Effect of Fowler's Solution on Animals

By Elmer Roberts and
W. M. Dawson

UNIVERSITY OF ILLINOIS
AGRICULTURAL EXPERIMENT STATION

BULLETIN 413

CONTENTS

Urbana, Illinois April, 1935

Publications in the Bulletin series report the results of investigations made by or sponsored by the Experiment Station

Effect of Fowler's Solution on Animals

By Elmer Roberts and W. M. Dawson[a]

FOWLER'S SOLUTION has long been used in fitting animals for showing in the belief that it aids in putting on fat and in producing a gloss on the hair. Since the active ingredient of Fowler's solution[b] is arsenic in the form of potassium arsenite, many have questioned whether injurious effects may not follow its use. To the extent that show animals represent the better animals of the breeds, injuries to them from the use of Fowler's solution would have far-reaching effects.

The present investigation is not concerned with the use of this drug for medicinal purposes under prescription of competent veterinarians but solely with its use in fitting animals for showing. The study was planned in order to obtain information on the effect of Fowler's solution on parent and offspring when fed to the sire; on parent and offspring when fed to the dam; and on immature animals.

EXPERIMENTAL PROCEDURE

Rabbits were used as subjects in this experiment because large numbers could be produced at relatively small cost, and results obtained with these animals may be considered indicative of those that would occur with other domestic animals. Approximately 3,000 animals were used in the experiment during a period of six years. The breeding stock consisted of 197 females and 48 males. The numbers of animals in various phases of the investigation are given in the tables.

Size of Dose.—Treated[c] rabbits weighing 2,000 to 3,000 grams were given orally by means of a pipette ¾ cc. of Fowler's solution daily. This amount was found not to be injurious or toxic, so far as could be determined by weight and visual inspection. These were the best criteria for the size of dose since no reliable measure of the effect of

---

[a]Elmer Roberts, Associate Professor of Animal Genetics, and W. M. Dawson, Assistant in Animal Husbandry. The University is indebted to the Horse Association of America for a fund for technical help during one year of these experiments.

[b]Arsenic trioxid (As_2O_3) 10 grams, potassium bicarbonate ($KHCO_3$) 20 grams, tincture of lavender 30 cc., and water to make 1,000 cc.

[c]The terms treated and untreated animals as used in this bulletin refer respectively to animals that have received Fowler's solution and control animals that have not been given this solution.

Fowler's solution on condition of hair and fat was available. With smaller animals the dose was reduced in proportion to the body weight. A full dose of the size described above was not used until after a period of one week, during which a smaller dose was given in order to accustom the animals to the treatment.

Three-fourths of a cubic centimeter of Fowler's solution per animal was determined as a satisfactory size of dose by preliminary tests in which daily doses of ¼, ½, ¾, 1, 1¼, and 1½ cc. were tried. The animals were carefully observed and weighed thruout these tests.

Daily doses of more than ¾ cc. of the solution proved clearly detrimental, as evidenced by weight, health, and appearance of the animals. As a further check on size of dose, the animals were taken off the treatment for several weeks, and after all were in good condition those which first received the smaller doses in the first test were given the larger doses, and *vice versa*. For example, animals receiving ¼ cc. in the first test were given 1½ cc. in the second; those given ½ cc. in the first test received 1¼ cc. in the second test, etc. The animals which in the first test had received the smaller doses showed injurious effects when given the larger doses in the second test.

An attempt to obtain information regarding the size of dosage used when Fowler's solution has been fed to domestic animals was unsuccessful; no one was found who was willing to admit having used it. Of course, it is sometimes given to show animals without the owner's knowledge.

Double Matings.—In order to eliminate many disturbing environmental and hereditary factors, double matings were used whenever the plan of the experiment would permit. Two males were mated to the same female, one immediately following the other, for the purpose of obtaining a litter having one mother but two fathers.

