

## PART II.

### I. SPERM MORPHOLOGY, AND THE RATE OF SPERM TRAVEL, IN THE GENITAL TRACT OF THE EWE.

The object of this experiment was to study the morphology of spermatozoa in the different divisions of the genital tract of the ewe at varying intervals after natural copulation, and to determine how soon after ejaculation spermatozoa could be recovered from the fallopian tubes.

#### 1. *Literature.*

The duration of vitality of spermatozoa and their distribution in the genitalia of the Merino ewe were studied by Quinlan, Marcé, and Roux (1932). Mated ewes were killed at intervals varying from 15 minutes to 48 hours. In some ewes the genitalia were examined under anaesthesia. Living spermatozoa were found in the vagina and cervix in large numbers fifteen minutes after coitus; very few in stained preparations from the pars indivisa of the uterus and none in the uterine horns and fallopian tubes. Six hours after coitus living spermatozoa were observed as far forward as the uterine extremity of the tubes. Spermatozoon motility became gradually reduced after twelve hours in the genital tract and no spermatozoa were found alive after just over 48 hours. The authors considered that live spermatozoa found in the uterus, uterine horns, and fallopian tubes after long intervals after copulation resulted from a continuous issue from the cervical canal which appeared to act as a reservoir for spermatozoa. Services up to 30 hours after the onset of oestrus produced 70 to 100 per cent. fertility, but after 30 hours fertility was reduced. Quinlan, *et al.* (1933), introduced spermatozoa artificially into the different divisions of the genital tract of the ewe. The secretion of the vagina was found to be unfavourable for sperm motility, the end-point being about 12 hours. The most favourable situation was the cervical canal where active motility was shown after 24 hours. In the uterine horns spermatozoa did not remain motile for more than 12 hours and in the fallopian tubes the time of survival was still less: only 5 per cent. were motile after 9 hours.

Warbritton, McKenzie, Berliner, and Andrews (1937) examined the genital tracts of ewes, 2, 12, and 24 hours after insemination. They selected the tube and horn on the side of the largest follicle or of a fresh corpus luteum and washed them and the cervix with physiological saline. The washings were pipetted onto slides and allowed to dry. Spermatozoa were found in the fallopian tubes of 21 of 25 ewes inseminated during oestrus, but the most numerous normal spermatozoa were found in the ewes that had been inseminated 12 hours after the beginning of oestrus. The authors suggested that this might be due to favourable conditions for sperm migration in the reproductive tract 10 to 12 hours after the beginning of oestrus. Green and Winters (1935), however, had found that spermatozoa reached the infundibulum of the ewe out of heat almost as quickly as when she was in heat, and concluded that "the reproductive tract of the ewe in heat gives no special response at copulation which tends to accelerate the advance of the sperm". Warbritton, *et al.* (1937) observed a greater number of abnormal spermatozoa in the tubes than in the horns. This would support the finding of Quinlan and co-workers that the time of survival of spermatozoa was less in the fallopian tubes than in the uterine

horns. Warbritton, *et al.* likewise came to the conclusion that the cervical canal was the most favourable site for sperm preservation and that vitality was soon lost in the vagina.

According to Neumann and Salzman (1940) spermatozoon motility was maintained for various periods up to 28 hours in the reproductive tract of healthy mares in oestrus. All motility had, however, ceased 36 hours after mating. They considered that spermatozoa probably reached the top of the fallopian tubes directly after entering the uterus. Great variation in sperm survival was observed depending on the health of the mare, period of sexual cycle, nature of the medium (mucus, etc.), "filling" of the genital tract and the quality of the sperm. Day (1942) obtained pregnancies in mares inseminated with more or less 2 billion spermatozoa up to six days prior to ovulation. Day draws attention to such a long period of sperm survival in the genitalia of the mare in view of the fact that horse sperm is so highly diluted by accessory secretions and presents so many difficulties for storage *in vitro*. No pregnancies were obtained when inseminations were made earlier or on the day of ovulation.

To study the mechanism of ascent of the spermatozoon in the female genital tract Florey and Walton (1931) created uterine fistulae in rabbits, rats, and guinea-pigs. At definite intervals after copulation, a sample of the uterine contents was obtained through the fistulae by means of a fine pipette which had been moistened with Ringer's solution. In the rabbit spermatozoa appeared 20 minutes to 2 hours from copulation. The numbers were small at first and increased gradually. The interval increased with the distance of the fistula from the cervix. These authors concluded that in the rabbit, spermatozoa penetrate into the uterus gradually and not rapidly by uterine "suction" or peristalsis. In the rat and guinea-pig, however, undiluted, highly concentrated semen might appear at the open fistula immediately after copulation. It was believed that a spasmodic contraction of the vagina was the principal factor involved and that the propulsion of semen into the uterus was assisted by the copulation plug which forms in these two animals. Rossman (1937) on the other hand, found no evidence that vaginal or cervical activity was involved in the transport of spermatozoa in the rat. He agreed, however, with Florey and Walton (1931) that spermatozoa were transported through the reproductive tract with great rapidity. Rossman allowed rats to mate and then anaesthetised the female by a subcutaneous injection of sodium amytal. The uterus was exposed by an incision and frozen *in situ* by pouring over it ninety-five per cent. alcohol, chilled to about  $-60^{\circ}$  with solid carbon dioxide. This rapid fixation demonstrated contractions which had occurred in the uterus and Rossman (1937) maintained that these contractions supplied the motive force in sperm transport.

The speed at which ram spermatozoa travel *in vitro* was determined by Phillips (1935). A glass tube, 12 mm. in diameter and 38.1 cm. long was divided into six sections by seven side tubes. A drop of semen was placed in a depression at one end of the tube and at various intervals a small drop of fluid was removed from the side tubes for examination. In Ringer's and normal salt solutions spermatozoa traversed the 38.1 cm. tube at the rate of 4.6 mm. per minute. The rate of travel slowed down as the spermatozoa advanced. Phillips and Andrews (1937) carried out experiments to compare this speed of travel of ram sperm *in vitro* with the rate spermatozoa could travel *in vivo*, and also to determine whether spermatozoa

from other species could attain the same rate of travel as ram sperm in the genitalia of the ewe. The rat was selected as the other species. Equal amounts of ram semen and a suspension of rat spermatozoa in Ringer's solution were mixed and inseminated into the anterior end of the vagina of a ewe. Seven ewes were used. They were slaughtered and the different sections of the tract examined at intervals varying from 7 hours and 7 minutes to 30 minutes after insemination. Ram spermatozoa were found in all sections of the genital tract including the upper end of the fallopian tube at all examinations, but rat spermatozoa had reached the fallopian tubes in only three cases. Ram spermatozoa were calculated to have travelled at the rate of 12.4 mm. per minute if the full thirty minutes were required. The rate of the rat spermatozoa was slower.

Green and Winters (1935) had found spermatozoa in the infundibulum approximately 5 hours after copulation in the ewe. This was irrespective of whether the ewes were in oestrus or not.

Schott and Phillips (1941) studied ovulation and sperm travel in ewes that were tested four times daily for oestrus. The ewes were slaughtered at various intervals from the time oestrus was first observed to examination of the ovaries. The fallopian tubes were divided into three approximately equal sections by haemostats and the remainder of the tract into its different compartments. The lumen of each tube was washed out with distilled water and the washings collected in small vials. Duplicate slides were made from each vial. The shortest time observed in which spermatozoa had reached the upper part of the fallopian tube was 16 minutes. In the majority of cases examined at intervals of 18 to 20 minutes sperm were in the upper sections of the tube. The average length of the genital tract from the posterior end of the cervix to the upper end of the fallopian tubes was 80 cm., and with sperm reaching the upper section in 20 minutes the rate of travel was therefore 4 cm. per minute. The authors showed that time of oestrus and time of ovulation did not influence sperm travel since in three young ewes that had not yet come into first oestrus sperm were found well up the tract in 14 to 20 minutes and in three old ewes, 7 to 10 days past oestrus, sperm had reached respectively the upper section of the tubes in 16 and 19 minutes and the lower section in 15 minutes after service.

Wimsatt (1942) was able to show that in certain species of *bat.* spermatozoa may not only survive in the female genital tract throughout the period of hibernation (over 5 months), but that spermatozoa of the autumn matings are capable of initiating development of the ova shed from the ovaries in the spring.

## 2. *The Experiment.*

### (a) *Materials and Methods.*

Fifteen Merino ewes were used in this study. Seven were slaughtered at intervals of 1, 2, 3, 5, 18, 18, and 20 hours after natural copulation for a study of sperm morphology, and eight at intervals of 30, 24, 15, 10, 9, 8, 6 and 6 minutes for examination of the different divisions of the tract for the presence of spermatozoa. The ewes were tested for oestrus by means of vasectomised rams once a day in a small paddock. The ewes were therefore in varying stages of oestrus when mated. The vasectomised rams were not permitted to mount the ewes, and when the genitalia were to be examined for the presence of spermatozoa aprons were attached to the teasers in order

to avoid any possibility of coitus before service by the normal ram. The ewe to be mated was held by an assistant and the ram allowed to copulate. The moment that the ram made his thrust was recorded and taken as the time of ejaculation. Only one service was allowed.

Immediately after slaughter the abdominal cavity was opened and with the organs *in situ* the fallopian tubes and horns were straightened out by rapid dissection of the meso-metrial attachments. Commencing at the ovarian end the fallopian tubes were divided into approximately three equal sections by clamping on small artery forceps. Immediately these clamps were in position the time was noted and the interval since ejaculation recorded. At the shortest intervals the sections of the fallopian tubes were also severed after being clamped off. Each horn was then clamped off from the body of the uterus which was again similarly separated from the anterior end of the cervical canal. Lastly, a forceps was applied to the posterior end of the cervical canal to separate it from the vagina. The length of the tract was measured from the posterior end of the cervix to the ovary.

Commencing with the upper sections, the fallopian tubes were cut (if this had not already been done) at the forceps into the three sections. By means of a fine needle and a syringe each section of both tubes was washed out with distilled water directly onto glass slides and allowed to evaporate in a warm atmosphere. Triplicate slides were made from each section. To avoid the possibility of spermatozoa being conveyed from one section to the other by the instruments, a different needle was used for each section and the anterior sections were handled first. The three slides from the anterior section of the left fallopian tube were marked LT, 1 (left tube, one); those from the middle section LT, 2, and from the posterior section LT, 3. The preparations from the right tube were marked in the same order RT, 1, RT 2 and RT, 3 respectively. Three slides were similarly made from each horn (LH and RH) and from the pars indivisa of the uterus. The cervical canal was opened, and smears made from the contents and also from the vagina. At intervals of one hour and longer after copulation, examinations for sperm motility were made. When searching for spermatozoa in preparations from the forward divisions, a magnification of 80 was used.

The condition of the ovaries was examined after slaughter of the ewes.

(b) *Sperm Morphology.*

Tables 41 to 47 show spermatozoon motility and the classification of abnormal spermatozoa in the various divisions of the genitalia at intervals of 1, 2, 3, 5, 18, 18, 20 hours after copulation. One ewe was used for each interval. In the vagina at one hour, no spermatozoa were motile. This was unexpected and probably accidental because at all other intervals at least some showed motility. The best motility was at the 3 hour interval when it was "fairly good", 50 per cent being motile. At 18 and 20 hours only a few spermatozoa were alive and their movements were feeble and oscillatory in nature. In the cervix, although motility became gradually weaker as the intervals between copulation and examination increased, there were still about 40 per cent. of spermatozoa motile at 20 hours. At 3 hours (Table 43) and at one 18 hour interval (Table 45) motility was actually better in the cervical canal than at the time of copulation. This must be due to the favourable conditions for sperm vitality which exist in the cervical canal as found by Quinlan, *et al.* (1933). It is possible, too, that the

#### SPERM PICTURE OF RAMS AND RATE OF SPERM TRAVEL.

secretions of this organ may stimulate spermatozoa to prolonged activity. The active motility shown in the cervical canal was not maintained after the spermatozoa had passed further forward along the genital tract. These results, which show that the secretions of the vagina are injurious to spermatozoa and that optimum conditions exist in the cervical canal, are in agreement with the work of Quinlan, *et al.* (1933), and Warbritton and co-workers (1937). It should be pointed out, however, that since the semen of the ram at normal coitus is deposited in the vagina the great majority of abnormal spermatozoa in the semen at the time of copulation are left behind in that organ and so contribute towards the extremely high abnormality counts found there at different intervals of time.

Because spermatozoa enter the uterine horns in such small numbers it was not possible to observe motility there at intervals before five hours. At five hours, motility in the horns and in the pars indivisa was good. At 18 and 20 hours it was only fairly good in the pars indivisa and of the few spermatozoa that were observed in the horns only a small proportion showed motility. In the washings from the tubes it was rarely possible to find spermatozoa in the wet preparations because of the dilution, and motility could not be determined. A different technique would have been required which would have delayed other observations unduly.

The number of abnormal spermatozoa in the vagina increased to very large proportions as the interval between copulation and examination lengthened. At one hour after ejaculation (Table 41) the number of abnormal spermatozoa per thousand had not increased. At the intervals of 2 and 3 hours the proportion of abnormal spermatozoa had increased perceptibly and at 5 hours it had risen from 20 per thousand at copulation to 506 (Table 44), representing a percentage increase of 2,530 (Table 48). At one 18 hour interval the increase was not marked (Table 45), but at the other and at 20 hours it was very great (Tables 46 and 47).

In the cervix, at 1, 2, and 3 hour intervals there was a smaller proportion of abnormal spermatozoa than in the semen at copulation. This must mean that most of the abnormal spermatozoa ejaculated into the vagina were not carried forward into the cervix, and that degeneration of the spermatozoa in the cervical canal had not yet commenced. At longer intervals a perceptible increase was observed, but the high figures recorded for the vagina were not attained. In the pars indivisa of the uterus a sufficient number of spermatozoa was found on only three occasions for an abnormality count to be made, *viz.*, at the intervals of 3, 5 and 20 hours. The position then was approximately similar to that in the cervix. An abnormality count from the horns was possible only at 20 hours, 36 abnormal spermatozoa per thousand being observed (Table 47). More observations at various intervals would be necessary before definite conclusions could be drawn, but it would appear that in the vagina spermatozoa begin to undergo degenerative changes in approximately two hours while in the cervical canal and uterus changed morphology was not observed before the 5th hour. The types of abnormal spermatozoa found in the different divisions of the genital tract at the various intervals after copulation were practically the same as in the semen at the time of ejaculation. The observation made by Quinlan, Maré, and Roux (1932) that spermatozoa accumulate in the cervical canal and pass out from there as a continuous issue is supported by this work. At no time have large numbers of spermatozoa been found in any division of the genital tract anterior to the cervix.

TABLE 41.\*

*Examination of the Different Divisions of the Reproductive Tract.**Ram No. 56947.**Ewe No. 61602.**Interval between ejaculation and examination: 1 hour.**Condition of Ovaries.—Corpus luteum in right ovary.**Sperm Motility and Abnormal Spermatozoa per 1,000.*

|                             | At *<br>Service. | 1 HOUR AFTER MATING. |                 |                   |                 |                 |
|-----------------------------|------------------|----------------------|-----------------|-------------------|-----------------|-----------------|
|                             |                  | Vagina.              | Cervix.         | Pars<br>Indivisa. | Horns.          | Tubes.          |
| Motility.....               | 4                | Nil                  | 90<br>Per Cent. | Fair              | Not<br>Observed | Not<br>Observed |
| Tailless sperm.....         | 12               | 8                    | 6               | —                 | —               | —               |
| Coiled tails.....           | 6                | 4                    | —               | —                 | —               | —               |
| Enlarged middle pieces..... | —                | —                    | —               | —                 | —               | —               |
| Double middle pieces.....   | 2                | —                    | —               | —                 | —               | —               |
| Middle piece beads.....     | —                | —                    | —               | —                 | —               | —               |
| Defective staining.....     | —                | 4                    | —               | —                 | —               | —               |
| Narrow heads.....           | 4                | 6                    | —               | —                 | —               | —               |
| Pyriform heads.....         | —                | —                    | —               | —                 | —               | —               |
| Megalo-sperm.....           | —                | —                    | —               | —                 | —               | —               |
| Micro-sperm.....            | —                | —                    | —               | —                 | —               | —               |
| TOTAL.....                  | 24               | 22                   | 6               | +                 | +               | +               |

\* Drop of semen collected as ram dismantled.

+ = Spermatozoa present, but too few to be classified.

\* Tables 5-40 appear in Appendix.

SPERM PICTURE OF RAMS AND RATE OF SPERM TRAVEL.

TABLE 42.

*Examination of the Different Divisions of the Reproductive Tract.*

*Ram No. 56947.*

*Ewe No. 61738.*

*Interval between ejaculation and examination: 2 hours.*

*Condition of Ovaries.—Corpus luteum in right ovary.*

*Sperm Motility and Abnormal Spermatozoa per 1,000.*

|                             | At *<br>Service. | 2 HOURS AFTER MATING. |                 |                   |                 |                 |
|-----------------------------|------------------|-----------------------|-----------------|-------------------|-----------------|-----------------|
|                             |                  | Vagina.               | Cervix.         | Pars<br>Indivisa. | Horns.          | Tubes.          |
| Motility.....               | 4                | Feeble                | 90<br>Per Cent. | Fair              | Few<br>Observed | Not<br>Observed |
| Tailless sperm.....         | 4                | 16                    | 2               | —                 | —               | —               |
| Coiled tails.....           | 8                | 12                    | 6               | —                 | —               | —               |
| Enlarged middle pieces..... | 2                | —                     | —               | —                 | —               | —               |
| Double middle pieces.....   | 6                | 14                    | —               | —                 | —               | —               |
| Middle piece beads.....     | —                | —                     | —               | —                 | —               | —               |
| Defective staining.....     | 2                | 2                     | 8               | —                 | —               | —               |
| Narrow heads.....           | 2                | 2                     | 2               | —                 | —               | —               |
| Pyriform heads.....         | —                | —                     | —               | —                 | —               | —               |
| Megalo-sperm.....           | 4                | 2                     | —               | —                 | —               | —               |
| Micro-sperm.....            | —                | 2                     | —               | —                 | —               | —               |
| TOTAL.....                  | 28               | 50                    | 18              | +                 | +               | +               |

\* Drop of semen collected as ram dismantled.

+ = Spermatozoa present, but too few to be classified.

TABLE 43.

*Examination of the Different Divisions of the Reproductive Tract.**Ram No. 62544.**Ewe No. unknown.**Interval between ejaculation and examination: 3 hours.**Condition of ovaries.—Recently ruptured follicle in right ovary.**Sperm Motility and Abnormal Spermatozoa per 1,000.*

|                             | At *<br>Service. | 3 HOURS AFTER MATING. |                 |                   |                 |                 |
|-----------------------------|------------------|-----------------------|-----------------|-------------------|-----------------|-----------------|
|                             |                  | Vagina.               | Cervix.         | Pars<br>Indivisa. | Horns.          | Tubes.          |
| Motility.....               | 3                | 50<br>Per Cent.       | 80<br>Per Cent. | Good              | Not<br>Observed | Not<br>Observed |
| Tailless sperm.....         | 32               | 104                   | 4               | 4                 | —               | —               |
| Coiled tails.....           | 124              | 204                   | 20              | 8                 | —               | —               |
| Enlarged middle pieces..... | —                | —                     | —               | —                 | —               | —               |
| Double middle pieces.....   | 2                | 4                     | —               | —                 | —               | —               |
| Middle piece beads.....     | 18               | 4                     | —               | —                 | —               | —               |
| Defective staining.....     | 10               | 148                   | 22              | 20                | —               | —               |
| Narrow heads.....           | —                | —                     | —               | —                 | —               | —               |
| Pyriform heads.....         | 4                | 4                     | —               | —                 | —               | —               |
| Megalo-sperm.....           | —                | —                     | —               | —                 | —               | —               |
| Micro-sperm.....            | 2                | —                     | —               | —                 | —               | —               |
| TOTAL.....                  | 192              | 468                   | 46              | 32                | +               | None found      |

+ = Spermatozoa present, but too few to be classified.



SPERM PICTURE OF RAMS AND RATE OF SPERM TRAVEL.

TABLE 44.

*Examination of the Different Divisions of the Reproductive Tract.*

*Ram No. 62030.*

*Ewe No. 61933.*

*Interval between ejaculation and examination: 5 hours.*

*Condition of Ovaries.*—Large unruptured follicle in right ovary.

*Sperm Motility and Abnormal Spermatozoa per 1,000.*

|                             | At *<br>Service. | 5 HOURS AFTER MATING. |                 |                   |        |                 |
|-----------------------------|------------------|-----------------------|-----------------|-------------------|--------|-----------------|
|                             |                  | Vagina.               | Cervix.         | Pars<br>Indivisa. | Horns. | Tubes.          |
| Motility.....               | 5                | Fair                  | 80<br>Per Cent. | Good              | Good   | Not<br>Observed |
| Tailless sperm.....         | 6                | 30                    | 4               | 6                 | —      | —               |
| Coiled tails.....           | 6                | 138                   | 10              | 4                 | —      | —               |
| Enlarged middle pieces..... | —                | —                     | —               | —                 | —      | —               |
| Double middle pieces.....   | —                | —                     | —               | —                 | —      | —               |
| Middle piece beads.....     | 2                | —                     | —               | —                 | —      | —               |
| Defective staining.....     | 6                | 338                   | 20              | 40                | —      | —               |
| Narrow heads.....           | —                | —                     | —               | —                 | —      | —               |
| Pyriform heads.....         | —                | —                     | —               | —                 | —      | —               |
| Megalo-sperm.....           | —                | —                     | —               | —                 | —      | —               |
| Micro-sperm.....            | —                | —                     | —               | —                 | —      | —               |
| TOTAL.....                  | 20               | 506                   | 34              | 50                | +      | +               |

\* Drop of semen collected as ram dismantled.

+ = Spermatozoa present, but too few to be classified.

TABLE 45.

*Examination of the Different Divisions of the Reproductive Tract.*

Ram No. 62418.

Ewe No. 61833.

Interval between ejaculation and examination: 18 hours.

Condition of Ovaries.—Large unruptured follicle in right ovary.

*Sperm Motility and Abnormal Spermatozoa per 1,000.*

|                             | At *<br>Service. | 18 HOURS AFTER MATING. |                 |                   |        |                 |
|-----------------------------|------------------|------------------------|-----------------|-------------------|--------|-----------------|
|                             |                  | Vagina.                | Cervix.         | Pars<br>Indivisa. | Horns. | Tubes.          |
| Motility.....               | 2                | Feeble                 | 90<br>Per Cent. | Feeble            | Feeble | Not<br>Observed |
| Tailless sperm.....         | 6                | 38                     | 20              | —                 | —      | —               |
| Coiled tails.....           | 18               | 97                     | 24              | —                 | —      | —               |
| Enlarged middle pieces..... | 6                | —                      | —               | —                 | —      | —               |
| Double middle pieces.....   | —                | 2                      | —               | —                 | —      | —               |
| Middle piece beads.....     | —                | —                      | —               | —                 | —      | —               |
| Defective staining.....     | 2                | 17                     | 2               | —                 | —      | —               |
| Narrow heads.....           | —                | —                      | —               | —                 | —      | —               |
| Pyriform heads.....         | —                | 2                      | —               | —                 | —      | —               |
| Megalo-sperm.....           | —                | —                      | —               | —                 | —      | —               |
| Micro-sperm.....            | —                | —                      | —               | —                 | —      | —               |
| TOTAL.....                  | 32               | 156                    | 46              | +                 | +      | +               |

\* Drop of semen collected as ram dismounted.

+ = Spermatozoa present, but too few to be classified.

SPERM PICTURE OF RAMS AND RATE OF SPERM TRAVEL.

TABLE 46.

*Examination of the Different Divisions of the Reproductive Tract.*

*Ram No. 62545.*

*Ewe No. 55938.*

*Interval between ejaculation and examination: 18 hours.*

*Condition of Ovaries.—Ruptured follicle in right ovary.*

*Sperm Motility and Abnormal Spermatozoa per 1,000.*

|                             | At *<br>Service. | 18 HOURS AFTER MATING. |                 |                   |                 |                 |
|-----------------------------|------------------|------------------------|-----------------|-------------------|-----------------|-----------------|
|                             |                  | Vagina.                | Cervix.         | Pars<br>Indivisa. | Horns.          | Tubes.          |
| Motility.....               | 5                | Feeble                 | 50<br>Per Cent. | Fair              | Not<br>Observed | Not<br>Observed |
| Tailless sperm.....         | —                | 482                    | 64              | —                 | —               | —               |
| Coiled tails.....           | 4                | 16                     | 8               | —                 | —               | —               |
| Enlarged middle pieces..... | —                | —                      | —               | —                 | —               | —               |
| Double middle pieces.....   | —                | —                      | —               | —                 | —               | —               |
| Middle piece beads.....     | —                | —                      | —               | —                 | —               | —               |
| Defective staining.....     | 2                | 30                     | 8               | —                 | —               | —               |
| Narrow heads.....           | —                | —                      | —               | —                 | —               | —               |
| Pyriform heads.....         | —                | —                      | —               | —                 | —               | —               |
| Megalo-sperm.....           | —                | —                      | —               | —                 | —               | —               |
| Micro-sperm.....            | —                | —                      | —               | —                 | —               | —               |
| TOTAL.....                  | 6                | 528                    | 80              | +                 | +               | +               |

\* Drop of semen collected as ram dismantled.

+ = Spermatozoa present, but too few to be classified.

TABLE 47.

*Examination of the Different Divisions of the Reproductive Tract.*

Ram No. 62030.

Ewe No. 61815.

Interval between ejaculation and examination: 20 hours.

Condition of Ovaries.—Ruptured follicle in left ovary.

*Sperm Motility and Abnormal Spermatozoa per 1,000.*

|                             | At *<br>Service. | 20 HOURS AFTER MATING. |                 |                   |         |                 |
|-----------------------------|------------------|------------------------|-----------------|-------------------|---------|-----------------|
|                             |                  | Vagina.                | Cervix.         | Pars<br>Indivisa. | Horns.  | Tubes.          |
| Motility.....               | 5                | Feeble                 | 40<br>Per Cent. | Fair              | Present | Not<br>Observed |
| Tailless sperm.....         | 6                | 356                    | 6               | 16                | 20      | —               |
| Coiled tails.....           | 14               | 76                     | 12              | 16                | 4       | —               |
| Enlarged middle pieces..... | —                | —                      | —               | —                 | —       | —               |
| Double middle pieces.....   | —                | —                      | —               | —                 | —       | —               |
| Middle piece heads.....     | —                | —                      | —               | —                 | —       | —               |
| Defective staining.....     | 6                | 452                    | 52              | 60                | 12      | —               |
| Narrow heads.....           | —                | —                      | —               | —                 | —       | —               |
| Pyramidal heads.....        | —                | —                      | —               | —                 | —       | —               |
| Megalo-sperm.....           | —                | —                      | —               | —                 | —       | —               |
| Micro-sperm.....            | —                | —                      | —               | —                 | —       | —               |
| TOTAL.....                  | 26               | 884                    | 70              | 92                | 36      | +               |

\* Drop of semen collected as ram dismounted.

+ = Spermatozoa present, but too few to be classified.

TABLE 48.

