the diet, without aureomycin, gave complete protection from mortality, but normal growth was not maintained. Growth was, however, much better than in inoculated but unmedicated birds.

3. Sulfamethazine at 0.075 and 0.050 percent, without aureomycin, failed to give complete protection from mortality, especially at the lower amount, nor was normal growth maintained. Mortality was less and growth was greater, however, than in inoculated but unmedicated birds.

4. The addition of aureomycin to the diet after withdrawal of sulfamethazine did not significantly increase growth.

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Egg Production and Reproduction as Affected by Arsanilic Acid and Penicillin*

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INVESTIGATIONS concerning the use of arsenicals in the chick ration have been conducted on a large scale, since the early work of Morehouse and Mayfield (1946) showed that these compounds stimulated chick growth. Similar investigations with mature birds have not been conducted as extensively; however, the research completed has indicated that such materials may also be of value for the later stages of growth and in the laying ration of the adult bird.

For example, Morehouse (1949), Pepper *et al.* (1954) and Libby *et al.* (1955) observed that time of sexual maturity was shortened by arsenical supplementation. Further, Libby *et al.* (1955) showed that arsanilic acid increased egg production from 33.2 to 38.4 percent and increased the feed conversion slightly. Carlson *et al.* (1955) reported that arsanilic acid supplementation increased egg production in a 12 percent protein ration. In addition, these workers found that antibiotics increased feed efficiency but had no consistent effect on body weight maintenance, mortality, egg quality, or hatchability of fertile eggs. Price *et al.* (1956) reported that 3-nitro-4-hydroxyphenyl arsonic acid increased egg production 4 to 6 percent and improved feed efficiency. Wharton and Fritz (1953) found that arsanilic acid had no effect on either fertility or hatchability, and Libby *et al.* (1953) made similar observations on hatchability.

In the present study, the effect of arsanilic acid both in the absence and presence of penicillin was investigated. Observations include egg production, feed efficiency, maintenance of body weight, fertility, embryonic mortality, and hatchability.

PROCEDURE

Two hundred and forty-four Delaware and 40 S. C. White Leghorn strain-cross pullets were housed at random in four

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TABLE 1.—*Composition of the basal ration*

Ingredient	Percent
Ground yellow corn	35.0
Ground milo	40.0
Soybean oil meal (44% protein)	7.0
Fish meal (63% protein)	2.5
Meat and bone meal (50% protein)	5.0
Dehydrated alfalfa meal (17% protein)	3.0
Dried whey product (50% lactose)	2.5
Ground limestone	3.2
Steamed bone meal	1.2
Salt, iodized	0.5
Vitamin A (10,000 USP/gm.)	0.022
Vitamin D_3 (15,000 ICU/gm.)	0.005
Vitamin mix 92 (Merck)*	0.040
Vitamin B_{12} "6" (Merck)†	0.070
Manganese sulfate supplement (70% manganese sulfate)	0.022

* Each pound contained 2,000 mg riboflavin, 4,000 mg. calcium pantothenate, 9,000 mg. niacin and 10,000 mg. choline chloride.

† Each pound is equivalent to the activity of 6 milligrams of vitamin B_{12}.

floor-pens with deep litter. Six New Hampshire roosters were also added to each pen. The Delaware birds were approximately sexually mature, and the White Leghorns had been in egg production about four months when placed on experiment. All groups were given an all-mash practical breeding ration *ad libitum*, (Table 1). Groups and treatments were as follows: pen one, the basal ration; pen two, basal ration plus 450 grams of Pro-Gen,[1,2] 20 percent, per ton; pen three, the basal plus 14.6 grams procaine penicillin G. per ton; and pen four, the basal ration supplemented with both compounds at similar levels.

Data collection began two weeks after the birds were placed on these regimes. Observations were made for eight 28-day periods starting January 16, 1956, and ending August 26, 1956. The birds were trapnested three consecutive days each week and total egg production per pen was determined daily. All Delaware eggs were saved for three to four successive days in certain periods and incubated to determine the effect of different treatments on reproduction.

The data were treated statistically by determining the standard error and subjecting the results to the "t" test.

RESULTS AND DISCUSSION

The addition of arsanilic acid to the basal ration resulted in an increase in the total number of eggs produced by 11.1 percent in the Delaware birds and 24.5 percent in the Leghorns based on the three day trapnest records (Table 2). On a seven-day total egg basis the increase of the arsanilic acid group was 13.2 percent higher than the basal. Statistical treatment could only be applied readily to the three-day trapnest records. On this basis, these differences were found to be mathematically nonsignificant, however, it is very probable that the differences were real on a total egg basis. Penicillin supplementation appeared to have no effect on egg production in either breed with the total egg value being approximately equal to the basal group.

When arsanilic acid and penicillin were supplemented in combination, egg production was increased 10.1 percent in the Delaware hens and 20.5 percent in the Leghorns based on the three day records. The group production for total eggs was increased 8.3 percent. Again, these differences were not great enough to be significant. Since these results are somewhat similar to those of the arsanilic acid group and unlike those of the penicillin, it would appear, however, that arsanilic acid was effective for increasing egg production under the conditions of this experiment.

