Schedule II.

Showing Details of Adjustment of "Three-day" Dip.

Strength of Dip.	No. of Beast.	October.								November.					
		9	12	15	18	21	24	27	30	2	5	8	11	14	17*
6¾ lb. Arsenite of Soda—with Soap and Paraffin—to 400 gallons (¾-strength).	85	X	X	X	X	X	X	O	O	O	O	X	X	X	X
	86	X	X	X	X	X	X	O	O	O	O	X	X	X	X
	87	X	X	X	X	X	X	O	O	O	O	X	X	X	X
	88	X	X	X	X	X	X	O	O	O	O	X	X	X	X
	89	X	X	X	X	X	X	O	O	O	O	X	X	X	X
4½ lb. Arsenite of Soda—with Soap and Paraffin—to 400 gallons (½-strength).	65	—	X	X	X	X	X	O	X	X	X	X	X	X	X
	66	—	X	X	X	X	X	O	X	X	X	X	X	X	X
	67	—	X	X	X	X	X	O	X	X	X	X	X	X	X
	68	—	X	X	X	X	X	O	X	X	X	X	X	X	X
	69	—	X	X	X	X	X	O	X	X	X	X	X	X	X
	70	—	X	X	X	X	X	O	X	X	X	X	X	X	X
	71	—	X	X	X	X	X	O	X	X	X	X	X	X	X
	72	—	X	X	X	X	X	O	X	X	X	X	X	X	X
	73	—	X	X	X	X	X	O	X	X	X	X	X	X	X
	74	—	X	X	X	X	X	O	X	X	X	X	X	X	X
4½ lb. Arsenite of Soda to 400 gallons (no Soap or Paraffin)	75	—	X	X	X	X	X	O	O	O	X	X	X	X	X
	76	—	X	X	X	X	X	O	O	O	X	X	X	X	X
	77	—	X	X	X	X	X	O	O	O	X	X	X	X	X
	78	—	X	X	X	X	X	O	O	O	X	X	X	X	X
	79	—	X	X	X	X	X	O	O	O	X	X	X	X	X
	80	—	X	X	X	X	X	O	O	O	X	X	X	X	X
	81	—	X	X	X	X	X	O	O	O	X	X	X	X	X
	82	—	X	X	X	X	X	O	O	O	X	X	X	X	X
	83	—	X	X	X	X	X	O	O	O	X	X	X	X	X
	84	—	X	X	X	X	X	O	O	O	X	X	X	X	X

The X indicates a dipping; the O the omission of the same.

* From this date all the cattle were dipped regularly in "three-day" dip at intervals of 72 hours.

SCHEDULE II (*continued*).

STRENGTH OF DIP.	No. of Beast.	OCTOBER.												NOVEMBER.								
		8	10	12	14	16	18	20	22	24	26	28	30	1	3	5	7	9	11	13	15	17*
4½ lb. Arsenite of Soda—with Soap and Paraffin—to 400 gallons (½-strength)	90	X	X	X	X	X	X	X	X	X	—	X	X	X	X	X	X	X	X	X	X	X
	91	X	X	X	X	X	X	X	X	X	—	X	X	X	X	X	X	X	X	X	X	X
	92	X	X	X	X	X	X	X	X	X	—	X	X	X	X	X	X	X	X	X	X	X
	93	X	X	X	X	X	X	X	X	X	—	X	X	X	X	X	X	X	X	X	X	X
	94	X	X	X	X	X	X	X	X	X	—	X	X	X	X	X	X	X	X	X	X	X
4½ lb. Arsenite of Soda to 400 gallons (no Soap or Paraffin)	95	X	X	X	X	X	X	X	X	X	O	O	O	O	X	X	X	X	X	X	X	X
	96	X	X	X	X	X	X	X	X	X	O	O	O	O	X	X	X	X	X	X	X	X
	97	X	X	X	X	X	X	X	X	X	O	O	O	O	X	X	X	X	X	X	X	X
	98	X	X	X	X	X	X	X	X	X	O	O	O	O	X	X	X	X	X	X	X	X
	99	X	X	X	X	X	X	X	X	X	O	O	O	O	X	X	X	X	X	X	X	X
	36	X	X	X	X	X	X	X	X	X	O	O	O	O	O	O	X	X	X	X	X	X
	42	X	X	X	X	X	X	X	X	X	O	O	O	O	O	O	X	X	X	X	X	X
	45	X	X	X	X	X	X	X	X	X	O	O	O	O	O	O	X	X	X	X	X	X
	63	X	X	X	X	X	X	X	X	X	O	O	O	O	O	O	X	X	X	X	X	X
	64	X	X	X	X	X	X	X	X	X	O	O	O	O	O	O	X	X	X	X	X	X
3½ lb. Arsenite of Soda—with Soap and Paraffin—to 400 gallons ($\frac{5}{12}$-strength)	100	X	X	X	X	X	X	X	X	X	—	X	X	X	X	X	X	X	X	X	X	X
	101	X	X	X	X	X	X	X	X	X	—	X	X	X	X	X	X	X	X	X	X	X
	102	X	X	X	X	X	X	X	X	X	—	X	X	X	X	X	X	X	X	X	X	X
	103	X	X	X	X	X	X	X	X	X	—	X	X	X	X	X	X	X	X	X	X	X
	104	X	X	X	X	X	X	X	X	X	—	X	X	X	X	X	X	X	X	X	X	X
3½ lb. Arsenite of Soda to 400 gallons (no Soap or Paraffin)	105	X	X	X	X	X	X	X	X	X	—	X	X	X	X	X	X	X	X	X	X	X
	106	X	X	X	X	X	X	X	X	X	—	X	X	X	X	X	X	X	X	X	X	X
	107	X	X	X	X	X	X	X	X	X	—	X	X	X	X	X	X	X	X	X	X	X
	108	X	X	X	X	X	X	X	X	X	—	X	X	X	X	X	X	X	X	X	X	X
	109	X	X	X	X	X	X	X	X	X	—	X	X	X	X	X	X	X	X	X	X	X

The X indicates a dipping; the O the omission of the same.
* From this date all the cattle were dipped regularly in "three-day" dip at intervals of 72 hours.

Schedule III.

Lethal Effects of "Three-day" and "Laboratory" Dips on Distended Female Brown Ticks.