*Showing the Percentage of Abnormal Spermatozoa in the Different Divisions of the Genital Tract at Various Intervals Relative to the Abnormality Count at the Time of Service.*

| Interval from Service to<br>Examination. | Abnormals<br>per 1,000 at<br>Service. | Vagina. | Cervix. | Pars<br>Indivisa. | Horns. |
|--|---------------------------------------|---------|---------|-------------------|--------|
| 1 hour.....                              | 24                                    | 92      | 25      | —                 | —      |
| 2 hours.....                             | 28                                    | 179     | 64      | —                 | —      |
| 3 hours.....                             | 192                                   | 244     | 24      | 17                | —      |
| 5 hours.....                             | 20                                    | 2,530   | 170     | 250               | —      |
| 18 hours.....                            | 32                                    | 488     | 144     | —                 | —      |
| 18 hours.....                            | 6                                     | 8,800   | 1,333   | —                 | —      |
| 20 hours.....                            | 26                                    | 3,400   | 269     | 354               | 138    |

*(c) The Rate of Sperm Travel.*

In order to determine how soon after copulation spermatozoa would reach the fallopian tubes, examination of the genital tracts of different ewes were made at intervals of 30, 24, 15, 10, 9, 8, 6, and 6 minutes. The results are tabulated in Table 49. In the cervix, spermatozoa were very numerous at 30 and at 10 minutes after ejaculation. At 15 and at 8 minutes they were numerous and at 24, 9, and 6 minutes they were recorded as being "frequent". In the pars indivisa of the uterus and in the horns spermatozoa were found with some difficulty. At least a few were found in the horns at all intervals. None were observed in the pars indivisa at 10 and at 8 minutes, although spermatozoa were present in the horns and fallopian tubes. They were, therefore, either missed at examination or no more had as yet entered the pars indivisa after the first number had passed through. The methods of examination have been explained in the chapter under "Materials and Methods", Part II.

In the fallopian tubes, spermatozoa were present in all sections of both tubes at 30, 24, and 15 minutes. At 10 minutes they were in all sections of the left tube and in the lowest section of the right tube. At 9 minutes none were found in the right tube, but they were present in all sections of the left tube. At 8 minutes no spermatozoa could be found in the lowest section of either tube, but a few were observed in the middle and top sections of both tubes. At one of the 6 minute intervals spermatozoa were in all sections of the left tube and in the top section of the right. At the other 6 minute interval one spermatozoon was found in the middle section of the left tube.

The average length of the genital tract, measured from the posterior end of the cervix to the ovary in the eight Merino ewes, was 41.9 cm. This is nearly half the length (80 cm.) recorded by Schott and Phillips (1941), who worked with a bigger breed of sheep.

Spermatozoa had thus reached the upper section of both fallopian tubes six minutes after ejaculation. The length of the genital tract in this case was 45 cm., and the rate of travel 7.5 cm. per minute.

Ovarian activity and the period the ewe was in oestrus did not influence the rate of sperm travel. This is in agreement with the findings of Green and Winters (1935) and Schott and Phillips (1941).

## II. SUMMARY AND CONCLUSIONS.

1. Spermatozoon vitality is rapidly reduced in the vagina of the ewe. A few spermatozoa still showed weak motility in the vagina 20 hours after copulation.
2. The cervical canal is the most favourable site for sperm preservation. 40 per cent. of spermatozoa in the cervix were motile 20 hours after copulation.
3. Spermatozoa progress from the cervical canal continuously and in small numbers.

4. Spermatozoa were found in the uppermost section of both fallopian tubes 6 minutes after ejaculation. They had travelled a distance of 45 cm. at the rate of 7.5 cm. per minute.

5. The progress of spermatozoa along the genital tract was independent of ovarian activity and the time ewes were in oestrus.

6. Degenerative changes in spermatozoa were observed in the vagina of the ewe 2 hours after copulation, and in the cervical canal after 5 hours.

TABLE 49.

*Examination of the Different Sections of the Genital Tract for the Presence of Spermatozoa at Various Intervals after Ejaculation. Only those Sections of the Tubes in which Spermatozoa were Found are Indicated.*

| Interval between Ejaculation and Examination. | Condition of Ovaries.                      | Cervix. | Pars Indivisa. | Horns.        | Left Tube.              | Right Tube.          | Length of Tract. |
|---|--|---------|----------------|---------------|-------------------------|----------------------|------------------|
| 30 min.                                       | Corp. lut., left ovary.....                | ++++    | +              | LH. +<br>RH + | LT1 +<br>LT2 +<br>LT3 + | RT1+<br>RT2+<br>RT3+ | 44 cm.           |
| 24 min.                                       | Ruptured foll., left ovary....             | ++      | +              | LH++<br>RH +  | LT1 +<br>LT2 +<br>LT3 + | RT1+<br>RT2+<br>RT3+ | 39 cm.           |
| 15 min.                                       | Corp. lut., left ovary.....                | +++     | +              | LH+<br>RH++   | LT1 +<br>LT2 +<br>LT3 + | RT1+<br>RT2+<br>RT3+ | 42 cm.           |
| 10 min.                                       | Unruptured follicle, left ovary            | ++++    | -              | LH+<br>RH+    | LT1 +<br>LT2 +<br>LT3 + | RT3+                 | 41 cm.           |
| 9 min.  | Ruptured follicle, left ovary..            | ++      | +              | LH++<br>RH++  | LT1 +<br>LT2 +<br>LT3 + |                      | 40 cm.           |
| 8 min.  | Corp. lut., right ovary.....               | +++     | -              | LH+<br>RH+    | LT1 +<br>LT2 +          | RT1+<br>RT2+         | 41 cm.           |
| 6 min.  | Unruptured foll. and corp. lut. left ovary | ++      | +              | LH+<br>RH+    | LT1 +<br>LT2 +<br>LT3 + | RT1+                 | 45 cm.           |
| 6 min.  | Unruptured foll., right ovary              | ++      | +              | LH+<br>RH+    | LT2 +                   |                      | 43 cm.           |

++++ = very numerous.  
+++ = numerous.  
++ = frequent.  
+ = few.  
- = none.

LH = left horn.                   LT1 = left tube, upper section.  
RH = right horn.                LT2 = left tube, middle section.  
LT3 = left tube, lower section.  
RT1 = right tube, upper section.  
RT2 = right tube, middle section.  
RT3 = right tube, lower section.

## III ACKNOWLEDGMENTS.

It is with much pleasure that I express my thanks to my promoter, Dr. J. Quinlan, Professor of Surgery and Obstetrics, who inspired this work and whose advice and guidance were greatly appreciated.

My thanks are due also to Mr. D. de Vos for assisting with the collection of the semen samples.

To Mr. Theo Meyer I am grateful for the excellent photographic reproductions of the figures and graphs.

## LITERATURE.

- ANDERSON, J. (1939). Investigations on the semen of fertile and sterile bulls. *Vet. J.*, Vol. 95 pp. 457-473.
- ANDERSON, J. (1941). Further Investigations on the semen of the bull. *Vet Rec.*, Vol. 53, p. 197.
- ANDERSON, J. (1941). Further Investigations on artificial insemination of cattle. *Jl. Agric. Sci.*, Vol. 31, p. 348.
- ANDERSON, J. (1942). The hydrogen-ion concentration of the semen of the bull. *Jl. Agric. Sci.*, Vol. 32, p. 298.
- BERLINER, V. R. (1942). Dilutors for stallion and jack semen. *Jl. An. Sci.*, Vol. 1, No. 4.
- BURCH, G. E. (1939). Artificial insemination in New York State dairy herds. *Cornell Vet.*, Vol. 29, p. 395.
- CARY, H. W. AND HOTCHKISS, R. S. (1935). A differential stain that advances the study of cell morphology. *Cornell Vet.*, Vol. 25, p. 79.
- COMSTOCK, R. E. (1939). A study of the mammalian sperm cell. I. Variations in the glycolytic power of spermatozoa and their relation to motility and its duration. *Jl. Exp. Zool.*, Vol. 81, No. 1.
- COMSTOCK, R. E., GREEN, W. W., WINTERS, L. M. AND NORDSKOG, A. W. (1943). Studies, of semen and semen production. *Tech. Bull.* 162.
- CHANG, M. C. (1943). Sperm production of a Pony Stallion and treatment of spermatozoa *in vitro* with special reference to artificial insemination of mares. *Jl. Agric. Sci.*, Vol. 33, Part 2.
- DAY, F. T. (1940). Clinical and experimental observations on reproduction in the mare. *Jl. Agric. Sci.*, Vol. 30, p. 244.
- DAY, F. T. (1942). Survival of spermatozoa in the genital tract of the mare. *Jl. Agric. Sci.*, Vol. 32, p. 108.
- DOGHERTY, R. W. (1941). Semen Studies, *Can. Jl. Comp. Med. and Vet. Sci.*, Vol. 5, p. 198.
- DONHAM, C. R. AND SIMMS, B. T. (1931). I.—Studies of the genitalia of bulls obtained from the abattoir. *Jl. Am. Vet. Med. Assoc.*, Vol. 31, pp. 658-664.
- DONHAM, G. R., SIMMS, B. T. AND SHAW, J. N. (1931). II.—The relation of the microscopic findings in semen to its fertility. *Jl. Am. Vet. Med. Assoc.*, Vol. 31, pp. 665-680.
- EASLEY, G. T., LASLEY, J. F. AND MCKENZIE, F. F. (1942). Influence of dilutors, rate of cooling and storage temperatures on survival of bull sperm. *Am. Jl. Vet. Res.*, Vol. 3 (9), pp. 358-363.
- ERB, R. E., ANDREWS, F. N. AND HILTON, J. H. (1942). Seasonal variations in semen quality of the dairy bull. *Jl. Dairy Sci.*, Vol. 25, pp. 815-826.
- FINCHAM, M. G., OLAFSON, P. AND FERGUSON, J. (1942). Sterility in bulls. *Cornell Vet.*, Vol. 32, p. 407.
- FLOREY, H. AND WALTON, A. (1931). Uterine fistula used to determine the mechanism of ascent of the spermatozoa in the female genital tract. *Proc. Physiol. Soc.*, 1931. *Jl. Physiol.*, Vol. 74.
- GREEN, W. W. AND WINTERS, L. M. (1935). Studies of the physiology of reproduction in the sheep. III.—The time of ovulation and rate of sperm travel. *Anat. Rec.*, Vol. 61, pp. 457-467.

- GUNN, R. M. C. (1936). Fertility in sheep. Artificial production of seminal ejaculation and the characters of the spermatozoa contained therein. *Coun. Sci. Ind. Res. (Aust.)*, Bull. No. 94.
- GUNN, R. M. C., SANDERS, R. N. AND GRANGER, W. (1942). Studies in fertility in sheep. 2: Seminal changes affecting fertility in rams. *Coun. Sci. Ind. Res. (Aust.)*, Bull. No. 148.
- HAMMOND, J. (1930). The effect of temperature on the survival *in vitro* of rabbit spermatozoa obtained from the vagina. *Brit. Jl. Exp. Biol.*, Vol. 7, pp. 175-195.
- HAMMOND, J. AND MARSHALL, F. H. A. (1925). Reproduction in the rabbit. Edinburgh.
- HERMAN, H. A. AND RAGSDALE, A. C. (1939). Artificial insemination of dairy cows. *Mo. Agric. Exp. Sta.*, Bull. 407.
- HERMAN, H. A. AND SWANSON, E. W. (1941). Variations in dairy bull semen with respect to its use in artificial insemination. *Res. Bull. Mo. Agric. Exp. Sta.*, No. 326.
- KELLEY, R. B. (1932). Sterility in animals. *Aust. Vet. Jl.*, Vol. 8, pp. 47-58.
- KELLEY, R. B. AND DUMARESQ, J. A. (1936). Studies in fertility of sheep. *Aust. Vet. Jl.*, Vol. 12, pp. 225-227.
- KUSNEZOV, M. P. (1934). *Probl. Anim. Husb.* 4 (U.S.S.R.), pp. 123-125. Quoted by Gunn, Sanders and Granger. *Coun. Sci. Ind. Res. (Aust.)*, Bull. 148, 1942
- LAGERLOF, NILS (1934). Morphologische Untersuchungen über Veränderungen im Spermabild und in den Heden beim Bullen mit Verminderter oder Aufgehobener Fertilität. *Acta. Path. et Microbiol. Scand.*, Suppl. 19.
- LAGERLOF, NILS (1936). Sterility in bulls. *Vet. Rec.*, Vol. 48, No. 41.
- LAMBERT, W. V. AND MCKENZIE, F. F. (1940). Artificial insemination in livestock breeding. *Cir. U.S. Dep. Agric.*, No. 567.
- LASLEY, J. F., EASLEY, G. T. AND MCKENZIE, F. F. (1942). A staining method for the differentiation of live and dead spermatozoa. I.—Application to staining of ram sperm. *Anat. Rec.*, Vol. 82, pp. 167-174.
- MACOMBER, D. AND SANDERS, M. B. (1929). The spermatozoa count. *New England Jl. Med.*, Vol. 200, p. 981.
- MARGOLIN, S., BARTLETT, J. W. AND LEPARD, O. L. (1943). The relation of longevity to fertility of bull semen. *Jl. Dairy Sci.*, Vol. 26, No. 11.
- MASON, L. W. (1929). Sterility with special reference to the spermatozoa. *Am. Jl. Obstet. and Gynec.*, Vol. 7, p. 376.
- MCKENZIE, F. F. AND BERLINER, V. (1937). The reproductive capacity of rams. *Mo. Agric. Expt. Sta. Res. Bull.* 265.
- MCKENZIE, F. F., MILLER, J. C. AND BAUGUESS, L. C. (1938). The reproductive organs and semen of the boar. *Mo. Agric. Exp. Sta. Res. Bull.* 279.
- MCKENZIE, F. F. AND PHILLIPS, R. W. (1934). Measuring fertility in the ram. A preliminary Report. *Jl. Am. Vet. Med. Assoc.*, Vol. 84, pp. 189-202.
- MILLER, F. W. AND EVANS, E. J. (1934). Technic of obtaining spermatozoa for physiological dairy studies and artificial insemination. *Jl. Agric. Res.*, Vol. 48, pp. 941-947.
- MOENCH, G. L. AND HOLT, H. (1931). Sperm morphology in relation to fertility. *Am. Jl. Obstet. and Gynec.*, Vol. 22, pp. 199-210.
- MOSKOVITS, E. (1934). *Monthly Bull. Agric. Sci. and Practice, Rome.*, Vol. 25. Quoted by Gunn, Sanders and Granger (1942). *Coun. Sci. Ind. Res. (Aust.)*, Bull. 148.
- NEUMANN, O. F. AND SALZMAN, A. A. (1940). The survival and rapidity of penetration of spermatozoa in the sexual organs of the mare. *An. Br. Abs.*, Vol. 13, No. 1, p. 10, March, 1945.
- ORR, W. AND DARLING, F. F. (1932). The physiology and genetical aspects of sterility in domesticated animals. *Imp. Bureau An. Gen.*
- PHILLIPS, P. H. (1939). Preservation of bull semen. *Jl. Biol. Chem.*, Vol. 130, p. 415.



- PHILLIPS, P. H. AND LARDY, H. A. (1940). A Yolk-buffer pabulum for the preservation of bull semen. *Jl. Dairy Sci.* Vol. 23, p. 399.
- PHILLIPS, R. W. (1935). The physiology of spermatozoa. *Am. Soc. An. Prod.*, Vol. 28, pp. 222-235.
- PHILLIPS, R. W. AND ANDREWS, F. N. (1937). The speed of travel of ram spermatozoa. *Anat. Rec.*, Vol. 68, pp. 127-132.
- PHILLIPS, R. W. AND MCKENZIE, F. F. (1934). The thermo-regulatory function and mechanism of the scrotum. *Mo. Agric. Expt. Sta. Res. Bull.* 217.
- QUINLAN, J. (1929). Researches into sterility of cows in South Africa. *15th Ann. Rpt. Dir. Vet. Serv. U of S.A.*, pp. 833-1055.
- QUINLAN, J. AND MARE, G. S. (1931). The physiological changes in the ovary of the Merino sheep in South Africa and their practical application in breeding. *17th Rep. Dir. Vet. Serv. and An. Ind. U. of S.A.*, p. 679.
- QUINLAN, J., MARE, G. S. AND ROUX, L. L. (1932). The vitality of the spermatozoa in the genital tract of the Merino ewe, with special reference to its practical application in breeding. *18th Rep. Dir. Vet. Serv. and An. Ind., Union of S.A.*, pp. 831-870.
- QUINLAN, J., MARE, G. S. AND ROUX, L. L. (1933). A study of the duration of motility of spermatozoa in the different divisions of the reproductive tract of the Merino ewe. *Onderstepoort Jl.*, Vol. 1, pp. 135-145.
- QUINLAN, J. AND ROUX, L. L. (1936). Researches into sterility of cows in South Africa. *Onderstepoort Jl.*, Vol. 6, No. 2, pp. 719-773.
- QUINLAN, J., STARKE, N. C. AND STEYN, H. P. (1943). Some aspects of sex-physiology and their relation to fertility of animals. A Review. *Jl. S.A.V.M.A.*, Vol. 14, pp. 1-9.
- QUINLAN, J., STEYN, H. P. AND DE VOS, D. (1941). Observations on artificial insemination of sheep with fresh and stored semen. *Onderstepoort Jl.*, Vol. 16, pp. 263-297.
- REDENZ, E. (1924). Versuch einer biologischen Morphologie des Nebenhodens. *Arch. f. mikr. Anat. u. Entw. Mech.*, Bd. 103. S. 593-628. Quoted by McKenzie, F. F. and Berliner, V., *Mo. Agric. Expt. Sta. Res. Bull.* 265 (1937).
- ROSSMAN, I. (1937). Uterine contractions and the transport of sperm in the rat. *Anat. Rec.*, Vol. 69, pp. 133-149.
- SALISBURY, G. W., WILLETT, E. L. AND SELIGMAN, J. (1942). The effect of the method of making semen smears upon the number of morphologically abnormal spermatozoa. *Jl. An. Sci.*, Vol. 1, pp. 199-205.
- SAVAGE, A., WILLIAMS, W. W. AND FOWLER, N. M. (1927). Transactions Roy. Soc. of Canada, Ottawa (1927). Quoted by Williams, W. W. and Savage, A. *Cornell Vet.*, Vol. 17, 1927.
- SCHOTT, R. G. AND PHILLIPS, R. W. (1940). Rate of sperm travel and time of ovulation in sheep. *Anat. Rec.*, Vol. 79, pp. 531-540.
- SIMEONE, F. A. AND YOUNG, W. C. (1931). A study of the function of the epididymis. VI.—The fate of non-ejaculated spermatozoa in the genital tract of the male guinea-pig. *Jl. Exp. Biol.*, Vol. 8, pp. 163-175.
- STARKE, N. C. (1943). Examination of the sire for fertility. *Jl. S.A.V.M.A.*, Vol. 14, pp. 142-147.
- SWANSON, E. W. AND HERMAN, H. A. (1941). Variations in bull semen and their relation to fertility. *Jl. Dairy Sci.*, Vol. 24, pp. 321-331.
- TERRILL, C. E. (1938). Reproductive capacity of Rambouillet Ram lambs as indicated by semen tests. *Am. Soc. An. Prod.*, 31st Ann. Meet. 308.
- TRIMBERGER, G. W. (1942). Present-day techniques of artificial insemination. *Abs. Jl. Dairy Sci.*, Vol. 25.
- WALTON, A. (1930). The effect of temperature on the survival *in vitro* of rabbit spermatozoa obtained from the vas deferens. *Brit. Jl. Exp. Biol.*, Vol. 7, pp. 201-219.
- WALTON, A. (1933). The technique of artificial insemination. Edinburgh. *Imperial Bureau An. Genet.*

- WALTON, A. (1938). The quantitative basis of fertility. *Folia morphologica*, Vol. 8.
- WARBRITTON, V., MCKENZIE, F. F., BERLINER, V. AND ANDREWS, F. N. (1937). Sperm survival in the genital tract of the ewe. *Am. Soc. An. Prod.*, Vol. 30, pp. 142-145.
- WEBSTER, W. M. (1932). Bovine sterility in New Zealand. *Aust. Vet. Jl.*, Vol. 8, pp. 199-222.
- WILLIAMS, W. L. (1939). The Diseases of the Genital Organs of Domestic Animals. 2nd edition.
- WILLIAMS, W. W. (1920). Diseases of the bull interfering with reproduction. *Jl. Am. Vet. Med. Assoc.*, Vol. 11, p. 29.
- WILLIAMS, W. W. AND SAVAGE, A. (1925). Observations on the seminal micropathology of bulls. *Cornell Vet.*, Vol. 15, pp. 353-375.
- WILLIAMS, W. W. AND SAVAGE, A. (1926). A note on examining bulls for genital soundness (and preparing semen smears for examination). *Jl. Am. Vet. Med. Assoc.*, Vol. 68, pp. 462-466.
- WILLIAMS, W. W. AND SAVAGE, A. (1927). Methods of determining the reproductive health and fertility of bulls. A review with additional notes. *Cornell Vet.*, Vol. 17, pp. 374-385.
- WIMSATT, W. A. (1942). Sperm survival in the female bat. *Anat. Rec.*, Vol. 83, pp. 299-307.
- YOUNG, W. C. (1929, a). A study of the function of the epididymis. I.—Is the attainment of full spermatozoon maturity attributable to some specific action of the epididymal secretion? *Jl. Morph. and Physiol.*, Vol. 47, pp. 479-495.
- YOUNG, W. C. (1929, b). A study of the function of the epididymis. II.—The importance of the aging process in sperm for the length of the period during which fertilizing capacity is retained by sperm isolated in the epididymis of the guinea-pig. *Jl. Morph. and Physiol.*, Vol. 48, pp. 475-491.
- YOUNG, W. C. (1931). A study of the function of the epididymis. III.—Functional changes undergone by spermatozoa during their passage through the epididymis and vas deferens in the guinea-pig. *Jl. Exp. Biol.*, Vol. 8, pp. 151-162.

SPERM PICTURE OF RAMS AND RATE OF SPERM TRAVEL.

APPENDIX I.

Tables 5 to 22. Numbers of abnormal spermatozoa of different types per thousand for the individual rams.

TABLE 5.  
*Merino Ram 45106. Numbers of Abnormal Spermatozoa of Different Types per Thousand.*

| Date.    | Tailless Sperm. | Coiled Tails. | Enlarged Middle Pieces. | Double Middle Pieces and Tails. | Middle Piece Beads. | Pyiform Middle Pieces. | Abaxial Attachments. | Defective Staining. | Narrow Heads. | Pyiform Heads. | Megalo-sperm. | Micro-sperm. | Double Heads. | Variation in Head Sizes. | Abnormals per 1,000. |
|----------|-----------------|---------------|-------------------------|---------------------------------|---------------------|------------------------|----------------------|---------------------|---------------|----------------|---------------|--------------|---------------|--------------------------|----------------------|
| 7/10/41  | —               | 2             | —                       | —                               | —                   | —                      | —                    | —                   | —             | —              | —             | —            | —             | —                        | 2                    |
| 14/10/41 | 6               | 2             | —                       | —                               | —                   | —                      | 14                   | —                   | —             | —              | —             | —            | —             | —                        | 22                   |
| 28/10/41 | 6               | —             | —                       | —                               | —                   | —                      | 6                    | —                   | —             | —              | —             | —            | —             | —                        | 12                   |
| 11/11/41 | —               | —             | —                       | —                               | —                   | —                      | 4                    | —                   | —             | —              | —             | —            | —             | —                        | 4                    |
| 28/11/41 | 6               | —             | —                       | —                               | —                   | —                      | 12                   | —                   | —             | —              | —             | —            | —             | —                        | 18                   |
| 12/12/41 | 2               | —             | —                       | —                               | —                   | —                      | 6                    | —                   | —             | —              | —             | —            | —             | —                        | 8                    |
| 2/1/42   | 2               | —             | —                       | —                               | —                   | —                      | —                    | —                   | —             | —              | —             | —            | —             | —                        | 2                    |
| 16/1/42  | —               | 2             | —                       | 6                               | —                   | —                      | —                    | —                   | —             | —              | —             | —            | —             | —                        | 2                    |
| 30/1/42  | —               | —             | —                       | —                               | —                   | —                      | —                    | —                   | —             | —              | —             | —            | —             | —                        | 8                    |
| 13/2/42  | —               | —             | —                       | —                               | —                   | —                      | 12                   | —                   | —             | —              | —             | —            | —             | —                        | 2                    |
| 27/2/42  | 6               | 64            | —                       | —                               | —                   | —                      | —                    | —                   | 2             | 2              | —             | —            | —             | —                        | 8                    |
| 13/3/42  | 4               | —             | —                       | —                               | —                   | —                      | —                    | —                   | —             | —              | —             | —            | —             | —                        | 12                   |
| 27/3/42  | 2               | —             | —                       | —                               | —                   | —                      | —                    | —                   | —             | 2              | —             | —            | —             | —                        | 74                   |
| 14/4/42  | —               | —             | —                       | —                               | —                   | —                      | —                    | —                   | —             | —              | —             | —            | —             | —                        | 6                    |
| 28/4/42  | —               | —             | —                       | —                               | —                   | —                      | —                    | —                   | —             | —              | —             | —            | —             | —                        | 6                    |
| 15/5/42  | 6               | 10            | —                       | —                               | —                   | —                      | —                    | —                   | —             | —              | —             | —            | —             | —                        | 12                   |
| 29/5/42  | 2               | 8             | —                       | —                               | —                   | —                      | —                    | —                   | —             | —              | —             | —            | —             | —                        | 24                   |
| 12/6/42  | 8               | 92            | —                       | 4                               | —                   | —                      | —                    | —                   | —             | —              | —             | —            | —             | —                        | 24                   |
| 26/6/42  | —               | 6             | —                       | —                               | —                   | —                      | 38                   | —                   | —             | —              | —             | —            | 2             | —                        | 144                  |
| 10/7/42  | —               | 4             | —                       | —                               | —                   | —                      | 14                   | —                   | —             | —              | —             | —            | —             | —                        | 20                   |
| 24/7/42  | 6               | 8             | —                       | —                               | —                   | —                      | 6                    | —                   | —             | —              | —             | —            | —             | —                        | 18                   |
| 7/8/42   | 8               | 20            | —                       | —                               | —                   | —                      | 18                   | —                   | —             | —              | 4             | —            | —             | —                        | 36                   |
| 21/8/42  | 10              | 8             | —                       | —                               | —                   | —                      | 10                   | —                   | —             | —              | —             | —            | —             | —                        | 46                   |
| 4/9/42   | 10              | 30            | —                       | —                               | —                   | —                      | 14                   | —                   | —             | —              | —             | —            | —             | —                        | 34                   |
| 18/9/42  | 4               | 6             | —                       | —                               | —                   | —                      | 22                   | —                   | —             | —              | —             | —            | —             | —                        | 92                   |
| 2/10/42  | 2               | 4             | —                       | 2                               | —                   | —                      | 26                   | —                   | —             | —              | —             | —            | —             | —                        | 44                   |
| 16/10/42 | 6               | 20            | —                       | —                               | —                   | —                      | 4                    | —                   | —             | —              | —             | —            | —             | —                        | 10                   |
| 30/10/42 | 4               | —             | —                       | —                               | —                   | —                      | 6                    | —                   | —             | —              | —             | —            | —             | —                        | 52                   |
| 17/11/42 | —               | 8             | —                       | —                               | —                   | —                      | 2                    | —                   | —             | —              | —             | —            | —             | —                        | 6                    |
|          |                 |               |                         |                                 |                     |                        | 6                    | —                   | —             | —              | —             | —            | —             | —                        | 14                   |

+++ = marked.

++ = fairly marked.

+ = slight.