Two kinds of males, different in the hereditary characters of color and albinism so that their young could be identified, were used. Each was homozygous, or pure, for color or albinism; the females were albinos. In a mixed litter from a white female mated successively to a colored male and a white male, the colored young will be the offspring of the colored male and the white young the offspring of the white male (Fig. 1). If fertilization is by chance, and the two kinds of spermatozoa are present in equal numbers and are equally vigorous, three kinds of litters — all-colored, all-white, and mixed — would be expected.

To eliminate the possibility of order of mating influencing the results, the colored and white males were alternated with respect to time

of service. The results of the matings furnish no evidence, however, that order of mating has any influence on the kind of young produced.

Length of Treatment.—Treated males were used in matings after having been given Fowler's solution daily for two weeks; females were mated after four weeks of treatment. In order to test the effects of

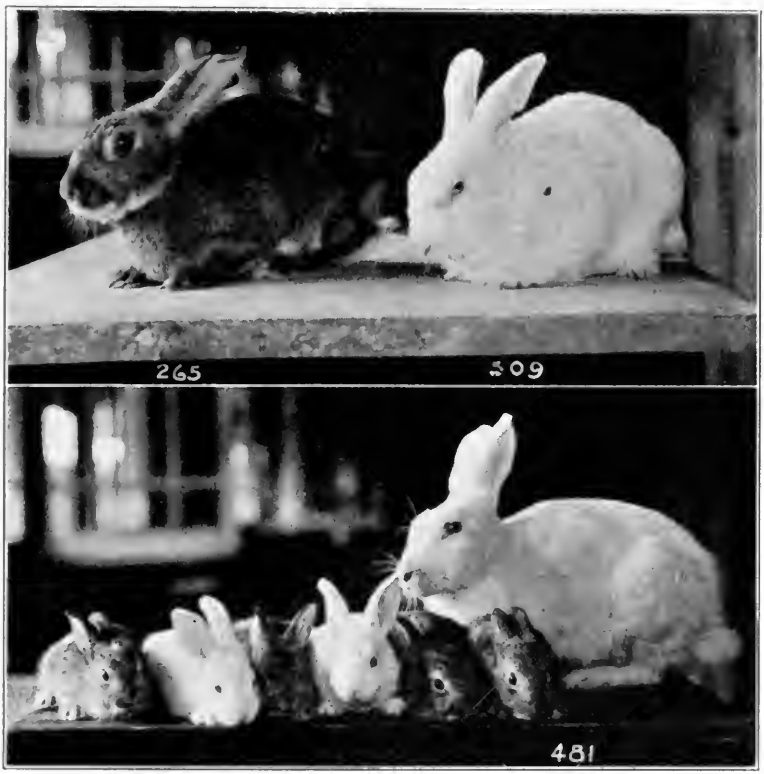

FIG. 1.—SIRES AND DAM WITH MIXED LITTER PRODUCED FROM DOUBLE MATING

The litter of four colored and two white young shown in the lower half of the photograph was produced by mating the white female to the two males at the top. The colored young were sired by the colored male and the white young by the white male.

longer periods of treatment, a few animals were given the solution daily for more than a year. Length of treatment appeared to have no influence on the results, similar effects being found in early and later periods of treatment.

EFFECT WHEN FED TO THE SIRE

Fertility.—In this experiment eight males fed Fowler's solution were used with untreated males in double matings with untreated females. The number of young from the treated males declined from 46.3 percent of the total number produced before any of the males were given the solution, to 22.5 percent during the period of treatment. Even after treatment was discontinued, the proportion of young produced by the treated males declined still further—to 15.9 percent of the total (Table 1).

TABLE 1.—YOUNG PRODUCED FROM DOUBLE MATINGS OF TREATED AND UNTREATED MALES WITH UNTREATED FEMALES BEFORE, DURING, AND AFTER THE FEEDING OF FOWLER'S SOLUTION TO THE TREATED MALE

Period	Number of litters	Number of young produced	Young from treated[a] males	Young from untreated[a] males
Total of all litters				
			perct.	*perct.*
Before treatment	30	162	46.3	53.7
During treatment	73	418	22.5	77.5
After treatment	56	346	15.9	84.1
Mixed litters				
Before treatment	11	67	50.7	49.3
During treatment	27	157	49.7	50.3
After treatment	16	106	45.3	54.7

[a]This experiment was started with eight treated males. One treated male died during treatment. A total of nine untreated males was used to obtain the desired number of double matings.

