18	209	MB4	5.10	3	developed pneumorectum	39.15	39.41	25
19	232	PL6	1.30	5	difficulty severing ovary	39.37	38.84	34
20	212	TJ3	2.40	3	difficulty finding ovary	39.25	38.81	34
21	219	MB3	8.00	2	animal moved continually	39.70	39.68	39
22	200	TJ5	3.20	4	difficulty penetrating vaginal wall	39.08	39.26	35
23	200	MB9	2.22	4		39.28	39.25	38
24	180	TJ6	2.20	5		39.26	38.87	41
25	202	MB2	10.00	1	pneumorectum	38.73	39.13	34
26	231	PL8	1.22	5		39.47	39.36	40
27	206	TJ4	2.40	2	difficulty severing ovary	39.17	38.96	44

* MB, TJ and PL are the author's initials, the number indicates the sequence of spaying

+ 1-very difficult, 2-difficult, 3-average, 4-easy, 5-very easy

Figures

Figure 1. The Willis spay instrument (WSI) showing the tear drop shaped cutting hole in the spear shaped head. The cutting edge is at the apex of the tear drop.

Figure 2. Side view of the Willis spay instrument showing the at right-angled bend that forms the handle.

Figure 3. The Willis spay instrument positioned inside the vagina, against the vaginal wall above the cervix.

Figure 4. The Willis spay instrument has penetrated the vaginal wall dorsal to the cervix.

Figure 5. An ovary has been manipulated into the cutting hole of the Willis spay instrument.

Figure 6. An ovary has been manipulated into the cutting hole of the Willis spay instrument.

Figure 7. The thumb and middle finger are on either side of the head fixing the ovary.

Figure 8. The ovary is severed by fixing the ovary with the thumb and forefinger, and slowly retracting the Willis spay instrument.

Figure 9. By slowly pulling on the handle of the WSI, the ovary is severed

Figure 10. The severed ovary and site of ovarian detachment.

Figure 11. The 20 L drum containing disinfectant used to hold the instrument between surgeries.

Figure 12. The operator (Peter Letchford) palpates the reproductive tract of a heifer while an assistant prepares to pass the instrument to him.

Figure 13. The instrument is inserted carefully into the vagina, avoiding the entrance to the urethra. The vulvar lips are parted by an assistant to aid entry.

Figure 14. Penetration of the vaginal wall has been achieved and an ovary is manipulated per rectum and manipulated/dropped into the cutting hole.

Figure 15. Severing the ovaries

Figure 16. Severing the ovaries.

Figure 17. The head of the instrument has begun to force through the vaginal wall.

Figure 18. The head and proximal shaft of the instrument are now free in the abdomen.

Figure 19. The severed ovary and site of uterine detachment.

Figure 20. The length of the WSI relative to the reproductive tract is shown. Note the strands of tissue attached to the severed ovaries.

Figure 21. A 200 mL blood clot found in the abdomen of a WSI spayed heifer 48 hr after surgery.

Figure 22. The 200 mL blood clot and severed ovaries found in the abdomen 48 hr after surgery.

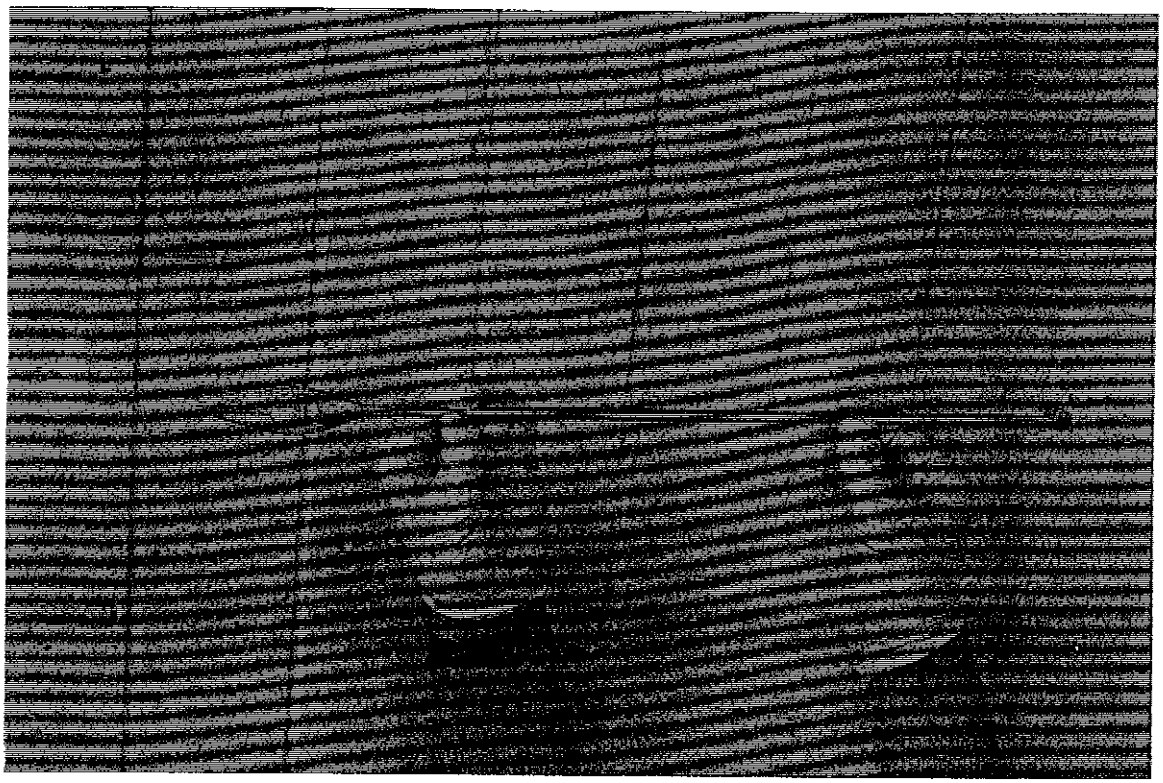
Figure 23. A 1.2 L blood clot lying in the ventral abdomen, found in a heifer 48 hr after being spayed with the WSI.