TABLE 6.  
*Merino Ram 54307. Numbers of Abnormal Spermatozoa of Different Types per Thousand.*

| Date.    | Tailless Sperm. | Coiled Tails. | Enlarged Middle Pieces. | Double Middle Pieces and Tails. | Middle Piece Beads. | Pilliform Middle Pieces. | Abaxial Attachments. | Defective Staining. | Narrow Heads. | Pyriform Heads. | Megalo-sperm. | Micro-sperm. | Double Heads. | Variation in Head Sizes. | Abnormals per 1,000. |
|----------|-----------------|---------------|-------------------------|---------------------------------|---------------------|--------------------------|----------------------|---------------------|---------------|-----------------|---------------|--------------|---------------|--------------------------|----------------------|
| 7/10/41  | —               | 6             | —                       | —                               | —                   | —                        | —                    | 4                   | —             | 2               | 4             | —            | —             | —                        | 16                   |
| 17/10/41 | 22              | 40            | —                       | —                               | —                   | —                        | —                    | —                   | —             | 12              | —             | —            | —             | —                        | 74                   |
| 31/10/41 | —               | —             | —                       | —                               | —                   | —                        | —                    | —                   | —             | —               | —             | —            | —             | —                        | 0                    |
| 14/11/41 | —               | —             | 4                       | —                               | 2                   | —                        | —                    | 2                   | —             | —               | —             | —            | —             | —                        | 2                    |
| 2/12/41  | 32              | —             | —                       | —                               | —                   | —                        | —                    | —                   | —             | —               | —             | —            | —             | —                        | 40                   |
| 19/12/41 | 12              | 16            | —                       | —                               | —                   | —                        | —                    | 2                   | —             | —               | 2             | —            | —             | —                        | 34                   |
| 6/1/42   | 4               | 6             | —                       | —                               | —                   | —                        | —                    | —                   | —             | 2               | —             | —            | —             | —                        | 12                   |
| 20/1/42  | —               | 2             | —                       | —                               | —                   | —                        | —                    | 4                   | —             | 2               | —             | —            | —             | —                        | 8                    |
| 3/2/42   | —               | —             | —                       | —                               | —                   | —                        | —                    | 2                   | —             | —               | —             | —            | —             | —                        | 8                    |
| 17/2/42  | 14              | 6             | —                       | —                               | —                   | —                        | —                    | 4                   | —             | —               | —             | —            | —             | —                        | 4                    |
| 3/3/42   | 16              | 14            | —                       | 4                               | —                   | —                        | —                    | 8                   | —             | —               | —             | 4            | —             | —                        | 28                   |
| 17/3/42  | 16              | 34            | —                       | —                               | —                   | —                        | —                    | 4                   | —             | —               | —             | —            | —             | —                        | 34                   |
| 31/3/42  | 14              | 12            | —                       | —                               | —                   | —                        | —                    | —                   | —             | —               | —             | —            | —             | —                        | 54                   |
| 17/4/42  | —               | —             | —                       | —                               | —                   | —                        | —                    | —                   | —             | —               | —             | —            | —             | —                        | 30                   |
| 5/5/42   | 4               | 4             | —                       | —                               | —                   | —                        | —                    | —                   | —             | —               | —             | —            | —             | —                        | 0                    |
| 19/5/42  | —               | 6             | —                       | —                               | —                   | —                        | —                    | —                   | —             | —               | —             | —            | —             | —                        | 8                    |
| 2/6/42   | 4               | 14            | —                       | —                               | —                   | —                        | —                    | —                   | —             | —               | —             | —            | —             | —                        | 8                    |
| 16/6/42  | —               | 24            | —                       | —                               | —                   | —                        | —                    | 10                  | —             | —               | 2             | —            | —             | —                        | 6                    |
| 30/6/42  | 6               | 90            | —                       | —                               | —                   | —                        | —                    | 2                   | —             | —               | —             | —            | 2             | —                        | 30                   |
| 14/7/42  | 10              | 8             | 2                       | —                               | 2                   | —                        | —                    | 8                   | —             | —               | —             | —            | —             | —                        | 28                   |
| 25/7/42  | 6               | 14            | —                       | —                               | —                   | —                        | —                    | 10                  | —             | —               | —             | —            | —             | —                        | 108                  |
| 11/8/42  | 34              | 306           | 18                      | —                               | —                   | —                        | —                    | 16                  | —             | 2               | —             | —            | —             | —                        | 34                   |
| 25/8/42  | 40              | 54            | —                       | —                               | —                   | —                        | —                    | 40                  | 2             | —               | —             | —            | —             | —                        | 38                   |
| 8/8/42   | 42              | 70            | —                       | —                               | —                   | —                        | —                    | 32                  | —             | —               | —             | 2            | —             | —                        | 412                  |
| 22/8/42  | 40              | 50            | 8                       | —                               | —                   | —                        | —                    | 46                  | —             | —               | —             | —            | —             | —                        | 128                  |
| 6/10/42  | 8               | 24            | —                       | 2                               | —                   | —                        | —                    | 36                  | —             | —               | —             | —            | —             | —                        | 180                  |
| 20/10/42 | 14              | 8             | —                       | —                               | —                   | —                        | —                    | 40                  | —             | —               | —             | —            | —             | —                        | 134                  |
| 3/11/42  | 12              | 10            | —                       | —                               | —                   | —                        | —                    | 12                  | —             | —               | —             | —            | —             | —                        | 54                   |
|          |                 |               |                         |                                 |                     |                          |                      | 6                   | —             | —               | —             | —            | —             | —                        | 28                   |
|          |                 |               |                         |                                 |                     |                          |                      | 6                   | —             | —               | —             | —            | —             | —                        | 28                   |

+++ = marked.

++ = fairly marked.

+ = slight.

SPERM PICTURE OF RAMS AND RATE OF SPERM TRAVEL.

TABLE 7.  
*Merino Ram 50549. Numbers of Abnormal Spermatozoa of Different Types per Thousand.*

| Date.    | Tallest Sperm. | Coiled Tails. | Enlarged Middle Pieces. | Double Middle Pieces and Tails. | Middle Piece Beads. | Piniform Middle Pieces. | Absaxial Attachments. | Defective Staining. | Narrow Heads. | Pyriform Heads. | Megalo-sperm. | Micro-sperm. | Double Heads. | Variation in Head Sizes. | Abnormals per 1,000. |
|----------|----------------|---------------|-------------------------|---------------------------------|---------------------|-------------------------|-----------------------|---------------------|---------------|-----------------|---------------|--------------|---------------|--------------------------|----------------------|
| 7/10/41  | 8              | 2             | —                       | —                               | —                   | —                       | —                     | 24                  | —             | —               | —             | —            | —             | —                        | 34                   |
| 21/10/41 | 8              | 2             | —                       | —                               | —                   | —                       | —                     | 38                  | —             | —               | —             | —            | —             | —                        | 48                   |
| 4/11/41  | 4              | 2             | —                       | 2                               | —                   | —                       | —                     | 14                  | —             | —               | —             | —            | —             | —                        | 26                   |
| 18/11/41 | 10             | 4             | 2                       | —                               | 4                   | —                       | —                     | 8                   | —             | —               | —             | —            | —             | —                        | 24                   |
| 5/12/41  | 22             | 6             | 2                       | 6                               | —                   | —                       | —                     | 52                  | —             | —               | —             | —            | —             | —                        | 86                   |
| 23/12/41 | 10             | 4             | —                       | —                               | —                   | —                       | —                     | 30                  | —             | —               | —             | —            | —             | —                        | 44                   |
| 9/1/42   | —              | 2             | —                       | —                               | —                   | —                       | —                     | —                   | —             | —               | —             | —            | —             | —                        | 2                    |
| 23/1/42  | —              | —             | —                       | —                               | —                   | —                       | —                     | —                   | —             | —               | —             | —            | —             | —                        | 0                    |
| 6/2/42   | —              | —             | —                       | 2                               | —                   | —                       | —                     | —                   | —             | —               | —             | —            | —             | —                        | 2                    |
| 20/2/42  | 18             | 16            | —                       | —                               | —                   | —                       | —                     | 34                  | —             | —               | —             | —            | —             | —                        | 68                   |
| 6/3/42   | 2              | 2             | —                       | —                               | —                   | —                       | —                     | 16                  | —             | —               | —             | —            | —             | —                        | 20                   |
| 20/3/42  | 6              | —             | —                       | —                               | —                   | —                       | —                     | 6                   | —             | —               | —             | —            | —             | —                        | 12                   |
| 7/4/42   | 2              | 2             | 2                       | —                               | —                   | —                       | —                     | 8                   | —             | —               | 2             | —            | —             | —                        | 16                   |
| 21/4/42  | —              | —             | —                       | —                               | —                   | —                       | —                     | —                   | —             | —               | —             | —            | —             | —                        | 0                    |
| 8/5/42   | 10             | —             | —                       | —                               | —                   | —                       | —                     | 62                  | —             | —               | —             | —            | —             | —                        | 74                   |
| 22/5/42  | 2              | —             | —                       | —                               | —                   | —                       | —                     | 24                  | —             | —               | —             | —            | —             | —                        | 26                   |
| 5/6/42   | 20             | 6             | —                       | —                               | —                   | —                       | —                     | 80                  | —             | —               | 2             | —            | —             | —                        | 108                  |
| 19/6/42  | 4              | 4             | —                       | —                               | —                   | —                       | —                     | 16                  | —             | —               | —             | —            | —             | —                        | 26                   |
| 3/7/42   | 4              | 6             | —                       | 6                               | —                   | —                       | —                     | 16                  | —             | —               | —             | —            | —             | —                        | 32                   |
| 17/7/42  | —              | 6             | —                       | 2                               | —                   | —                       | —                     | 24                  | —             | —               | 2             | —            | —             | —                        | 34                   |
| 31/7/42  | 24             | 14            | 2                       | —                               | —                   | —                       | —                     | 106                 | —             | —               | —             | —            | —             | —                        | 146                  |
| 14/8/42  | 30             | 6             | —                       | —                               | —                   | —                       | —                     | 74                  | —             | —               | 2             | —            | —             | +                        | 112                  |
| 28/8/42  | 42             | 4             | —                       | 2                               | —                   | —                       | —                     | 38                  | —             | —               | —             | —            | —             | —                        | 86                   |
| 11/9/42  | 4              | 118           | —                       | 2                               | —                   | —                       | —                     | 6                   | —             | —               | 2             | —            | —             | —                        | 140                  |
| 25/9/42  | 30             | 6             | —                       | 2                               | —                   | —                       | —                     | 30                  | —             | —               | —             | —            | —             | —                        | 68                   |
| 9/10/42  | 12             | 44            | —                       | —                               | —                   | —                       | —                     | 30                  | —             | —               | —             | —            | —             | —                        | 86                   |
| 23/10/42 | 6              | 14            | —                       | —                               | —                   | —                       | —                     | 22                  | —             | —               | —             | —            | —             | —                        | 42                   |
| 6/11/42  | 6              | 40            | —                       | —                               | —                   | —                       | —                     | 16                  | —             | —               | —             | —            | —             | —                        | 64                   |

+++ = marked.      ++ = fairly marked.      + = slight.

TABLE 8.  
*Merino Ram 50735. Numbers of Abnormal Spermatozoa of Different Types per Thousand.*

| Date.     | Tailless Sperm. | Coiled Tails. | Enlarged Middle Pieces. | Double Middle Pieces and Tails. | Middle Piece Beads. | Filiform Middle Pieces. | Absaxial Attachments. | Defective Staining. | Narrow Heads. | Pyritiform Heads. | Megalo-sperm. | Micro-sperm. | Double Heads. | Variation in Head Sizes. | Abnormals per 1,000. |
|-----------|-----------------|---------------|-------------------------|---------------------------------|---------------------|-------------------------|-----------------------|---------------------|---------------|-------------------|---------------|--------------|---------------|--------------------------|----------------------|
| 7/10/41.  | 10              | 6             | —                       | —                               | —                   | —                       | —                     | 8                   | —             | —                 | 8             | —            | —             | —                        | 32                   |
| 10/10/41. | 8               | 2             | —                       | —                               | —                   | —                       | —                     | —                   | —             | —                 | —             | —            | —             | —                        | 12                   |
| 24/10/41. | 2               | —             | —                       | —                               | —                   | —                       | —                     | —                   | —             | —                 | —             | —            | —             | —                        | 14                   |
| 7/11/41.  | 2               | —             | —                       | —                               | —                   | —                       | —                     | —                   | —             | —                 | —             | —            | —             | —                        | 24                   |
| 25/11/41. | 4               | 12            | 2                       | —                               | —                   | —                       | —                     | 6                   | —             | —                 | —             | 2            | —             | —                        | 28                   |
| 9/12/41.  | 6               | 10            | —                       | —                               | —                   | —                       | —                     | 10                  | —             | —                 | —             | —            | —             | —                        | 34                   |
| 30/12/41. | 12              | 4             | —                       | —                               | —                   | —                       | —                     | —                   | —             | 2                 | —             | —            | —             | —                        | 16                   |
| 13/1/42.  | 64              | 50            | 6                       | 18                              | —                   | —                       | 4                     | 22                  | —             | 10                | —             | —            | —             | —                        | 200                  |
| 27/1/42.  | 6               | 24            | —                       | —                               | —                   | —                       | —                     | 12                  | —             | —                 | —             | —            | —             | —                        | 46                   |
| 10/2/42.  | 38              | 26            | —                       | —                               | —                   | —                       | —                     | 4                   | —             | —                 | —             | —            | —             | —                        | 114                  |
| 24/2/42.  | 2               | 10            | 6                       | 2                               | —                   | —                       | —                     | 28                  | 2             | 44                | —             | —            | —             | —                        | 56                   |
| 10/3/42.  | 4               | 2             | —                       | —                               | —                   | —                       | —                     | 2                   | —             | —                 | —             | —            | —             | —                        | 8                    |
| 24/3/42.  | 6               | 6             | —                       | —                               | —                   | —                       | —                     | —                   | —             | —                 | —             | —            | —             | —                        | 24                   |
| 10/4/42.  | 26              | 8             | —                       | —                               | —                   | —                       | —                     | 10                  | —             | —                 | —             | —            | —             | —                        | 88                   |
| 24/4/42.  | 4               | 22            | 2                       | —                               | —                   | —                       | —                     | 52                  | —             | —                 | —             | —            | —             | —                        | 52                   |
| 12/5/42.  | 16              | 4             | —                       | —                               | —                   | —                       | —                     | 20                  | —             | —                 | —             | —            | —             | —                        | 36                   |
| 26/5/42.  | 8               | 6             | —                       | —                               | —                   | —                       | —                     | 16                  | —             | —                 | —             | —            | —             | —                        | 14                   |
| 9/6/42.   | 4               | 10            | —                       | —                               | —                   | —                       | —                     | —                   | —             | —                 | —             | —            | —             | —                        | 14                   |
| 23/6/42.  | 16              | 24            | —                       | —                               | —                   | —                       | —                     | —                   | —             | —                 | —             | —            | —             | —                        | 50                   |
| 7/7/42.   | —               | 6             | —                       | —                               | —                   | —                       | —                     | —                   | —             | —                 | —             | —            | —             | —                        | 14                   |
| 21/7/42.  | 6               | 6             | —                       | —                               | —                   | —                       | —                     | 10                  | —             | —                 | —             | —            | —             | —                        | 34                   |
| 4/8/42.   | 2               | 18            | —                       | —                               | —                   | —                       | —                     | 20                  | —             | —                 | —             | —            | —             | —                        | 30                   |
| 18/8/42.  | 12              | 14            | —                       | —                               | —                   | —                       | —                     | 6                   | —             | —                 | —             | —            | —             | —                        | 32                   |
| 1/9/42.   | 14              | 12            | —                       | —                               | —                   | —                       | —                     | 4                   | —             | —                 | —             | —            | —             | —                        | 34                   |
| 15/9/42.  | 46              | 30            | —                       | —                               | —                   | —                       | —                     | 38                  | —             | 2                 | —             | —            | —             | —                        | 114                  |
| 29/9/42.  | 14              | 8             | —                       | —                               | —                   | —                       | —                     | 12                  | —             | —                 | —             | —            | —             | —                        | 36                   |
| 12/10/42. | —               | 10            | —                       | —                               | —                   | —                       | —                     | —                   | —             | —                 | —             | —            | 2             | —                        | 14                   |
| 27/11/42. | 6               | 20            | —                       | —                               | —                   | —                       | —                     | —                   | —             | —                 | —             | —            | —             | —                        | 26                   |
| 10/11/42. | 6               | 32            | —                       | —                               | —                   | —                       | —                     | 18                  | —             | —                 | —             | —            | —             | —                        | 56                   |

SPERM PICTURE OF RAMS AND RATE OF SPERM TRAVEL.

TABLE 9.  
*Ronney Marsh Ram 56939. Numbers of Abnormal Spermatozoa of Different Types per Thousand.*

| Date.     | Tallest Sperm. | Coiled Tails. | Enlarged Middle Pieces. | Double Middle Pieces and Tails. | Middle Piece Beads. | Pyiform Middle Pieces. | Absaxial Attachments. | Defective Staining. | Narrow Heads. | Pyiform Heads. | Megalo-sperm. | Micro-sperm. | Double Heads. | Variation in Head Sizes. | Abnormals per 1,000. |
|-----------|----------------|---------------|-------------------------|---------------------------------|---------------------|------------------------|-----------------------|---------------------|---------------|----------------|---------------|--------------|---------------|--------------------------|----------------------|
| 14/10/41. | 44             | 156           | —                       | —                               | 214                 | —                      | —                     | 2                   | 2             | —              | —             | 6            | —             | —                        | 424                  |
| 28/10/41. | 30             | 128           | 12                      | —                               | 6                   | 2                      | —                     | 8                   | —             | 26             | —             | —            | —             | —                        | 212                  |
| 11/11/41. | 86             | 74            | 4                       | —                               | 14                  | 4                      | 2                     | 10                  | —             | 16             | —             | 10           | —             | —                        | 216                  |
| 28/11/41. | 18             | 16            | 6                       | —                               | 4                   | —                      | —                     | 56                  | —             | 6              | —             | —            | —             | —                        | 106                  |
| 12/12/41. | 66             | 260           | —                       | —                               | 14                  | —                      | —                     | 56                  | —             | 2              | 2             | —            | —             | —                        | 400                  |
| 2/1/42.   | 140            | 212           | —                       | —                               | 178                 | 2                      | 18                    | 52                  | —             | 64             | —             | 36           | —             | —                        | 702                  |
| 16/1/42.  | 76             | 256           | 20                      | —                               | 90                  | —                      | —                     | 14                  | 3             | 24             | —             | 4            | —             | —                        | 486                  |
| 30/1/42.  | 82             | 128           | 4                       | —                               | 14                  | 2                      | —                     | 14                  | —             | 24             | —             | 8            | —             | —                        | 276                  |
| 13/2/42.  | 42             | 74            | 2                       | —                               | 10                  | —                      | —                     | 26                  | —             | 4              | 2             | —            | —             | —                        | 160                  |
| 27/2/42.  | 16             | 44            | 4                       | —                               | 38                  | —                      | —                     | 20                  | —             | 6              | —             | —            | —             | —                        | 128                  |
| 13/3/42.  | 34             | 80            | 60                      | 2                               | 70                  | 2                      | 2                     | 114                 | —             | 24             | —             | 4            | —             | —                        | 392                  |
| 27/3/42.  | 10             | 4             | —                       | —                               | 2                   | —                      | —                     | 14                  | —             | 4              | —             | —            | —             | —                        | 34                   |
| 14/4/42.  | 10             | 58            | —                       | —                               | 4                   | 2                      | —                     | 24                  | —             | —              | —             | —            | —             | —                        | 98                   |
| 28/4/42.  | 14             | 50            | —                       | —                               | —                   | —                      | —                     | 14                  | —             | —              | 2             | —            | —             | —                        | 80                   |
| 15/5/42.  | 8              | 26            | —                       | —                               | —                   | —                      | —                     | 22                  | —             | —              | —             | —            | —             | —                        | 56                   |
| 29/5/42.  | 12             | 42            | —                       | —                               | —                   | —                      | —                     | 40                  | —             | —              | —             | —            | —             | —                        | 94                   |
| 12/6/42.  | 34             | 98            | —                       | 4                               | 12                  | 6                      | —                     | 414                 | —             | —              | 2             | —            | —             | —                        | 570                  |
| 26/6/42.  | 36             | 352           | 82                      | 2                               | 42                  | —                      | —                     | 64                  | —             | 28             | —             | —            | —             | —                        | 606                  |
| 10/7/42.  | 48             | 228           | 18                      | —                               | 32                  | —                      | —                     | 40                  | —             | 12             | —             | —            | —             | —                        | 378                  |
| 23/7/42.  | 58             | 280           | 14                      | —                               | 34                  | —                      | —                     | 472                 | —             | 34             | —             | —            | —             | —                        | 892                  |
| 7/8/42.   | 250            | 300           | 50                      | —                               | —                   | —                      | —                     | 300                 | —             | —              | —             | —            | —             | —                        | 900                  |

+++ = marked.

++ = fairly marked.

+ = slight.

Ram died 22/8/42.

TABLE 10.  
*Romney Marsh Ram 56947.*  
*Numbers of Abnormal Spermatozoa of Different Types per Thousand.*

| Date.    | Tailless Sperm. | Coiled Tails. | Enlarged Middle Pieces. | Double Middle Pieces and Tails. | Middle Piece Beads. | Riform Middle Pieces. | Abaxial Attachments. | Defective Staining. | Narrow Heads. | Pyriiform Heads. | Megalo-sperm. | Micro-sperm. | Double Heads. | Variation in Head Sizes. | Abnormals per 1,000. |
|----------|-----------------|---------------|-------------------------|---------------------------------|---------------------|-----------------------|----------------------|---------------------|---------------|------------------|---------------|--------------|---------------|--------------------------|----------------------|
| 17/10/41 | 4               | 2             | —                       | —                               | —                   | —                     | —                    | 4                   | —             | —                | —             | —            | —             | —                        | 16                   |
| 31/10/41 | 6               | 6             | —                       | —                               | —                   | —                     | —                    | 2                   | 4             | —                | —             | —            | —             | —                        | 20                   |
| 14/11/41 | 2               | —             | —                       | —                               | —                   | —                     | —                    | 2                   | 4             | —                | —             | —            | —             | —                        | 10                   |
| 2/12/41  | 28              | 6             | 20                      | 2                               | 2                   | —                     | 80                   | 44                  | 4             | 8                | —             | —            | —             | +                        | 154                  |
| 19/12/41 | 24              | 6             | 4                       | 4                               | —                   | —                     | 44                   | 20                  | 20            | 16               | 10            | —            | —             | +                        | 128                  |
| 6/1/41   | 112             | 104           | —                       | —                               | 8                   | 2                     | 12                   | 12                  | 4             | 24               | 2             | —            | —             | +                        | 278                  |
| 20/1/42  | 30              | 54            | 2                       | —                               | —                   | —                     | 8                    | 2                   | 12            | 12               | 4             | —            | —             | +                        | 122                  |
| 3/2/42   | 6               | 6             | 2                       | —                               | —                   | —                     | 2                    | 2                   | 8             | —                | —             | —            | —             | +                        | 26                   |
| 17/2/42  | 4               | 4             | 2                       | 2                               | —                   | 2                     | 2                    | 2                   | 10            | —                | —             | —            | —             | +                        | 32                   |
| 3/3/42   | 4               | 2             | —                       | —                               | —                   | —                     | —                    | —                   | —             | —                | —             | —            | —             | +                        | 12                   |
| 17/3/42  | 12              | 16            | 2                       | 4                               | —                   | —                     | —                    | —                   | 2             | —                | —             | —            | —             | —                        | 12                   |
| 31/3/42  | 0               | 4             | 2                       | —                               | —                   | —                     | 30                   | 20                  | —             | —                | —             | —            | —             | —                        | 70                   |
| 17/4/42  | 4               | 26            | 8                       | —                               | —                   | —                     | 20                   | 20                  | 4             | —                | —             | —            | —             | +                        | 12                   |
| 5/5/42   | 20              | 28            | 4                       | 2                               | —                   | —                     | 28                   | 28                  | —             | —                | —             | —            | —             | —                        | 78                   |
| 19/5/42  | 2               | 4             | —                       | —                               | —                   | —                     | 8                    | —                   | —             | —                | —             | —            | —             | —                        | 36                   |
| 2/6/42   | 28              | 30            | —                       | 2                               | —                   | —                     | 88                   | —                   | —             | 2                | —             | —            | —             | —                        | 150                  |
| 16/6/42  | 16              | 74            | 14                      | 8                               | 2                   | —                     | 136                  | —                   | —             | —                | —             | —            | —             | +                        | 250                  |
| 30/6/42  | 70              | 24            | —                       | 14                              | 6                   | —                     | 318                  | —                   | 6             | 6                | —             | —            | —             | +                        | 444                  |
| 14/7/42  | 124             | 76            | —                       | 2                               | —                   | —                     | 244                  | —                   | 4             | —                | —             | —            | —             | +                        | 450                  |
| 28/7/42  | 104             | 570           | —                       | 4                               | 14                  | —                     | 48                   | —                   | —             | —                | —             | —            | —             | +                        | 744                  |
| 11/8/42  | 32              | 86            | 16                      | 10                              | 80                  | —                     | 56                   | —                   | 2             | —                | —             | —            | —             | +                        | 284                  |
| 25/8/42  | 108             | 174           | —                       | 4                               | 6                   | —                     | 60                   | —                   | 4             | 6                | 8             | —            | —             | +                        | 374                  |
| 8/9/42   | 16              | 12            | —                       | —                               | —                   | —                     | 58                   | —                   | —             | 2                | —             | —            | —             | +                        | 90                   |
| 22/9/42  | 10              | 22            | —                       | —                               | 4                   | —                     | 34                   | —                   | —             | 6                | —             | —            | —             | +                        | 76                   |
| 6/10/42  | 14              | 22            | —                       | —                               | 10                  | —                     | 10                   | —                   | 2             | —                | —             | —            | —             | +                        | 60                   |
| 20/10/42 | 62              | 88            | 40                      | —                               | 76                  | 4                     | 62                   | —                   | —             | 172              | —             | —            | 2             | +                        | 504                  |
| 3/11/42  | 96              | 76            | 8                       | 6                               | 6                   | —                     | 124                  | —                   | 4             | 86               | —             | —            | —             | +                        | 414                  |

+++ = marked.      ++ = fairly marked.      + = slight.



SPERM PICTURE OF RAMS AND RATE OF SPERM TRAVEL.