Not all the litters from the double matings resulted in young from both males; many litters included young from only one of the males even tho the female had been served by two males. Considering only those litters that included young from both males (mixed litters, Table 1), we find that the percentage of young from the treated males was not significantly less than from the untreated males even tho the proportion of mixed litters did decline perceptibly and, as stated above, the total number of young from the treated males, considering all litters, also declined markedly.

Some of the double matings did not result in any litters (compare Tables 1 and 2). Turning our attention to matings rather than litters, we find that the average number of young *per mating* from the treated

males declined from 1.7 before treatment to 1.0 during treatment, and to .7 after treatment was discontinued; while the number of young from the untreated males during the same periods increased from 2.0 to 3.3 to 3.9 per mating (Table 2).

TABLE 2.—NUMBER OF YOUNG PER MATING IN DOUBLE MATINGS OF UNTREATED AND TREATED MALES WITH UNTREATED FEMALES

Period	Number of double matings	Number of young per mating	
		From treated males	From untreated males
Before treatment	44	1.7	2.0
During treatment	97	1.0	3.3
After treatment	75	.7	3.9

TABLE 3.—PERCENTAGE OF LITTERS FROM DOUBLE MATINGS THAT INCLUDED YOUNG FROM TREATED MALES

Period	Number of litters	Number of litters with young from treated male	Percentage of litters with young from treated male
Before treatment	30	19	63.3
During treatment	73	30	41.1
After treatment	56	18	32.1
Total	159	67	....

Further evidence of the decline in the ability of treated males to produce young in competition with untreated males in the double matings is given in Table 3. The proportion of litters from double matings that included young from the treated males declined from 63.3 percent before treatment, to 41.1 percent during treatment, to 32.1 percent after treatment was discontinued.

The foregoing results from double matings suggest that some reduction took place in the amount or potency of the semen from the treated males. That this did occur is shown by the data in Table 6.

During the same period that double matings were made, these same treated and untreated males were also mated singly with untreated females. Thus there was no competition between the semen from two different males as in the double matings. Under these conditions no significant difference was found between the size of the litters from the treated males and the size of the litters from the untreated males (Table 4). Thus even tho the numbers of sperms produced by the

treated males may have been less than they would have been had these males not been treated, they apparently were still large enough to fertilize all the eggs ovulated.

Mortality of Young.—The greatest proportion of young dead at birth, 20 percent, occurred among the young from treated males during the period of treatment. This was almost double the percentage of young dead at birth from untreated males (Table 5).

TABLE 4.—AVERAGE SIZE OF LITTER FROM SINGLE MATINGS OF TREATED AND UNTREATED MALES WITH UNTREATED FEMALES

Period	Treated males		Untreated males	
	Number of litters	Average number per litter	Number of litters	Average number per litter
Before treatment	6	5.7	7	5.7
During treatment	28	6.8	37	6.4
After treatment	19	6.1	18	6.9
Total	53	...	62	...

TABLE 5.—PERCENTAGE OF YOUNG DEAD AT BIRTH IN LITTERS FROM DOUBLE MATINGS OF TREATED AND UNTREATED MALES WITH UNTREATED FEMALES

Period	Treated males		Untreated males	
	Number of young	Percentage dead at birth	Number of young	Percentage dead at birth
Before treatment	75	1.3	87	5.7
During treatment	97	20.0	321	10.6
After treatment	55	7.3	291	4.5

Activity of Males.—A total of 56 observations were made of the activity of 7 treated males when placed with females at the time of mating. They were classed as active or slow depending upon the vigor of their movements as observed at the time of service. Sixty-one percent of the services were classed as active; 39 percent as slow. Of an equal number of observations on the activity of untreated males during mating 96 percent were active; 4 percent slow.