Figure 24. The 1.2 L blood clot after further dissection.

Figure 25. The WSI in position. Note the size of the ovaries and the absence of tissue attached to them compared to Figure 26

Figure 26. The WSI in position. Note the size of the severed ovaries and the strands of tissue attached to them.

Figure 1



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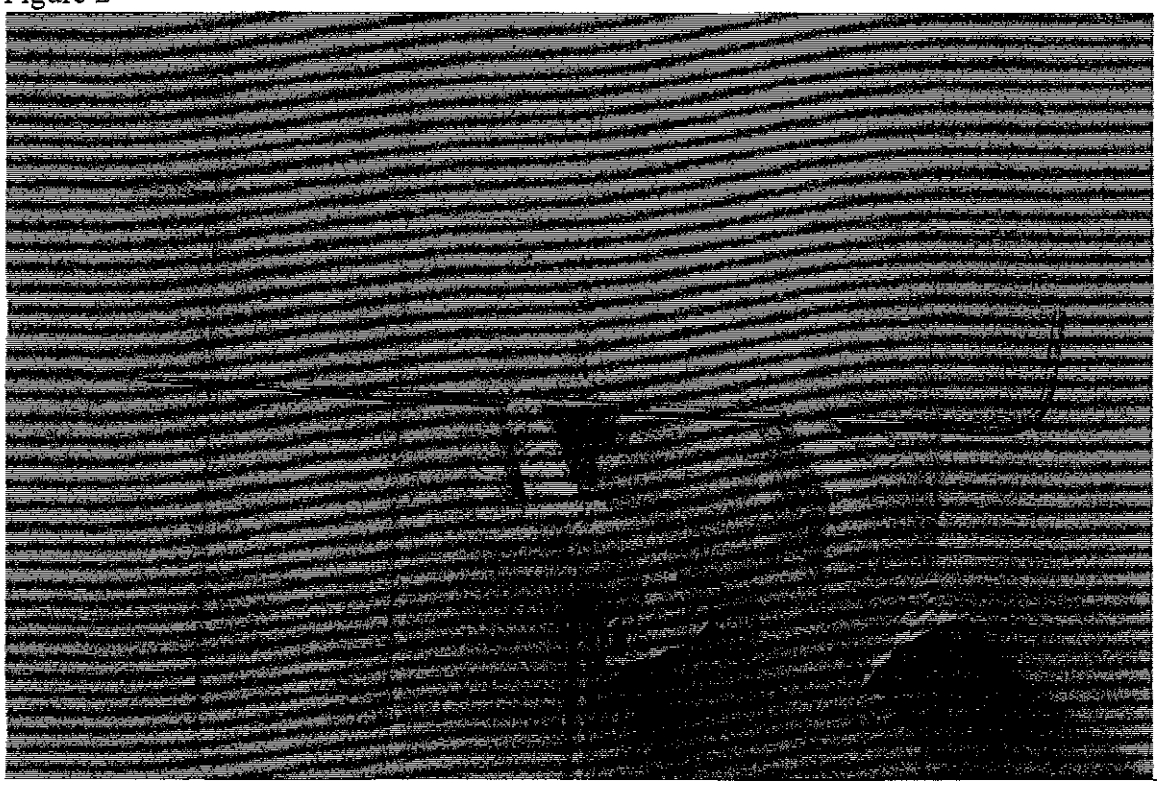

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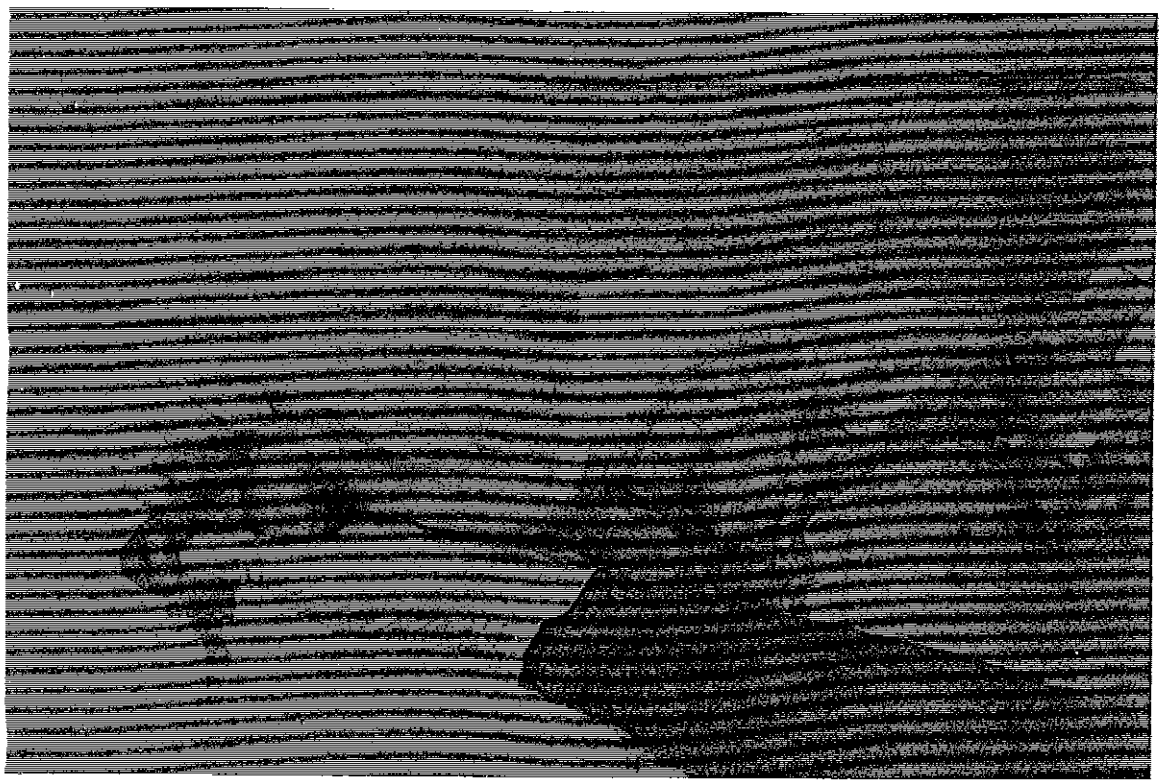

