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by

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For many years past in horse-breeding countries it has been common knowledge amongst those connected with this work that certain stallions were considered poor getters and a good deal of blame has been thrown on such horses for the failure of mares to get in foal, but the important part played by the male in the reproductive state of our herds and flocks has not been so generally recognised by the farming community or by their advisers.

The highly fertile bull is quickly recognised as such and is, generally, valued by the owner because of the good results obtained, but the sterile animal often is not blamed soon enough for the farmer to get another bull before the mating season has nearly passed.

A good instance of this failure to recognise the sterile bull was brought to my notice in December 1939 when on the 4th of that month I was asked to examine a two-year old Jersey bull which had been serving a herd of 43 cows without settling one animal. Six services were obtained from this bull without any trouble, but not one sperm was found by the usual microscopical examination. Such findings as this one are very satisfactory to the examiner because he can make a definite assessment of the bull's total infertility and can follow this up with the very valuable advice to procure another bull.

Between the highly fertile bull at the top of the scale and the totally infertile one at the bottom, must surely come the bull of moderate or of low fertility. The moderate bulls and those of low fertility are not quite so easily understood by the farmer as the more outstanding classes because it might reasonably be thought that a bull is able to settle 50 cows successfully if he can manage a dozen. It is not usual in practice to find that a bull of low fertility does settle a herd satisfactorily although some of the cows will hold at the first round.

Professor Williams of New York pioneered the work showing that examination of semen provided a guide to the fertility of bulls and horses according to the various characteristics of the sperm-content.

In his classic work "Diseases of the Genital Organs of Domestic Animals" 1921, Williams deals extensively with the fertility of the male, the interesting statements in his conclusions being:-

1. Sterility of varying degrees in bulls is very common.
2. Such sterility is associated commonly either with an arrest in the development of the sperm cell or with disintegration after reaching maturity.
3. It appears that the devitalisation of the spermatozoa is due to the toxic substances derived from some bacterial infection.
4. The determination of the motility of spermatozoa does not constitute a reliable standard for the measurement of their vitality and power of fecundation.

The method enunciated by Professor Williams has been largely followed during the examination and classification of many hundreds of bulls, together with a few rams, boars and horses during the past eleven years.

Having been stationed in the Waikato to make an endeavour to find some solution to the perplexing problem of sterility, it appeared from histories supplied by farmers that the bull was, in many cases, the root cause of the trouble being experienced in getting the cows in calf. With this idea in view, samples of semen were collected and, almost at once, these samples proved that fertility in practice coincided with the microscopical characteristics of the service.

Two instances may be quoted to show this correlation between actual fertility as seen in the herd and the classification of fertility by the examiner.

In April 1930 a sample was obtained from a bull said to be giving good results. This sample showed all the features then looked for in good semen, namely:

- (1) Good quantity of semen.
- (2) Good quality of semen.
- (3) Good motility of spermatozoa.
- (4) Good life of spermatozoa.
- (5) Good morphology of spermatozoa.

This bull's record for the season was 91% at first service on 24 cows.

The second case worthy of mention was investigated in June 1930 and afforded a sample at the other end of the scale of fertility. The history of the herd was that no cow was in calf to this bull and explains the reason for my visit.

The sample showed:

- (1) Good quantity of semen.
- (2) Poor quality of semen.
- (3) No motility of sperms.
- (4) No life of sperms.
- (5) Bad morphology of sperms.

These two examples served as the starting point for many more examinations as opportunity offered when the succeeding breeding seasons came along and I have to thank several farmers who put some considerable time at my disposal for the purpose of collecting samples for examination.

Over 1600 samples of semen have been examined from various parts of the country, but most of these were obtained in the Waikato district.

Many bulls were examined twice, some three times and a few four or five times.

One interesting bull was examined 8 years in succession and on each occasion his fertility was classed good. His records are given because they are somewhat outstanding. The percentages represent success at the first service, the figures for the second round not being available.

1932	-	91%
1933	-	82%
1934	-	78%
1935	-	88%
1936	-	74%

82% making an average of 82%
in the same herd over 5 years.

If this bull also produced good stock, what a prize to a farmer!