TABLE 11.  
*Blackhead Persian Ram 62030. Numbers of Abnormal Spermatozoa of Different Types per Thousand.*

| Date.    | Tailless Sperm. | Coiled Tails. | Enlarged Middle Pieces. | Double Middle Pieces and Tails. | Middle Piece Beads. | Filiform Middle Pieces. | Abaxial Attachments. | Defective Staining. | Narrow Heads. | Pyiform Heads. | Megalo-sperm. | Micro-sperm. | Double Heads. | Variation in Head Sizes. | Abnormals per 1,000. |
|----------|-----------------|---------------|-------------------------|---------------------------------|---------------------|-------------------------|----------------------|---------------------|---------------|----------------|---------------|--------------|---------------|--------------------------|----------------------|
| 14/10/41 | —               | 4             | —                       | —                               | —                   | —                       | —                    | 4                   | —             | —              | —             | —            | —             | —                        | 8                    |
| 24/10/41 | 2               | —             | —                       | —                               | —                   | —                       | —                    | 4                   | —             | —              | —             | —            | —             | —                        | 6                    |
| 7/11/41  | 4               | 40            | —                       | —                               | —                   | —                       | —                    | —                   | —             | —              | —             | 6            | —             | —                        | 64                   |
| 25/11/41 | 10              | 6             | 2                       | 4                               | 4                   | —                       | 74                   | —                   | —             | —              | 2             | —            | —             | —                        | 92                   |
| 9/12/41  | 4               | 6             | —                       | —                               | —                   | 2                       | 2                    | —                   | —             | 2              | —             | —            | —             | —                        | 16                   |
| 30/12/41 | 2               | 2             | —                       | —                               | —                   | —                       | 4                    | —                   | —             | —              | 4             | —            | —             | —                        | 12                   |
| 13/1/42  | —               | —             | —                       | —                               | —                   | —                       | —                    | —                   | —             | 2              | —             | —            | —             | —                        | 2                    |
| 27/1/42  | 2               | 8             | —                       | —                               | —                   | —                       | 4                    | —                   | —             | —              | —             | —            | —             | —                        | 14                   |
| 10/2/42  | 2               | 6             | —                       | —                               | —                   | —                       | 4                    | —                   | —             | 4              | 2             | —            | —             | —                        | 18                   |
| 24/2/42  | 2               | 2             | —                       | —                               | —                   | —                       | 4                    | —                   | —             | 2              | —             | —            | —             | —                        | 12                   |
| 10/3/42  | 2               | —             | —                       | —                               | —                   | —                       | —                    | —                   | —             | 2              | —             | —            | —             | —                        | 2                    |
| 24/3/42  | 4               | 4             | —                       | —                               | —                   | —                       | —                    | —                   | —             | —              | —             | —            | —             | —                        | 8                    |
| 10/4/42  | 4               | 2             | —                       | —                               | —                   | —                       | 16                   | —                   | —             | —              | —             | —            | —             | —                        | 22                   |
| 24/4/42  | 6               | 12            | —                       | —                               | —                   | —                       | 2                    | —                   | —             | —              | —             | —            | —             | —                        | 24                   |
| 12/5/42  | 2               | 20            | 4                       | —                               | —                   | —                       | —                    | —                   | —             | —              | —             | —            | —             | —                        | 22                   |
| 26/5/42  | 2               | 14            | —                       | —                               | —                   | —                       | 24                   | —                   | —             | —              | 2             | —            | —             | —                        | 42                   |
| 9/6/42   | 6               | 2             | —                       | —                               | —                   | —                       | 2                    | —                   | —             | —              | —             | —            | —             | —                        | 10                   |
| 23/6/42  | 4               | 4             | —                       | —                               | —                   | —                       | —                    | —                   | —             | —              | —             | —            | —             | —                        | 12                   |
| 7/7/42   | —               | 6             | —                       | —                               | —                   | —                       | —                    | —                   | —             | —              | —             | 2            | —             | —                        | 34                   |
| 21/7/42  | 4               | 14            | —                       | —                               | —                   | —                       | 16                   | —                   | —             | —              | —             | —            | —             | —                        | 34                   |
| 4/8/42   | 2               | 10            | —                       | —                               | —                   | —                       | 22                   | —                   | —             | —              | —             | —            | —             | —                        | 16                   |
| 18/8/42  | 2               | 6             | —                       | —                               | —                   | —                       | 8                    | —                   | —             | —              | —             | —            | —             | —                        | 14                   |
| 1/9/42   | —               | 10            | —                       | —                               | —                   | —                       | —                    | —                   | —             | —              | —             | —            | —             | —                        | 4                    |
| 15/9/42  | —               | —             | —                       | —                               | —                   | —                       | 2                    | —                   | —             | —              | —             | —            | —             | —                        | 4                    |
| 29/9/42  | 4               | 4             | —                       | —                               | —                   | —                       | 2                    | —                   | —             | —              | —             | 2            | —             | —                        | 10                   |
| 13/10/42 | 2               | 6             | —                       | —                               | —                   | —                       | —                    | —                   | —             | 2              | —             | —            | —             | —                        | 12                   |
| 27/10/42 | —               | 12            | —                       | —                               | —                   | —                       | 2                    | —                   | —             | —              | —             | —            | —             | —                        | 16                   |
| 10/11/42 | 2               | 2             | —                       | —                               | —                   | —                       | —                    | —                   | —             | —              | 2             | —            | —             | —                        | 4                    |

++++ = marked.

++ = fairly marked.

+ = slight.

TABLE 12.  
Dorset Horn Ram 56956. Numbers of Abnormal Spermatozoa of Different Types per Thousand.

| Date.    | Tailless Sperm. | Coiled Tails. | Enlarged Middle Pieces. | Double Middle Pieces and Tails. | Middle Piece Beads. | Filiform Middle Pieces. | Abaxial Attachments. | Defective Staining. | Narrow Heads. | Pyiform Heads. | Megalo-sperm. | Micro-sperm. | Double Heads. | Variation in Head Sizes. | Abnormals per 1,000. |
|----------|-----------------|---------------|-------------------------|---------------------------------|---------------------|-------------------------|----------------------|---------------------|---------------|----------------|---------------|--------------|---------------|--------------------------|----------------------|
| 14/10/41 | 4               | 6             | —                       | —                               | —                   | —                       | —                    | 14                  | —             | —              | 4             | —            | —             | —                        | 28                   |
| 28/10/41 | 10              | 2             | —                       | —                               | —                   | —                       | —                    | —                   | —             | —              | —             | —            | —             | —                        | 12                   |
| 11/11/41 | 16              | 2             | —                       | —                               | —                   | —                       | —                    | —                   | —             | 6              | —             | —            | —             | —                        | 24                   |
| 28/11/41 | 12              | 4             | —                       | —                               | 34                  | —                       | —                    | —                   | —             | 2              | 6             | —            | —             | —                        | 58                   |
| 12/12/41 | 16              | 14            | —                       | —                               | —                   | —                       | 2                    | 10                  | —             | —              | —             | —            | —             | —                        | 42                   |
| 2/1/42   | 124             | 440           | —                       | —                               | 22                  | —                       | —                    | 16                  | —             | 4              | —             | —            | —             | —                        | 606                  |
| 16/1/42  | 280             | 194           | 6                       | —                               | 8                   | —                       | —                    | 54                  | —             | 4              | —             | —            | —             | —                        | 548                  |
| 30/1/42  | 8               | 14            | —                       | 2                               | 4                   | —                       | —                    | 24                  | —             | 2              | —             | 2            | —             | —                        | 56                   |
| 13/2/42  | 40              | 24            | —                       | —                               | —                   | —                       | —                    | 140                 | —             | —              | —             | —            | —             | —                        | 204                  |
| 27/2/42  | 46              | 32            | —                       | —                               | 12                  | —                       | —                    | 22                  | —             | —              | —             | 2            | —             | —                        | 114                  |
| 13/3/42  | 12              | 28            | —                       | —                               | 2                   | —                       | —                    | 20                  | —             | 4              | —             | —            | —             | —                        | 66                   |
| 27/3/42  | 380             | 50            | 2                       | —                               | —                   | —                       | —                    | 370                 | —             | —              | —             | —            | —             | —                        | 802                  |
| 14/4/42  | —               | —             | Occasional sperm only.  | —                               | —                   | —                       | —                    | —                   | —             | —              | —             | —            | —             | —                        | —                    |
| 28/4/42  | —               | —             | Occasional sperm only.  | —                               | —                   | —                       | —                    | —                   | —             | —              | —             | —            | —             | —                        | —                    |
| 15/5/42  | 14              | 230           | 2                       | 2                               | 18                  | —                       | 6                    | 30                  | —             | 12             | —             | 26           | 2             | —                        | 342                  |
| 29/5/42  | 12              | 90            | 4                       | 2                               | —                   | —                       | —                    | 8                   | —             | 6              | —             | 12           | —             | —                        | 134                  |
| 12/6/42  | 8               | 42            | —                       | —                               | —                   | —                       | —                    | 34                  | —             | 4              | —             | —            | —             | —                        | 88                   |
| 26/6/42  | 32              | 42            | 2                       | —                               | 12                  | —                       | —                    | 86                  | —             | —              | —             | —            | —             | —                        | 174                  |
| 10/7/42  | 166             | 148           | —                       | 6                               | —                   | —                       | —                    | 118                 | —             | —              | —             | —            | —             | —                        | 440                  |
| 24/7/42  | 22              | 104           | —                       | 6                               | —                   | —                       | —                    | 26                  | —             | —              | 2             | —            | —             | —                        | 160                  |
| 7/8/42   | 6               | 36            | —                       | —                               | 4                   | —                       | —                    | 66                  | —             | —              | —             | —            | —             | —                        | 114                  |
| 21/8/42  | 10              | 34            | —                       | —                               | —                   | 2                       | —                    | 40                  | —             | —              | —             | —            | —             | —                        | 84                   |
| 4/9/42   | 10              | 18            | —                       | —                               | —                   | —                       | —                    | 60                  | —             | —              | —             | —            | —             | —                        | 106                  |
| 18/9/42  | 110             | 134           | 2                       | —                               | 18                  | —                       | —                    | 82                  | 4             | 6              | —             | —            | —             | —                        | 364                  |
| 2/10/42  | 150             | 206           | 8                       | 2                               | 26                  | —                       | —                    | 40                  | 2             | 34             | —             | —            | —             | —                        | 474                  |
| 16/10/42 | 50              | 498           | 28                      | —                               | 32                  | —                       | —                    | 32                  | —             | 64             | —             | —            | —             | —                        | 706                  |
| 30/10/42 | 22              | 90            | —                       | 12                              | 2                   | —                       | —                    | 22                  | —             | 16             | —             | —            | —             | —                        | 164                  |
| 17/11/42 | 34              | 196           | —                       | 4                               | —                   | —                       | —                    | 40                  | —             | 76             | —             | —            | —             | —                        | 352                  |

+++ = marked.

++ = fairly marked.

+ = slight.

SPERM PICTURE OF RAMS AND RATE OF SPERM TRAVEL.

TABLE 13.  
Dorset Horn Ram 62548. Numbers of Abnormal Spermatozoa of Different Types per Thousand.

| Date.    | Tailless Sperm. | Coiled Tails. | Enlarged Middle Pieces. | Double Middle Pieces and Tails. | Middle Piece Beads. | Piliform Middle Pieces. | Abaxial Attachments. | Defective Staining. | Narrow Heads. | Pyiform Heads. | Megalo-sperm. | Micro-sperm. | Double Heads. | Variation in Head Sizes. | Abnormals per 1,000 |
|----------|-----------------|---------------|-------------------------|---------------------------------|---------------------|-------------------------|----------------------|---------------------|---------------|----------------|---------------|--------------|---------------|--------------------------|---------------------|
| 17/10/41 | 6               | 8             | —                       | —                               | —                   | —                       | —                    | 8                   | —             | —              | —             | —            | —             | —                        | 22                  |
| 31/10/41 | 2               | —             | —                       | —                               | —                   | —                       | —                    | —                   | —             | —              | —             | —            | —             | —                        | 2                   |
| 14/11/41 | 4               | 8             | —                       | —                               | —                   | —                       | —                    | 4                   | —             | —              | —             | —            | —             | —                        | 16                  |
| 2/12/41  | —               | —             | 2                       | —                               | —                   | —                       | —                    | 6                   | —             | —              | —             | 2            | —             | —                        | 10                  |
| 19/18/41 | 2               | —             | —                       | —                               | —                   | —                       | —                    | —                   | —             | —              | 2             | —            | —             | —                        | 4                   |
| 6/1/42   | 4               | 14            | —                       | —                               | —                   | —                       | —                    | 14                  | —             | —              | —             | —            | —             | —                        | 32                  |
| 20/1/42  | 6               | 8             | —                       | —                               | —                   | —                       | —                    | 8                   | —             | —              | 2             | —            | —             | —                        | 24                  |
| 3/2/42   | 2               | 4             | —                       | —                               | —                   | —                       | —                    | —                   | —             | —              | —             | —            | —             | —                        | 10                  |
| 17/2/42  | 2               | 2             | —                       | —                               | —                   | —                       | —                    | —                   | —             | —              | —             | —            | —             | —                        | 8                   |
| 3/3/42   | 2               | 8             | 4                       | —                               | —                   | —                       | —                    | 4                   | —             | —              | —             | —            | —             | —                        | 22                  |
| 17/3/42  | 6               | 20            | —                       | —                               | 2                   | —                       | —                    | 4                   | —             | —              | —             | 2            | —             | —                        | 40                  |
| 31/3/42  | —               | 2             | —                       | —                               | 2                   | —                       | —                    | 10                  | —             | —              | —             | —            | —             | —                        | 2                   |
| 17/4/42  | 2               | 18            | —                       | —                               | —                   | —                       | —                    | —                   | —             | —              | —             | —            | —             | —                        | 20                  |
| 17/4/42  | —               | 4             | —                       | —                               | 2                   | —                       | —                    | —                   | —             | —              | —             | —            | —             | —                        | 10                  |
| 6/6/42   | —               | 36            | —                       | —                               | —                   | —                       | —                    | 2                   | —             | 2              | —             | —            | —             | —                        | 52                  |
| 19/5/42  | 12              | —             | —                       | —                               | —                   | —                       | —                    | 4                   | —             | —              | —             | —            | —             | —                        | —                   |
| 2/6/42   | 10              | 254           | —                       | —                               | 34                  | 6                       | —                    | 26                  | —             | 16             | 4             | 2            | —             | —                        | 352                 |

+++ = marked.

++ = fairly marked.

+ = slight.

Ram died.

TABLE 14.  
*Ronderib Afrikaner Ram 62418. Numbers of Abnormal Spermatozoa of Different Types per Thousand.*

| Date.         | Tailless Sperm. | Coiled Tails. | Enlarged Middle Pieces. | Double Middle Pieces and Tails. | Middle Piece Beads. | Filiform Middle Pieces. | Absaxial Attachments. | Defective Staining. | Narrow Heads. | Pyriform Heads. | Megalosperm. | Micro-sperm. | Double Heads. | Variation in Head Sizes. | Abnormals per 1,000. |
|---------------|-----------------|---------------|-------------------------|---------------------------------|---------------------|-------------------------|-----------------------|---------------------|---------------|-----------------|--------------|--------------|---------------|--------------------------|----------------------|
| 21/10/41..... | 22              | 2             | 2                       | —                               | —                   | —                       | —                     | 18                  | —             | —               | —            | —            | —             | —                        | 44                   |
| 4/11/41.....  | 46              | 6             | 6                       | —                               | —                   | —                       | —                     | 50                  | —             | —               | —            | —            | —             | —                        | 108                  |
| 18/11/41..... | 14              | 6             | —                       | —                               | —                   | —                       | —                     | 32                  | —             | —               | 8            | —            | —             | —                        | 60                   |
| 5/12/41.....  | 10              | 6             | —                       | —                               | —                   | —                       | —                     | 40                  | —             | —               | 6            | —            | —             | —                        | 62                   |
| 23/12/41..... | 16              | 8             | —                       | —                               | —                   | —                       | —                     | 14                  | —             | —               | 2            | —            | —             | —                        | 40                   |
| 9/1/42.....   | 8               | 6             | —                       | 2                               | —                   | —                       | —                     | 12                  | —             | —               | 2            | —            | —             | —                        | 30                   |
| 23/1/42.....  | 2               | 6             | —                       | —                               | —                   | —                       | —                     | —                   | —             | —               | —            | —            | —             | —                        | 8                    |
| 6/2/42.....   | 8               | 48            | —                       | —                               | —                   | —                       | —                     | 6                   | —             | —               | —            | —            | —             | —                        | 62                   |
| 20/2/42.....  | —               | 8             | —                       | —                               | —                   | —                       | —                     | 10                  | —             | 2               | —            | —            | —             | —                        | 20                   |
| 6/3/42.....   | 8               | 6             | 2                       | —                               | —                   | —                       | —                     | 10                  | —             | —               | —            | —            | —             | —                        | 26                   |
| 20/3/42.....  | 4               | 22            | 4                       | —                               | —                   | —                       | —                     | 2                   | —             | —               | —            | —            | —             | —                        | 32                   |
| 7/4/42.....   | 2               | 6             | —                       | —                               | —                   | —                       | —                     | 6                   | —             | —               | —            | 2            | —             | —                        | 16                   |
| 21/4/42.....  | 2               | —             | —                       | —                               | —                   | —                       | —                     | —                   | —             | —               | —            | —            | —             | —                        | 2                    |
| 8/5/42.....   | 4               | 10            | —                       | —                               | —                   | —                       | —                     | 12                  | —             | —               | —            | —            | —             | —                        | 26                   |
| 22/5/42.....  | 12              | 6             | —                       | —                               | —                   | —                       | —                     | 60                  | —             | —               | —            | —            | —             | —                        | 84                   |
| 5/6/42.....   | 4               | 22            | 2                       | —                               | 4                   | —                       | —                     | 44                  | —             | 4               | 2            | —            | —             | —                        | 78                   |
| 19/6/42.....  | 14              | 22            | —                       | 2                               | —                   | —                       | —                     | 28                  | —             | —               | —            | —            | —             | —                        | 64                   |
| 3/7/42.....   | 30              | 12            | —                       | —                               | —                   | —                       | —                     | 80                  | —             | —               | —            | —            | —             | —                        | 126                  |
| 17/7/42.....  | 2               | 18            | 4                       | —                               | 2                   | —                       | —                     | 20                  | —             | —               | —            | —            | —             | —                        | 46                   |
| 31/7/42.....  | 2               | 58            | 4                       | 4                               | —                   | —                       | —                     | 14                  | —             | —               | —            | —            | —             | —                        | 88                   |
| 14/8/42.....  | 40              | 36            | —                       | —                               | —                   | —                       | —                     | 32                  | —             | —               | —            | —            | —             | —                        | 112                  |
| 28/8/42.....  | 98              | 42            | —                       | —                               | —                   | —                       | —                     | 46                  | —             | —               | —            | —            | —             | —                        | 188                  |
| 11/9/42.....  | 30              | 10            | —                       | —                               | —                   | —                       | —                     | 62                  | —             | —               | 2            | —            | —             | —                        | 108                  |
| 25/9/42.....  | 26              | 22            | 2                       | —                               | —                   | —                       | —                     | 34                  | —             | —               | —            | —            | —             | —                        | 92                   |
| 9/10/42.....  | 10              | 8             | —                       | —                               | —                   | —                       | —                     | 56                  | —             | —               | —            | —            | —             | —                        | 76                   |
| 23/10/42..... | 4               | 18            | —                       | —                               | —                   | —                       | —                     | 2                   | —             | —               | —            | —            | —             | —                        | 24                   |
| 6/11/42.....  | 6               | 18            | —                       | —                               | —                   | —                       | —                     | 12                  | —             | —               | —            | 2            | —             | —                        | 38                   |

+++ = marked.      ++ = fairly marked.      + = slight.

## SPERM PICTURE OF RAMS AND RATE OF SPERM TRAVEL.

TABLE 15.  
*Ronderib Afrikaner Ram 62546. Numbers of Abnormal Spermatozoa of Different Types per Thousand.*

| Date.         | Tailless Sperm. | Coiled Tails. | Enlarged Middle Pieces. | Double Middle Pieces and Tails. | Middle Piece Beads. | Filliform Middle Pieces. | Abaxial Attachments. | Defective Staining. | Narrow Heads. | Pyiform Heads. | Megalo-sperm. | Micro-sperm. | Double Heads. | Variation in Head Sizes. | Abnormals per 1,000. |
|---------------|-----------------|---------------|-------------------------|---------------------------------|---------------------|--------------------------|----------------------|---------------------|---------------|----------------|---------------|--------------|---------------|--------------------------|----------------------|
| 17/10/41..... | 2               | —             | —                       | —                               | —                   | —                        | —                    | 2                   | —             | —              | 4             | —            | —             | —                        | 8                    |
| 31/10/41..... | 2               | 6             | —                       | —                               | —                   | —                        | —                    | 4                   | —             | —              | —             | —            | —             | —                        | 12                   |
| 14/11/41..... | —               | —             | —                       | —                               | —                   | —                        | 4                    | —                   | —             | —              | —             | —            | —             | —                        | 2                    |
| 2/12/41.....  | 6               | 4             | —                       | —                               | —                   | —                        | —                    | —                   | —             | —              | 4             | —            | —             | —                        | 18                   |
| 19/12/41..... | 6               | 2             | —                       | —                               | —                   | —                        | —                    | 2                   | —             | —              | 2             | —            | —             | —                        | 12                   |
| 6/1/42.....   | 2               | —             | —                       | —                               | —                   | —                        | —                    | 8                   | —             | —              | —             | —            | —             | —                        | 10                   |
| 20/1/42.....  | —               | 2             | —                       | —                               | —                   | —                        | —                    | 2                   | —             | —              | 4             | —            | —             | —                        | 8                    |
| 3/2/42.....   | —               | 6             | —                       | —                               | —                   | —                        | —                    | 6                   | —             | —              | 2             | —            | —             | —                        | 14                   |
| 17/2/42.....  | —               | —             | —                       | —                               | —                   | —                        | —                    | —                   | —             | —              | —             | —            | —             | —                        | 0                    |
| 3/3/42.....   | —               | —             | —                       | —                               | —                   | —                        | —                    | —                   | —             | —              | —             | —            | —             | —                        | 2                    |
| 17/3/42.....  | 18              | 182           | 2                       | —                               | 2                   | —                        | —                    | 56                  | —             | —              | 6             | 2            | —             | —                        | 276                  |
| 31/3/42.....  | —               | 4             | 2                       | —                               | 10                  | —                        | —                    | 6                   | —             | —              | —             | —            | —             | —                        | 12                   |
| 17/4/42.....  | —               | 2             | —                       | —                               | —                   | —                        | —                    | —                   | —             | —              | —             | —            | —             | —                        | 4                    |
| 5/5/42.....   | —               | 2             | —                       | —                               | —                   | —                        | —                    | —                   | —             | —              | —             | —            | —             | —                        | 2                    |
| 19/5/42.....  | —               | 8             | —                       | —                               | —                   | —                        | —                    | —                   | —             | —              | —             | —            | —             | —                        | 10                   |
| 2/6/42.....   | —               | 4             | —                       | —                               | —                   | —                        | —                    | —                   | —             | —              | —             | —            | —             | —                        | 4                    |
| 16/6/42.....  | —               | 12            | —                       | 2                               | —                   | —                        | —                    | —                   | —             | —              | —             | —            | —             | —                        | 4                    |
| 30/6/42.....  | 2               | 16            | —                       | —                               | —                   | —                        | —                    | 4                   | —             | —              | —             | —            | —             | —                        | 18                   |
| 14/7/42.....  | 8               | 84            | 6                       | —                               | 4                   | —                        | —                    | 46                  | —             | —              | —             | —            | —             | —                        | 64                   |
| 28/7/42.....  | 6               | 42            | —                       | 4                               | —                   | —                        | —                    | 74                  | —             | —              | 2             | —            | —             | —                        | 178                  |
| 11/8/42.....  | 20              | 168           | 2                       | —                               | —                   | —                        | —                    | 14                  | —             | —              | —             | —            | —             | —                        | 66                   |
| 25/8/42.....  | 24              | 56            | 2                       | 2                               | 2                   | —                        | —                    | 42                  | —             | 4              | 2             | —            | —             | —                        | 240                  |
| 8/9/42.....   | —               | 8             | —                       | —                               | —                   | —                        | —                    | 82                  | —             | —              | —             | —            | —             | —                        | 170                  |
| 22/9/42.....  | —               | 2             | —                       | —                               | —                   | —                        | —                    | 2                   | —             | —              | —             | 2            | —             | —                        | 10                   |
| 6/10/42.....  | 10              | 18            | —                       | —                               | —                   | —                        | —                    | 10                  | —             | —              | —             | —            | —             | —                        | 8                    |
| 20/10/42..... | 2               | 16            | —                       | —                               | —                   | —                        | —                    | —                   | —             | —              | —             | —            | —             | —                        | 38                   |
| 3/11/42.....  | 10              | 24            | —                       | 2                               | —                   | —                        | —                    | —                   | —             | —              | —             | —            | —             | —                        | 18                   |
|               |                 |               |                         |                                 |                     |                          |                      | 2                   | —             | —              | 2             | —            | —             | —                        | 40                   |

+++ = marked.

++ = fairly marked.

+ = slight.

TABLE 16.  
*Ronderib Afrikaner Ram 62419. Numbers of Abnormal Spermatozoa of Different Types per Thousand.*

| Date.         | Tailless Sperm. | Coiled Tails. | Enlarged Middle Pieces. | Double Middle Pieces and Tails. | Middle Piece Beads. | Filliform Middle Pieces. | Abaxial Attachments. | Defective Staining. | Narrow Heads. | Pyriform Heads. | Megalo-sperm. | Micro-sperm. | Double Heads. | Variation in Head Sizes. | Abnormals per 1,000. |
|---------------|-----------------|---------------|-------------------------|---------------------------------|---------------------|--------------------------|----------------------|---------------------|---------------|-----------------|---------------|--------------|---------------|--------------------------|----------------------|
| 14/10/41..... | 12              | —             | —                       | —                               | —                   | —                        | —                    | 14                  | —             | —               | —             | —            | —             | —                        | 26                   |
| 23/10/41..... | 4               | —             | —                       | —                               | —                   | —                        | —                    | 4                   | —             | —               | —             | —            | —             | —                        | 8                    |
| 11/11/41..... | 10              | —             | —                       | 2                               | —                   | —                        | —                    | 16                  | —             | —               | —             | —            | —             | —                        | 28                   |
| 28/11/41..... | 12              | —             | 4                       | —                               | 2                   | —                        | —                    | —                   | —             | —               | —             | —            | —             | —                        | 18                   |
| 12/12/41..... | 2               | 2             | —                       | —                               | —                   | —                        | —                    | 2                   | —             | —               | —             | —            | —             | —                        | 6                    |
| 2/1/42.....   | 4               | —             | —                       | —                               | —                   | —                        | —                    | —                   | —             | —               | 4             | —            | —             | —                        | 8                    |
| 16/1/42.....  | 6               | 2             | —                       | —                               | —                   | —                        | —                    | 18                  | —             | —               | —             | —            | —             | —                        | 26                   |
| 30/1/42.....  | 6               | 2             | —                       | —                               | —                   | —                        | —                    | 8                   | —             | —               | 4             | —            | —             | —                        | 18                   |
| 13/2/42.....  | 2               | 2             | —                       | 2                               | —                   | —                        | —                    | 4                   | —             | —               | —             | —            | —             | —                        | 8                    |
| 27/2/42.....  | 6               | 8             | —                       | —                               | —                   | —                        | —                    | 2                   | —             | —               | —             | —            | —             | —                        | 18                   |
| 13/3/42.....  | 4               | 2             | —                       | —                               | —                   | —                        | —                    | —                   | —             | —               | —             | —            | —             | —                        | 6                    |
| 27/3/42.....  | —               | —             | —                       | —                               | —                   | —                        | —                    | 4                   | —             | —               | —             | —            | —             | —                        | 4                    |
| 14/4/42.....  | 2               | 2             | —                       | —                               | —                   | —                        | —                    | —                   | —             | —               | —             | —            | —             | —                        | 4                    |
| 28/4/42.....  | 6               | 6             | —                       | —                               | —                   | —                        | —                    | —                   | —             | —               | —             | —            | —             | —                        | 12                   |
| 15/5/42.....  | 18              | 6             | —                       | —                               | —                   | —                        | —                    | 12                  | —             | —               | —             | —            | —             | —                        | 36                   |
| 29/5/42.....  | 2               | 2             | —                       | —                               | —                   | —                        | —                    | —                   | —             | —               | —             | —            | —             | —                        | 4                    |
| 12/6/42.....  | 52              | 16            | —                       | —                               | —                   | —                        | —                    | 52                  | —             | —               | —             | —            | —             | —                        | 120                  |
| 26/6/42.....  | 6               | 8             | —                       | 4                               | —                   | —                        | —                    | 40                  | —             | —               | —             | —            | —             | —                        | 58                   |
| 10/7/42.....  | 4               | 4             | —                       | —                               | —                   | —                        | —                    | —                   | —             | —               | —             | —            | —             | —                        | 8                    |
| 24/7/42.....  | 36              | 20            | —                       | —                               | —                   | —                        | —                    | 124                 | —             | —               | —             | —            | —             | —                        | 180                  |
| 7/8/42.....   | 36              | 12            | —                       | 4                               | —                   | —                        | —                    | 42                  | —             | —               | 2             | —            | —             | —                        | 96                   |
| 21/8/42.....  | 10              | 10            | —                       | 4                               | —                   | —                        | —                    | 34                  | —             | —               | —             | —            | —             | —                        | 58                   |
| 4/9/42.....   | —               | 4             | —                       | —                               | —                   | —                        | —                    | 6                   | —             | —               | —             | —            | —             | —                        | 10                   |
| 18/9/42.....  | —               | 2             | —                       | —                               | —                   | —                        | —                    | 2                   | —             | —               | —             | —            | —             | —                        | 4                    |
| 2/10/42.....  | 18              | 10            | —                       | —                               | —                   | —                        | —                    | 18                  | —             | —               | —             | —            | —             | —                        | 48                   |
| 16/10/42..... | 4               | 16            | —                       | —                               | 6                   | —                        | —                    | 4                   | —             | —               | —             | —            | —             | —                        | 30                   |
| 30/10/42..... | 4               | 6             | —                       | —                               | —                   | —                        | —                    | 8                   | —             | —               | —             | —            | —             | —                        | 20                   |
| 17/11/42..... | 2               | 40            | 2                       | 2                               | —                   | —                        | —                    | 2                   | —             | —               | —             | —            | —             | —                        | 48                   |

+++ = marked.      ++ = fairly marked.      + = slight.