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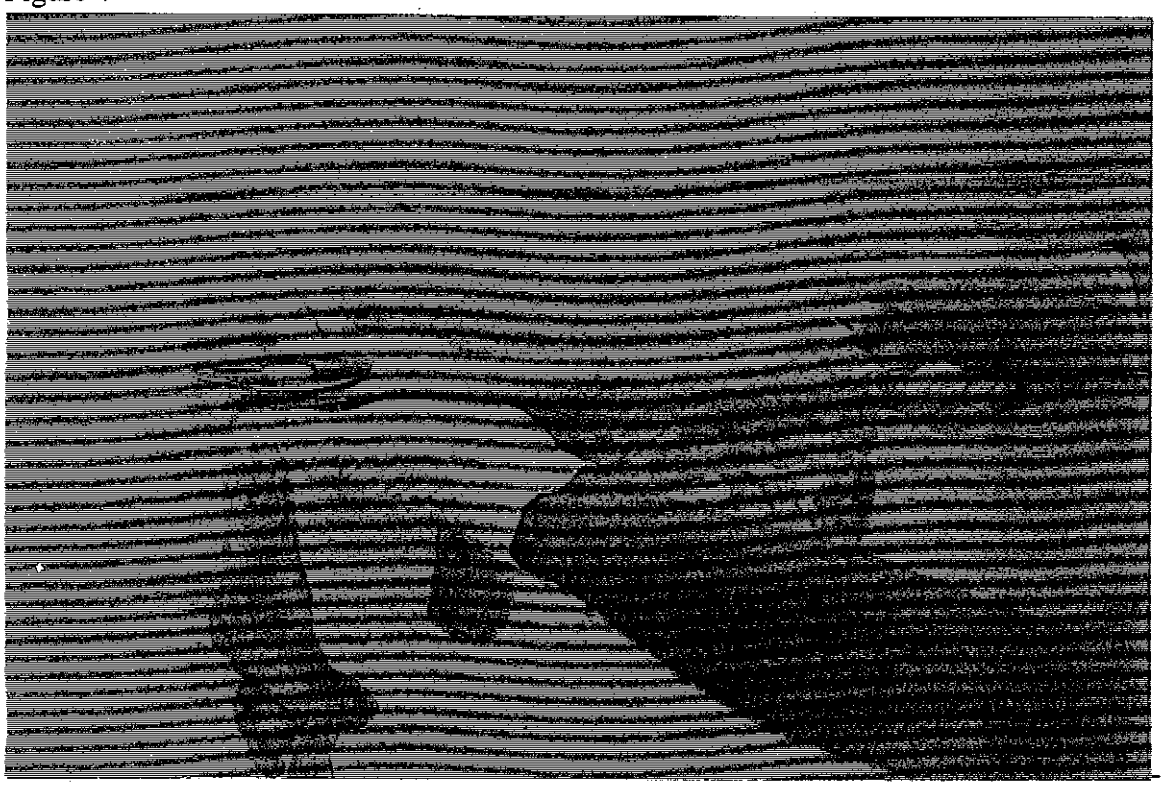