Semen and Sperm.—Semen for examination was recovered from the reproductive tract of the female after mating by means of a rubber catheter. The ease of recovery seemed to depend largely on the amount of semen that had been deposited by the male. The amounts

recovered were arbitrarily classified into three groups: large, medium, and small.

The animals fed Fowler's solution produced less semen than did the untreated animals. Microscopic examination of the semen showed also that the semen of the treated animals had fewer sperm per given volume than had the semen of the untreated animals (Table 6).

No significant differences in motility of the sperm were observed between the two groups. Likewise no differences were found between the percentages of nonmotile sperm.

The fact that the use of Fowler's solution caused a decrease both in the amount of semen produced and in the number of sperm in a given volume of semen may account for the lessened ability of the treated animals to produce young in double matings when competing with untreated animals producing larger numbers of sperm.

TABLE 6.—RELATIVE AMOUNTS OF SEMEN AND RELATIVE NUMBERS AND MOTILITY OF SPERMATOZOA PRODUCED BY TREATED AND UNTREATED MALES

Measure	Seven treated males		Nine untreated males	
	Number of observations	Percent of total	Number of observations	Percent of total
Relative amounts of semen recovered				
Large	20	50.0	42	79.2
Medium	12	30.0	7	13.2
Small	8	20.0	4	7.6
Total	40	....	53	....
Relative numbers of spermatozoa				
Numerous	29	65.9	47	87.0
Medium	10	22.7	6	11.1
Few	5	11.4	1	1.9
Total	44	....	54	....
Relative motility of spermatozoa				
High	29	65.9	34	63.0
Medium	14	31.8	19	35.2
Low	1	2.3	1	1.8
Total	44	....	54	....
Relative numbers of nonmotile spermatozoa				
None	29	65.9	38	70.4
Few	8	18.2	9	16.7
Many	7	15.9	7	12.2
Total	44	....	54	....

EFFECT WHEN FED TO THE DAM

Fifteen females which had produced at least one litter were fed Fowler's solution in an attempt to discover the effects of arsenic on breeding females. These females were mated to untreated males. Four of these 15 females failed to produce litters during treatment. This left 11 females which produced young both before and during treatment. Three more became sterile during the test, after producing one or more litters. Nine of the 15 treated females died during the test; 5 of 15 untreated females used as controls died during the same period. The average age at the time of death of the treated animals was 778 days and of the untreated, 1,049 days.

Fertility.—The average size of litter of the 11 females producing young both before and during treatment was reduced from 6.24 ± .18 before treatment to 5.20 ± .26 for the period during treatment (Table 7). The difference of 1.05 ± .32 indicates that the probability of this

TABLE 7.—FERTILITY OF ELEVEN TREATED FEMALES MATED TO UNTREATED MALES, AND MORTALITY OF YOUNG BEFORE AND DURING TREATMENT

Period	Number of litters	Number of young	Average size of litter	Percent of young dead—		
				At birth	At 10 days	At 60 days
Before treatment.....	25	156	6.24±.18	3.8	26.4	35.4
During treatment.....	35	182	5.20±.26	8.7	58.1	69.8

result occurring by chance is only 1 in 37. Furthermore, young females generally produce smaller litters than do older females. Since the females were younger before the period of treatment than during the period, the effect of Fowler's solution may therefore be greater than is apparent from the difference found.

Records were also kept of the number of services during the entire test. Before the females were given Fowler's solution, the average number of services required for each litter produced was 1.08; during treatment it was 1.23; after treatment it was 1.78. These data suggest that fertility was permanently impaired in the treated animals. The percentage of infertile matings increased from 8.0 before treatment to 22.7 during treatment.

Mortality of Young.—There was a much higher mortality among the young from females given Fowler's solution than among the young from these same females before treatment (Table 7). In fact

the percentage of young dead at birth and at ten days more than doubled after the females were given Fowler's solution. The percentage dead at 60 days increased from 35.4 percent before the feeding of Fowler's solution to 69.8 during treatment.