SPERM PICTURE OF RAMS AND RATE OF SPERM TRAVEL.

TABLE 17.  
*Ronderib Afrikaner Ram 62549.*  
*Numbers of Abnormal Spermatozoa of Different Types per Thousand.*

| Date.    | Tailless Sperm. | Coiled Tails. | Enlarged Middle Pieces. | Double Middle Pieces and Tails. | Middle Piece Beads. | Filiform Middle Pieces. | Absaxial Attachments. | Defective Staining. | Narrow Heads. | Pyramiform Heads. | Megalo-sperm. | Micro-sperm. | Double Heads. | Variation in Head Sizes. | Abnormals per 1,000. |
|----------|-----------------|---------------|-------------------------|---------------------------------|---------------------|-------------------------|-----------------------|---------------------|---------------|-------------------|---------------|--------------|---------------|--------------------------|----------------------|
| 10/10/41 | 6               | 2             |                         |                                 |                     |                         |                       | 20                  |               |                   |               |              |               |                          | 28                   |
| 24/10/41 | 14              |               |                         |                                 |                     |                         |                       | 6                   |               |                   |               |              |               |                          | 20                   |
| 7/11/41  | 26              | 10            |                         | 2                               |                     |                         |                       | 10                  |               |                   |               | 2            |               |                          | 50                   |
| 25/11/41 | 6               |               |                         |                                 |                     |                         |                       |                     |               |                   |               |              |               |                          | 6                    |
| 9/12/41  |                 | 6             |                         | 2                               | 2                   |                         |                       | 30                  |               |                   | 4             |              |               |                          | 44                   |
| 30/12/41 | 10              |               |                         |                                 |                     |                         |                       | 2                   |               |                   |               |              |               |                          | 18                   |
| 13/1/42  | 4               | 2             |                         |                                 |                     |                         |                       | 2                   |               |                   |               |              |               |                          | 12                   |
| 27/1/42  | 6               | 2             |                         | 2                               |                     |                         |                       | 4                   |               |                   | 4             |              |               |                          | 14                   |
| 10/2/42  | 2               | 2             |                         | 2                               |                     | 2                       |                       | 4                   |               |                   |               |              |               |                          | 16                   |
| 24/2/42  | 4               |               |                         |                                 |                     |                         |                       | 6                   |               |                   | 2             | 2            |               |                          | 4                    |
| 10/3/42  | 4               | 4             |                         | 2                               |                     |                         |                       |                     |               |                   |               |              |               |                          | 4                    |
| 24/3/42  |                 | 2             |                         |                                 |                     |                         |                       |                     |               |                   | 2             |              |               |                          | 12                   |
| 10/4/42  |                 | 4             |                         |                                 |                     |                         |                       | 26                  |               |                   |               |              |               |                          | 28                   |
| 24/4/42  |                 | 4             |                         |                                 |                     |                         |                       | 2                   |               |                   |               |              |               |                          | 6                    |
| 12/5/42  | 2               | 4             |                         |                                 |                     |                         |                       | 8                   |               |                   |               |              |               |                          | 8                    |
| 26/5/42  | 8               | 16            |                         |                                 |                     |                         |                       | 2                   |               |                   |               |              |               |                          | 6                    |
| 9/6/42   | 6               | 16            |                         | 6                               |                     |                         |                       | 12                  |               |                   | 2             |              |               |                          | 44                   |
| 23/6/42  | 8               | 10            |                         |                                 |                     |                         |                       |                     |               |                   |               |              |               |                          | 22                   |
| 7/7/42   | 16              | 16            |                         | 2                               | 2                   |                         |                       | 34                  |               |                   | 2             |              |               |                          | 58                   |
| 21/7/42  | 30              | 4             |                         | 4                               |                     |                         |                       | 36                  |               |                   |               |              |               |                          | 68                   |
| 4/8/42   | 2               | 20            |                         |                                 |                     |                         |                       | 58                  |               |                   |               |              |               |                          | 96                   |
| 18/8/42  | 6               | 14            |                         |                                 |                     |                         |                       | 30                  |               |                   |               |              |               |                          | 52                   |
| 1/9/42   | 30              | 28            |                         | 6                               |                     |                         |                       | 4                   |               |                   | 4             |              |               |                          | 24                   |
| 15/9/42  | 12              | 36            |                         | 8                               |                     |                         |                       | 8                   |               |                   |               |              |               |                          | 76                   |
| 29/9/42  | 28              | 42            |                         | 6                               |                     |                         |                       | 16                  |               |                   |               |              |               |                          | 72                   |
| 13/10/42 | 14              | 34            | 4                       | 6                               |                     |                         |                       | 42                  |               |                   |               |              |               |                          | 112                  |
| 27/10/42 | 14              | 6             |                         |                                 |                     |                         |                       | 56                  |               |                   |               |              |               |                          | 114                  |
| 10/11/42 | 4               | 4             |                         |                                 | 2                   |                         |                       | 8                   |               |                   |               | 2            |               |                          | 30                   |

+++ = marked.

++ = fairly marked.

+ = slight.

TABLE 18.  
*Ronderib Afrikaaner Ram 62543. Numbers of Abnormal Spermatozoa of Different Types per Thousand.*

| Date.         | Tailless Sperm. | Coiled Tails. | Enlarged Middle Pieces. | Double Middle Pieces and Tails. | Middle Piece Beads. | Filiform Middle Pieces. | Abaxial Attachments. | Defective Staining. | Narrow Heads. | Pyiform Heads. | Megalo-sperm. | Micro-sperm. | Double Heads. | Variation in Head Sizes. | Abnormals per 1,000. |
|---------------|-----------------|---------------|-------------------------|---------------------------------|---------------------|-------------------------|----------------------|---------------------|---------------|----------------|---------------|--------------|---------------|--------------------------|----------------------|
| 7/10/41.....  | 16              | —             | —                       | —                               | —                   | —                       | —                    | 8                   | —             | —              | —             | —            | —             | —                        | 24                   |
| 21/10/41..... | 6               | 4             | 2                       | —                               | —                   | —                       | —                    | 6                   | —             | —              | —             | 4            | —             | —                        | 22                   |
| 4/11/41.....  | 6               | 2             | —                       | —                               | 4                   | —                       | —                    | 6                   | —             | —              | —             | 2            | —             | —                        | 20                   |
| 18/11/41..... | 6               | —             | —                       | —                               | —                   | —                       | —                    | 6                   | —             | —              | —             | —            | —             | —                        | 12                   |
| 5/12/41.....  | 4               | 4             | —                       | —                               | —                   | —                       | —                    | 8                   | —             | —              | —             | —            | —             | —                        | 8                    |
| 23/12/41..... | 4               | 4             | —                       | —                               | —                   | —                       | —                    | 2                   | —             | —              | —             | —            | —             | —                        | 10                   |
| 9/1/42.....   | 2               | 4             | —                       | 2                               | —                   | —                       | —                    | 2                   | 2             | —              | —             | —            | —             | —                        | 8                    |
| 23/1/42.....  | —               | —             | —                       | —                               | —                   | —                       | —                    | —                   | —             | —              | —             | —            | —             | —                        | 0                    |
| 6/2/42.....   | —               | —             | —                       | —                               | —                   | —                       | —                    | —                   | —             | —              | —             | —            | —             | —                        | 0                    |
| 20/2/42.....  | —               | —             | —                       | —                               | —                   | —                       | —                    | —                   | —             | —              | —             | —            | —             | —                        | 0                    |
| 6/3/42.....   | 4               | 2             | —                       | —                               | —                   | —                       | —                    | —                   | —             | —              | —             | —            | —             | —                        | 6                    |
| 20/3/42.....  | 4               | —             | —                       | —                               | —                   | —                       | —                    | 4                   | —             | —              | —             | —            | —             | —                        | 6                    |
| 7/4/42.....   | 4               | 4             | —                       | —                               | —                   | —                       | —                    | —                   | —             | —              | —             | —            | —             | —                        | 8                    |
| 21/4/42.....  | —               | 4             | —                       | 2                               | —                   | —                       | —                    | 2                   | —             | —              | —             | —            | —             | —                        | 10                   |
| 8/5/42.....   | —               | 6             | —                       | —                               | —                   | —                       | —                    | —                   | —             | —              | —             | —            | —             | —                        | 10                   |
| 22/5/42.....  | —               | 4             | 2                       | —                               | —                   | —                       | —                    | 2                   | —             | —              | —             | —            | —             | —                        | 8                    |
| 5/6/42.....   | 10              | 8             | —                       | —                               | —                   | —                       | —                    | 12                  | —             | —              | —             | —            | —             | —                        | 20                   |
| 19/6/42.....  | 4               | 10            | —                       | —                               | —                   | —                       | —                    | —                   | —             | —              | —             | —            | —             | —                        | 18                   |
| 3/7/42.....   | —               | 6             | 2                       | —                               | —                   | —                       | —                    | —                   | —             | —              | —             | —            | —             | —                        | 24                   |
| 17/7/42.....  | 2               | 8             | —                       | —                               | —                   | —                       | —                    | 10                  | —             | —              | —             | —            | —             | —                        | 10                   |
| 31/7/42.....  | 6               | 28            | —                       | —                               | —                   | —                       | —                    | 6                   | —             | —              | —             | —            | —             | —                        | 16                   |
| 14/8/42.....  | 6               | 10            | —                       | —                               | —                   | —                       | —                    | 6                   | —             | —              | —             | —            | —             | —                        | 42                   |
| 28/8/42.....  | 2               | 18            | —                       | —                               | —                   | —                       | —                    | 2                   | —             | —              | —             | —            | —             | —                        | 18                   |
| 11/9/42.....  | —               | 2             | —                       | 4                               | —                   | —                       | —                    | 6                   | —             | 2              | —             | —            | 2             | —                        | 34                   |
| 25/9/42.....  | 8               | 4             | —                       | 2                               | —                   | —                       | —                    | —                   | —             | —              | —             | —            | —             | —                        | 4                    |
| 9/10/42.....  | 2               | 2             | —                       | 4                               | —                   | —                       | —                    | 10                  | —             | —              | 2             | —            | —             | —                        | 26                   |
| 6/11/42.....  | 2               | 10            | —                       | —                               | —                   | —                       | —                    | 4                   | —             | —              | —             | —            | —             | —                        | 8                    |
|               |                 |               |                         |                                 |                     |                         |                      |                     |               |                |               |              |               |                          | 16                   |



## SPERM PICTURE OF RAMS AND RATE OF SPERM TRAVEL.

TABLE 19.  
*Welsh Mountain* × *Ronderib Afrikaner Ram 62541*.  
*Numbers of Abnormal Spermatozoa of Different Types per Thousand.*

| Date.    | Tailless Sperm. | Coiled Tails. | Enlarged Middle Pieces. | Double Middle Pieces and Tails. | Middle Piece Beads. | Filiform Middle Pieces. | Abaxial Attachments. | Defective Staining. | Narrow Heads. | Pyritiform Heads. | Megalo-sperm. | Micro-sperm. | Double Heads. | Variation in Head Sizes. | Abnormals per 1,000. |
|----------|-----------------|---------------|-------------------------|---------------------------------|---------------------|-------------------------|----------------------|---------------------|---------------|-------------------|---------------|--------------|---------------|--------------------------|----------------------|
| 3/10/41  | 2               | 2             |                         |                                 |                     |                         |                      |                     |               |                   | 2             |              |               |                          | 6                    |
| 10/10/41 | 2               |               |                         |                                 |                     |                         |                      |                     |               |                   |               |              |               |                          | 4                    |
| 24/10/41 | 6               |               |                         |                                 |                     |                         |                      |                     |               |                   | 2             |              |               |                          | 6                    |
| 7/11/41  |                 | 8             | 2                       |                                 |                     |                         |                      |                     |               |                   |               | 2            |               |                          | 12                   |
| 25/11/41 | 2               | 4             |                         | 2                               |                     |                         |                      |                     |               |                   |               |              |               |                          | 4                    |
| 9/12/41  | 4               |               |                         |                                 |                     |                         |                      | 6                   |               |                   |               |              |               |                          | 4                    |
| 30/12/41 | 2               | 4             |                         | 4                               |                     |                         |                      | 2                   |               |                   |               |              |               |                          | 4                    |
| 13/1/42  |                 |               |                         |                                 |                     |                         | 2                    |                     |               |                   |               |              |               |                          | 4                    |
| 27/1/42  | 6               | 4             |                         |                                 |                     |                         |                      | 2                   |               |                   |               |              |               |                          | 8                    |
| 10/2/42  | 6               |               |                         |                                 |                     |                         |                      |                     |               |                   |               |              |               |                          | 10                   |
| 24/2/42  | 6               |               |                         |                                 |                     |                         |                      | 6                   |               |                   |               |              |               |                          | 6                    |
| 10/3/42  |                 | 2             | 2                       |                                 |                     |                         |                      | 2                   |               | 2                 |               |              |               |                          | 12                   |
| 24/3/42  |                 | 4             |                         |                                 |                     |                         |                      |                     |               |                   |               |              |               |                          | 12                   |
| 10/4/42  | 4               | 4             |                         |                                 |                     |                         |                      | 6                   |               |                   |               |              |               |                          | 8                    |
| 24/4/42  | 4               | 4             |                         |                                 |                     |                         |                      |                     |               |                   |               |              |               |                          | 6                    |
| 12/5/42  | 2               | 2             |                         |                                 |                     |                         |                      | 2                   |               |                   |               |              |               |                          | 28                   |
| 24/4/42  | 4               | 4             |                         |                                 |                     |                         |                      | 4                   |               |                   |               |              |               |                          | 20                   |
| 26/5/42  | 4               | 20            |                         |                                 |                     |                         |                      | 4                   |               |                   |               |              |               |                          | 50                   |
| 9/6/42   | 4               | 8             |                         |                                 |                     |                         |                      | 4                   |               |                   |               |              |               |                          | 86                   |
| 23/6/48  | 4               | 32            |                         |                                 |                     |                         |                      | 14                  |               |                   |               |              |               |                          | 74                   |
| 7/7/42   | 12              | 50            |                         | 2                               |                     |                         |                      | 20                  |               | 2                 |               |              |               | ++                       | 220                  |
| 21/7/42  | 2               | 58            |                         |                                 |                     |                         |                      | 14                  |               |                   |               |              |               |                          | 74                   |
| 4/8/42   | 16              | 200           |                         |                                 |                     |                         |                      |                     |               |                   |               |              |               |                          | 74                   |
| 18/8/42  | 8               | 62            |                         | 2                               |                     |                         |                      | 2                   |               |                   |               |              |               |                          | 14                   |
| 1/9/42   | 4               | 8             |                         |                                 |                     |                         |                      | 2                   |               |                   |               |              |               |                          | 46                   |
| 15/9/42  | 4               | 36            |                         |                                 |                     |                         |                      | 6                   |               |                   |               |              |               |                          | 30                   |
| 29/9/42  | 2               | 28            |                         |                                 |                     |                         |                      |                     |               |                   |               |              |               |                          | 34                   |
| 13/10/42 | 4               | 26            |                         | 2                               |                     |                         |                      | 2                   |               |                   |               |              |               |                          | 86                   |
| 27/10/42 | 2               | 78            |                         |                                 | 4                   |                         |                      | 2                   |               |                   |               |              |               |                          | 6                    |
| 10/11/42 | 2               | 4             |                         |                                 |                     |                         |                      |                     |               |                   |               |              |               |                          | 2                    |

+++ = marked.

++ = fairly marked.

+ = slight.

TABLE 20.  
*Welsh Mountain* × *Ronderib Afrikaner* Ran 62542.  
*Numbers of Abnormal Spermatozoa of Different Types per Thousand.*

| Date.    | Tailless Sperm. | Coiled Tails. | Enlarged Middle Pieces. | Double Middle Pieces and Tails. | Middle Piece | Beads. | Uniform Middle Pieces. | Abaxial Attachments. | Defective Staining. | Narrow Heads. | Pyriform Heads. | Megalo-sperm. | Micro-sperm. | Double Heads. | Variation in Head Sizes. | Abnormals per 1,000. |
|----------|-----------------|---------------|-------------------------|---------------------------------|--------------|--------|------------------------|----------------------|---------------------|---------------|-----------------|---------------|--------------|---------------|--------------------------|----------------------|
| 3/10/41  | 8               | —             | —                       | —                               | —            | —      | —                      | —                    | 62                  | 2             | —               | 2             | —            | —             | —                        | 74                   |
| 24/10/41 | 38              | 8             | —                       | —                               | —            | —      | —                      | —                    | 88                  | —             | —               | —             | —            | —             | —                        | 134                  |
| 4/11/41  | 24              | —             | —                       | —                               | —            | —      | —                      | —                    | 84                  | —             | —               | 4             | —            | —             | —                        | 112                  |
| 18/11/41 | 56              | 30            | 22                      | —                               | —            | —      | —                      | —                    | 58                  | —             | —               | —             | —            | —             | —                        | 166                  |
| 5/12/41  | 28              | 16            | 4                       | —                               | —            | —      | —                      | 2                    | 70                  | —             | —               | —             | —            | —             | —                        | 120                  |
| 23/12/41 | 26              | 8             | 6                       | —                               | —            | —      | —                      | —                    | 80                  | —             | —               | —             | —            | —             | —                        | 120                  |
| 9/1/42   | 10              | 10            | —                       | 2                               | —            | —      | —                      | —                    | 148                 | —             | —               | —             | —            | —             | —                        | 168                  |
| 23/1/42  | 24              | 16            | —                       | 2                               | —            | —      | —                      | —                    | 268                 | —             | —               | —             | —            | —             | —                        | 314                  |
| 6/2/42   | 4               | —             | —                       | —                               | —            | —      | —                      | —                    | 102                 | —             | —               | —             | —            | —             | —                        | 108                  |
| 20/2/42  | 44              | 4             | —                       | —                               | —            | —      | —                      | —                    | 150                 | —             | —               | 2             | —            | —             | —                        | 200                  |
| 6/3/42   | 16              | 18            | —                       | 2                               | —            | —      | —                      | —                    | 64                  | —             | —               | —             | —            | —             | —                        | 100                  |
| 20/3/42  | 28              | 10            | —                       | —                               | —            | —      | —                      | —                    | 52                  | —             | —               | 2             | —            | —             | —                        | 92                   |
| 7/4/42   | 64              | —             | —                       | —                               | —            | —      | —                      | —                    | 38                  | —             | —               | —             | —            | —             | —                        | 102                  |
| 21/4/42  | 6               | 26            | —                       | —                               | —            | —      | —                      | —                    | 208                 | —             | —               | —             | —            | —             | —                        | 240                  |
| 8/5/42   | 12              | 8             | —                       | —                               | —            | —      | —                      | —                    | 50                  | —             | —               | —             | —            | —             | —                        | 70                   |
| 22/5/42  | 20              | 6             | —                       | —                               | —            | —      | —                      | —                    | 80                  | —             | —               | —             | —            | —             | —                        | 106                  |
| 5/6/42   | 14              | 34            | —                       | —                               | 6            | —      | —                      | —                    | 142                 | —             | —               | —             | —            | —             | —                        | 196                  |
| 19/6/42  | 36              | 90            | —                       | —                               | —            | —      | —                      | —                    | 268                 | —             | —               | —             | —            | —             | —                        | 394                  |
| 3/7/42   | 20              | 82            | —                       | —                               | —            | —      | —                      | —                    | 208                 | —             | —               | —             | —            | —             | —                        | 310                  |
| 17/7/42  | 12              | 48            | —                       | —                               | —            | —      | —                      | —                    | 106                 | —             | —               | —             | —            | —             | —                        | 192                  |
| 31/7/42  | 28              | 24            | —                       | 2                               | —            | —      | —                      | —                    | 160                 | —             | —               | —             | —            | —             | —                        | 222                  |
| 14/8/42  | 12              | 30            | —                       | —                               | 8            | —      | —                      | —                    | 54                  | —             | —               | —             | —            | —             | —                        | 184                  |
| 28/8/42  | 54              | 76            | —                       | —                               | 88           | —      | —                      | —                    | 96                  | —             | —               | —             | —            | —             | —                        | 226                  |
| 11/9/42  | 8               | 22            | —                       | —                               | 26           | —      | —                      | —                    | 40                  | —             | —               | —             | —            | —             | —                        | 96                   |
| 25/9/42  | 22              | 36            | —                       | —                               | 4            | —      | —                      | —                    | 110                 | —             | —               | —             | —            | —             | —                        | 168                  |
| 9/10/42  | 18              | 36            | —                       | —                               | —            | —      | —                      | —                    | 98                  | —             | —               | —             | —            | —             | —                        | 156                  |
| 23/10/42 | 16              | 16            | —                       | —                               | —            | —      | —                      | —                    | 62                  | —             | —               | —             | —            | —             | —                        | 94                   |
| 6/11/42  | 6               | 14            | —                       | —                               | —            | —      | —                      | —                    | 20                  | —             | —               | —             | —            | —             | —                        | 40                   |

+++ = marked.

++ = fairly marked.

+ = slight.

SPERM PICTURE OF RAMS AND RATE OF SPERM TRAVEL.

TABLE 21.  
*Southdown × Blackhead Persian Ram 62545.*  
*Numbers of Abnormal Spermatozoa of Different Types per Thousand.*

| Date.         | Tailless Sperm. | Coiled Tails. | Enlarged Middle Pieces. | Double Middle Pieces and Tails. | Middle Piece Beads. | Filiform Middle Pieces. | Axial Attachments. | Defective Staining. | Narrow Heads. | Pyiform Heads. | Megalo-sperm. | Micro-sperm. | Double Heads. | Variation in Head Sizes. | Abnormals per 1,000. |
|---------------|-----------------|---------------|-------------------------|---------------------------------|---------------------|-------------------------|--------------------|---------------------|---------------|----------------|---------------|--------------|---------------|--------------------------|----------------------|
| 3/10/41.....  | 2               | —             | —                       | —                               | —                   | —                       | —                  | —                   | —             | —              | —             | —            | —             | —                        | 2                    |
| 21/10/41..... | 10              | 12            | —                       | —                               | —                   | —                       | —                  | —                   | —             | —              | —             | —            | —             | —                        | 22                   |
| 4/11/41.....  | —               | 2             | —                       | —                               | —                   | —                       | —                  | 4                   | —             | —              | —             | —            | —             | —                        | 6                    |
| 18/11/41..... | 4               | —             | 20                      | —                               | —                   | —                       | —                  | —                   | —             | —              | —             | —            | —             | —                        | 24                   |
| 5/12/41.....  | —               | —             | 2                       | —                               | —                   | —                       | —                  | 2                   | —             | —              | —             | —            | —             | —                        | 4                    |
| 23/12/41..... | 14              | 8             | 2                       | —                               | —                   | —                       | —                  | —                   | —             | —              | —             | 2            | —             | —                        | 26                   |
| 9/1/42.....   | 4               | 2             | —                       | —                               | —                   | —                       | —                  | —                   | —             | —              | —             | —            | —             | —                        | 6                    |
| 23/1/42.....  | 4               | 8             | —                       | —                               | —                   | —                       | —                  | —                   | —             | —              | —             | —            | —             | —                        | 12                   |
| 6/2/42.....   | 4               | —             | —                       | —                               | —                   | —                       | —                  | 4                   | —             | —              | 4             | —            | —             | —                        | 12                   |
| 20/2/42.....  | 4               | 6             | —                       | —                               | —                   | —                       | —                  | 8                   | —             | —              | —             | —            | —             | —                        | 18                   |
| 6/3/42.....   | 4               | 2             | —                       | —                               | —                   | —                       | —                  | 2                   | —             | —              | 2             | —            | —             | —                        | 2                    |
| 20/3/42.....  | —               | 4             | —                       | —                               | —                   | —                       | —                  | —                   | —             | —              | —             | —            | —             | —                        | 4                    |
| 7/4/42.....   | —               | 4             | —                       | 4                               | —                   | —                       | —                  | —                   | —             | —              | 4             | —            | —             | —                        | 16                   |
| 21/4/42.....  | —               | —             | —                       | —                               | —                   | —                       | —                  | 4                   | —             | —              | —             | —            | —             | —                        | 0                    |
| 8/5/42.....   | 4               | 2             | —                       | —                               | —                   | —                       | —                  | 8                   | —             | —              | —             | —            | —             | —                        | 14                   |
| 23/5/42.....  | 2               | 4             | —                       | —                               | —                   | —                       | —                  | 22                  | —             | —              | —             | —            | —             | —                        | 28                   |
| 5/6/42.....   | 8               | 18            | 2                       | 6                               | —                   | —                       | —                  | 20                  | —             | —              | —             | —            | —             | —                        | 54                   |
| 19/6/42.....  | 18              | 6             | —                       | —                               | —                   | —                       | —                  | 34                  | —             | —              | —             | —            | —             | —                        | 58                   |
| 3/7/42.....   | 4               | 4             | —                       | —                               | —                   | —                       | —                  | 40                  | —             | —              | —             | —            | —             | —                        | 48                   |
| 17/7/42.....  | 6               | 6             | —                       | 2                               | —                   | —                       | —                  | 62                  | —             | —              | —             | —            | —             | —                        | 76                   |
| 31/7/42.....  | 8               | 22            | 2                       | 4                               | —                   | —                       | —                  | 10                  | —             | —              | 4             | —            | —             | —                        | 50                   |
| 14/8/42.....  | 4               | 2             | —                       | —                               | —                   | —                       | —                  | 6                   | —             | —              | —             | —            | —             | —                        | 12                   |
| 25/8/42.....  | 4               | 16            | —                       | —                               | —                   | —                       | —                  | 6                   | —             | —              | —             | —            | —             | —                        | 28                   |
| 8/9/42.....   | 4               | —             | —                       | —                               | —                   | —                       | —                  | 8                   | —             | —              | —             | —            | —             | —                        | 28                   |
| 22/9/42.....  | 2               | 10            | —                       | —                               | —                   | —                       | —                  | 4                   | —             | 2              | —             | —            | —             | —                        | 10                   |
| 6/10/42.....  | 4               | 2             | —                       | —                               | —                   | —                       | —                  | 8                   | —             | —              | —             | —            | —             | —                        | 20                   |
| 20/10/42..... | 4               | —             | —                       | —                               | —                   | —                       | —                  | —                   | —             | —              | —             | —            | —             | —                        | 6                    |
| 3/11/42.....  | 4               | 4             | —                       | 2                               | —                   | —                       | —                  | —                   | —             | —              | —             | —            | —             | —                        | 2                    |
|               |                 |               |                         |                                 |                     |                         |                    |                     |               |                |               |              |               |                          | 10                   |

+++ = marked,

++ = fairly marked,

+ = slight.