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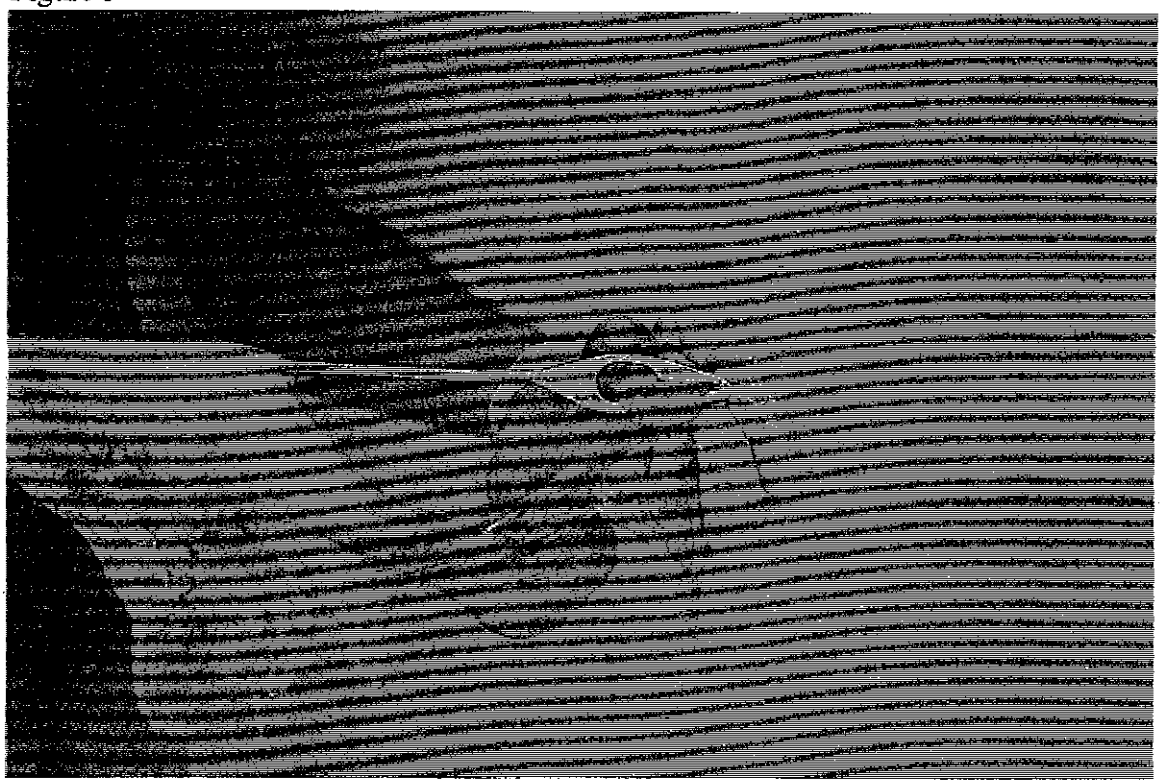

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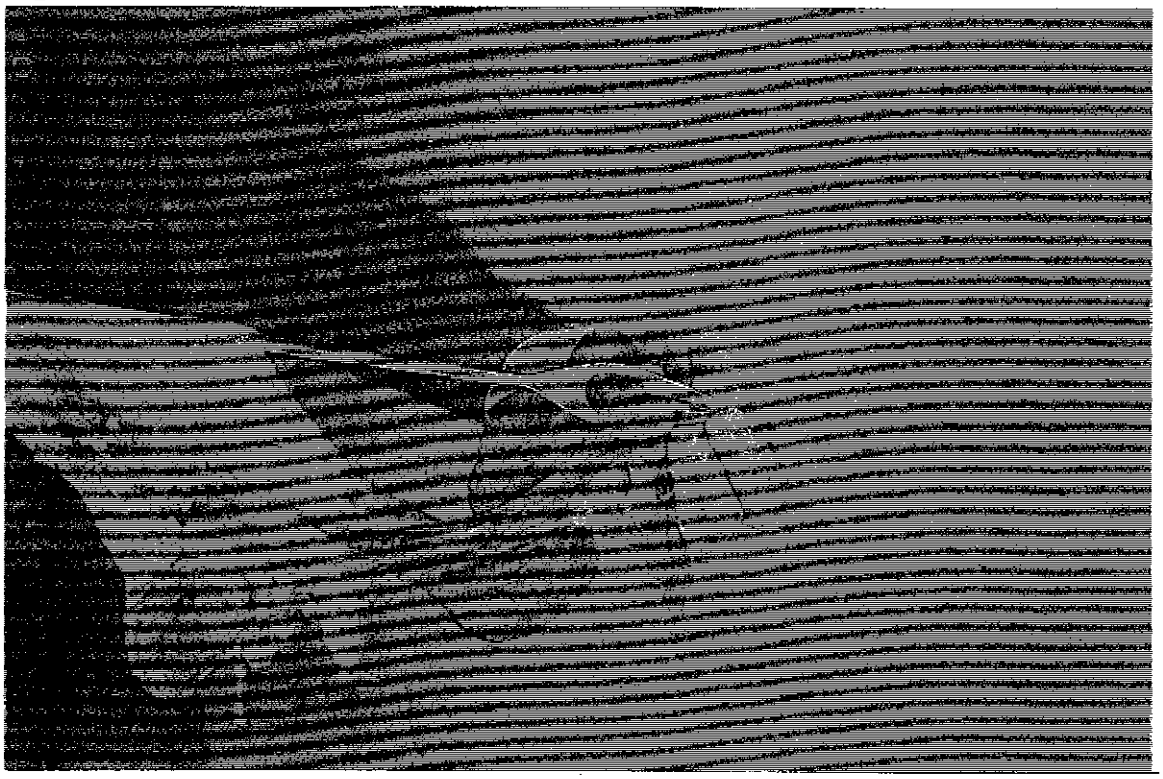
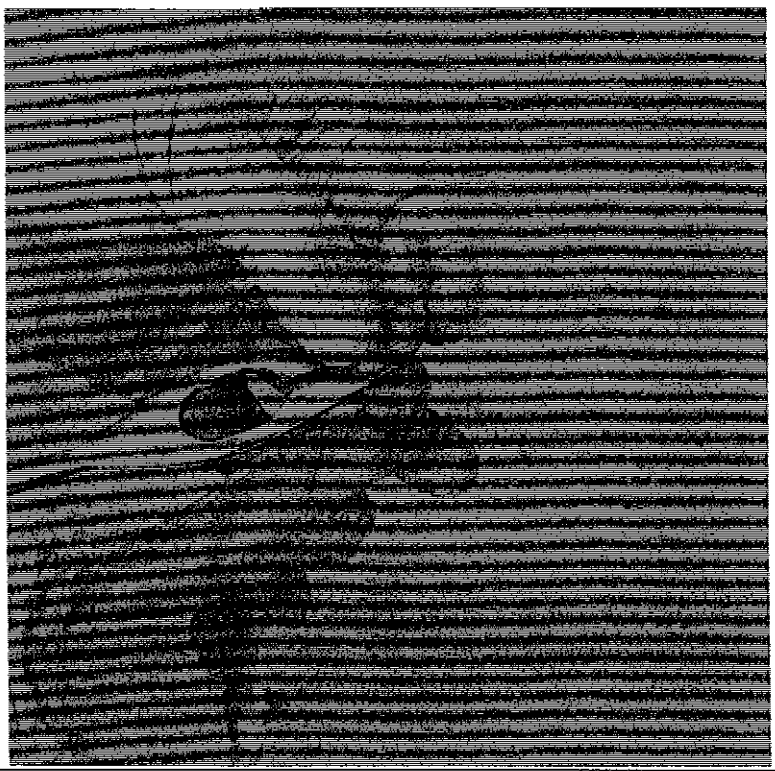