[1] The Pro-Gen used in this experiment was furnished by Abbott Laboratories, North Chicago, Illinois. Supported in part by research grants from Abbott Laboratories and the Colorado Research Foundation.

[2] Pro-Gen, 20%, Abbott Laboratories, contains 20 percent arsanilic acid.

TABLE 2.—*Arsanilic acid and penicillin effects on egg production factors*

Group	Egg production			Feed eff. lbs. feed/ doz. eggs	Gain in body wt., gms.	Percent Mortality
	3-day trapnest		7-day total[2]			
	Delaware	S.C.W.L.	Both breeds	Both breeds	Delaware	Delaware
1	48.9±3.0[1]	43.5±10.6[1]	50.8[2]	6.45	302±26[1]	19.7
2	55.0±2.6	57.6± 6.3	58.5	5.79	385±33*	14.8
3	48.4±2.7	35.7± 8.7	50.3	6.66	446±31**	19.7
4	54.4±2.8	54.7± 5.3	55.4	6.05	394±29*	18.0

[1] Mean ± standard error.
[2] Percent egg production on a hen-day basis, includes floor eggs.
* Significant increase.
** Highly significant increase.

Feed efficiency was also improved noticeably when arsanilic acid was added alone or in combination with penicillin. This was particularly marked when arsanilic acid was used alone (Table 2). The group given penicillin alone showed a slight depression in feed efficiency, however, such results could occur from factors other than the presence of the antibiotic in the diet. In all cases, feed efficiency values are somewhat high since feed consumed by the six males was not deducted from the total feed consumed by each pen.

All treatments resulted in a significant increase in body weights of the Delaware hens over the controls with the greatest increase resulting from penicillin supplementation. There appeared to be no effect on mortality of the Delaware hens by any of the three treatments. Body weight measurements and percent mortality of the Leghorns are not reported here since these experimental groups were considered too small for such measurements.

Percent fertility was approximately equal in all groups of Delawares except the penicillin supplemented group (Table 3). This group was only slightly lower than the other groups and no definite conclusions can be made. Further, the male birds were not rotated between pens, therefore, this could have been a factor. Observations on embryonic mortality made at 7 and 21 days were slightly higher for the penicillin supplemented group at both periods. This resulted in a lower percent of normal chicks for this group compared to the other three groups. Further work needs to be conducted before any definite conclusions can be drawn, however. All other groups were very similar, therefore, it was concluded that arsanilic acid had no detrimental effect on reproduction.

From these data it seems that arsanilic acid may be effective for increasing egg production in hens that normally lay at a median rate. This supports the data of Libby *et al.* (1955) and Price *et al.* (1956) who showed that arsenical compounds were effective for increasing egg production in very low producing hens. These data do not agree with those of Lillie *et al.* (1957), who found that arsenical supplementation had no effect on egg production

TABLE 3.—*The effect of arsanilic acid and penicillin on reproduction*

(Delawares)

Group	Total eggs set	Percent fertile	Percent of fertile eggs		
			7-day embryonic mortality	21-day[1] embryonic mortality	Percent normal chicks
1	618	91.6	5.3	11.7	81.1
2	704	90.9	5.8	8.8	83.4
3	627	87.2	7.7	13.9	75.1
4	636	93.7	3.7	10.6	83.6

[1] Includes dead embryos, weak or crippled chicks and pips.

in hens laying at a median rate. Such differences in results may be attributed to environmental factors. More work should be conducted with this compound on birds that normally have a median or high production rate to further ascertain its effects. The data also indicated that this compound had no effect on fertility or hatchability which is in agreement with the results of Libby *et al.* (1953) and Wharton and Fritz (1953).

Penicillin was effective for increasing the body weight of the hens but had no effect on egg production, feed efficiency, fertility or hatchability. In general, the two compounds supplemented in combination gave results similar to the arsanilic acid supplementation. The consistency in response of hens given arsanilic acid increases the probability that this compound was effective under the conditions of this experiment.

SUMMARY

The effect of arsanilic acid, procaine penicillin, and the two materials combined on egg production, feed efficiency, body weight gain, mortality, and reproduction was studied.

Arsanilic acid supplementation resulted in an improved rate of egg production, feed efficiency, and body weight gain. This treatment had no marked effect on reproduction as measured by percent fertility and hatchability of fertile eggs. Arsanilic acid and penicillin combined gave results very similar to the arsanilic acid supplementation alone.

Penicillin alone was non-effective for increasing egg production, feed efficiency, hen mortality, fertility or hatchability, but increased body weight to a highly significant degree.

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NEWS AND NOTES

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GEORGIA NOTES

Kenneth N. May has been appointed to the staff of the Poultry Division at the University of Georgia as a cooperative agent with the USDA. As Assistant Professor of Poultry Husbandry and Assistant Poultry Husbandman, his work involves primarily the processing and marketing of poultry and poultry products.

He was born in Livingston, Louisiana and later attended Louisiana State University where he received his B.S. and M.S. degrees. While attending Louisiana State, he worked as Assistant State

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