TABLE 22.  
*Karakul Ram 62544. Numbers of Abnormal Spermatozoa of Different Types per Thousand.*

| Date.    | Tailless Sperm. | Coiled Tails. | Enlarged Middle Pieces. | Double Middle Pieces and Tails. | Middle Piece Beads. | Fill form Middle Pieces. | Abaxial Attachments. | Defective Staining. | Narrow Heads. | Pyiform Heads. | Megalo-sperm. | Micro-sperm. | Double Heads. | Variation in Head Sizes. | Abnormals per 1,000. |
|----------|-----------------|---------------|-------------------------|---------------------------------|---------------------|--------------------------|----------------------|---------------------|---------------|----------------|---------------|--------------|---------------|--------------------------|----------------------|
| 14/11/41 | 4               | 8             | —                       | —                               | —                   | —                        | —                    | —                   | —             | 2              | 2             | 2            | —             | +                        | 18                   |
| 28/11/41 | 6               | 4             | 2                       | —                               | —                   | —                        | —                    | —                   | —             | —              | —             | —            | —             | —                        | 12                   |
| 12/12/41 | —               | 4             | —                       | —                               | —                   | —                        | —                    | 6                   | —             | —              | 6             | 2            | —             | +                        | 18                   |
| 2/1/42   | 2               | —             | —                       | —                               | —                   | —                        | —                    | 2                   | —             | —              | 2             | —            | —             | +                        | 6                    |
| 16/1/42  | —               | —             | —                       | —                               | —                   | —                        | —                    | 8                   | —             | —              | —             | —            | —             | —                        | 6                    |
| 30/1/42  | —               | —             | —                       | —                               | —                   | —                        | —                    | —                   | —             | —              | —             | —            | —             | —                        | 8                    |
| 13/2/42  | 2               | 2             | —                       | —                               | —                   | —                        | —                    | 4                   | —             | —              | —             | —            | —             | —                        | 0                    |
| 27/2/42  | 8               | 6             | —                       | —                               | —                   | —                        | —                    | —                   | —             | —              | —             | —            | —             | —                        | 8                    |
| 13/3/42  | 4               | 32            | —                       | —                               | —                   | —                        | —                    | 6                   | —             | 2              | 8             | —            | —             | +                        | 14                   |
| 27/3/42  | 4               | 14            | —                       | —                               | —                   | —                        | —                    | —                   | —             | —              | —             | —            | —             | +                        | 52                   |
| 14/4/42  | 10              | 14            | —                       | —                               | —                   | —                        | —                    | —                   | —             | —              | —             | —            | —             | +                        | 24                   |
| 28/4/42  | 4               | 26            | —                       | —                               | —                   | —                        | —                    | 2                   | —             | —              | —             | —            | —             | —                        | 12                   |
| 15/5/42  | —               | 64            | —                       | —                               | —                   | —                        | —                    | 8                   | —             | —              | —             | —            | —             | —                        | 38                   |
| 29/5/42  | —               | 54            | —                       | —                               | —                   | —                        | —                    | 4                   | 4             | —              | —             | —            | —             | —                        | 72                   |
| 12/6/42  | 34              | 198           | 2                       | —                               | —                   | —                        | —                    | 4                   | —             | 4              | —             | —            | —             | —                        | 96                   |
| 26/6/42  | 14              | 378           | —                       | —                               | —                   | —                        | —                    | 62                  | —             | 6              | —             | —            | —             | +                        | 306                  |
| 10/7/42  | 10              | 288           | —                       | —                               | —                   | —                        | —                    | 26                  | —             | 2              | —             | —            | —             | —                        | 440                  |
| 24/7/42  | 12              | 446           | —                       | —                               | —                   | —                        | —                    | 6                   | —             | —              | —             | —            | —             | —                        | 328                  |
| 7/8/42   | 6               | 224           | —                       | —                               | —                   | —                        | —                    | 10                  | —             | 6              | —             | 6            | —             | —                        | 612                  |
| 21/8/42  | 10              | 168           | —                       | —                               | —                   | —                        | —                    | 14                  | —             | 6              | —             | —            | —             | —                        | 278                  |
| 4/9/42   | 12              | 122           | 2                       | —                               | —                   | —                        | —                    | 18                  | —             | —              | —             | —            | —             | +                        | 346                  |
| 18/9/42  | 18              | 256           | —                       | —                               | —                   | —                        | —                    | 8                   | —             | 2              | —             | —            | —             | —                        | 272                  |
| 2/10/42  | 6               | 300           | —                       | —                               | —                   | —                        | —                    | 26                  | —             | —              | —             | —            | —             | —                        | 362                  |
| 16/10/42 | 10              | 134           | —                       | —                               | —                   | —                        | —                    | 36                  | —             | 2              | —             | —            | —             | —                        | 190                  |
| 30/10/42 | 4               | 68            | —                       | —                               | —                   | —                        | —                    | 2                   | —             | —              | —             | —            | —             | —                        | 74                   |
| 17/11/42 | 6               | 26            | —                       | —                               | —                   | —                        | —                    | 14                  | —             | —              | —             | —            | —             | —                        | 46                   |

+++ = marked.

++ = fairly marked.

+ = slight.

## SPERM PICTURE OF RAMS AND RATE OF SPERM TRAVEL.

## APPENDIX II.

Tables 23 to 40. Protocols for the individual rams.

TABLE 23.

*Protocol for Merino Ram 45106.*

| Date.         | Vol. of Semen. (c.c.). | Motility Rating. | Conc. (Millions per mm. <sup>3</sup> ). | Total No. Sperm. (Millions). | Abn. per 1,000. | Total Abn. in Ejaculate. (Millions). | Total Normals in Ejaculate. (Millions). |
|---------------|------------------------|------------------|---|------------------------------|-----------------|--------------------------------------|---|
| 7/10/41.....  | 0.9                    | 5                | 1.4                                     | 1,260                        | 2               | 2.5                                  | 1,257.5                                 |
| 14/10/41..... | 0.5                    | 4                | 3.2                                     | 1,600                        | 22              | 35.2                                 | 1,564.8                                 |
| 28/10/41..... | 0.4                    | 5                | 3.3                                     | 1,320                        | 12              | 15.8                                 | 1,304.2                                 |
| 11/11/41..... | 1.6                    | 4                | 3.5                                     | 5,600                        | 4               | 22.4                                 | 5,577.6                                 |
| 28/11/41..... | 1.2                    | 5                | 3.5                                     | 4,200                        | 18              | 75.6                                 | 4,124.4                                 |
| 12/12/41..... | 0.6                    | 5                | 3.5                                     | 2,100                        | 8               | 16.8                                 | 2,083.2                                 |
| 2/ 1/42.....  | 1.0                    | 5                | 2.3                                     | 2,300                        | 2               | 4.6                                  | 2,295.4                                 |
| 16/ 1/42..... | 1.0                    | 5                | 1.9                                     | 1,900                        | 2               | 3.8                                  | 1,896.2                                 |
| 30/ 1/42..... | 0.9                    | 4                | 3.3                                     | 2,970                        | 8               | 23.8                                 | 2,946.2                                 |
| 13/ 2/42..... | 1.1                    | 5                | 3.2                                     | 3,520                        | 12              | 42.2                                 | 3,477.8                                 |
| 27/ 2/42..... | 0.7                    | 1                | 0.01                                    | 70                           | 74              | 5.2                                  | 64.8                                    |
| 13/ 3/42..... | 1.1                    | 5                | 2.7                                     | 2,970                        | 6               | 17.8                                 | 2,952.2                                 |
| 27/ 3/42..... | 0.9                    | 5                | 3.1                                     | 2,790                        | 14              | 39.1                                 | 2,750.9                                 |
| 14/ 4/42..... | 0.6                    | 4                | 2.5                                     | 1,500                        | 6               | 9.0                                  | 1,491.0                                 |
| 28/ 4/42..... | 0.7                    | 4                | 2.5                                     | 1,750                        | 12              | 21.0                                 | 1,729.0                                 |
| 15/ 5/42..... | 0.7                    | 3                | 0.5                                     | 350                          | 24              | 8.4                                  | 341.6                                   |
| 29/ 5/42..... | 0.6                    | 5                | 3.3                                     | 1,980                        | 24              | 47.5                                 | 1,932.5                                 |
| 12/ 6/42..... | 0.8                    | 1                | 0.08                                    | 64                           | 144             | 9.2                                  | 54.8                                    |
| 26/ 6/42..... | 0.6                    | 5                | 4.4                                     | 2,640                        | 20              | 52.8                                 | 2,587.2                                 |
| 10/ 7/42..... | 0.6                    | 5                | 3.2                                     | 1,920                        | 18              | 34.6                                 | 1,885.4                                 |
| 24/ 7/42..... | 0.9                    | 5                | 3.6                                     | 3,240                        | 36              | 116.6                                | 3,123.4                                 |
| 7/ 8/42.....  | 0.8                    | 4                | 1.4                                     | 1,120                        | 46              | 51.5                                 | 1,068.5                                 |
| 21/ 8/42..... | 0.8                    | 4                | 1.1                                     | 880                          | 34              | 29.9                                 | 850.1                                   |
| 4/ 9/42.....  | 0.5                    | 3                | 1.5                                     | 750                          | 92              | 69.0                                 | 681.0                                   |
| 18/ 9/42..... | 0.8                    | 5                | 5.1                                     | 4,080                        | 44              | 179.5                                | 3,900.5                                 |
| 2/10/42.....  | 1.1                    | 4                | 3.4                                     | 3,740                        | 10              | 37.4                                 | 3,702.6                                 |
| 16/10/42..... | 0.6                    | 3                | 0.8                                     | 480                          | 52              | 25.0                                 | 455.0                                   |
| 30/10/42..... | 0.7                    | 3                | 0.6                                     | 420                          | 6               | 2.5                                  | 417.5                                   |
| 17/11/42..... | 0.9                    | 5                | 5.3                                     | 4,770                        | 14              | 66.8                                 | 4,703.2                                 |

TABLE 24.

*Protocol for Merino Ram 45307.*

| Date.         | Vol. of Semen.<br>(c.c.). | Motility Rating. | Conc.<br>(Millions per mm. <sup>3</sup> ). | Total No. Sperm.<br>(Millions). | Abn. per 1,000. | Total Abn. in Ejaculate.<br>(Millions). | Total Normals in Ejaculate.<br>(Millions). |
|---------------|---------------------------|------------------|--|---------------------------------|-----------------|---|--|
| 7/10/41.....  | 0·8                       | 5                | 4·5  | 3,600                           | 16              | 57·6                                    | 3,542·4                                    |
| 17/10/41..... | 0·9                       | 3                | 0·6  | 540                             | 74              | 40·0                                    | 500·0                                      |
| 31/10/41..... | 0·8                       | 5                | 2·0  | 1,600                           | 0               | 0                                       | 1,600·0                                    |
| 14/11/41..... | 0·7                       | 5                | 2·2  | 1,540                           | 2               | 3·8                                     | 1,536·9                                    |
| 2/12/41.....  | 0·6                       | 2                | 0·3  | 180                             | 40              | 7·2                                     | 172·8                                      |
| 19/12/41..... | 0·5                       | 2                | 0·4  | 200                             | 34              | 6·8                                     | 193·2                                      |
| 6/ 1/42.....  | 0·8                       | 3                | 1·1  | 880                             | 12              | 10·6                                    | 869·4                                      |
| 20/ 1/42..... | 1·1                       | 3                | 1·1  | 1,210                           | 8               | 9·7                                     | 1,200·3                                    |
| 3/ 2/42.....  | 1·4                       | 3                | 0·4  | 560                             | 4               | 2·2                                     | 557·8                                      |
| 17/ 2/42..... | 1·4                       | 4                | 0·9  | 1,260                           | 28              | 35·3                                    | 1,224·7                                    |
| 3/ 3/42.....  | 1·1                       | 3                | 0·6  | 660                             | 34              | 22·4                                    | 637·6                                      |
| 17/ 3/42..... | 1·2                       | 1                | 0·05                                       | 60                              | 54              | 3·2                                     | 56·8                                       |
| 31/ 3/42..... | 1·1                       | 4                | 0·6  | 660                             | 30              | 19·8                                    | 640·2                                      |
| 17/ 4/42..... | 0·5                       | 4                | 1·4  | 700                             | 0               | 0                                       | 700·0                                      |
| 5/ 5/42.....  | 0·8                       | 3                | 1·1  | 880                             | 8               | 7·0                                     | 873·0                                      |
| 19/ 5/42..... | 1·0                       | 4                | 1·7  | 1,700                           | 6               | 10·2                                    | 1,689·8                                    |
| 2/ 6/42.....  | 1·2                       | 3                | 1·4  | 1,680                           | 30              | 50·4                                    | 1,629·6                                    |
| 16/ 6/42..... | 0·8                       | 3                | 1·7  | 1,360                           | 28              | 38·1                                    | 1,321·9                                    |
| 30/ 6/42..... | 0·8                       | 2                | 0·8  | 640                             | 106             | 67·8                                    | 572·2                                      |
| 14/ 7/42..... | 1·0                       | 3                | 1·2  | 1,200                           | 34              | 40·8                                    | 1,159·2                                    |
| 28/ 7/42..... | 0·9                       | 3                | 0·7  | 630                             | 38              | 23·9                                    | 606·1                                      |
| 11/ 8/42..... | 1·0                       | 2                | 0·2  | 200                             | 412             | 82·4                                    | 117·6                                      |
| 25/ 8/42..... | 0·8                       | 4                | 1·3  | 1,040                           | 128             | 133·1                                   | 906·9                                      |
| 8/ 9/42.....  | 1·6                       | 3                | 0·9  | 1,440                           | 182             | 259·2                                   | 1,180·8                                    |
| 22/ 9/42..... | 1·0                       | 3                | 0·7  | 700                             | 134             | 93·8                                    | 606·2                                      |
| 6/10/42.....  | 1·1                       | 4                | 0·7  | 770                             | 54              | 41·6                                    | 728·4                                      |
| 20/10/42..... | 0·9                       | 3                | 0·9  | 810                             | 28              | 22·7                                    | 787·3                                      |
| 3/11/42.....  | 1·0                       | 5                | 0·7  | 700                             | 28              | 19·6                                    | 680·4                                      |

## SPERM PICTURE OF RAMS AND RATE OF SPERM TRAVEL.

TABLE 25.

*Protocol for Merino Ram 50549.*

| Date.         | Vol. of Semen.<br>(c.c.). | Motility Rating. | Conc.<br>(Millions per mm. <sup>3</sup> ). | Total No. Sperm.<br>(Millions). | Abn. per 1,000. | Total Abn. in Ejaculate.<br>(Millions). | Total Normals in Ejaculate.<br>(Millions). |
|---------------|---------------------------|------------------|--|---------------------------------|-----------------|---|--|
| 7/10/41.....  | 2.1                       | 5                | 2.3  | 4,830                           | 34              | 164.2                                   | 4,665.8                                    |
| 21/10/41..... | 0.4                       | 4                | 5.6  | 2,240                           | 48              | 107.5                                   | 2,132.5                                    |
| 4/11/41.....  | 0.7                       | 5                | 1.5  | 1,050                           | 26              | 27.3                                    | 1,022.7                                    |
| 18/11/41..... | 0.6                       | 4                | 1.2  | 720                             | 24              | 17.3                                    | 702.7                                      |
| 5/12/41.....  | 1.2                       | 3                | 3.9  | 4,680                           | 86              | 402.5                                   | 4,277.9                                    |
| 23/12/41..... | 0.8                       | 4                | 1.4  | 1,120                           | 44              | 49.3                                    | 1,070.7                                    |
| 9/ 1/42.....  | 0.8                       | 3                | 0.5  | 400                             | 2               | 0.8                                     | 399.2                                      |
| 23/ 1/42..... | 0.9                       | 4                | 1.8  | 1,620                           | 0               | 0                                       | 1,620.0                                    |
| 6/ 2/42.....  | 0.9                       | 5                | 1.3  | 1,170                           | 2               | 2.3                                     | 1,167.7                                    |
| 20/ 2/42..... | 0.6                       | 3                | 0.4  | 240                             | 68              | 16.3                                    | 223.7                                      |
| 6/ 3/42.....  | 0.9                       | 5                | 2.1  | 1,890                           | 20              | 37.8                                    | 1,852.2                                    |
| 20/ 3/42..... | 1.1                       | 4                | 1.7  | 1,870                           | 12              | 22.4                                    | 1,847.6                                    |
| 7/ 4/42.....  | 0.8                       | 5                | 2.2  | 1,760                           | 16              | 28.2                                    | 1,731.8                                    |
| 21/ 4/42..... | 0.6                       | 4                | 0.8  | 480                             | 0               | 0                                       | 480.0                                      |
| 8/ 5/42.....  | 0.8                       | 4                | 1.6  | 1,280                           | 74              | 94.7                                    | 1,185.3                                    |
| 22/ 5/42..... | 0.6                       | 4                | 3.2  | 1,920                           | 26              | 49.9                                    | 1,870.1                                    |
| 5/ 6/42.....  | 0.7                       | 4                | 6.9  | 4,830                           | 108             | 521.6                                   | 4,308.4                                    |
| 19/ 6/42..... | 0.7                       | 4                | 4.0  | 3,200                           | 26              | 83.2                                    | 3,116.8                                    |
| 3/ 7/42.....  | 1.0                       | 4                | 3.1  | 3,100                           | 32              | 99.2                                    | 3,000.8                                    |
| 17/ 7/42..... | 0.7                       | 4                | 2.0  | 1,400                           | 34              | 47.6                                    | 1,352.4                                    |
| 31/ 7/42..... | 0.8                       | 4                | 5.5  | 4,400                           | 146             | 642.4                                   | 3,757.6                                    |
| 14/ 8/42..... | 0.8                       | 4                | 6.4  | 5,080                           | 112             | 569.0                                   | 4,511.0                                    |
| 28/ 8/42..... | 0.9                       | 4                | 5.9  | 5,310                           | 86              | 456.7                                   | 4,853.3                                    |
| 11/ 9/42..... | 0.6                       | 1                | 0.03                                       | 18                              | 140             | 2.5                                     | 15.5                                       |
| 25/ 9/42..... | 0.8                       | 3                | 1.6  | 1,280                           | 68              | 87.0                                    | 1,193.0                                    |
| 9/10/42.....  | 0.9                       | 1                | 0.01                                       | 9                               | 86              | 0.8                                     | 8.2  |
| 23/10/42..... | 1.0                       | 1                | 0.04                                       | 40                              | 42              | 1.7                                     | 38.3                                       |
| 6/11/42.....  | 0.6                       | 1                | 0.08                                       | 48                              | 64              | 3.1                                     | 44.9                                       |

TABLE 26.  
*Protocol for Merino Ram 50735.*

| Date.         | Vol of Semen (c.c.). | Motility Rating | Conc. (Millions per mm <sup>3</sup> ). | Total No. Sperm (Millions). | Abn. per 1,000. | Total Abn. in Ejaculate. (Millions). | Total Normals in Ejaculate. (Millions). |
|---------------|----------------------|-----------------|--|-----------------------------|-----------------|--------------------------------------|---|
| 7/10/41.....  | 1.7                  | 4               | 3.0                                    | 5,100                       | 32              | 163.2                                | 4,936.8                                 |
| 10/10/41..... | 1.4                  | 4               | 1.3                                    | 1,820                       | 12              | 21.8                                 | 1,798.2                                 |
| 24/10/41..... | 1.3                  | 5               | 2.6                                    | 3,380                       | 14              | 47.3                                 | 3,332.7                                 |
| 7/11/41.....  | 1.6                  | 5               | 3.3                                    | 5,080                       | 24              | 121.9                                | 4,958.1                                 |
| 25/11/41..... | 1.1                  | 4               | 3.8                                    | 4,180                       | 28              | 117.2                                | 4,062.8                                 |
| 9/12/41.....  | 2.0                  | 4               | 2.2                                    | 4,400                       | 34              | 149.6                                | 4,250.4                                 |
| 30/12/41..... | 1.8                  | 4               | 0.3                                    | 540                         | 16              | 8.6                                  | 531.4                                   |
| 13/ 1/42..... | 1.0                  | 2               | 0.2                                    | 200                         | 200             | 40.0                                 | 160.0                                   |
| 27/ 1/42..... | 1.0                  | 3               | 0.4                                    | 400                         | 46              | 9.6                                  | 390.4                                   |
| 10/ 2/42..... | 0.9                  | 3               | 0.4                                    | 360                         | 114             | 41.0                                 | 319.0                                   |
| 24/ 2/42..... | 1.0                  | 3               | 0.8                                    | 800                         | 56              | 44.8                                 | 755.2                                   |
| 10/ 3/42..... | 0.9                  | 3               | 0.9                                    | 810                         | 8               | 6.5                                  | 803.5                                   |
| 24/ 3/42..... | 1.4                  | 5               | 2.7                                    | 3,780                       | 24              | 90.7                                 | 3,689.3                                 |
| 10/ 4/42..... | 1.1                  | 2               | 0.2                                    | 220                         | 88              | 19.4                                 | 200.6                                   |
| 24/ 4/42..... | 0.9                  | 2               | 0.7                                    | 630                         | 52              | 32.8                                 | 597.2                                   |
| 12/ 5/42..... | 0.8                  | 3               | 0.9                                    | 720                         | 36              | 25.9                                 | 694.1                                   |
| 26/ 5/42..... | 1.0                  | 4               | 1.8                                    | 1,800                       | 14              | 25.2                                 | 1,774.8                                 |
| 9/ 6/42.....  | 1.0                  | 5               | 4.6                                    | 4,600                       | 14              | 64.4                                 | 4,535.6                                 |
| 23/ 6/42..... | 1.1                  | 3               | 0.6                                    | 660                         | 50              | 33.0                                 | 627.0                                   |
| 7/ 7/42.....  | 0.8                  | 5               | 3.6                                    | 2,880                       | 14              | 40.3                                 | 2,839.7                                 |
| 21/ 7/42..... | 1.5                  | 4               | 6.4                                    | 9,600                       | 34              | 326.4                                | 9,273.6                                 |
| 4/ 8/42.....  | 0.9                  | 4               | 1.4                                    | 1,260                       | 32              | 40.3                                 | 1,219.7                                 |
| 18/ 8/42..... | 0.7                  | 3               | 1.6                                    | 1,120                       | 30              | 33.6                                 | 1,086.4                                 |
| 1/ 9/42.....  | 1.3                  | 5               | 4.1                                    | 5,330                       | 34              | 181.2                                | 5,148.8                                 |
| 15/ 9/42..... | 0.7                  | 2               | 0.6                                    | 420                         | 114             | 47.9                                 | 372.1                                   |
| 29/ 9/42..... | 1.0                  | 5               | 3.3                                    | 3,300                       | 36              | 118.8                                | 3,181.2                                 |
| 13/10/42..... | 0.7                  | 5               | 3.0                                    | 2,100                       | 14              | 29.4                                 | 2,070.6                                 |
| 27/10/42..... | 0.7                  | 3               | 0.7                                    | 490                         | 26              | 12.7                                 | 477.3                                   |
| 10/11/42..... | 1.0                  | 3               | 0.4                                    | 400                         | 56              | 22.4                                 | 377.6                                   |



## SPERM PICTURE OF RAMS AND RATE OF SPERM TRAVEL.

TABLE 27.  
*Protocol for Romney Marsh Ram 56939.*

| Date.         | Vol. of Semen. (c.c.). | Motility. Rating. | Conc. (Millions per mm. <sup>3</sup> ). | Total No. Sperm. (Millions). | Abn. per 1,000. | Total Abn. in Ejaculate. (Millions). | Total Normals in Ejaculate. (Millions). |
|---------------|------------------------|-------------------|---|------------------------------|-----------------|--------------------------------------|---|
| 14/10/41..... | 0.4                    | 1                 | 0.3                                     | 120                          | 424             | 50.9                                 | 69.1                                    |
| 28/10/41..... | 0.6                    | 1                 | 0.5                                     | 300                          | 212             | 63.6                                 | 236.4                                   |
| 11/11/41..... | 0.7                    | 1                 | 0.7                                     | 490                          | 216             | 105.8                                | 384.2                                   |
| 28/11/41..... | 0.5                    | 2                 | 2.1                                     | 1,050                        | 106             | 111.3                                | 938.7                                   |
| 12/12/41..... | 0.6                    | 2                 | 1.2                                     | 720                          | 400             | 288.0                                | 432.0                                   |
| 2/1/42.....   | 1.3                    | 1                 | 0.05                                    | 65                           | 702             | 45.8                                 | 19.2                                    |
| 16/1/42.....  | 0.9                    | 2                 | 1.2                                     | 1,080                        | 486             | 527.0                                | 553.0                                   |
| 30/1/42.....  | 1.0                    | 1                 | 0.07                                    | 70                           | 276             | 19.3                                 | 50.7                                    |
| 13/2/42.....  | 0.7                    | 2                 | 0.2                                     | 140                          | 160             | 22.4                                 | 117.6                                   |
| 27/2/42.....  | 0.7                    | 3                 | 0.6                                     | 420                          | 128             | 53.8                                 | 366.2                                   |
| 13/3/42.....  | 1.0                    | 1                 | 0.02                                    | 20                           | 392             | 7.8                                  | 12.2                                    |
| 27/3/42.....  | 1.1                    | 4                 | 2.5                                     | 2,750                        | 34              | 93.5                                 | 2,656.5                                 |
| 14/4/42.....  | 0.7                    | 1                 | 0.9                                     | 630                          | 98              | 61.7                                 | 568.3                                   |
| 28/4/42.....  | 0.9                    | 2                 | 1.3                                     | 1,170                        | 80              | 93.6                                 | 1,076.4                                 |
| 15/5/42.....  | 0.9                    | 3                 | 2.5                                     | 2,250                        | 56              | 126.0                                | 2,124.0                                 |
| 29/5/42.....  | 0.9                    | 3                 | 4.9                                     | 4,410                        | 94              | 414.5                                | 3,995.5                                 |
| 12/6/42.....  | 1.1                    | 2                 | 3.3                                     | 3,630                        | 570             | 2,069.1                              | 1,560.9                                 |
| 26/6/42.....  | 0.5                    | 1                 | 0.07                                    | 35                           | 606             | 21.2                                 | 13.8                                    |
| 10/7/42.....  | 0.8                    | 1                 | 0.8                                     | 640                          | 378             | 241.9                                | 398.1                                   |
| 24/7/42.....  | 0.6                    | 0                 | 0.05                                    | 30                           | 892             | 25.8                                 | 3.2                                     |
| 7/8/42.....   | 0.2                    | 0                 | No count made.                          | —                            | 900             | —                                    | —                                       |
| 21/8/42.....  | 0.3                    | 0                 | 0.2                                     | 60                           | —               | —                                    | —                                       |

Ram died on 22/8/42.