In 1937 this bull was becoming unsuitable for further use in this herd and was put, at my suggestion, into a herd which had given a good deal of trouble to get in calf for some years.

In this fresh herd he was not able to show his usual results (this was quite expected, as similar instances can be quoted), his record being only 42% on the first round; however, in 1938 his reputation was retrieved by 91% on 61 cows. As a nine year old in 1938 this bull was the only one used on the herd numbering 58 cows which he settled satisfactorily, although he was only 57% successful on the first round.

Not on many farms in this country would a 9 year old bull be kept solo to serve 58 cows, for such bulls are not very frequently met. In his original herd he was 82% successful over 5 years and when put into a troublesome herd he was 63% successful on the first rounds during 3 years.

Specimens have been examined from bulls which put up records of 100% but these bulls had not served as many as 58 cows.

The fertility of bulls, whose services appear to the examiner neither good nor bad, but are assessed as moderate, is not so easy to understand, because it is well known that a bull may give services which would be classed as moderate one day and good the next day. Even the unsatisfactory bull may be classified as good at a later date. This change in quality of service is quite marked, more especially in the medium grades of fertility but, fortunately, is not seen to any serious extent in good or bad bulls.

Owing to this fluctuation in quality, it is advisable to obtain a second sample, say a few days later, if the examiner is not satisfied with the sample or if the owner considers the classification does not coincide with results in practice.

Even given the opportunity of two separate samples, the examination may prove incorrect in a few cases. Four years ago two young bulls in different herds were examined and, although it was known that neither of them had put a cow in calf, two examinations did not allow a lower classification in either case than poor or very poor. Fortunately, these instances are not common, the sterile bull usually being easy to pick.

Again, during last season, I put two bulls, which proved totally useless at first services, into the good class although their histories were known at the time of examination. In one of these cases, the bull had proved very satisfactory during the previous two seasons on 60 cows and it is hard to believe that a 5 year old bull can suddenly go completely sterile and yet show a good service. If such a bull is unable to settle any cows, the pathological state of the semen is not revealed by the microscope. When other methods of examination are brought into use, it may be possible to detect the lack of fertility in these difficult cases.

Possibly another service later on might have revealed sufficient abnormality to enable a low assessment to be made, but I do not think sufficient alteration would be apparent in many instances to drop the assessment lower than into the moderate class.

It is a pity that a case of this nature could not be enquired into further by taking the animal over and seeing his results on a different lot of cows. If this were done, some very useful information would be gained.

Coming further down the scale, the farmer should soon recognise the sterile animal or the animal of very low fertility because the cows return one after another, but it sometimes happens that a bull is well in his second round of service before his uselessness is realised.

In support of this statement concerning the reluctance of the farmer to blame the bull for the return of the cows, two epidemics of sterility investigated the season before last may be quoted.

In one instance 43 cows received 64 services without one cow holding and a new bull was not procured until the first week in December when the original bull was examined and declared sterile.

In another outbreak, the 25 cows were served once and the first six returns were served a second time before another bull was put in.

Both these bulls were diagnosed as sterile on two occasions and, as usually happens, fresh bulls were entirely successful in both herds.

The result of such failure to reproduce is now much more readily understood by the farmer than it was a few years ago, but it must be remembered that rams, boars and horses can be affected in a similar way.

Professor Lagerlof's more recent work at Stockholm on the fertility of bovine males has again demonstrated the truth of Williams' findings. Lagerlof states that sterility or low fertility in bulls is quite common in Sweden.

From investigation of the records covering over 2000 bulls recorded in the Swedish Bull Society, he says about 25 per cent of the bulls culled were disposed of because of low fertility. Certainly some of his observations do not agree with ours, for he says that more bulls were discarded because of their incapacity to copulate than because of their inability to fertilise. Incapacity to serve is rare in this country except in those cases where injury is apparent.

As mentioned above, failure to conceive is evident amongst equine species in this as in all other horse-breeding countries.

In his article on "Fertility of Stallions", written back in 1926, Sanders of Cambridge stated:

"The decline has been fairly constant and the mean fertility has fallen from 61 per cent to 50%, a fall of roughly 0.3 per cent per annum."