Figure 7

Figure 8



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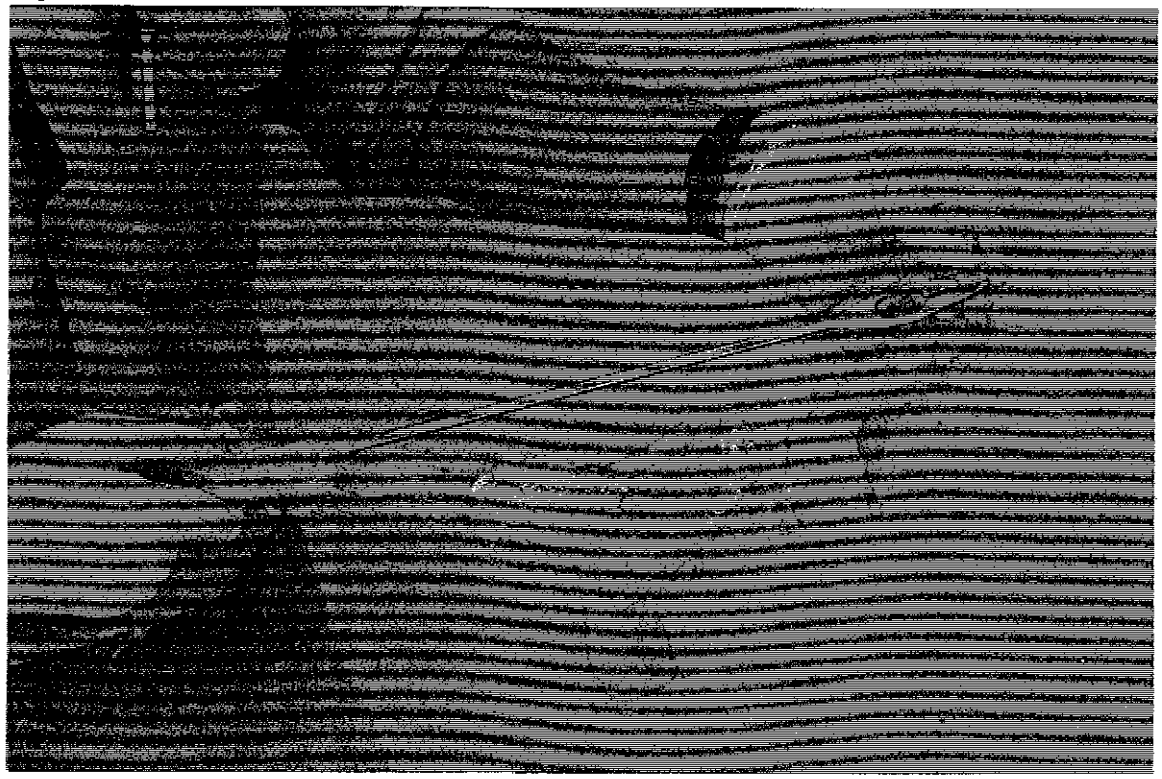

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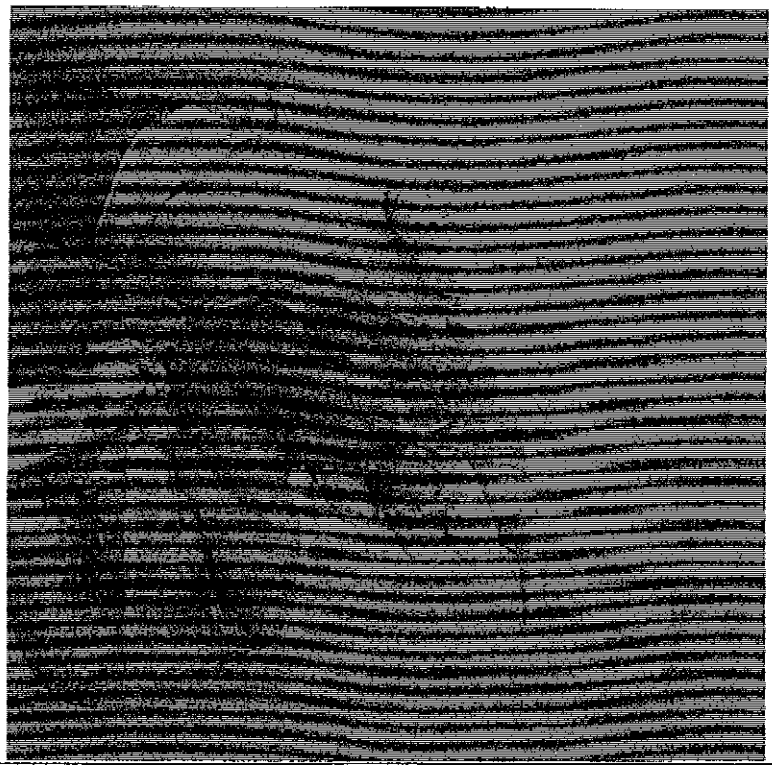