TABLE 28.  
*Protocol for Romney Marsh Ram 56947.*

|               |     |   |     |       |     |         |         |
|---------------|-----|---|-----|-------|-----|---------|---------|
| 17/10/41..... | 1.1 | 4 | 1.0 | 1,100 | 16  | 17.6    | 1,082.4 |
| 31/10/41..... | 1.1 | 5 | 1.9 | 2,090 | 20  | 41.8    | 2,048.2 |
| 14/11/41..... | 1.5 | 4 | 1.7 | 2,550 | 10  | 25.5    | 2,524.5 |
| 2/12/41.....  | 1.8 | 4 | 2.8 | 5,040 | 154 | 776.2   | 4,263.8 |
| 19/12/41..... | 1.4 | 2 | 2.6 | 3,640 | 128 | 465.9   | 3,174.1 |
| 6/1/42.....   | 0.9 | 2 | 0.5 | 450   | 278 | 125.1   | 324.9   |
| 20/1/42.....  | 0.8 | 4 | 0.8 | 640   | 122 | 70.1    | 569.9   |
| 3/2/42.....   | 1.1 | 2 | 0.3 | 330   | 26  | 8.6     | 321.4   |
| 17/2/42.....  | 1.7 | 3 | 1.0 | 1,700 | 32  | 54.4    | 1,645.6 |
| 3/3/42.....   | 1.4 | 4 | 1.2 | 1,680 | 12  | 20.2    | 1,659.8 |
| 17/3/42.....  | 1.2 | 1 | 0.2 | 240   | 52  | 12.5    | 227.5   |
| 31/3/42.....  | 1.4 | 4 | 1.7 | 2,380 | 12  | 28.6    | 2,351.4 |
| 17/4/42.....  | 1.0 | 3 | 1.8 | 1,800 | 70  | 126.0   | 1,674.0 |
| 5/5/42.....   | 1.0 | 3 | 1.5 | 1,500 | 78  | 117.0   | 1,383.0 |
| 19/5/42.....  | 1.1 | 3 | 3.3 | 3,630 | 36  | 130.7   | 3,499.3 |
| 2/6/42.....   | 1.5 | 4 | 3.4 | 5,000 | 150 | 750.0   | 4,250.0 |
| 16/6/42.....  | 1.2 | 2 | 0.7 | 840   | 250 | 210.0   | 630.0   |
| 30/6/42.....  | 1.4 | 3 | 3.5 | 4,900 | 444 | 2,175.6 | 2,724.4 |
| 14/7/42.....  | 1.0 | 1 | 1.7 | 1,700 | 450 | 765.0   | 935.0   |
| 28/7/42.....  | 0.8 | 1 | 0.3 | 240   | 744 | 178.6   | 61.4    |
| 11/8/42.....  | 1.3 | 3 | 2.7 | 3,570 | 284 | 1,013.9 | 2,556.1 |
| 25/8/42.....  | 0.7 | 3 | 1.1 | 770   | 374 | 288.0   | 482.0   |
| 8/9/42.....   | 1.6 | 5 | 4.3 | 6,880 | 90  | 619.2   | 6,260.8 |
| 22/9/42.....  | 0.8 | 4 | 2.3 | 1,840 | 76  | 139.8   | 1,700.2 |
| 6/10/42.....  | 0.9 | 4 | 3.6 | 3,240 | 60  | 194.4   | 3,045.6 |
| 20/10/42..... | 0.8 | 2 | 0.6 | 480   | 504 | 241.9   | 238.1   |
| 3/11/42.....  | 1.2 | 2 | 0.4 | 480   | 414 | 189.7   | 281.3   |

TABLE 29.

*Protocol for Blackhead Persian Ram 62030.*

| Date.         | Vol. of Semen.<br>(c.c.). | Motility Rating. | Conc.<br>(Millions per mm. <sup>3</sup> ). | Total No. Sperm.<br>(Millions). | Abn. per 1,000. | Total Abn. in Ejaculate.<br>(Millions). | Total Normals in Ejaculate.<br>(Millions). |
|---------------|---------------------------|------------------|--|---------------------------------|-----------------|---|--|
| 14/10/41..... | 1.0                       | 5                | 4.6  | 4,600                           | 8               | 36.8                                    | 4,563.2                                    |
| 24/10/41..... | 0.8                       | 5                | 4.1  | 3,280                           | 6               | 19.7                                    | 3,260.3                                    |
| 7/11/41.....  | 1.0                       | 4                | 1.2  | 1,200                           | 64              | 76.8                                    | 1,123.2                                    |
| 25/11/41..... | 1.0                       | 3                | 4.8  | 4,800                           | 92              | 44.2                                    | 4,755.8                                    |
| 9/12/41.....  | 1.1                       | 5                | 3.3  | 3,630                           | 16              | 58.1                                    | 3,571.9                                    |
| 30/12/41..... | 0.5                       | 5                | 1.5  | 750                             | 12              | 9.0                                     | 741.0                                      |
| 13/ 1/41..... | 0.8                       | 5                | 2.1  | 1,680                           | 2               | 3.4                                     | 1,676.6                                    |
| 27/ 1/42..... | 1.4                       | 5                | 4.1  | 5,740                           | 14              | 80.4                                    | 5,659.6                                    |
| 10/ 2/42..... | 1.0                       | 5                | 0.7  | 700                             | 18              | 12.6                                    | 687.4                                      |
| 24/ 2/42..... | 0.5                       | 5                | 2.8  | 1,400                           | 12              | 16.8                                    | 1,383.2                                    |
| 10/ 3/42..... | 0.8                       | 4                | 0.9  | 720                             | 2               | 1.4                                     | 718.6                                      |
| 24/ 3/42..... | 1.1                       | 5                | 5.5  | 6,050                           | 8               | 48.4                                    | 6,001.6                                    |
| 10/ 4/42..... | 0.7                       | 5                | 4.2  | 2,940                           | 22              | 64.7                                    | 2,875.3                                    |
| 24/ 4/42..... | 0.7                       | 5                | 2.1  | 1,470                           | 24              | 35.3                                    | 1,434.7                                    |
| 12/ 5/42..... | 0.9                       | 4                | 2.5  | 2,250                           | 22              | 49.5                                    | 2,200.5                                    |
| 26/ 5/42..... | 0.7                       | 5                | 3.8  | 2,660                           | 42              | 111.7                                   | 2,548.3                                    |
| 9/ 6/42.....  | 0.5                       | 4                | 4.0  | 2,000                           | 10              | 20.0                                    | 1,980.0                                    |
| 23/ 6/42..... | 0.6                       | 5                | 5.0  | 3,000                           | 12              | 36.0                                    | 2,988.0                                    |
| 7/ 7/42.....  | 1.3                       | 4                | 4.6  | 2,980                           | 12              | 35.8                                    | 2,944.2                                    |
| 21/ 7/42..... | 0.7                       | 4                | 3.8  | 2,660                           | 34              | 90.4                                    | 2,569.6                                    |
| 4/ 8/42.....  | 0.8                       | 3                | 4.2  | 3,360                           | 34              | 114.2                                   | 3,245.8                                    |
| 18/ 8/42..... | 0.8                       | 5                | 5.3  | 4,240                           | 16              | 67.8                                    | 4,172.2                                    |
| 1/ 9/42.....  | 1.0                       | 5                | 5.1  | 5,100                           | 14              | 71.4                                    | 5,028.6                                    |
| 15/ 9/42..... | 0.9                       | 5                | 5.5  | 4,950                           | 4               | 19.8                                    | 4,930.2                                    |
| 29/ 9/42..... | 0.8                       | 5                | 2.1  | 1,680                           | 10              | 16.8                                    | 1,663.2                                    |
| 13/10/42..... | 0.8                       | 4                | 1.8  | 1,440                           | 12              | 17.3                                    | 1,422.7                                    |
| 27/10/42..... | 0.8                       | 5                | 2.7  | 2,160                           | 16              | 34.6                                    | 2,125.4                                    |
| 10/11/42..... | 0.6                       | 5                | 2.3  | 1,380                           | 4               | 5.5                                     | 1,374.5                                    |

## SPERM PICTURE OF RAMS AND RATE OF SPERM TRAVEL.

TABLE 30.  
*Protocol for Dorset Horn Ram 56956.*

| Date.         | Vol. of Semen. (c.c.). | Motility Rating. | Conc. (Millions per mm. <sup>3</sup> ). | Total No. Sperm. (Millions).    | Abn. per 1,000. | Total Abn. in Ejaculate. (Millions). | Total Normals in Ejaculate. (Millions). |
|---------------|------------------------|------------------|---|---------------------------------|-----------------|--------------------------------------|---|
| 14/10/41..... | 1.5                    | 4                | 1.5                                     | 2,250                           | 28              | 63.0                                 | 2,187.0                                 |
| 28/10/41..... | 1.2                    | 3                | 0.6                                     | 720                             | 12              | 8.6                                  | 711.4                                   |
| 11/11/41..... | 0.7                    | 4                | 1.0                                     | 700                             | 24              | 16.8                                 | 683.2                                   |
| 28/11/41..... | 0.9                    | 3                | 1.0                                     | 855                             | 58              | 47.6                                 | 807.4                                   |
| 12/12/41..... | 1.1                    | 3                | 0.8                                     | 880                             | 42              | 32.0                                 | 848.0                                   |
| 2/ 1/42.....  | 2.2                    | 2                | 0.5                                     | 1,100                           | 606             | 666.6                                | 493.4                                   |
| 16/ 1/42..... | 1.1                    | 1                | 2.1                                     | 2,310                           | 548             | 1,265.9                              | 1,044.1                                 |
| 30/ 1/42..... | 1.7                    | 3                | 2.4                                     | 4,080                           | 56              | 228.0                                | 3,852.0                                 |
| 13/ 2/42..... | 1.1                    | 4                | 3.1                                     | 3,410                           | 204             | 695.6                                | 2,714.4                                 |
| 27/ 2/42..... | 1.3                    | 3                | 0.5                                     | 650                             | 114             | 74.1                                 | 575.9                                   |
| 13/ 3/42..... | 1.0                    | 2                | 0.5                                     | 500                             | 66              | 33.0                                 | 467.0                                   |
| 27/ 3/42..... | 1.4                    | 0                | 2.2                                     | 3,080                           | 802             | 2,486.2                              | 593.8                                   |
| 14/ 4/42..... | 0.3                    | 0                | Occasional sperm ; ram appeared         | Occasional sperm ; ram appeared | to be sick.     | 0                                    | 0                                       |
| 28/ 4/42..... | —                      | 0                | Occasional sperm ; ram appeared         | Occasional sperm ; ram appeared | to be sick.     | 0                                    | 0                                       |
| 15/ 5/42..... | 1.0                    | 2                | 0.3                                     | 300                             | 342             | 102.6                                | 197.4                                   |
| 29/ 5/42..... | 1.0                    | 3                | 1.4                                     | 140                             | 134             | 18.8                                 | 121.2                                   |
| 12/ 6/42..... | 1.2                    | 3                | 2.1                                     | 2,520                           | 88              | 221.7                                | 2,298.3                                 |
| 26/ 6/42..... | 0.9                    | 2                | 1.6                                     | 1,440                           | 174             | 250.6                                | 1,189.4                                 |
| 10/ 7/42..... | 0.5                    | 1                | 0.2                                     | 100                             | 440             | 44.0                                 | 396.0                                   |
| 24/ 7/42..... | 2.3                    | 3                | 1.3                                     | 2,990                           | 160             | 478.4                                | 2,511.6                                 |
| 7/ 8/42.....  | 1.5                    | 4                | 3.6                                     | 5,400                           | 114             | 615.6                                | 4,784.4                                 |
| 21/ 8/42..... | 1.3                    | 4                | 2.8                                     | 3,640                           | 84              | 305.8                                | 33,34.2                                 |
| 4/ 9/42.....  | 2.0                    | 4                | 4.4                                     | 8,800                           | 106             | 932.8                                | 7,867.2                                 |
| 18/ 9/42..... | 1.7                    | 3                | 4.8                                     | 8,180                           | 364             | 2,977.5                              | 5,202.5                                 |
| 2/10/42.....  | 0.9                    | 1                | 1.9                                     | 1,710                           | 474             | 810.5                                | 899.5                                   |
| 16/10/42..... | 1.1                    | 2                | 0.8                                     | 880                             | 706             | 621.3                                | 258.7                                   |
| 30/10/42..... | 0.7                    | 2                | 0.3                                     | 210                             | 164             | 34.4                                 | 175.6                                   |
| 17/11/42..... | 1.0                    | 2                | 0.9                                     | 900                             | 352             | 316.8                                | 583.2                                   |

TABLE 31.  
*Protocol for Dorset Horn Ram 62548.*

|               |     |   |      |       |     |       |         |
|---------------|-----|---|------|-------|-----|-------|---------|
| 17/10/41..... | 1.0 | 4 | 0.7  | 700   | 22  | 15.4  | 684.6   |
| 31/10/41..... | 1.1 | 4 | 1.0  | 1,067 | 2   | 2.1   | 1,064.9 |
| 14/11/41..... | 0.6 | 3 | 0.9  | 540   | 16  | 8.6   | 531.4   |
| 2/12/41.....  | 1.0 | 4 | 1.4  | 1,400 | 10  | 14.0  | 1,386.0 |
| 19/12/41..... | 0.9 | 4 | 0.9  | 810   | 4   | 3.2   | 806.8   |
| 6/ 1/42.....  | 1.7 | 2 | 0.6  | 1,020 | 32  | 32.6  | 987.4   |
| 20/ 1/42..... | 1.2 | 1 | 0.2  | 240   | 24  | 5.8   | 234.2   |
| 3/ 2/42.....  | 1.4 | 2 | 0.2  | 280   | 10  | 2.8   | 277.2   |
| 17/ 2/42..... | 1.3 | 2 | 0.3  | 390   | 8   | 3.1   | 386.9   |
| 3/ 3/42.....  | 1.4 | 3 | 0.3  | 420   | 22  | 9.2   | 410.8   |
| 17/ 3/42..... | 0.8 | 1 | 0.03 | 24    | 40  | 1.0   | 23.0    |
| 31/ 3/42..... | 0.8 | 4 | 1.5  | 1,200 | 2   | 2.4   | 1,197.2 |
| 17/ 4/42..... | 0.7 | 1 | 0.2  | 140   | 20  | 2.8   | 137.2   |
| 5/ 5/42.....  | 0.9 | 4 | 2.4  | 2,160 | 10  | 21.6  | 2,138.4 |
| 19/ 5/42..... | 1.0 | 3 | 1.1  | 1,100 | 52  | 57.2  | 1,042.8 |
| 2/ 6/42.....  | 1.1 | 3 | 0.8  | 880   | 352 | 309.8 | 570.2   |

Ram died.

TABLE 32.

*Protocol for Ronderib Afrikaner Ram 62418.*

| Date.         | Vol. of Semen.<br>(c c.). | Motility Rating. | Conc.<br>(Millions per mm. <sup>3</sup> ). | Total No. Sperm.<br>(Millions). | Abn. per 1,000. | Total Abn. in Ejaculate.<br>(Millions). | Total Normals in Ejaculate<br>(Millions). |
|---------------|---------------------------|------------------|--|---------------------------------|-----------------|---|---|
| 21/10/41..... | 0·4                       | 4                | 5·5  | 2,200                           | 44              | 96·8                                    | 2,103·2                                   |
| 4/11/41.....  | 0·5                       | 3                | 3·3  | 1,650                           | 108             | 178·2                                   | 1,471·8                                   |
| 18/11/41..... | 0·8                       | 4                | 3·0  | 2,400                           | 60              | 144·0                                   | 2,256·0                                   |
| 5/12/41.....  | 1·5                       | 3                | 5·8  | 8,700                           | 62              | 539·4                                   | 8,163·6                                   |
| 23/12/41..... | 1·3                       | 4                | 2·1  | 2,730                           | 40              | 99·2                                    | 2,630·8                                   |
| 9/ 1/42.....  | 0·4                       | 2                | 0·2  | 80                              | 30              | 2·4                                     | 77·6                                      |
| 23/ 1/42..... | 0·8                       | 5                | 2·0  | 1,600                           | 8               | 12·8                                    | 1,587·2                                   |
| 6/ 2/42.....  | 1·0                       | 4                | 0·4  | 400                             | 62              | 24·8                                    | 375·2                                     |
| 20/ 2/42..... | 1·5                       | 5                | 1·3  | 1,950                           | 20              | 39·0                                    | 1,911·0                                   |
| 6/ 3/42.....  | 1·4                       | 5                | 3·7  | 5,180                           | 26              | 134·7                                   | 5,045·3                                   |
| 20/ 3/42..... | 1·1                       | 4                | 1·2  | 1,320                           | 32              | 42·2                                    | 1,277·8                                   |
| 7/ 4/42.....  | 1·0                       | 5                | 2·6  | 2,600                           | 16              | 41·6                                    | 2,558·4                                   |
| 21/ 4/42..... | 0·6                       | 5                | 3·3  | 1,980                           | 2               | 4·0                                     | 1,976·0                                   |
| 8/ 5/42.....  | 1·6                       | 4                | 3·2  | 5,120                           | 26              | 133·1                                   | 4,986·9                                   |
| 22/ 5/42..... | 0·9                       | 3                | 1·7  | 1,530                           | 84              | 128·5                                   | 1,401·5                                   |
| 5/ 6/42.....  | 1·2                       | 2                | 3·3  | 3,960                           | 78              | 308·9                                   | 3,651·1                                   |
| 19/ 6/42..... | 0·8                       | 2                | 1·6  | 1,280                           | 64              | 81·9                                    | 1,198·1                                   |
| 3/ 7/42.....  | 0·7                       | 3                | 4·0  | 2,800                           | 126             | 352·8                                   | 2,447·2                                   |
| 17/ 7/42..... | 0·9                       | 4                | 4·1  | 3,690                           | 46              | 169·7                                   | 3,520·3                                   |
| 31/ 7/42..... | 0·8                       | 3                | 1·1  | 880                             | 88              | 77·4                                    | 802·6                                     |
| 14/ 8/42..... | 0·8                       | 3                | 1·4  | 1,120                           | 112             | 125·4                                   | 994·6                                     |
| 28/ 8/42..... | 0·9                       | 4                | 3·9  | 3,510                           | 188             | 659·9                                   | 2,850·1                                   |
| 11/ 9/42..... | 1·0                       | 4                | 3·9  | 3,900                           | 108             | 421·2                                   | 3,478·8                                   |
| 25/ 9/42..... | 0·8                       | 3                | 3·2  | 2,560                           | 92              | 235·5                                   | 2,324·5                                   |
| 9/10/42.....  | 0·8                       | 5                | 6·7  | 5,360                           | 76              | 407·4                                   | 4,952·6                                   |
| 23/10/42..... | 0·7                       | 5                | 3·2  | 2,240                           | 24              | 53·8                                    | 2,186·2                                   |
| 6/11/42.....  | 0·8                       | 5                | 2·1  | 1,680                           | 38              | 63·8                                    | 1,616·2                                   |

## SPERM PICTURE OF RAMS AND RATE OF SPERM TRAVEL.

TABLE 33.

*Protocol for Ronderib Afrikaner Ram 62546.*

| Date.         | Vol. of Semen. (c.c.). | Motility Rating. | Conc. (Millions per mm. <sup>3</sup> ). | Total No. Sperm. (Millions). | Abn. per 1,000. | Total Abn. in Ejaculate. (Millions). | Total Normals in Ejaculate. (Millions). |
|---------------|------------------------|------------------|---|------------------------------|-----------------|--------------------------------------|---|
| 17/10/41..... | 1.5                    | 5                | 3.6                                     | 5,400                        | 8               | 43.2                                 | 5,356.8                                 |
| 31/10/41..... | 1.6                    | 4                | 4.5                                     | 7,200                        | 12              | 100.8                                | 7,099.2                                 |
| 14/11/41..... | 0.7                    | 5                | 2.0                                     | 1,400                        | 2               | 2.8                                  | 1,397.2                                 |
| 2/12/41.....  | 2.2                    | 5                | 4.5                                     | 9,900                        | 18              | 128.2                                | 9,771.8                                 |
| 19/12/41..... | 1.4                    | 5                | 5.0                                     | 7,000                        | 12              | 84.0                                 | 6,916.0                                 |
| 6/1/42.....   | 1.0                    | 4                | 5.9                                     | 5,900                        | 10              | 59.0                                 | 5,841.0                                 |
| 20/1/42.....  | 1.0                    | 5                | 0.8                                     | 800                          | 8               | 6.4                                  | 793.6                                   |
| 3/2/42.....   | 1.2                    | 5                | 1.5                                     | 1,800                        | 14              | 25.2                                 | 1,774.8                                 |
| 17/2/42.....  | 1.2                    | 5                | 2.2                                     | 2,640                        | 0               | 0                                    | 2,640.0                                 |
| 3/3/42.....   | 1.6                    | 5                | 3.7                                     | 5,920                        | 2               | 11.8                                 | 5,908.2                                 |
| 17/3/42.....  | 0.9                    | 4                | 2.0                                     | 1,800                        | 276             | 496.8                                | 1,303.2                                 |
| 31/3/42.....  | 1.0                    | 4                | 2.4                                     | 2,400                        | 12              | 28.8                                 | 2,371.2                                 |
| 17/4/42.....  | 1.3                    | 5                | 2.0                                     | 2,600                        | 4               | 10.4                                 | 2,589.6                                 |
| 5/5/42.....   | 0.8                    | 4                | 1.7                                     | 1,260                        | 2               | 2.5                                  | 1,257.5                                 |
| 19/5/42.....  | 0.9                    | 3                | 1.1                                     | 990                          | 10              | 9.9                                  | 980.1                                   |
| 2/6/42.....   | 0.8                    | 5                | 2.4                                     | 1,920                        | 4               | 7.7                                  | 1,912.3                                 |
| 16/6/42.....  | 0.8                    | 4                | 1.9                                     | 1,520                        | 18              | 27.4                                 | 1,492.6                                 |
| 30/6/42.....  | 1.2                    | 2                | 2.2                                     | 2,640                        | 64              | 169.0                                | 2,471.0                                 |
| 14/7/42.....  | 1.5                    | 2                | 4.3                                     | 6,450                        | 178             | 1,148.1                              | 5,301.9                                 |
| 28/7/42.....  | 0.7                    | 3                | 2.4                                     | 1,680                        | 66              | 110.9                                | 1,569.1                                 |
| 11/8/42.....  | 0.9                    | 3                | 2.1                                     | 1,890                        | 240             | 453.6                                | 1,226.4                                 |
| 25/8/42.....  | 1.2                    | 4                | 2.9                                     | 3,480                        | 170             | 591.6                                | 2,888.4                                 |
| 8/9/42.....   | 1.0                    | 5                | 3.3                                     | 3,300                        | 10              | 33.0                                 | 3,267.0                                 |
| 22/9/42.....  | 0.9                    | 5                | 2.5                                     | 2,250                        | 8               | 17.0                                 | 2,233.0                                 |
| 6/10/42.....  | 1.2                    | 4                | 4.4                                     | 5,280                        | 38              | 200.6                                | 5,079.4                                 |
| 20/10/42..... | 0.6                    | 5                | 3.5                                     | 2,100                        | 18              | 37.3                                 | 2,062.2                                 |
| 3/11/42.....  | 0.8                    | 5                | 1.8                                     | 1,440                        | 40              | 57.6                                 | 1,382.4                                 |

TABLE 34.

*Protocol for Ronderib Afrikaner Ram 62419.*

| Date.         | Vol. of Semen.<br>(c.c.). | Motility Rating. | Conc.<br>(Millions per mm. <sup>3</sup> ). | Total No. Sperm.<br>(Millions). | Abn. per 1,000. | Total Abn. in Ejaculate.<br>(Millions). | Total Normals in Ejaculate.<br>(Millions). |
|---------------|---------------------------|------------------|--|---------------------------------|-----------------|---|--|
| 14/10/41..... | 0.9                       | 5                | 4.9  | 4,410                           | 26              | 114.7                                   | 4,285.3                                    |
| 28/10/41..... | 1.6                       | 5                | 2.8  | 4,480                           | 8               | 35.8                                    | 4,444.2                                    |
| 11/11/41..... | 1.0                       | 5                | 4.3  | 4,300                           | 28              | 120.4                                   | 4,179.6                                    |
| 28/11/41..... | 0.9                       | 4                | 1.5  | 1,350                           | 18              | 24.3                                    | 1,325.7                                    |
| 12/12/41..... | 0.6                       | 5                | 2.8  | 1,680                           | 6               | 10.1                                    | 1,669.9                                    |
| 2/1/42.....   | 1.6                       | 5                | 2.6  | 4,160                           | 8               | 33.3                                    | 4,126.7                                    |
| 16/1/42.....  | 0.8                       | 4                | 2.8  | 2,240                           | 26              | 58.2                                    | 2,181.3                                    |
| 30/1/42.....  | 1.5                       | 5                | 3.3  | 4,950                           | 18              | 89.1                                    | 4,860.9                                    |
| 13/2/42.....  | 1.2                       | 5                | 3.2  | 3,840                           | 8               | 30.7                                    | 3,809.3                                    |
| 27/2/42.....  | 1.2                       | 4                | 1.3  | 1,560                           | 18              | 28.1                                    | 1,531.9                                    |
| 13/3/42.....  | 0.9                       | 5                | 0.8  | 720                             | 6               | 4.3                                     | 715.7                                      |
| 27/3/42.....  | 0.9                       | 5                | 1.8  | 1,628                           | 4               | 6.5                                     | 1,621.5                                    |
| 14/4/42.....  | 0.7                       | 4                | 1.5  | 1,050                           | 4               | 4.2                                     | 1,045.8                                    |
| 28/4/42.....  | 0.9                       | 4                | 1.6  | 1,440                           | 12              | 17.3                                    | 1,422.7                                    |
| 15/5/42.....  | 1.2                       | 5                | 5.6  | 6,720                           | 36              | 241.9                                   | 6,478.1                                    |
| 29/5/42.....  | 0.9                       | 5                | 1.5  | 1,350                           | 4               | 5.4                                     | 1,344.6                                    |
| 12/6/42.....  | 1.2                       | 2                | 4.4  | 5,280                           | 120             | 633.6                                   | 4,646.4                                    |
| 26/6/42.....  | 1.6                       | 5                | 3.8  | 6,080                           | 58              | 352.6                                   | 5,727.4                                    |
| 10/7/42.....  | 0.7                       | 4                | 2.3  | 1,610                           | 8               | 12.9                                    | 1,597.1                                    |
| 24/7/42.....  | 0.7                       | 2                | 0.7  | 490                             | 180             | 88.2                                    | 401.8                                      |
| 7/8/42.....   | 1.0                       | 5                | 4.6  | 4,600                           | 96              | 441.6                                   | 4,158.4                                    |
| 21/8/42.....  | 2.0                       | 5                | 4.8  | 9,600                           | 58              | 556.8                                   | 9,043.2                                    |
| 4/9/42.....   | 0.8                       | 5                | 2.3  | 1,840                           | 10              | 18.4                                    | 1,821.6                                    |
| 18/9/42.....  | 1.0                       | 5                | 3.3  | 3,300                           | 4               | 13.2                                    | 3,286.8                                    |
| 2/10/42.....  | 0.8                       | 3                | 2.2  | 1,760                           | 48              | 84.5                                    | 1,675.5                                    |
| 17/10/42..... | 0.7                       | 5                | 2.9  | 2,030                           | 30              | 60.9                                    | 969.1                                      |
| 30/10/42..... | 1.2                       | 3                | 1.7  | 2,040                           | 20              | 40.8                                    | 1,999.2                                    |
| 17/11/42..... | 1.2                       | 4                | 1.0  | 1,200                           | 48              | 57.6                                    | 1,152.0                                    |

## SPERM PICTURE OF RAMS AND RATE OF SPERM TRAVEL.

TABLE 35.