GROWTH OF YOUNG FROM PARENTS FED FOWLER'S SOLUTION

To determine the effect on the growth of the young when Fowler's solution was fed to either the sire or the dam, weights of the young when one of the parents was treated were compared with the weights of the young when neither parent was treated. The weights used in these comparisons were the average weights of the animals taken at regular intervals up to 150 days of age.

When Fed to Sire.—For each mixed litter, when possible, the average weight was calculated for male young from the treated sire, for male young from the untreated sire, for female young from the

TABLE 8.—MEAN DIFFERENCES IN THE WEIGHTS OF YOUNG FROM TREATED AND UNTREATED MALES MATED TO UNTREATED FEMALES

Age	Number of pairs	Average weight of young		Mean difference in weight of young from treated and untreated sires	Odds that difference occurred by chance
		From treated sire	From untreated sire		
days		*grams*	*grams*	*grams*	
20 to 30.....	7	234.1	265.5	31.4	1 : 10.4
45 to 55.....	7	669.7	790.3	120.6	1 : 16.0
95 to 105.....	7	1 364.7	1 480.0	115.3	1 : 3.8
145 to 155.....	5	1 942.4	2 046.8	104.4	1 : 5.0

treated sire, and for female young from the untreated sire. An analysis was then made by the paired method of the average weights of the young of similar sex in the same litters coming from the treated and untreated sires.

A study of the growth of the young from mixed litters that occurred when treated and untreated males were mated with the same female furnishes a critical test of the influence that the feeding of Fowler's solution to a sire may have on the growth of the young (Table 8). At no age was there a significant difference between the weights of the young from the treated males and those from the untreated males. The mean differences, however, were slightly in favor of the young from the untreated males.

Because in the analysis by the paired method only seven pairs from five different litters were available, a further study was made of the growth of all the young from both single and mixed litters on which weights were taken.

The differences in the growth of the young made it necessary to study separately the young from colored males and white males and also to study separately the young from small and large litters. When this was done and a similar study was made on the controls (Table 9, Sire treated and Control 1), no consistent differences were apparent in the growth of the young from treated and untreated males.

TABLE 9.—AVERAGE WEIGHTS OF YOUNG FROM TREATED AND UNTREATED SIRES AND FROM TREATED AND UNTREATED DAMS

Kind of young[a]	Number of young	Average weight per animal at—			
		20 days	50 days	100 days	150 days
White, 4 to 5 in litter		*grams*	*grams*	*grams*	*grams*
Sire treated	19	272	860	1 608	2 045
Dam treated	9	306	914	1 659	2 048
Control 1	21	288	943	1 649	2 089
Control 2	28	278	873	1 618	2 061
White, 6 to 7 in litter					
Sire treated	36	197	647	1 275	1 286
Dam treated	30	221	820	1 460	1 825
Control 1	29	250	886	1 667	2 175
Control 2	39	204	655	1 295	1 818
Colored, 4 to 5 in litter					
Sire treated	4	304	1 261	2 280	3 008
Colored, 6 to 7 in litter					
Sire treated	10	254	832	1 689	2 129
Control	17	206	697	1 469	1 982

[a] *Control 1* consists of young from untreated sires when untreated dams were mated to both treated and untreated males. *Control 2* is made up of the young produced by the dam before the feeding of Fowler's solution was started.

When Fed to the Dam.—The growth of young from females fed Fowler's solution was also studied and the average weights of the young produced both before and during the feeding of Fowler's solution were compared (Table 9, Dam treated and Control 2).

The slightly greater weights, during the first 100 days, of the young produced after the dams were given Fowler's solution may have been due merely to the increased age of the dams. When the weights of the young from treated dams are compared with the weights of the young from untreated dams used as controls (Table

9, Dam treated and Control 1) the difference is much less in all litters and is in favor of the control group with the larger litters.

It is possible by the use of statistical methods to show a significant difference in the weights of certain of the groups. However, when all the groups are compared these differences do not appear to result from a controlled factor, such as the feeding of Fowler's solution, but from some uncontrolled factor, such as slight differences in the genetic factors for size in the different groups. An indication of this is shown in Table 9 by the difference in the size of the young from colored sires and white sires when both were fed Fowler's solution.