It will be observed that these observations were based on the effect exerted by three different strengths of dip, namely, one-quarter strength (½ lb arsenite of soda to 100 gallons), one-half strength (1 to 100 gallons), and full strength (2⅛ lb. to 100 gallons), and that the results show that 1 lb. to 100 gallons is sufficient to prevent the eggs laid from hatching out, while, in some cases, the females died before commencing the process of laying. In the case of the weaker dip, it will be noticed that development was not certainly arrested, but that the females laid eggs, which, in one or two cases, succeeded in hatching out. In the case of the full strength (Laboratory Dip), out of a test of fourteen ticks, all were killed by the dip, although two survived long enough to commence the laying of a few eggs, which were unable to hatch.

In some of the above cases, where only one-quarter strength was used, it will be noticed that eggs were laid, and development occurred within the same (in some cases to a considerable extent) before the inhibitive influence of the dipping on the parent tick appeared to be exerted. In the majority of cases, however, in which eggs were laid, no commencing development of the egg could be traced.

The effect of the "Three-day" dip (or 1 lb. to 100 gallons), therefore, upon tick life may be judged from the above results.

Schedule IV.

The Effect of "Three-day" Dip at intervals of seventy-two hours upon Adult Tick Life generally.

Ten cattle were taken for a preliminary observation. They were harbouring the numbers of ticks shown below, and were dipped upon 12th January and 15th January, 1911, being kept under conditions which precluded the possibility of further infestment by ticks during this interval.

	12th January.		15th January.		18th January.	
	Number of Ticks.		Number of Ticks.		Number of Ticks.	
	Below Tail.	In Brush.	Below Tail.	In Brush.	Below Tail.	In Brush.
No. 42	2 Alive	18 Alive	0 Alive	6 Alive 7 Dead	0 Alive	0 Alive. 2 Dead.
No. 67	3 Alive	24 Alive	0 Alive	9 Alive 10 Dead	0 Alive	6 Alive.* 2 Dead.
No. 68	4 Alive	0 Alive	0 Alive	0 Alive 0 Dead	0 Alive	0 Alive.
No. 75	11 Alive	0 Alive	1 Alive	0 Alive 0 Dead	0 Alive 1 Dead	0 Alive.
No. 80	1 Alive	8 Alive	0 Alive	0 Alive 0 Dead	0 Alive	0 Alive.
No. 81	3 Alive	1 Alive	0 Alive	0 Alive 0 Dead	0 Alive	0 Alive.
No. 90	0 Alive	8 Alive	0 Alive.	2 Alive 1 Dead	0 Alive	0 Alive. 1 Dead.
No. 91	4 Alive	39 Alive	0 Alive 2 Dead	17 Alive 18 Dead	0 Alive	4 Alive.* 10 Dead.
No. 94	3 Alive	10 Alive	1 Alive 1 Dead	4 Alive 4 Dead	0 Alive 1 Dead	0 Alive. 4 Dead.
No. 95	2 Alive	11 Alive	0 Alive 1 Dead	6 Alive 4 Dead	0 Alive	0 Alive. 1 Dead.
Totals	33 Alive At commencement.	119 Alive	2 Alive 4 Dead	44 Alive 44 Dead	0 Alive 2 Dead	10 Alive.* 20 Dead.

* See notes.

Total ticks on cattle on 12th January ... 152 alive.

Total ticks on cattle on 15th January ...
- 46 alive, attached.
- 48 dead, attached.
- 58 dead, dropped off.

152

Effect of one immersion in "Three-day" Dip, after 72 hours ... ...
- 30·2 per cent. ticks survive.
- 31·5 per cent. ticks dead attached.
- 38·3 per cent. ticks dead dropped off.

Total ticks on cattle on 18th January ...
- 10 alive.
- 22 dead, attached.
- 14 dead, dropped off.

Effect of two immersions in "Three-day" Dip, after 144 hours ... ...
- 6·5 per cent. ticks survive (see observation below concerning survivors).
- 46 per cent. ticks found dead.
- 47·5 per cent. ticks dead dropped off.

It will be seen that the above cattle harboured 152 live ticks at the time of their first dipping. At the end of seventy-two hours 31 per cent. of these ticks were found dead and attached to their hosts, 30 per cent. were alive, while 38 per cent. had died and become detached. A further dipping was then given, with the result at the end of a further seventy-two hours that only ten ticks remained alive. These ten survivors present upon animals Nos. 67 and 91 existed in aggregations or clumps of ticks, which past observation has shown to be much less rapidly affected by the action of the dip than separate ticks. Such collections of ticks are, however, easily detected by reason of their bulk when they exist, and the touching of these masses with a small quantity of ear-dressing mixture will destroy within a few hours all signs of life, though even this procedure is unnecessary by reason of their ultimate death.

A fuller series of observations was then undertaken, comprising 207 computations, details of which, by reason of their length, are not quoted. The result of such extended experiment was found to compare closely with the above figures, the exact percentages being as follows for the end of the seventy-two hours period:—

Second observation:—
Effect of one immersion in "Three-day"
Dip, after 72 hours ... ... 30·7 per cent. alive.
27·3 per cent. dead, attached.
42 per cent. dead, dropped off.

In each test it will be observed about 30 per cent. of the ticks are alive at the expiration of seventy-two hours, but many are sick and continue to fall rapidly, irrespectively of a secon : immersion.

The significance to be attached to the temporary survival of a few forms of adult tick life is dealt with in the text of the report.

The increased lethal effect exerted by the "Three-day" dip when used at forty-eight hours' interval is noticed in Schedule V.

Schedule V.

The lethal effect of dips (one-half and five-twelfths strengths) at intervals of forty-eight hours, showing the increase of efficiency resulting from the addition of soap and paraffin.

All the cattle mentioned below were dipped on 12th November.