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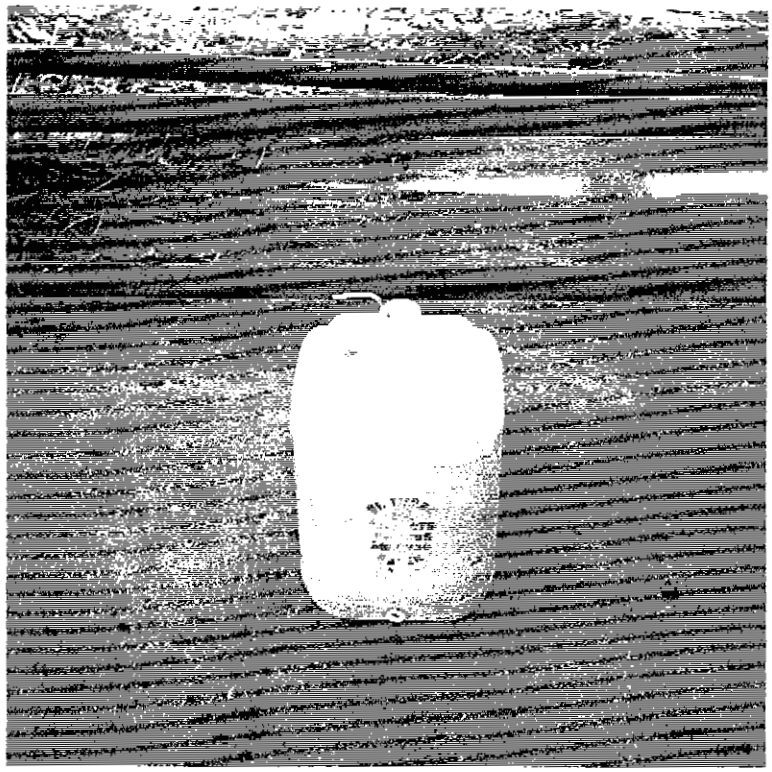
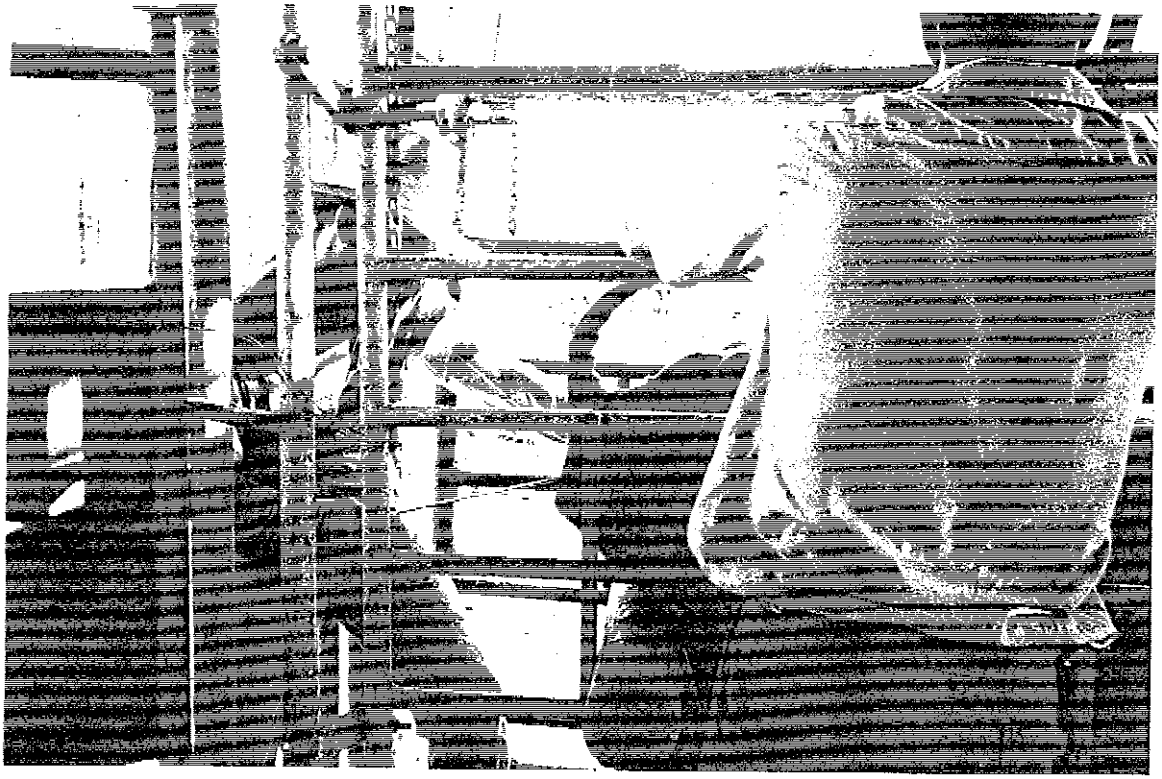