Savage's comment on this statement is that it would be unreasonable to conclude that in 150 years time the fertility of the thoroughbred will be nil but, in view of the evidence on which it is founded, the statement arrests attention and compels thought.

Our Departmental leaflet on sterility issued in 1912 suggested that the presence of the organism associated with contagious abortion may have the effect of destroying the virility of spermatozoa, venereal disease and overwork on the part of the bull are mentioned and treatment of the genitals by flushing the sheath is recommended in order to prevent the spread of infection during coition; otherwise, the fertility of the male, per se, as the principal factor, is not questioned. This leaflet was withdrawn from circulation some years ago when the responsible officers became satisfied that a good deal of the sterility seen in our herds was, in fact, due to low fertility on the male side. Even the most sceptical must now admit that a fair proportion of blame for lack of fertilisation can be sheeted home to low grade semen.

In dealing with sterility I am not mindful of the many abnormal conditions to which the female genital organs are heir. The female is more highly organised biologically than is the male and, consequently, is more subject to dysfunction and departure from the normal, but pathological conditions, sufficient to account for many outbreaks of sterility often are not detectable in the herds giving trouble.

Omitting many services taken at Ruakura for experimental purposes, the number of semen samples examined now reaches over 1600.

The chief objects of this work were to determine the value of semen examination and to investigate the role played by the quality of semen in the reproductive process in our herds.

It has been my endeavour to classify the fertility of each animal into one of the 5 classes designated as "Good" meaning a fertility of 70% or upwards; "Moderate" 70% to 50%; "Unsatisfactory" 50% to 30%; "Bad" 30% to 10%; and "Sterile" 10% to 0%.

Irregularities have occurred in several instances, but these exceptions have not overshadowed the main trend of experience which has proved that semen examination does usually indicate the degree of fertility and that low fertility in the male animal is the cause of a large amount of the infertility seen in our herds. From the examinations carried out on imported bulls, one would say that this country does not suffer in isolated splendour, alone.

Naturally, the first and most important point in this matter is the history of fertility as seen by the farmer. If the cows are holding quite satisfactorily, it can be taken for granted that the bull is quite fertile.

In many cases the history is different and the herd is showing too many returns. Semen examination often results in partial or total condemnation of the bull.

The last link in the chain of incriminating evidence of the infertile male may be obtained post mortem when examination of the testes reveals a diseased condition microscopically, the sperms present a hopeless picture microscopically and the testicular tissues reveal extensive degeneration histologically.

Several cases have thus been followed up to the bitter end, and all the data obtained have given evidence of either partial or total infertility.

One instance may be quoted:-

In 1935, two bulls in a herd with a bad history were examined and condemned on the sperm-picture. After death, the sperm-picture was confirmed. The histology demonstrated the correctness of the original classification, the histologist's report being:-

- No.1 Sections show a definite degeneration very similar to that seen in our rats on incomplete diet. The bull was definitely sterile.
- No.2 The spermatids are sloughing off before they become spermatozoa and are degenerating in the seminiferous tubules. There are practically no fully grown sperm.

More bulls might have been followed to this extreme limit but, if the history and the sperm-picture agreed, the bull was usually culled and it was found to be difficult to obtain the necessary material.

Owing to a change in the standard of classification and a slight alteration in the nomenclature of the classes used, it is not possible to give exact details of the first period's work under the headings used now, but results of a good number of bulls will show that the findings in general were fairly correct, and agree to some extent with results of the past two seasons.

							<u>New Method</u>			
105	Good	bulls	showed	success	at	1st	Service	65%)		
135	Fair	"	"	"	"	"	"	53%)	59%	66%
103	Poor	"	"	"	"	"	"	41%)	32%	33%
99	Bad	"	"	"	"	"	"	24%)		
24	Sterile put only 2 or 3 cows in calf.									

These figures agree fairly well with the results supplied by farmers during the past two years for bulls examined in that period thus:

<u>Classification</u>	<u>No. of Bulls</u>	<u>Average % Performance at first service.</u>	<u>Expected Average Percentage.</u>
Good	58	66%	70% or over
Moderate	57	54%	70% to 50%
Unsatisfactory	18	31%	50% to 30%
Bad	2	13%	30% to 10%
Sterile	10	Only 3 cows in calf to 2 bulls 10% to 0%	

Of the 269 examinations made during the past two years, the samples were classified as below and are compared with the classification for 7 years previously.