Strength of Dip.	No. of Beast.	12th Nov. No. of Ticks.	13th Nov. No. of Ticks.		14th Nov. No. of Ticks.		Percentage Killed.
		Alive.	Alive.	Dead.	Alive.	Dead.	
4 lb. Arsenite of Soda to 400 gallons (*no Soap or Paraffin*)	95	38	25	13	7	18	
	96	12	4	8	0	3	
	97	35	1	26	0	1	
	98	24	3	21	0	1	
	99	46	18	19	0	12	
		155	51	87	7	35	95·5 % killed.
4 lb. Arsenite of Soda to 400 gallons (*with Soap and Paraffin*)	90	22	13	9	0	5	
	91	29	18	11	1	7	
	92	17	7	10	0	4	
	93	15	1	14	0	0	
	94	25	14	11	2	7	
		108	53	55	3	23	97·3 % killed.
3½ lb. Arsenite of Soda to 400 gallons (*no Soap or Paraffin*)	105	13	3	7	1	3	
	106	38	11	26	2	7	
	108	13	3	6	2	1	
	109	14	12	11	1	1	
		78	19	50	6	12	92·3 % killed.
3½ lb. Arsenite of Soda to 400 gallons (*with Soap and Paraffin*)	100	16	8	6	0	3	
	101	26	7	14	2	6	
	102	23	8	15	0	6	
	103	20	1	8	0	1	
	104	15	8	5	0	5	
		100	32	48	2	21	98 % killed.

A notable feature of the above table is the great increase of destructive effect produced upon the tick where the dippings are given at intervals of one clear day (forty-eight hours). These frequent immersions were continued till the commencement of the above experiment at which time sixteen dippings had been given (with a short intermission as shown in Schedule II).

Before receiving their final dipping, the animals in question were intentionally infested with numbers of ticks, and on 12th November they were dipped in fluids of two different strengths and composition as shown.

Even where the arsenical content was as low as 14 oz. to the 100 gallons (3½ lb. to 400 gallons), and where no soap or paraffin was employed the destructive effect at the end of forty-eight hours equalled

92.3 per cent., which effect was increased by almost 6 per cent. (98 per cent.) by the addition of these agents.

The above results are interesting as showing (*a*) the possibility of the repetition of the dipping process every forty-eight hours in the "Three-day" Dip, and (*b*) the greatly increased lethal effect produced by this system of frequent dipping. No alteration however is made in the practical application of these observations inasmuch as our end is attained by the adoption of a system of dipping arranged to meet with exactness the life phases of the tick; and beyond this point it does not seem necessary to go either in reduction of interval or severity of effect.

Schedule VI.

Observation of the schedule below shows that a distinct repelling or revulsive effect is exercised by the dipping fluid upon the immature forms of tick life, and that—while the hungry adult tick attaches itself freely to even a freshly-dipped beast—a period of immunity is possessed by the animal from the attack of the larva and nymph for a considerable time after immersion.

How long such immunity to attack persists has not been accurately determined, but it appears to depend to a large extent upon the presence in the coat of the animal of the paraffin component of the dip, the young ticks commencing to attach themselves as this agent becomes dissipated or evaporated from the hair. This period of immunity thus gained—even though it may persist for only a few hours—is of the utmost service in delaying the attachment—and consequent maturing—of the young tick, the destruction of which it is thus possible to accomplish with certainty.

Schedule I shows the possibility of the maturing and escape of the larva in as short a time as sixty-eight hours. Escape of infectious forms of tick life under such circumstances would be possible during the period (four hours) left unprotected between the 68th and 72nd (or dipping) hour unless a restraining effect was exercised by the dip as shown herewith, by which a temporary immunity to attack is ensured.

Observations on Larvae.

Calf (41) *sprayed with "Three-day" dipping fluid.*
Control calf (147) *remained unsprayed.*

21st January.—A number of active larvae of the brown tick were placed upon various parts of the body of the above calves (chiefly upon the ears and belly).

24th January (seventy-two hours).—No larval ticks could be discovered upon the control calf. A number of engorging forms present on calf (41).

Repeat Experiment.

Calf (42) *dipped in tank.*
Control calf (148) *remained undipped.*

4th February.—A large number of active larvae were placed upon these two calves at the same time and in approximately equal numbers.

7th February (seventy-two hours).—No single live larva discoverable in the coat of calf (42) though a number of dead larvae were present.

On control calf (148) thirty-five to forty larvae were found engorged partially or completely.

Observations on Nymphs.

Calf (36) *was dipped in tank.*

Control calf (149) *remained undipped.*

25th February.—On this date both these calves were turned into the "nymph enclosure" (see foot note).

After remaining in this enclosure for six or eight hours they were removed.

On examination on 28th February (seventy-two hours after exposure) showed a large number of nymphs beginning to fill upon calf (149), while upon calf (36) only one could be discovered attached to the ear.

Observations on Adult Forms.

Four beasts (two recently dipped and two undipped) were turned into a tick-infested paddock. After twelve hours' grazing they were examined and the numbers of ticks present upon the recently-dipped cattle exceeded those upon the undipped—a somewhat unexpected result. The numbers of ticks upon the previously-dipped cattle however rapidly decreased owing to the exertion of the poisonous "residual" effect.

The general conclusion from the above experiments therefore is, that while recent dipping exerts no restraint upon the actual attack of the adult brown tick, it retards to a marked extent the invasion of the young or immature forms, a conclusion which is confirmed in the experimental results secured by practical tests.

Note.—"*Nymphal Enclosure.*"

This enclosure consisted of a wide circle about 40 yards in diameter, the walls of which circle were constructed of lengths of roofing-iron joined end to end. In this enclosure innumerable tick eggs were placed under suitable covers. As the larvae hatched out and became hungry, rabbits were placed in the enclosure. The larvae were found to attach rapidly and in great numbers, and in this way mature larva were dropped within the enclosure and in due time moulted, stocking the enclosure with thousands of nymphs. A further enclosure was constructed for the production—and maintenance under natural conditions—of large numbers of larvae for the purposes of the experimental work.

Schedule VII.

Details for Preparation of "Three-day" Dipping Fluid.

To mix 400 *gallons*:—

4 lb. Arsenite of soda (80 per cent. arsenic).
3 lb. Soft soap.
1 gallon Paraffin.

The above ingredients may be mixed in the same manner as

directed for the preparation of the Laboratory Dip, which is briefly as follows:—

Dissolve the soap and arsenite separately in a sufficient quantity of hot water; add the soap solution to the paraffin and beat into an emulsion; then add water to make up to 400 gallons, stirring vigorously the while.