Figure 12

Figure 13



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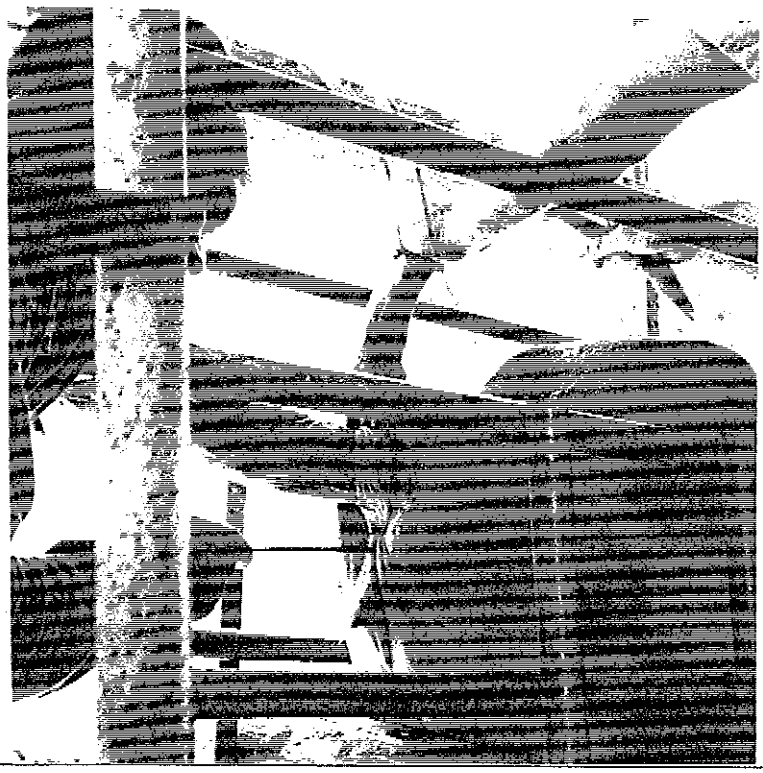
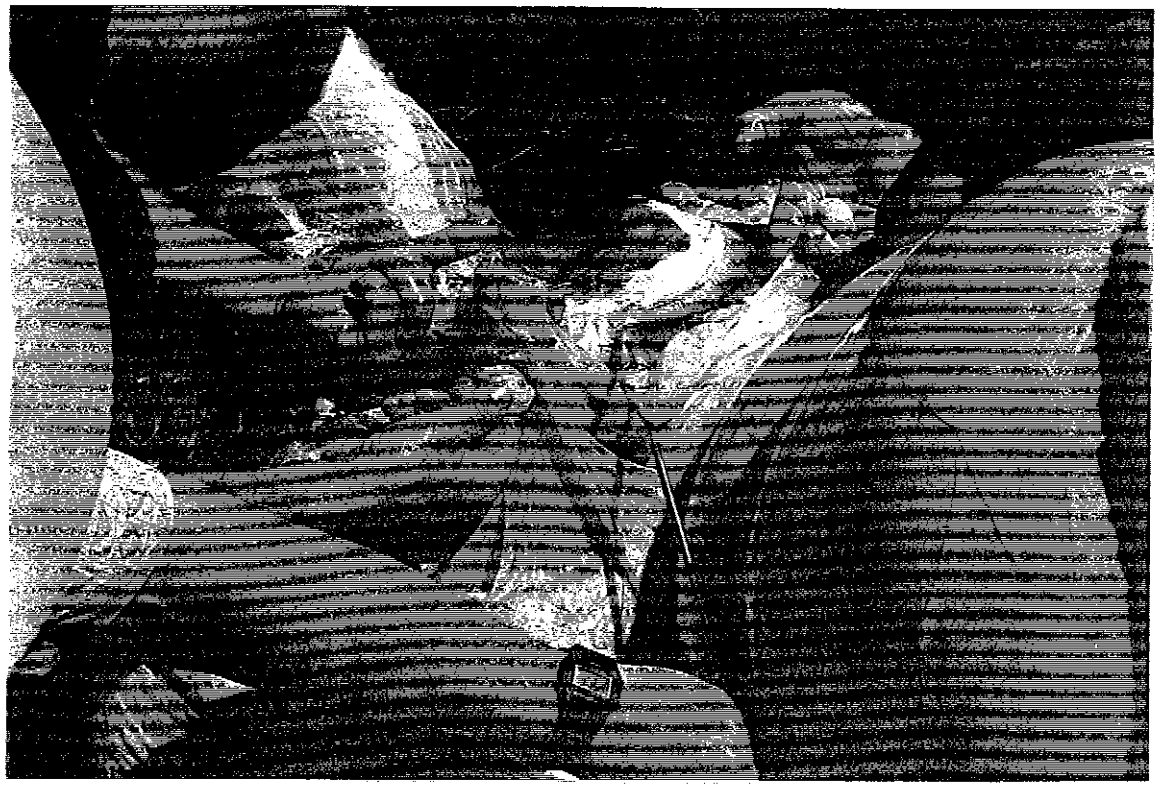


