1-1-1944

Farm science looks ahead

C. R. Orton

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THE FRONT COVER

The front cover of this bulletin was designed by A. S. Margolin, of the Division of Forestry, West Virginia University. The central figure was drawn from a carving of a wild turkey done in burl-apple wood by W. J. Martin, of Brasstown, North Carolina.
foreword

Many and complicated are the problems the farmer has faced in these critical war years. Yet, with the aid of Nature, he has performed almost a miracle of production.

During this period the farmer has become aware, as never before, how very important are certain natural resources. I mean especially the primary resources—water and minerals—of which I spoke on the covers of my Epistle to the Farm in 1942.

Every year our water supply is becoming more insecure. Hundreds of our farmers hauled water during the late summer and fall of 1944. This situation can and must be corrected if those farmers are to keep on in their business.

Research at this Experiment Station is being channeled toward establishing more organic matter in our soils, encouraging more tree growth on our hillsides, and building more small dams and ponds. Why? To slow down and halt the water where it is needed to slake the thirst of animals, and to regulate the flow of water in our streams.

Civilizations have gone to pieces through poverty and starvation—and lack of water has been a root of the tragedy. We must not let this happen here.

Water is the No. 1 problem in our State and Nation!
Among the topics you will find

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Figure 1. The committee on type classification as well as type inspectors of the National Ayrshire Breeders Association look over a splendid specimen of the Reymann Memorial Ayrshire herd.
Farm Crops and Soils*

*The material in this report was compiled by the Editor.

Variety Is Important in All Species of Crops

Although we haven't produced any new varieties of small grains or soybeans in West Virginia, we are still on the job testing new varieties from other places and trying to produce some new ones. The importance of variety can best be shown by some tests made with oats at Wardensville last year. Our agronomists got 32 samples of oats from farmers in the Eastern Panhandle area and planted these under uniform conditions. The yields varied from 14.0 to 38.9 bushels per acre. All samples had the same fertilizer treatment and were grown on the same soil. Any differences are accounted for by variations in germination, weeds, diseases, and yielding ability. Similar tests are being made with barley and wheat, and similar differences are expected.

Recently some new oat varieties which are resistant to stem and leaf rusts have been produced in the midwestern states. Although we don't always have these diseases, last year the resistant varieties Boone, Tama, and Vicland averaged 32.3 bushels per acre as compared to an average of 21.9 bushels for nine non-resistant varieties in tests at Reedsville, Wardensville, and in Pocahontas County. These resistant varieties were high in all of these tests and yielded as well as the other varieties at other locations where rust was not severe. Tama and Vicland have been added to the list of recommended varieties along with Gopher, Lenroe, and Patterson. But Tama and Vicland are short-strawed, and they should be grown only on fertile land or on land that is well fertilized.

Variety is equally important in wheat, barley, and soybeans, and it pays to use the best one obtainable. According to our tests these are: Thorne, Nittany, Fulhio, Trumbull, and Leap's Prolific for wheat; Scottish Pearl, Tennessee No. 52, and Kentucky Nos. 1 and 2 for barley; and Kingwa, Wilson, and Scioto for soybeans. R. O. Weibel and E. J. Wellhausen did this work.

West Virginia Hybrids Coming Into Their Own

From many state and cooperative tests we are finding hybrid corn varieties of higher yield, resistance to disease, and superior adaptation to local conditions. Those making exceptionally good records in several years' trials are released to growers and are placed on the recommended list for production. In order to qualify for that list, a hybrid variety must outyield the best local varieties by at least 15 percent. And it must have favorable characters of ear, grain, and fodder, as well as resistance to common diseases and to lodging.

Average corn yields have been rising within the state, thanks to hybrid trend. A still higher average yield may be expected as the recommended
varieties become more popular and as cultural practices improve. In 1944 the best adapted varieties in the trials at Morgantown and at Lakin, and in five of the county trials, yielded at rates of over 100 bushels of dry shelled corn per acre.

Our long-continued corn-breeding project by J. L. Cartledge and E. J. Wellhausen is now paying dividends in the form of superior hybrid varieties, bred in West Virginia. Four hybrids have now been released for production. The Agronomy Department is increasing the foundation stocks of these hybrids and, in cooperation with the Extension Division, is securing seed growers to meet farmers' increasing demands. The West Virginia Associated Crop Growers, which is the official seed-certifying agency in the state, produced in 1944 enough seed to plant about 6,000 acres in 1945.

A limited number of sweet-corn, single-cross hybrids have been grown and tested by cooperating growers and gardeners. We are aiming at a series of about four varieties which can be planted all at the same time and which will yield table corn of superior quality throughout the growing season.

As Ever, Yield of Crops Rests on Fertility

The yield of crops changes from variety to variety and from soil to soil. T. C. McIlvaine and G. G. Pohlman have been testing rotations and fertilizers at the Lakin Experiment Farm for 7 years and by now there are some highly interesting results. We have corn yields ranging from 12.3 to 98.6 bushels (average) per acre, wheat yields varying from 9.9 to 23.0 bushels, barley yields from 15.8 to 40.9 bushels, and clover and timothy-hay yields from 1,220 to 4,180 pounds per acre. These extreme ranges in yield are the result of the kind of rotation, the use of manure and cover crops, and the lime and fertilizer used.