*Protocol for Ronderib Afrikaner Ram 62549.*

| Date.         | Vol. of Semen.<br>(c.c.). | Motility Rating. | Conc.<br>(Millions per mm. <sup>3</sup> ). | Total No. Sperm.<br>(Millions). | Abn. per 1,000. | Total Abn. in Ejaculate.<br>(Millions). | Total Normals in Ejaculate.<br>(Millions). |
|---------------|---------------------------|------------------|--|---------------------------------|-----------------|---|--|
| 10/10/41..... | 0.7                       | 4                | 4.8  | 3,360                           | 28              | 94.1                                    | 3,265.9                                    |
| 24/10/41..... | 0.8                       | 5                | 5.5  | 4,400                           | 20              | 88.0                                    | 4,312.0                                    |
| 7/11/41.....  | 0.6                       | 3                | 0.6  | 360                             | 50              | 18.0                                    | 342.0                                      |
| 25/11/41..... | 1.1                       | 4                | 3.6  | 3,960                           | 6               | 23.8                                    | 3,936.2                                    |
| 9/12/41.....  | 1.5                       | 1                | 0.7  | 1,050                           | 44              | 46.2                                    | 1,003.8                                    |
| 30/12/41..... | 1.3                       | 4                | 5.4  | 7,020                           | 18              | 126.4                                   | 6,893.6                                    |
| 13/1/42.....  | 0.8                       | 5                | 3.1  | 2,480                           | 12              | 29.8                                    | 2,450.2                                    |
| 27/1/42.....  | 1.1                       | 4                | 3.0  | 3,300                           | 14              | 46.2                                    | 3,253.8                                    |
| 10/2/42.....  | 1.5                       | 4                | 2.9  | 4,350                           | 16              | 69.6                                    | 4,280.4                                    |
| 24/2/42.....  | 1.5                       | 4                | 1.4  | 2,100                           | 4               | 8.4                                     | 2,091.6                                    |
| 10/3/42.....  | 1.1                       | 3                | 1.3  | 1,430                           | 12              | 17.2                                    | 1,412.8                                    |
| 24/3/42.....  | 1.1                       | 3                | 0.7  | 770                             | 28              | 21.6                                    | 748.4                                      |
| 10/4/42.....  | 0.8                       | 3                | 0.7  | 560                             | 6               | 3.4                                     | 556.6                                      |
| 24/4/42.....  | 0.8                       | 4                | 3.5  | 2,400                           | 8               | 19.2                                    | 2,380.8                                    |
| 12/5/42.....  | 1.2                       | 4                | 2.4  | 2,880                           | 6               | 17.3                                    | 2,862.7                                    |
| 26/5/42.....  | 0.8                       | 5                | 1.7  | 1,360                           | 44              | 59.8                                    | 1,300.2                                    |
| 9/6/42.....   | 0.7                       | 3                | 1.3  | 910                             | 22              | 20.0                                    | 890.0                                      |
| 23/6/42.....  | 1.8                       | 3                | 2.1  | 3,780                           | 58              | 219.2                                   | 3,560.8                                    |
| 7/7/42.....   | 0.7                       | 2                | 1.3  | 910                             | 68              | 61.9                                    | 838.1                                      |
| 21/7/42.....  | 1.5                       | 3                | 4.5  | 6,750                           | 96              | 648.0                                   | 6,102.0                                    |
| 4/8/42.....   | 0.9                       | 3                | 1.3  | 1,170                           | 52              | 60.8                                    | 1,109.2                                    |
| 18/8/42.....  | 0.7                       | 4                | 1.1  | 770                             | 24              | 18.5                                    | 751.5                                      |
| 1/9/42.....   | 0.6                       | 4                | 3.7  | 2,220                           | 76              | 168.7                                   | 2,051.3                                    |
| 15/9/42.....  | 0.8                       | 3                | 3.0  | 2,400                           | 72              | 172.8                                   | 2,227.2                                    |
| 29/9/42.....  | 1.0                       | 4                | 3.9  | 3,900                           | 112             | 436.8                                   | 3,463.2                                    |
| 13/10/42..... | 0.6                       | 4                | 5.7  | 3,420                           | 114             | 389.9                                   | 3,030.1                                    |
| 27/10/42..... | 1.0                       | 5                | 2.9  | 2,900                           | 30              | 87.0                                    | 2,813.0                                    |
| 10/11/42..... | 0.6                       | 5                | 1.5  | 900                             | 10              | 9.0                                     | 891.0                                      |

TABLE 36.

*Protocol for Ronderib Afrikaner Ram 62543.*

| Date.         | Vol. of Semen. (c.c.). | Motility Rating. | Conc. (Millions per mm <sup>3</sup> ). | Total No. Sperm. (Millions) | Abn. per 1,000. | Total Abn. in Ejaculate. (Millions). | Total Normals in Ejaculate. (Millions). |
|---------------|------------------------|------------------|--|-----------------------------|-----------------|--------------------------------------|---|
| 7/10/41.....  | 0·6                    | 4                | 3·4                                    | 2,040                       | 24              | 49·0                                 | 1,991·0                                 |
| 21/10/41..... | 0·6                    | 5                | 5·8                                    | 3,480                       | 22              | 76·6                                 | 3,403·4                                 |
| 4/11/41.....  | 0·5                    | 4                | 3·5                                    | 1,750                       | 20              | 35·0                                 | 1,715·0                                 |
| 18/11/41..... | 0·9                    | 5                | 5·7                                    | 5,130                       | 12              | 61·6                                 | 5,068·4                                 |
| 5/12/41.....  | 1·1                    | 4                | 5·7                                    | 6,270                       | 8               | 50·2                                 | 6,219·8                                 |
| 23/12/41..... | 0·8                    | 5                | 3·4                                    | 2,720                       | 10              | 27·2                                 | 2,692·8                                 |
| 9/ 1/42.....  | 0·5                    | 5                | 1·3                                    | 650                         | 8               | 5·2                                  | 644·8                                   |
| 23/ 1/42..... | 1·0                    | 5                | 4·8                                    | 4,800                       | 12              | 57·6                                 | 4,742·4                                 |
| 6/ 2/42.....  | 0·8                    | 5                | 2·6                                    | 2,080                       | 0               | 0                                    | 2,080·0                                 |
| 20/ 2/42..... | 1·4                    | 4                | 0·8                                    | 1,120                       | 0               | 0                                    | 1,120·0                                 |
| 6/ 3/42.....  | 0·8                    | 4                | 1·6                                    | 1,280                       | 6               | 7·7                                  | 1,272·3                                 |
| 20/ 3/42..... | 0·7                    | 5                | 1·6                                    | 1,120                       | 8               | 9·0                                  | 1,111·0                                 |
| 7/ 4/42.....  | 0·8                    | 3                | 0·8                                    | 640                         | 10              | 6·4                                  | 633·6                                   |
| 21/ 4/42..... | 1·4                    | 4                | 5·7                                    | 7,950                       | 10              | 79·5                                 | 7,870·5                                 |
| 8/ 5/42.....  | 0·7                    | 5                | 2·9                                    | 2,030                       | 8               | 16·2                                 | 2,013·8                                 |
| 22/ 5/42..... | 0·7                    | 4                | 4·1                                    | 2,870                       | 20              | 57·4                                 | 2,812·6                                 |
| 5/ 6/42.....  | 0·8                    | 4                | 2·5                                    | 2,000                       | 18              | 36·0                                 | 1,964·0                                 |
| 19/ 6/42..... | 0·7                    | 5                | 5·4                                    | 3,780                       | 24              | 90·7                                 | 3,689·3                                 |
| 3/ 7/42.....  | 0·6                    | 5                | 3·6                                    | 2,160                       | 10              | 21·6                                 | 2,138·4                                 |
| 17/ 7/42..... | 0·8                    | 4                | 2·1                                    | 1,680                       | 16              | 26·9                                 | 1,653·1                                 |
| 31/ 7/42..... | 0·9                    | 3                | 0·5                                    | 450                         | 42              | 18·9                                 | 431·1                                   |
| 14/ 8/42..... | 0·9                    | 5                | 2·4                                    | 2,160                       | 18              | 38·9                                 | 2,121·1                                 |
| 28/ 8/42..... | 0·8                    | 4                | 3·7                                    | 2,960                       | 34              | 100·6                                | 2,859·4                                 |
| 11/ 9/42..... | 0·7                    | 5                | 3·1                                    | 2,170                       | 4               | 8·7                                  | 2,161·3                                 |
| 25/ 9/42..... | 1·0                    | 5                | 6·9                                    | 6,900                       | 26              | 179·4                                | 6,720·6                                 |
| 9/10/42.....  | 0·5                    | 5                | 1·9                                    | 950                         | 8               | 7·6                                  | 942·4                                   |
| 23/10/42..... | 0·7                    | 5                | 2·2                                    | 1,540                       | 0               | 0                                    | 1,540·0                                 |
| 6/11/42.....  | 0·6                    | 5                | 2·4                                    | 1,440                       | 16              | 23·0                                 | 1,417·0                                 |



## SPERM PICTURE OF RAMS AND RATE OF SPERM TRAVEL.

TABLE 37.

*Protocol for Welsh Mountain × Ronderib Afrikaner Ram 62541.*

| Date.         | Vol. of Semen.<br>(c.c.). | Motility Rating. | Conc.<br>(Millions per mm. <sup>3</sup> ). | Total No. Sperm.<br>(Millions). | Abn. per 1,000. | Total Abn. in Ejaculate.<br>(Millions). | Total Normals in Ejaculate.<br>(Millions). |
|---------------|---------------------------|------------------|--|---------------------------------|-----------------|---|--|
| 3/10/41.....  | 0.9                       | 5                | 3.2  | 2,880                           | 6               | 17.3                                    | 2,862.7                                    |
| 10/10/41..... | 0.5                       | 5                | 2.8  | 1,400                           | 4               | 5.6                                     | 1,394.4                                    |
| 24/10/41..... | 0.7                       | 4                | 1.9  | 1,330                           | 6               | 8.0                                     | 1,322.0                                    |
| 7/11/41.....  | 0.8                       | 4                | 0.7  | 560                             | 12              | 6.7                                     | 553.3                                      |
| 25/11/41..... | 0.8                       | 4                | 1.4  | 1,120                           | 4               | 4.5                                     | 1,115.5                                    |
| 9/12/41.....  | 0.9                       | 5                | 6.1  | 5,490                           | 14              | 76.9                                    | 5,413.1                                    |
| 30/12/41..... | 1.0                       | 4                | 2.8  | 2,800                           | 4               | 11.2                                    | 2,788.8                                    |
| 13/ 1/42..... | 0.6                       | 4                | 3.1  | 1,860                           | 8               | 14.9                                    | 1,845.1                                    |
| 27/ 1/42..... | 1.1                       | 5                | 1.1  | 1,210                           | 10              | 12.1                                    | 1,197.9                                    |
| 10/ 2/42..... | 0.9                       | 4                | 1.2  | 1,080                           | 6               | 6.5                                     | 1,073.5                                    |
| 24/ 2/42..... | 1.0                       | 3                | 0.4  | 400                             | 12              | 4.8                                     | 395.2                                      |
| 10/ 3/42..... | 0.8                       | 5                | 2.8  | 2,240                           | 6               | 13.4                                    | 2,226.6                                    |
| 24/ 3/42..... | 1.4                       | 4                | 0.8  | 1,130                           | 12              | 13.6                                    | 1,116.4                                    |
| 10/ 4/42..... | 0.7                       | 4                | 1.1  | 770                             | 8               | 6.2                                     | 763.8                                      |
| 24/ 4/42..... | 0.8                       | 4                | 1.8  | 1,440                           | 6               | 8.6                                     | 1,431.4                                    |
| 12/ 5/42..... | 0.7                       | 4                | 3.3  | 2,310                           | 28              | 64.7                                    | 2,245.3                                    |
| 26/ 5/42..... | 1.3                       | 2                | 1.9  | 2,470                           | 20              | 49.4                                    | 2,420.6                                    |
| 9/ 6/42.....  | 0.9                       | 3                | 1.5  | 1,350                           | 50              | 67.5                                    | 1,282.5                                    |
| 23/ 6/42..... | 1.0                       | 2                | 1.3  | 1,300                           | 86              | 111.8                                   | 1,238.2                                    |
| 7/ 7/42.....  | 1.3                       | 4                | 4.7  | 6,110                           | 74              | 452.1                                   | 5,657.9                                    |
| 21/ 7/42..... | 1.0                       | 3                | 0.8  | 800                             | 220             | 176.0                                   | 624.0                                      |
| 4/ 8/42.....  | 0.6                       | 3                | 1.3  | 780                             | 74              | 57.7                                    | 622.3                                      |
| 18/ 8/42..... | 0.6                       | 5                | 3.1  | 1,860                           | 14              | 26.0                                    | 1,834.0                                    |
| 1/ 9/42.....  | 0.7                       | 4                | 4.3  | 3,010                           | 46              | 138.5                                   | 2,871.5                                    |
| 15/ 9/42..... | 0.7                       | 5                | 2.0  | 1,400                           | 30              | 42.0                                    | 1,358.0                                    |
| 29/ 9/42..... | 0.8                       | 5                | 4.2  | 3,360                           | 34              | 114.2                                   | 3,245.8                                    |
| 13/10/42..... | 0.5                       | 5                | 6.2  | 3,100                           | 86              | 266.6                                   | 2,833.4                                    |
| 27/10/42..... | 0.4                       | 5                | 2.4  | 960                             | 6               | 5.8                                     | 954.2                                      |
| 10/11/42..... | 0.6                       | 4                | 3.0  | 1,800                           | 2               | 3.6                                     | 1,796.4                                    |

TABLE 38.

*Protocol for Welsh Mountain × Ronderib Afrikaner Ram 62542.*

| Date.         | Vol. of Semen.<br>(c.c.). | Motility Rating. | Conc. (Millions per mm. <sup>3</sup> ). | Total No. Sperm. (Millions). | Abn. per 1,000. | Total Abn. in Ejaculate. (Millions). | Total Normals in Ejaculate. (Millions). |
|---------------|---------------------------|------------------|---|------------------------------|-----------------|--------------------------------------|---|
| 3/10/41.....  | 1.2                       | 3                | 1.3                                     | 1,560                        | 74              | 115.4                                | 1,444.6                                 |
| 24/10/41..... | 0.7                       | 1                | 1.1                                     | 770                          | 134             | 103.2                                | 666.8                                   |
| 4/11/41.....  | 0.7                       | 2                | 1.0                                     | 679                          | 112             | 76.1                                 | 602.9                                   |
| 18/11/41..... | 1.0                       | 1                | 1.0                                     | 980                          | 166             | 162.7                                | 817.3                                   |
| 5/12/41.....  | 0.4                       | 2                | 1.7                                     | 680                          | 120             | 81.6                                 | 598.4                                   |
| 23/12/41..... | 1.3                       | 4                | 1.2                                     | 1,560                        | 120             | 187.2                                | 1,372.8                                 |
| 9/1/42.....   | 0.9                       | 1                | 1.2                                     | 1,080                        | 168             | 181.4                                | 898.6                                   |
| 23/1/42.....  | 1.4                       | 1                | 1.3                                     | 1,820                        | 314             | 571.5                                | 1,248.5                                 |
| 6/2/42.....   | 0.8                       | 2                | 1.3                                     | 1,040                        | 108             | 112.3                                | 927.7                                   |
| 20/2/42.....  | 1.2                       | 1                | 1.4                                     | 1,680                        | 200             | 336.0                                | 1,344.0                                 |
| 6/3/42.....   | 0.9                       | 2                | 0.7                                     | 630                          | 100             | 63.0                                 | 567.0                                   |
| 20/3/42.....  | 1.5                       | 2                | 0.8                                     | 1,200                        | 92              | 110.4                                | 1,089.6                                 |
| 7/4/42.....   | 1.2                       | 1                | 0.5                                     | 600                          | 102             | 61.2                                 | 538.8                                   |
| 21/4/42.....  | 0.7                       | 2                | 1.1                                     | 770                          | 240             | 184.8                                | 585.2                                   |
| 8/5/42.....   | 1.4                       | 2                | 0.8                                     | 1,120                        | 70              | 78.4                                 | 1,041.6                                 |
| 22/5/42.....  | 1.0                       | 1                | 1.9                                     | 1,900                        | 106             | 201.4                                | 1,698.6                                 |
| 5/6/42.....   | 1.2                       | 1                | 2.0                                     | 2,400                        | 196             | 470.4                                | 1,929.6                                 |
| 19/6/42.....  | 0.9                       | 1                | 1.7                                     | 1,530                        | 394             | 602.8                                | 927.2                                   |
| 3/7/42.....   | 0.8                       | 1                | 1.5                                     | 1,200                        | 310             | 372.0                                | 828.0                                   |
| 17/7/42.....  | 1.5                       | 1                | 1.9                                     | 2,850                        | 192             | 547.2                                | 2,302.8                                 |
| 31/7/42.....  | 1.2                       | 1                | 1.3                                     | 1,560                        | 222             | 346.3                                | 1,213.7                                 |
| 14/8/42.....  | 0.9                       | 3                | 1.6                                     | 1,440                        | 184             | 265.0                                | 1,175.0                                 |
| 28/8/42.....  | 0.8                       | 1                | 0.6                                     | 480                          | 226             | 108.5                                | 371.5                                   |
| 11/9/42.....  | 0.7                       | 2                | 1.4                                     | 980                          | 96              | 94.1                                 | 885.9                                   |
| 25/9/42.....  | 2.8                       | 2                | 1.5                                     | 4,200                        | 168             | 705.6                                | 3,494.4                                 |
| 9/10/42.....  | 0.8                       | 3                | 1.0                                     | 800                          | 156             | 124.8                                | 675.2                                   |
| 23/10/42..... | 0.9                       | 2                | 2.1                                     | 1,890                        | 94              | 177.7                                | 1,712.3                                 |
| 6/11/42.....  | 1.0                       | 3                | 2.1                                     | 2,100                        | 40              | 84.0                                 | 2,016.0                                 |

## SPERM PICTURE OF RAMS AND RATE OF SPERM TRAVEL.

TABLE 39.

*Protocol for Southdown × Blackhead Persian Ram 62545.*

| Date.         | Vol. of Semen.<br>(c.c.). | Motility Rating. | Conc.<br>(Millions per mm. <sup>3</sup> ). | Total No. Sperm.<br>(Millions). | Abn. per 1,000. | Total Abn. in Ejaculate.<br>(Millions). | Total Normals in Ejaculate.<br>(Millions). |
|---------------|---------------------------|------------------|--|---------------------------------|-----------------|---|--|
| 3/10/42.....  | 0·8                       | 5                | 2·3  | 1,840                           | 2               | 3·7                                     | 1,836·3                                    |
| 21/10/42..... | 0·5                       | 5                | 1·8  | 900                             | 22              | 19·8                                    | 880·2                                      |
| 4/11/41.....  | 0·5                       | 5                | 2·5  | 1,250                           | 6               | 7·5                                     | 1,242·5                                    |
| 19/11/41..... | 1·1                       | 4                | 2·7  | 2,970                           | 24              | 71·3                                    | 2,898·7                                    |
| 5/12/41.....  | 0·8                       | 4                | 1·1  | 880                             | 4               | 3·5                                     | 876·5                                      |
| 23/12/41..... | 0·9                       | 4                | 1·9  | 1,710                           | 26              | 44·5                                    | 1,665·5                                    |
| 9/ 1/42.....  | 0·6                       | 5                | 2·1  | 1,260                           | 6               | 7·6                                     | 1,252·4                                    |
| 23/ 1/42..... | 1·1                       | 5                | 1·6  | 1,760                           | 12              | 21·1                                    | 1,738·9                                    |
| 6/ 2/42.....  | 1·0                       | 4                | 0·9  | 900                             | 12              | 10·8                                    | 889·2                                      |
| 20/ 2/42..... | 0·3                       | 3                | 1·7  | 510                             | 18              | 9·2                                     | 500·8                                      |
| 6/ 3/42.....  | 1·3                       | 4                | 0·9  | 1,170                           | 8               | 9·4                                     | 1,160·6                                    |
| 20/ 3/42..... | 1·0                       | 3                | 1·0  | 1,000                           | 4               | 4·0                                     | 996·0                                      |
| 7/ 4/42.....  | 0·9                       | 5                | 4·2  | 3,780                           | 16              | 60·5                                    | 3,710·5                                    |
| 21/ 4/42..... | 1·0                       | 4                | 3·6  | 3,600                           | 0               | 0                                       | 3,600·0                                    |
| 8/ 5/42.....  | 1·0                       | 4                | 1·2  | 1,200                           | 14              | 16·8                                    | 1,183·2                                    |
| 22/ 5/42..... | 0·6                       | 4                | 3·5  | 2,100                           | 28              | 58·8                                    | 2,041·2                                    |
| 5/ 6/42.....  | 1·0                       | 4                | 5·8  | 5,800                           | 54              | 313·2                                   | 5,486·8                                    |
| 19/ 6/42..... | 0·9                       | 4                | 5·2  | 4,680                           | 58              | 271·4                                   | 4,408·6                                    |
| 3/ 7/42.....  | 1·2                       | 5                | 5·1  | 6,120                           | 48              | 293·8                                   | 5,826·2                                    |
| 17/ 7/42..... | 1·8                       | 4                | 3·0  | 5,400                           | 76              | 410·4                                   | 4,989·6                                    |
| 31/ 7/42..... | 0·8                       | 4                | 1·8  | 1,440                           | 50              | 72·0                                    | 1,368·0                                    |
| 14/ 8/42..... | 0·7                       | 5                | 3·0  | 2,700                           | 12              | 32·4                                    | 2,667·6                                    |
| 25/ 8/42..... | 0·8                       | 5                | 4·6  | 3,680                           | 28              | 103·0                                   | 357·7                                      |
| 8/ 9/42.....  | 1·0                       | 5                | 4·4  | 4,400                           | 10              | 44·0                                    | 4,356·0                                    |
| 22/ 9/42..... | 0·7                       | 4                | 3·6  | 2,540                           | 20              | 50·8                                    | 2,489·2                                    |
| 6/10/42.....  | 0·5                       | 3                | 1·2  | 600                             | 6               | 3·6                                     | 596·4                                      |
| 20/10/42..... | 1·0                       | 5                | 4·1  | 4,100                           | 2               | 8·2                                     | 4,091·8                                    |
| 3/11/42.....  | 0·9                       | 5                | 2·1  | 1,890                           | 10              | 18·9                                    | 1,871·1                                    |

TABLE 40.  
*Protocol for Karakul Ram 62544.*

| Date.         | Vol. of Semen.<br>(c.c.). | Motility Rating. | Conc.<br>(Millions per mm. <sup>3</sup> ). | Total No. Sperm.<br>(Millions). | Abn. per 1,000. | Total Abn. in Ejaculate.<br>(Millions). | Total Normals in Ejaculate.<br>(Millions). |
|---------------|---------------------------|------------------|--|---------------------------------|-----------------|---|--|
| 14/11/41..... | 1.1                       | 2                | 0.2  | 220                             | 18              | 4.0                                     | 216  |
| 28/11/41..... | 0.9                       | 4                | 2.1  | 1,890                           | 12              | 22.7                                    | 1,867.3                                    |
| 12/12/41..... | 0.5                       | 5                | 3.3  | 1,650                           | 18              | 29.7                                    | 1,620.3                                    |
| 2/ 1/42.....  | 0.8                       | 4                | 2.0  | 1,600                           | 6               | 9.6                                     | 1,590.4                                    |
| 16/ 1/42..... | 0.8                       | 5                | 4.9  | 3,900                           | 8               | 31.2                                    | 3,868.8                                    |
| 30/ 1/42..... | 0.8                       | 4                | 1.6  | 1,280                           | 0               | 0                                       | 1,280.0                                    |
| 13/ 2/42..... | 0.8                       | 4                | 0.5  | 400                             | 8               | 3.2                                     | 396.0                                      |
| 27/ 2/42..... | 1.0                       | 4                | 2.2  | 2,200                           | 14              | 30.8                                    | 2,169.2                                    |
| 13/ 3/42..... | 0.8                       | 5                | 0.9  | 720                             | 52              | 37.4                                    | 682.6                                      |
| 27/ 3/42..... | 0.9                       | 4                | 1.9  | 1,710                           | 24              | 41.0                                    | 1,669.0                                    |
| 14/ 4/42..... | 0.7                       | 3                | 1.4  | 980                             | 12              | 11.8                                    | 968.2                                      |
| 28/ 4/42..... | 1.1                       | 4                | 2.3  | 2,530                           | 38              | 96.1                                    | 2,433.9                                    |
| 15/ 5/42..... | 0.6                       | 4                | 4.6  | 2,760                           | 72              | 198.7                                   | 2,561.3                                    |
| 29/ 5/42..... | 0.7                       | 5                | 5.4  | 3,780                           | 96              | 362.9                                   | 3,417.1                                    |
| 12/ 6/42..... | 0.9                       | 3                | 6.2  | 5,580                           | 306             | 1,707.5                                 | 3,872.5                                    |
| 26/ 6/42..... | 0.8                       | 2                | 0.6  | 480                             | 440             | 211.2                                   | 268.8                                      |
| 10/ 7/42..... | 0.9                       | 2                | 0.8  | 720                             | 328             | 236.2                                   | 483.8                                      |
| 24/ 7/42..... | 1.0                       | 1                | 0.1  | 100                             | 612             | 61.2                                    | 38.8                                       |
| 7/ 8/42.....  | 0.7                       | 3                | 1.0  | 700                             | 278             | 194.6                                   | 505.4                                      |
| 21/ 8/42..... | 0.8                       | 3                | 0.6  | 480                             | 346             | 166.1                                   | 313.9                                      |
| 4/ 9/42.....  | 0.8                       | 1                | 0.1  | 80                              | 272             | 21.8                                    | 58.2                                       |
| 18/ 9/42..... | 1.0                       | 1                | 0.1  | 100                             | 372             | 37.2                                    | 62.8                                       |
| 2/10/42.....  | 0.8                       | 2                | 0.8  | 640                             | 362             | 231.7                                   | 408.3                                      |
| 16/10/42..... | 0.7                       | 3                | 1.5  | 1,050                           | 190             | 199.5                                   | 850.5                                      |
| 30/10/42..... | 0.9                       | 5                | 2.3  | 2,070                           | 74              | 153.2                                   | 1,916.8                                    |
| 17/11/42..... | 1.4                       | 4                | 0.2  | 280                             | 46              | 12.9                                    | 267.2                                      |