Figure 17

Figure 18

Figure 19



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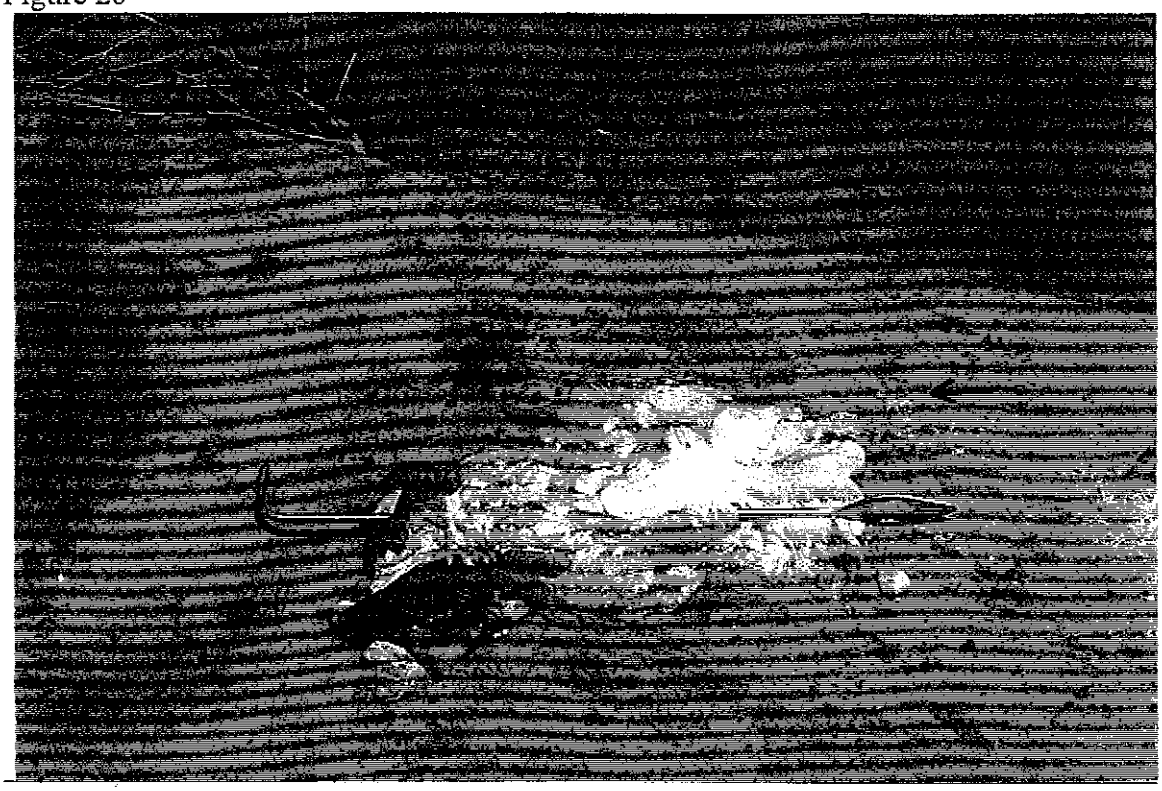

Figure 21

Figure 22

Figure 23

Figure 24

Figure 25

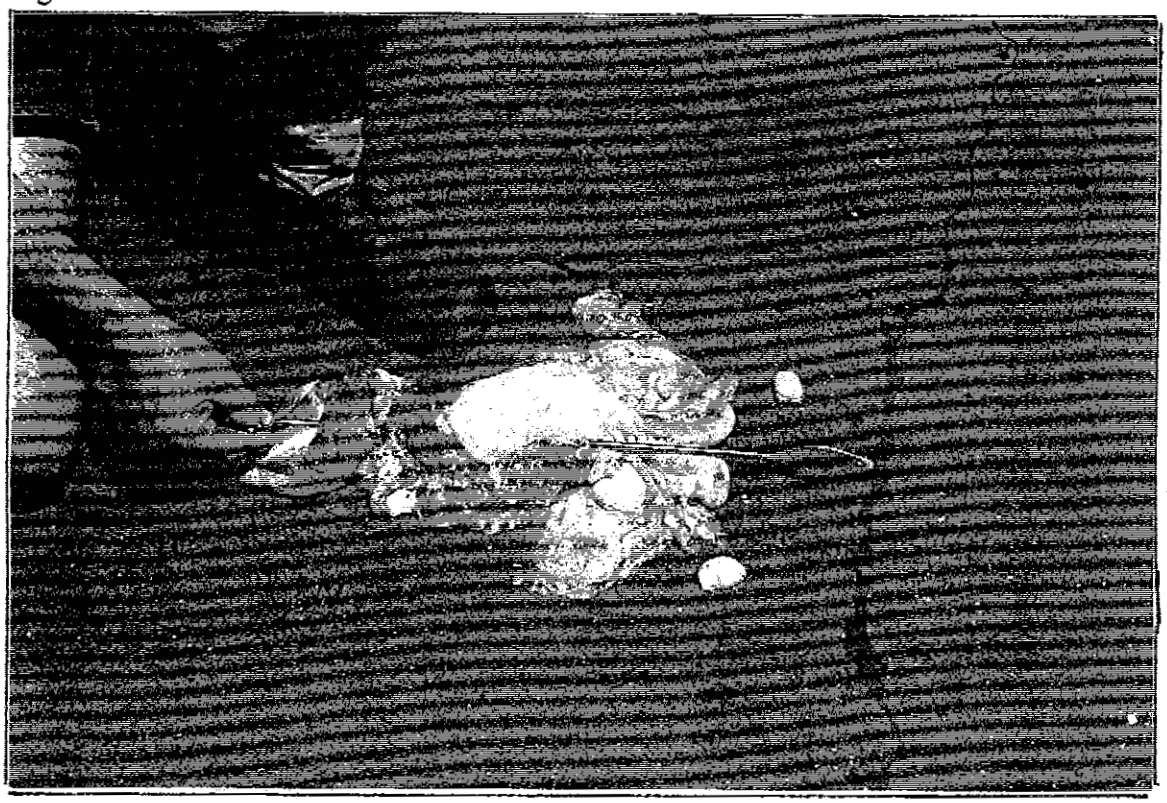

Figure 26