If, however, it is found inconvenient to use heat in the preparation of the dip as above, the dipping fluid may be prepared as follows:—

Take the 3 lb. of soap, place in a bucket, and fill up with water about 3 gallons); the soap should then be broken by the hand into small pieces. In this way, and by continuous stirring, the 3 lb. of soap can be dissolved in about fifteen minutes. Then add the paraffin as above and heat into an emulsion. Take, in a similar manner, the 4 lb. of arsenite, which will be found to become dissolved in about the same time with constant stirring.

This solution, together with the emulsion, should then be placed in the mixing tank and water added, with constant stirring, up to 400 gallons. This quantity may then be allowed to run into the dipping tank.

If it is desired to mix at one time sufficient materials for the whole contents of a dipping tank of, say, 3200 gallons capacity, the following method may be adopted:—

Place the total quantity of soft soap—24 lb.—into the 400-gallon mixing tank and add about 200 gallons of cold water. This mixture should remain—with occasional stirrings—until next day, when the soap will be found to have completely dissolved.

The paraffin (8 gallons) may then be added and the whole beaten into an emulsion.

Although it will probably be found to be most convenient to dissolve the arsenite of soda in a few gallons of hot water, this may be carried out in a short time with cold water in the following manner:—

Place two or three pounds in a bucketful of water and stir vigorously for five or ten minutes; allow any undissolved particles to settle, and pour off the liquid into the tank containing the emulsion; then add more arsenite to that remaining in the bucket and fill up with water again, repeating this till all the arsenite has become dissolved.

After thoroughly mixing the emulsion and arsenite solution, the whole may be run into the dipping tank and water added until this is filled to its proper quantity.

In order to ascertain the quantity of dipping fluid removed from the tank by animals at a single dipping, several observations were made with horses, cattle, and sheep.

The following were the average amounts thus carried away after ample time had been allowed for drainage:—

Horses removed on an average ¾ to 1 gallon of dip per head.
Cattle removed on an average ½ to ¾ gallon of dip per head.
Sheep (*shorn*) removed on an average 3-10ths of a gallon of dip per head.
Sheep (*unshorn*) removed on an average 1 gallon of dip per head.

Schedule VIII.

Details for Preparation of "Three-day" Ear Dressing.

Paraffin oil: 1 quart.
Paraffin wax candles, No. 6: 6 to 8.

One quart of paraffin should be cautiously warmed in an open vessel and the candles, broken in small pieces, dropped into the oil, when they will rapidly dissolve.

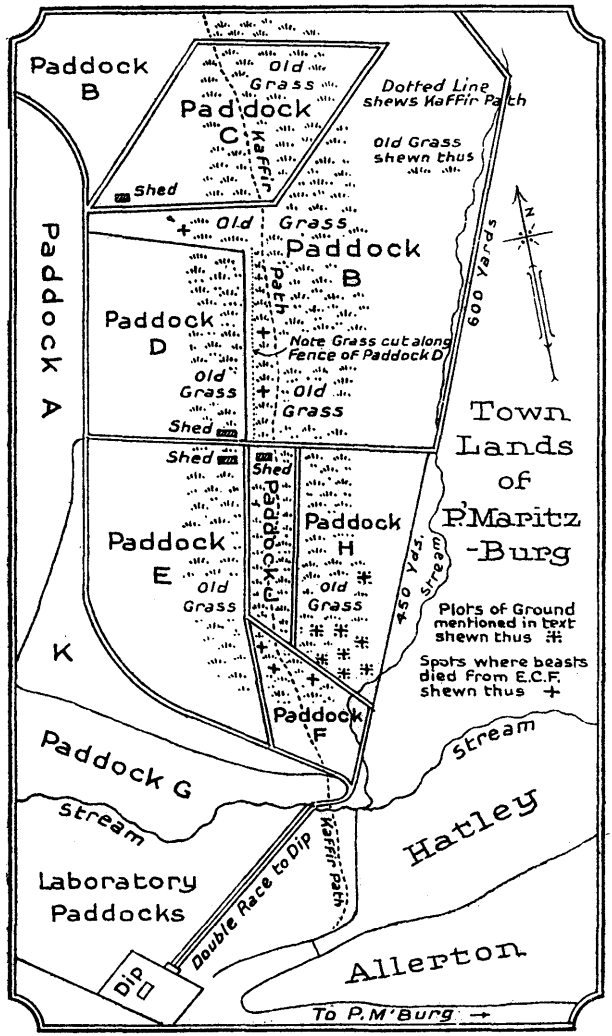
In hot weather it will be found that eight candles to the quart are necessary to produce a mixture of the required consistency, while during cold weather five or six candles will be found sufficient.

The above quantity will suffice for dressing the ears of from 120 to 150 animals, dependent upon temperature, manner of use, etc.

The mixture is best applied with a small swab tied to the end of a stick, and it will be found that no irritation attends even its repeated application to any external part.

It is not necessary to state that when preparing the above mixture over an open fire care should be taken by reason of its great inflammability.

SCHEDULE IX.



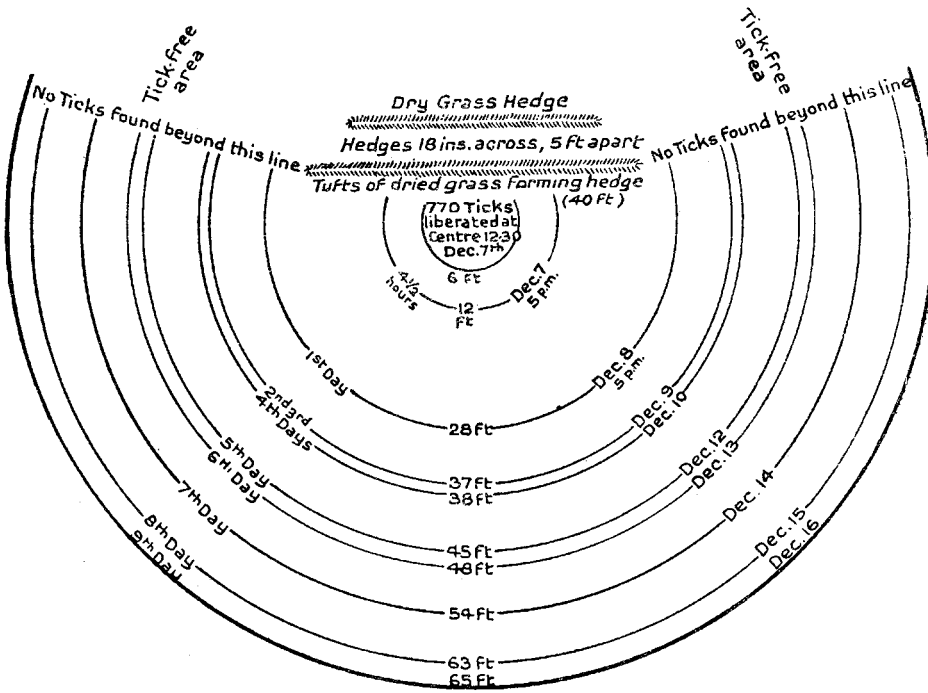
The accompanying map gives a general ground plan of the arrangement of the paddocks alluded to in the text of the report. The shaded portions in the centre of the map are intended to denote areas of long (last year's) grass. In the laying out of the paddocks the inclusion of a portion of old grass was designed in order that experimental work contemplated should be conducted under conditions of the veldt, such as obtain at different seasons.