A study of all the data gives no evidence that the feeding of Fowler's solution to either the sire or the dam had any effect on the growth of the offspring, tho as pointed out on page 192, it did increase mortality.

EFFECT OF FEEDING FOWLER'S SOLUTION TO IMMATURE ANIMALS

Nineteen immature rabbits, varying in age from 76 to 128 days at the beginning of the experiment, were each given ¼ cc. of Fowler's solution daily for a period of 88 days. They were weighed at regular intervals and at the end of the test certain bones were weighed and measured and the toenails weighed. Equal numbers of animals of similar ages were used as controls and the same weights and measurements recorded.

Gain in Weight.—The average gain of 19 animals fed Fowler's solution was 630.5 ± 26.7 grams, and for 19 controls the average gain was 718.6 ± 33.0 grams. The difference of 88.1 ± 42.4 grams is not significant.

By pairing a treated animal with a control animal on the basis of age, sex, and initial weight, nine pairs with a greatest difference of nine days in age and 28 grams in initial weight were studied. Eight of the nine pairs showed a gain in weight in favor of the untreated animals. The probability that the mean difference in gain between the treated and untreated animals in these nine pairs was due to chance is only 1 to 200. A probable cause for the greater gains by the controls is that they were less susceptible to infection than the treated animals. Six of the nine treated animals had "colds" while only one of the controls was affected.

A study was also made of the weights of toenails. No significant difference was found, the average weight for the treated animals being .30 gram and for the controls .29 gram.

Size of Bones.—Weights and measurements were taken of the tibia, femur, and humerus, and measurements were taken of the skull of 19 treated and 19 untreated immature rabbits. In no set of comparisons was there a significant difference between the treated and the untreated animals (Table 10).

TABLE 10.—WEIGHTS AND MEASUREMENTS OF BONES OF NINETEEN TREATED AND NINETEEN UNTREATED IMMATURE ANIMALS

(Length in millimeters, weight in grams)

Bone	Treated	Untreated	Difference
Humerus			
Length	70.8 ±.40	70.5 ±.33	+.3 ±.51
Weight	2.88±.039	2.72±.045	+.06±.06
Femur			
Length	93.1 ±.34	92.3 ±.41	+.8 ±.53
Weight	5.40±.068	5.48±.095	−.08±.12
Tibia			
Length	103.4 ±.54	102.4 ±.49	+.92±.73
Weight	5.06±.083	5.08±.078	−.02±.11
Skull			
Length (dorsal)	88.1 ±.30	88.7 ±.27	−.6 ±.40
Length (ventral)	48.2 ±.20	48.4 ±.23	−.2 ±.30
Width (base)	29.3 ±.11	29.3 ±.16	0

These results do not support the conclusions of Gies[3*] and Eeckhout,[1*] who claimed that arsenic had a beneficial influence on both growth of animals and size of bone. In the work of Gies, while the differences are in favor of the arsenic-fed animals, the number of animals involved is too small to permit definite conclusions. In Eeckhout's study the arsenic-fed animals appeared to be significantly larger. Eeckhout did not, however, analyze his data statistically. When his data are subjected to statistical analysis, the differences in size of bones, while in favor of the arsenic-fed animals, are not significant, the odds in favor of the bones of the arsenic-fed animals being larger than the controls being in no comparison greater than 7.9:1.

Strength of Bone.—The breaking strength of the bones of the treated and untreated animals was studied by using the tibia. The animals were paired on the basis of sex, initial weight, and age. All the bones were prepared in the same way but were not freed of fat. A Scott machine of the vertical type for testing the strength of ma-

*These numbers refer to literature citations on page 202.

terials was used. The force was applied at the center of a four-centimeter span of bone. Of the twelve pairs of tibiae tested, the breaking strength of five pairs was in favor of the treated animals, of six in favor of the untreated, and the members of one pair had the same breaking strength (Table 11). The average force needed to