<u>Class</u>	<u>Number</u>	<u>Percentage</u>	<u>Old Classification</u>	<u>No.</u>	<u>Percentage</u>
Good	108	or 40%	Good or Fair	397	47%
Moderate	107	or 40%			
Unsatisfactory	37	or 14%	Poor and Bad	411	49%
Bad	7	or 2%			
Sterile	10	or 4%	Sterile	24	3%

These figures can hardly be taken as truly representing the bull population of this country because a large number of visits were arranged and examinations carried out for the simple reason that trouble was being experienced in these herds; thus the number of good bulls is lower probably than would be found if all the bulls in a district were examined. They will show, however, that the question of fertility in the male is no longer a question of little importance to the primary industries of this country.

During the past season a bull-testing service was inaugurated by the Research Division after a special trial made the previous year and the results have been sent to Mr Ward for analysis.

The scheme was worked by the aid of the Veterinarians and Stock Inspectors of the Livestock Division who collected the samples of semen and forwarded them to Ruakura for examination.

Owing to the difficulty experienced in obtaining clean and representative samples by taking the material from the cow in the old-fashioned way, artificial vaginas are being distributed for use in the main dairying centres and, by this means, it is hoped that the samples collected will be more suitable for examination. If the subject of investigation is a highly fertile bull and the cow is suitable in all respects there is not much difficulty in collecting useful material from the cow, but, if as often happens, the service is watery or the cow is unsuitable, a good deal of trouble is demanded in collection and the examination is often of little value.

From work lately published in America, it seems probable that another string will be added to the bow of the examiner in the way of a different kind of test to assess the fertilising power of semen.

This Phillips-Lardy standard is based on the finding that ascorbic acid is present in normal bovine blood plasma to the

extent of 0.2 to 0.4 milligrams per c.c. and that normal semen contains 3 to 7 milligrams per c.c.

If this chemical and totally different type of test can be applied, it may help the examiner in the difficult cases which are not properly revealed by the microscope. It is our intention to put the ascorbic acid test under trial during the coming season.

A subsidiary biological test enunciated by these workers relies on the length of life in egg yolk and buffer solution of spermatozoa. They find that sperms of different fertilising power live different lengths of time thus:-

Good sperms	should be motile	150 - 200	hours
Fair	" " " "	100 - 150	" "
Poor	" " " "	under 100	" "

This life test may be useful, but I should feel dubious about relying on a difference of 50 hours life for dropping the classification from good to poor. It is well known that sperms collected one day may show a short life while those collected from the same bull the next day will remain alive their allotted span which may be more than three score hours and ten.

There will be some grave difficulties in applying this test to services taken at a distance in that egg yolk does not keep well and refrigerators will not be available for immediate use by the collectors in the various districts. However, a trial will be given to see how much reliance can be placed on the test.

The method of examination so far used is shown by the sheet used to report details at the time of examination.

There is no doubt that examination of semen does, usually, reveal the fertility of the male and that, if a fair number of animals are examined, the assessments on the average will coincide with results in practice as found by the farmer.

In conclusion, I should like to quote Professor Williams once more. In 1932 he stated:-

"In very rare instances a bull may show low fertility and high rate of abortion associated with highly motile sperms which reveal no evidence of disease when studied under the microscope."

The sexual health of these bulls must then be determined by the highly expensive method of trying him out in the herd.

In almost every case the safety of the bulls as a sire is determinable authentically by an examination of the sperms.

So in Loethe's instance, the sperms showed no fault but, clinically, the bull was dangerous. Loethe was dealing with an undetermined factor, a sort of "virus X", which may possibly have been the vesicular venereal disease.

After ample allowance for such limitations, the study of the stained sperms remains a test of unusual merit, and, applied at reasonable intervals, constitutes the most reliable means known for recognising and controlling the perils of genital disease in the male.

After several years work on similar lines, I can truly say that our results in New Zealand fully coincide with that of Williams, Savage, Lagerlof and others who have interested themselves in this problem.