Paddocks in which the disease was likely to become established were as a precautionary measure doubly fenced, where such paddocks abutted upon the town lands, with a safe interval or space between the fences. The watering of the cattle in certain of the paddocks was provided for by the placing of half-tubs just within the fence. These were filled by buckets from the outside, thereby avoiding any unnecessary entry of the paddocks themselves.

SCHEDULE X.

Tick Migration Experiment.

Second Observation.



The above diagram is intended to show the rate and distance at which adult hungry ticks are able to travel.

The experiment was carried out on a piece of short, closely-trimmed grass upon which no ticks existed. The outer circle on the above diagram denotes the wall (composed of sheets of roofing iron joined end to end) of which the enclosure was constructed. This enclosure, originally only some fifty feet in diameter, was enlarged day by day as found necessary in order to keep pace with the extension of the ticks. Precaution was taken against risk of escape of ticks in crawling up this wall by tarring the top edge of the iron.

On 7th December, about mid-day, 770 active adult ticks were liberated at the centre of the 6-ft. circle. They appeared to disperse rapidly in all directions. After some hours the ground was closely observed, and the progress of the most advanced ticks marked by means of small sticks. Twenty-four hours later the ground was again closely searched, and the spots at which advancing ticks were discovered were again pegged out. In this way the progress made and the distance covered were recorded daily. As the longer distances were reached the search became more difficult, owing to the increased area of the circle, and the thinning out of the ticks. The ultimate point of sixty-five feet was not gained until nine days after liberation, only two of the more adventurous insects reaching this point. It is possible there may have been others which escaped detection, but this is not probable,

as the daily search by a number of natives was long and close, in addition to which by far the greater number of the 770 ticks liberated were subsequently collected, so that no room for large margin of error exists.

Six feet behind the central point of the enclosure a line of turfs (each about eighteen inches square, and cut from spots where old tall grass existed) was dug into the ground level with the surface of the surrounding grass. Packed closely, so as to secure normal density, these turfs form a miniature hedge, or belt, of old grass forty feet in length, while behind the hedge a second belt was placed at a distance of five feet, the grass between the rows being left undisturbed. Of the 770 ticks liberated, 453, or 59 per cent., were collected from the first hedge three weeks later. Only nineteen had penetrated the grass, traversed the interval, and gained the further hedge, while beyond this second belt of grass no ticks could be found, though careful daily search was made.

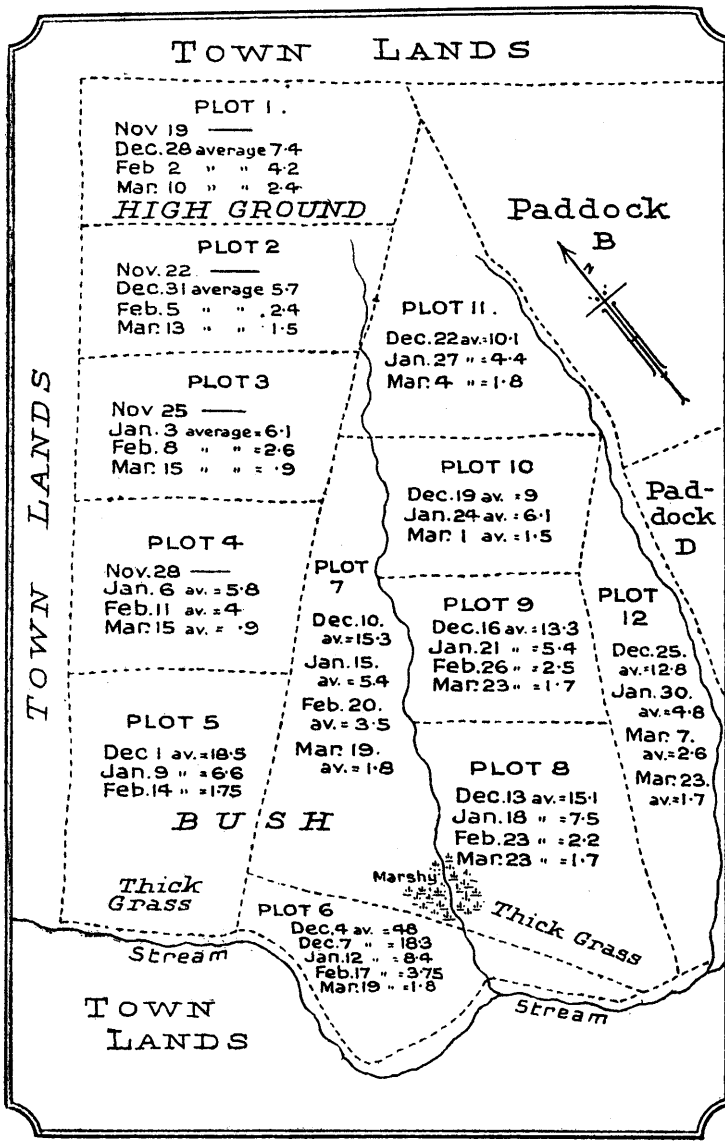
Within the centre or 6-ft. circle, where search was made three weeks later, 111 ticks were collected, which had not moved more than six feet from their point of liberation, forming an unprogressive minority of 14.4 per cent. of the total number, while 26.7 per cent. had travelled further afield.

Preliminary trials on a smaller scale had been made during the previous month, and as the results of the two experiments were in accord, observations were discontinued at the end of four weeks.