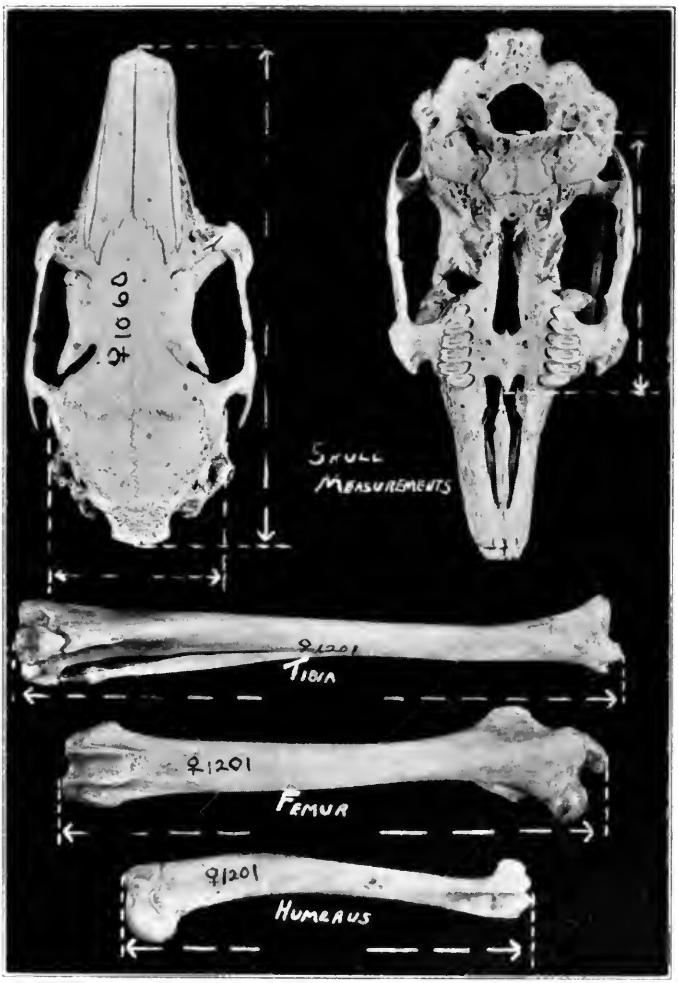

FIG. 2.—KINDS OF MEASUREMENTS MADE ON BONES OF RABBITS

Young rabbits were paired on the basis of weight, age, and sex. One of a pair was given Fowler's solution, otherwise the two had the same treatment. Length of humerus, femur, tibia, and skull measurements, as indicated in the figure, were taken. No significant differences were found.

TABLE 11.—BREAKING STRENGTH OF TIBIA OF TREATED AND UNTREATED IMMATURE ANIMALS

Pair	Sex	Treatment	Breaking force	Pair	Sex	Treatment	Breaking force
			lbs.				*lbs.*
1.....	F	Treated	43	7.....	M	Treated	109
	F	Control	92		M	Control	69
2.....	F	Treated	94	8.....	M	Treated	66
	F	Control	68		M	Control	91
3.....	F	Treated	69	9.....	M	Treated	86
	F	Control	70		M	Control	83
4.....	F	Treated	92	10.....	F	Treated	71
	F	Control	69		F	Control	74
5.....	F	Treated	94	11.....	F	Treated	67
	F	Control	92		F	Control	67
6.....	F	Treated	70	12.....	F	Treated	69
	F	Control	93		F	Control	72

break the tibiae of all untreated animals tested was 78.3 pounds; of treated animals 77.5 pounds, an insignificant difference.

EFFECT ON GENERAL HEALTH

The use of Fowler's solution lowered the resistance of these experimental rabbits to disease. Snuffles, colds, and pneumonia were much more prevalent among the treated animals, both the immature animals and those used for breeding. In one test with 44 immature animals, 12 of the 22 treated animals had "colds" during the test and 3 died; 4 of the 22 untreated animals had "colds" and 1 died.