In reviewing the above findings, it may be objected that the conditions as regards the tick were artificial, and not such as obtain naturally.

The establishment, however, of some standard as to the rate and distance of tick travel may possibly be of great use in certain circumstances when attempting to estimate the probabilities and risks of infection of certain paddocks, fence lines, etc., while an accurate estimation of the risk of spread from any spot known to have been liable to infestment by mechanically transported ticks may prove of equal value. The utility of the belt of old grass as a defensive line needs, for the practical farmer, no comment.

SCHEDULE XI.



The above is a rough ground plan of paddock A showing its subdivisions. The top part of the map marked "high ground" is some 750 feet above the level of the spruit shown below. This fact will account for the difference between the numbers of ticks found, say, in plots 1 and 6. The sloping sides of the two streams flowing south were covered with bush and scrub, while the low ground at the level near the main stream was in places marshy and covered with rank grass and reeds, which harboured large numbers of ticks.

Paddock A had been grazed over by cattle (which were regularly dipped) for some time prior to its sub-division for purposes of the above experiment, otherwise the number of ticks collected would have been considerably greater. An excessive number of ticks on a given area would not, however, appear to increase the trouble or time of clearing the same, provided a suitable proportion is maintained between the size of the ground and the numbers of beasts grazing the same.

Schedule XII

Relative Tick Activity during Day and Night.

18th February.—Two rabbits were placed in a paddock containing a large number of nymphs and larvae at 7.30 p.m., remaining until 11.30 p.m. (four hours). At that time they were examined with the result that only a single larval tick was found attached.

Control.

19th February.—Two rabbits were placed in the same enclosure from 8 a.m. to noon (four hours). On examination they were found to be infected with large numbers of nymphs and larvae.

The above experiment was repeated on 24th March, when the two rabbits, exposed from 7 p.m. to 11 p.m., were found to have picked up twelve nymphs in all—an average of six.

The two *controls*, liberated from 2 p.m. to 6 p.m., were found to have fifty-six nymphs attached—an average of twenty-eight—or over three and a half times the number picked up during the same length of time at night.

To control the above observations on rabbits, a calf was turned into the same paddock on 6th March from 7 p.m. to 11 p.m. On examination after the four hours' exposure, a single tick could be found attached.

Another calf, placed in the paddock from 11 a.m. to 3 p.m., was found to have picked up eighteen adult ticks and nine nymphs.

The above instances show the difference which exists in tick-activity between the hours of darkness and light. This difference seems difficult to account for inasmuch as no eyes exist in the tick, which cannot in consequence be dependent upon the sense of sight for selection or prehension of its host. Night and day, therefore—apart from the question of temperature—would presumably be indifferent to the tick when seeking attachment. Such, however, cannot be the case as the foregoing instances show.

The difference between night and day may possibly be a matter of moment when determining, in any given case, the probability of infection having occurred or the general question of movement of stock.

Complete immunity cannot be looked for during the hours of darkness, but the risks of infection are obviously much lessened.

Schedule XIII.

Residual Effect of "Three-day" Dip in Horses and Cattle.

In order to determine what lethal effect immersion in the Three-day dip fluid exercised on adult ticks becoming attached shortly after the host had been dipped, a number of cattle were cleaned from ticks and then dipped. After three days the number of ticks dead and alive on these beasts were counted; since none of the ticks passed through the dipping tank the dead ticks found must have perished as the result of the saturation of the skin with arsenic at previous dipping or dippings, and to this reserve lethal power possessed by recently-dipped cattle the term residual effect has been applied. The average percentage of ticks thus killed in one hundred and seven (107) computations was found to be 16.8 per cent. in the case of cattle dipped in the "Three-day" dipping fluid.

In horses, two hundred and twenty computations were made in the same way as in the case of cattle, with the result that the average residual effect in this animal was found to be 22.5 per cent., while in certain cases this figure was considerably exceeded, as the following observation will show.

On 19th December four frequently dipped horses were cleaned of their ticks and dipped in "Three-day" dip. Four control horses were also cleaned but left undipped. These eight animals were then turned into a paddock moderately infested with ticks. After three days' grazing the four dipped horses were found to have attached to them twelve live ticks and seven dead ones, while the undipped horses had picked up thirty-two ticks, all of which were alive. Thus, out of nineteen ticks picked up by the dipped horses, seven, or 36.8 per cent., were killed as the result of the residual effect of the dipping given before their attachment.

It would seem also that a slight repellant effect was exercised in this case by the dip, inasmuch as the dipped horses picked up only about half the number of ticks found attached to the undipped animals.

It is probable, however—judging from the observations—a larger number of ticks than those actually found would have attached themselves to the dipped horses, and, becoming poisoned, would have loosed their hold before the estimation was made. In such a case the "residual effect" would be shown by even a higher figure than 36.8 per cent. as in the last test.

The 22.5 per cent. based on the 220 observations quoted above is therefore a low figure at which to estimate this "residual effect" in the horse.

It is not necessary to recall the fact—brought out in Part II of this report published previously—that this increased destructive effect can only be looked for where frequent or short-interval dipping is adopted.

Schedule XIV.

The Agency of the Tail Tuft in the Collection of Ticks.

First Observation, 1st December, 1910.

No. of Beast.	Long Tails.		No. of Beast.	Short Tails.	
	In Brush.	At Root of Tail.		In Brush.	At Root of Tail.
42	0 Ticks	13 Ticks	68	0 Ticks	2 Ticks
49	4 ,,	20 ,,	77	1 ,,	19 ,,
65	5 ,,	19 ,,	81	0 ,,	7 ,,
66	17 ,,	21 ,,	83	0 ,,	11 ,,
67	24 ,,	7 ,,	85	0 ,,	14 ,,
75	4 ,,	7 ,,	86	0 ,,	16 ,,
76	9 ,,	17 ,,	87	0 ,,	18 ,,
78	8 ,,	9 ,,	88	0 ,,	21 ,,
79	4 ,,	11 ,,	89	1 ,,	14 ,,
80	15 ,,	18 ,,	90	0 ,,	20 ,,
82	4 ,,	11 ,,	92	2 ,,	14 ,,
84	1 ,,	19 ,,	93	0 ,,	12 ,,
91	3 ,,	34 ,,	94	7 ,,	14 ,,
95	19 ,,	8 ,,	96	0 ,,	9 ,,
100	6 ,,	9 ,,			
Totals...	123 Ticks	223 Ticks	Totals..	11 Ticks	191 Ticks

	Long Tails.	Short Tails.
Percentage in brush	35·5 %	5·4 %
Percentage under tail	64·5 %	94·6 %
Total number of ticks collected	346	202
Average per beast collected	23	14·4

The long tails collect 60 *per cent. more ticks than the short tails.*

Second Observation, 4th December, 1910.

No. of Beast.	Long Tails.		No. of Beast.	Short Tails.	
	In Brush.	At Root of Tail.		In Brush.	At Root of Tail.
42	4 Ticks	17 Ticks	68	0 Ticks	36 Ticks
49	8 ,,	59 ,,	77	3 ,,	53 ,,
65	12 ,,	21 ,,	81	0 ,,	11 ,,
66	10 ,,	41 ,,	83	1 ,,	51 ,,
67	47 ,,	26 ,,	85	0 ,,	22 ,,
75	10 ,,	26 ,,	86	2 ,,	38 ,,
76	26 ,,	35 ,,	87	3 ,,	37 ,,
78	15 ,,	45 ,,	88	1 ,,	34 ,,
79	14 ,,	49 ,,	89	2 ,,	35 ,,
80	70 ,,	45 ,,	90	9 ,,	12 ,,
82	0 ,,	36 ,,	92	0 ,,	32 ,,
84	11 ,,	56 ,,	93	6 ,,	39 ,,
91	53 ,,	35 ,,	94	0 ,,	35 ,,
95	68 ,,	15 ,,	96	3 ,,	24 ,,
100	15 ,,	76 ,,			
Totals...	363 Ticks	582 Ticks	Totals..	30 Ticks	479 Ticks

	Long Tails.	Short Tails.
Percentage in brush	38·4 %	5 9 %
Percentage under tail	61·6 %	94·1 %
Total number of ticks collected	945	509
Average per beast	63	36·3

The long tails collect 73·5 *per cent. more than the short tails.*

The above figures show the value of the tuft of the tail as an instrument for the collection of ticks. In the first observation the animals with a tail tuft (or long tail) were the means of collecting 60 per cent. more ticks than the beasts with cropped tails, while in the second observation the tuft was responsible for an excess of 73.5 per cent. over the stump tails. These figures are striking testimony to the agency of the long tail in the collection and destruction of as many ticks as possible. The comfortable delusion of clipping the tail and finding the number of the ticks apparently decrease in consequence must be in future abandoned.

One disadvantage of the tuft should be noticed, and that is the tendency for ticks to collect in clumps at certain spots among the long hair, which latter furnishes a considerable protection from the process acting doubtless on the principle of the thatch. This difficulty, however, is easily overcome by the occasional use of a little of the dressing mixture described in Schedule VIII, which will retain its deterrent effect for some time.

Schedule XV.

The Suitability of "Three-day" Dip in the Treatment of Scab in Sheep.

A flock of 160 sheep (merinos), carrying heavy fleeces, were allowed to become scabby, and the disease was permitted to run its course unchecked until it assumed an advanced and aggravated form. Half the sheep were then shorn and half retained their long wool.

On 5th December the whole flock was passed through the dip, the sheep swimming straight through and climbing out at the far end to drain. They were then turned out. Unfortunately, through an oversight, the flock was folded during the ensuing night in the old infected kraal, and there is no doubt re-infection became established to some extent in this way.

On 12th December half the flock (consisting of forty-five shorn and thirty-five unshorn) were again passed through the tank in order to observe the effect of the repetition of the dipping at so short a period as seven days. No ill effects were observed.

On 19th December the whole flock was again dipped, as, although the disease seemed checked, a few sheep continued to scratch and nibble.

On 28th December the whole flock was again dipped. Very little evidence of scratching or biting could be detected even after close watching, while scrapings from six of the apparently worst cases failed to show any evidence of live scab insects.

On 4th January the dipping was repeated, no signs of scratching or biting being observed and all scrapings being negative.

Since this time the flock has been passed through the dip every week for some sixteen to eighteen weeks in all. No accident has occurred nor has any sign of return of the disease been detected, while the flock has remained in excellent condition.

These results, which must be considered as satisfactory, proving both the possibility of the frequent immersion of sheep without danger and the ease with which an intractable disease such as scab

can be controlled without other than routine treatment. No hand-dressing or special treatment was resorted to, and the disease in the long-fleeced sheep became eradicated as rapidly as in the recently-shorn animals.

There is little doubt the eradication of the disease would have been even more rapidly effected had not the flock, after their first immersion, been folded for the night on grossly infected ground.

Schedule XVI.

Effect of Weekly Dipping Process with Laboratory Dip upon Secretion of Milk.

The following figures, furnished by the courtesy of the manager of a large dairy establishment, are based upon the milk yield of about 125 cows over a period of six months.

Analysis of the figures will show that the average yield of milk upon the days of dipping was 1375 lb. (based upon the morning milking prior to—and the evening ditto after—dipping).

The average figure for the other six days—upon which no dipping took place—is 1354 lb. or slightly less than the average for the actual dipping day.

These figures—based as they are upon adequate numbers over an extended period—answer the objections which are still frequently urged against dipping by reason of its effect upon the yield of milk.

SCHEDULE XVI—(*continued*).

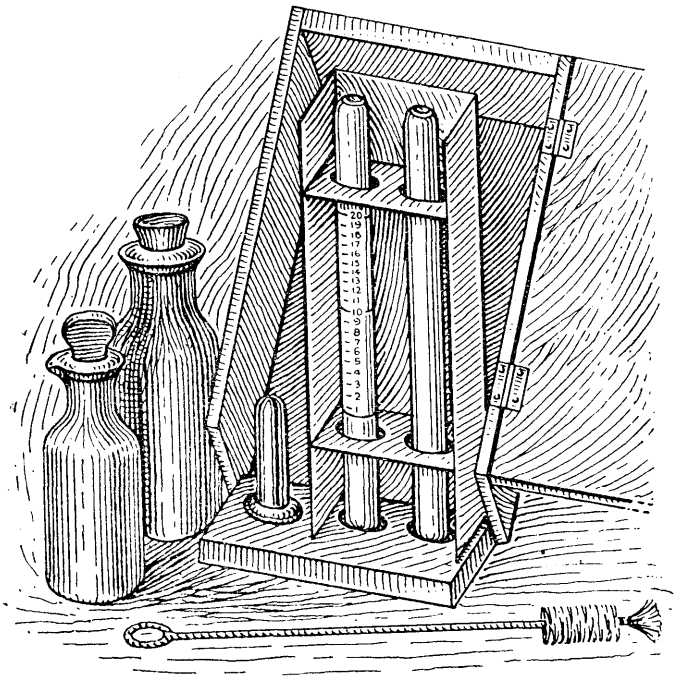
Effect of Weekly Dipping Process with Laboratory Dip upon Secretion of Milk.