The increased susceptibility to infection appeared as early as one to two weeks after feeding of the solution was begun. In addition, postmortem examination of 11 rabbits which had been fed Fowler's solution showed that 10 of the 11 had diseased livers or kidneys. These organs showed congestion, degeneration, and inflammation. Among 17 rabbits which had not been fed Fowler's solution, only 4 had diseased livers or kidneys. Increased susceptibility of treated animals may admittedly have been due to the administration of too large doses of Fowler's solution. Many persons acquainted with its use with domestic animals, however, are also of the opinion, based upon observation, that its use produces a greater susceptibility to disease.

DETECTION OF ARSENIC-FED ANIMALS

Tests made of the hair of some of the treated rabbits in these experiments disclosed the presence of arsenic. Other investiga-

tions[2,4-6*] have shown that arsenic can be recovered easily in the urine, feces, and hair of treated animals.

Use could be made of these facts, if desired, to eliminate such animals from competition in shows and to prevent their sale as breeders.

SUMMARY OF EXPERIMENTAL FINDINGS AND THEIR APPLICATION TO FARM ANIMALS

The purpose of this study was to determine the possible effects of feeding Fowler's solution to domestic animals. Since experimental work with the larger animals is slow and expensive, rabbits were used in the belief that the results obtained with them would indicate what would be expected with farm animals, such as horses and cattle. The following results were obtained with rabbits.

Male rabbits fed Fowler's solution produced a significantly smaller number of young in litters from double matings than did untreated males, with a greater percentage of young dead at birth. Treated males on the average were distinctly less active than untreated males at the time of service and produced relatively less semen and fewer sperm per volume of semen.

The feeding of Fowler's solution to females increased the mortality of the young and the number of services necessary to produce a litter.

Fowler's solution fed either to sire or dam had no effect on growth of the progeny.

The growth of immature animals was retarded by the use of Fowler's solution. The effect was, however, probably caused indirectly thru an increased susceptibility to disease.

Observations on living animals, as well as post-mortem examinations, indicated that the use of Fowler's solution was in general detrimental to health. The treated animals were more susceptible to respiratory diseases and pathological conditions of liver and kidney than were untreated animals.

It would appear logical to conclude from the above results that the feeding of Fowler's solution to farm animals for the purpose of fitting them for showing would detract from their value as breeders because of impairment to fertility and sexual activity and increased mortality among the offspring. Both breeding and immature animals would be expected to be more susceptible to disease. Among immature animals the contraction of respiratory and other diseases would tend to interfere with normal growth. Also detrimental effects on internal

organs such as kidney and liver would be expected among animals of any age.

The decreased activity observed among arsenic-fed animals at time of mating is probably indicative of decreased activity at other times. If this is true, such decreased activity is very likely associated with an increase in rate of fat deposition. This may be at least a partial explanation of the general belief that arsenic aids in putting on fat.

It has been shown that the presence of arsenic can be detected in the urine, feces, and the hair of treated animals. Use could be made of these facts if it is desired to eliminate such animals from competition in shows and to prevent their sale for breeding purposes.

LITERATURE CITED

1. EECKHOUT, A. VANDEN. De invloed van arsenik op den wasdom der beenderen. Vlaamsch natuur—on geneeskundig congres, Ghents Handel. **17**, 206-217. 1913.
2. FORBES, E. B. and associates. The mineral metabolism of the milch cow. Ohio Agr. Exp. Sta. Bul. 363. 1922.
3. GIES, Th. Experimentelle Untersuchingen über den Einfluss des Arsenic auf den Organismus. Arch. Expt. Path. u. Pharmakol. 175-197. 1878.
4. GREEN, H. H. The fate of arsenic after ingestion by, and injection into, livestock, and after the absorption through the skin in dipping. So. African Jour. Sci. **11**, 72-73. 1918.
5. ———— and DIJKMAN, C. D. Some experiments on the fate of arsenic in the animal body. So. African Jour. Sci. **15**, 640-651. 1919.
6. WIEDNER, JAMES. Über den biologischen Arsennachweis in Hautschippen und Haaren nach intravenoser Sulvarraniryicktion. Arch. de Med. Cirug. y especialid. **12**, No. 7. 296-306. 1923.

8,050—4-35—7275