DAILY MILKING RECORD FOR A PERIOD OF SIX MONTHS.

Date. June.	Quantity of milk in lb.	Remarks.	Date. July.	Quantity. of milk in lb.	Remarks.	Date. Aug.	Quantity. of milk in lb.	Remarks.	Date. Sept.	Quantity. of milk in lb.	Remarks.	Date. Oct.	Quantity. of milk in lb.	Remarks.	Date. Nov.	Quantity. of milk in lb.	Remarks.
1	1146		1	1049		1	1181		1	1386		1	1704	Dipped	1	1374	
2	1148	*Av.* 1158	2	1067	Dipped	2	1306	*Av.* 1245	2	1365	*Av.* 1381	2	1678		2	1564	
3	1182		3	999		3	1370		3	1334	Dipped	3	1649	*Av.* 1636	3	1565	*Av.* 1581
4	1199	Dipped	4	1071	*Av.* 1027	4	1420	*Av.* 1422	4	1225		4	1583		4	1616	
5	1134		5	1013		5	1478		5	1346	*Av.* 1319	5	1632		5	1554	Dipped
6	1181	*Av.* 1163	6	1033		6	1511	Dipped	6	1286		6	1648	*Av.* 1647	6	1537	
7	1174		7	1038	*Av.* 1042	7	1515		7	1286		7	1662		7	1565	*Av.* 1560
8	1169		8	1055		8	1602	*Av.* 1493	8	1258	*Av.* 1274	8	1681	Dipped	8	1580	
9	1117	*Av.* 1119	9	1037	Dipped	9	1362		9	1279		9	1626		9	1600	
10	1072		10	1000		10	1509		10	1175	Dipped	10	1546	*Av.* 1612	10	1471	*Av.* 1502
11	1080	Dipped	11	1036	*Av.* 1028	11	1550	*Av.* 1521	11	1246		11	1665		11	1536	
12	1063		12	1040		12	1504		12	1348	*Av.* 1292	12	1594	*Av.* 1665	12	1594	Dipped
13	1134	*Av.* 1119	13	1043		13	1492	Dipped	13	1283		13	1699		13	1488	
14	1160		14	1047	*Av.* 1106	14	1382		14	1324		14	1702	Dipped	14	1543	*Av.* 1531
15	1126		15	1228		15	1444	*Av.* 1146	15	1407	*Av.* 1377	15	1702		15	1564	
16	1086	*Av.* 1089	16	1222	Dipped	16	1413		16	1401		16	1709	*Av.* 1650	16	1519	
17	1057		17	1218		17	1497		17	1426	Dipped	17	1593		17	1532	*Av.* 1562
18	1100	Dipped	18	1222	*Av.* 1226	18	1482	*Av.* 1468	18	1360		18	1650		18	1635	
19	1000		19	1232		19	1426		19	1499	*Av.* 1434	19	1554	*Av.* 1510	19	1540	Dipped
20	1067	*Av.* 1049	20	1211		20	1468	Dipped	20	1444		20	1550		20	1500	
21	1081		21	1165	*Av.* 1182	21	1408		21	1462		21	1427		21	1563	*Av.* 1540
22	1068		22	1172		22	1335	*Av.* 1369	22	1503	*Av.* 1452	22	1613	Dipped	22	1559	
23	1034	*Av.* 1044	23	1178	Dipped	23	1366		23	1392		23	1538		23	1533	
24	1032		24	1155		24	1430		24	1393	Dipped	24	1546	*Av.* 1536	24	1381	*Av.* 1478
25	1025	Dipped	25	1179	*Av.* 1194	25	1480	*Av.* 1464	25	1496		25	1524		25	1522	
26	935		26	1248		26	1483		26	1477	*Av.* 1516	26	1594		26	1515	Dipped
27	965	*Av.* 971	27	1310		27	1320	Dipped	27	1555		27	1569	*Av.* 1565	27	1424	
28	1014		28	1278	*Av.* 1274	28	1312		28	1455		28	1534		28	1549	*Av.* 1486
29	1000		29	1234		29	1326	*Av.* 1437	29	1579	*Av.* 1549	29	1570	Dipped	29	1487	
30	1033	*Av.* 1027	30	1256	Dipped	30	1374		30	1615		30	1400		30	1540	
31	1049		31	1248		31	1393					31	1537	*Av.* 1437			

Schedule XVII.

The "Isometer".



The apparatus delineated above is one devised by Dr. Watkins-Pitchford and named by him the "Isometer". It is used for the estimation of the exact percentages of arsenic present in any sample of dipping fluid. Two tubes, one of which is graduated, are held in a metal frame attached to one end of the containing wooden case. This frame serves as a stand for the testing apparatus which is blackened to prevent reflection of light through the fluids.

The right hand tube is filled with the dip fluid to be tested. The method of testing is briefly as follows:—The left hand tube is filled by the coloured testing fluid as far as the first mark on the tube. The dip in the right hand plain tube is then poured cautiously into the second or graduated tube, where it mixes with the testing fluid. As the mark numbered ten is approached in this latter tube the colour of the fluid gradually changes, and when the mark is finally reached the tints of the two tubes are exactly alike. When, however, the dip to be tested is stronger than the standard "Laboratory Dip" the identity of colour of the two tubes is reached before the fluid reaches to the mark 10. Conversely when the dip is weak the column of fluid is not matched in colour until it reaches above this mark. The point at which colour correspondence between the two tubes takes plece is noted on the graduated glass scale of the tube, and the number of this graduation is found upon reference to an accompanying table to give the exact amount of arsenite of soda or of water which is necessary to bring the dip to the standard strength.