What lime has accomplished is shown below:

<table>
<thead>
<tr>
<th>Varieties</th>
<th>No Lime</th>
<th>Limed</th>
<th>Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>49.6 bu.</td>
<td>68.0 bu.</td>
<td>18.4 bu.</td>
</tr>
<tr>
<td>Wheat</td>
<td>14.8 bu.</td>
<td>16.6 bu.</td>
<td>1.8 bu.</td>
</tr>
<tr>
<td>Barley</td>
<td>23.7 bu.</td>
<td>28.6 bu.</td>
<td>4.9 bu.</td>
</tr>
</tbody>
</table>

These per-acre averages are for 27 different rotation and fertilizer treatments.

Kind of Fertilizer Is Governed by Conditions

Potash fertilizers have increased the yield of crops in most rotations, particularly where lime has been applied. The use of 25 pounds of muriate of potash per acre increased corn yields by 11.3 bushels per acre on the limed plots as compared with 3.5 bushels per acre increase on the unlimed plots. On the other hand, nitrogen has been most effective on the unlimed plots, the increase in yield being 10.7 bushels per acre for 10 pounds of nitrogen as compared with 6.0 bushels per acre on the limed areas. A considerable part of this difference is due to the effect of legumes, which were much better on the limed areas.
The value of manure in addition to superphosphate for corn is evident here:

<table>
<thead>
<tr>
<th>Rotation</th>
<th>Manured</th>
<th>Fertilized</th>
<th>Increase for manure</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-year rotation</td>
<td>96.8 bu.</td>
<td>79.1 bu.</td>
<td>19.7 bu.</td>
</tr>
<tr>
<td>3-year rotation</td>
<td>88.2 bu.</td>
<td>80.4 bu.</td>
<td>7.8 bu.</td>
</tr>
<tr>
<td>2-year rotation</td>
<td>89.8 bu.</td>
<td>83.0 bu.</td>
<td>6.8 bu.</td>
</tr>
</tbody>
</table>

The greatest gain is in the longer rotations, even though the corn is preceded by clover-timothy in all cases. The results show rather definitely that by good cropping systems, lime, manure, and fertilizers, yields can be maintained at a high level on this soil (Wheeling fine sandy loam).

**Figure 2.** Pools of water, along with unsightly mounds of earth piled high, follow in the wake of typical stripmining operations. Our laws need to be revised to assure the revegetation of stripmine spoil areas.

**Even Level Land Should Have Winter Cover**

What cover crops can do to increase yield is shown for a corn-wheat rotation:

<table>
<thead>
<tr>
<th>Cover Crop</th>
<th>Corn</th>
<th>Wheat</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>33.7 bu.</td>
<td>16.1 bu.</td>
</tr>
<tr>
<td>Lespedeza</td>
<td>72.3 bu.</td>
<td>17.7 bu.</td>
</tr>
<tr>
<td>Sweet clover</td>
<td>76.4 bu.</td>
<td>18.3 bu.</td>
</tr>
<tr>
<td>Three-year rotation</td>
<td>89.6 bu.</td>
<td>20.4 bu.</td>
</tr>
</tbody>
</table>

All areas received lime and 250 pounds per acre of complete fertilizer (4-10-6) for corn and wheat.

*Complete fertilizer (4-10-6) applied at rate of 250 lbs. per acre in hill.
Results with a three-year rotation with clover and timothy following wheat are given here for comparison. Although yields may be maintained at a fairly high level with cover crops, adding a sod crop containing a legume the third year has given better results than a cover crop plowed under as green manure.

**Scratch the Pasture Surface, Then Reseed**

For years lime and superphosphate have been recommended as standard treatment for pastures. Marked improvement has resulted in all cases. However, in areas where there are few desirable species, the improvement has not always been fast enough and distinct enough to convince the farmer. If little or no bluegrass and clover are present, there’s not much hope that lime and fertilizer will bring in any seed.

Some years ago we tried seeding directly on the sod. Results—mediocre. Later on we tried plowing and also diskimg on strips on the contour, as a method of preparing a seedbed for grass and legume seedings in pasture. Results were so favorable that further tests were started in 1943 in Greenbrier, Nicholas, Wetzel, and Monongalia Counties. A plowed area, a surface-tilled area (using a disk, spring-tooth harrow, or field cultivator), and an untilled area were compared. Lime was applied as needed, and superphosphate was applied at the rate of 500 pounds per acre to all plots. The cultivated areas were then seeded to a mixture of grasses and legumes. R. M. Smith and G. G. Pohlman conducted this experiment.

Results on nine areas spring-seeded in 1943 showed that by plowing narrow strips on the contour, a fair stand of grass, with some legumes, could be obtained, and the erosion hazard was reduced but not entirely eliminated. However, surface cultivation on the contour gave a good stand of legumes, and no erosion was noted.

The highest yield usually showed up on the areas having surface cultivation and seed. In all cases these areas had more legumes than either of the other areas. Those tested were selected because the amount of clover and bluegrass present was so small that we expected rather slow effects from surface treatment. However, a few of the areas did have some clover, and in the second year they are showing marked effects from surface treatment. But in general, early yields in 1944 were higher from the tilled areas.

It now appears that a mixture containing sweet clover, alsike clover, white clover, orchard grass, redtop, and Kentucky bluegrass will be entirely satisfactory. Korean lespedeza may be added to the mixture where it is adapted.

Present indications are that the ground should be worked when fairly wet. This may be either in the early spring, or in midsummer after a rainy spell. The use of a disk or spring-tooth harrow on sod ground at such time does not appear to be harmful to the soil structure.
When Better Bluegrasses Are Found—

Many strains of bluegrass have been grown for several years. In 1944 we selected 40 strains and collected seed to test these under pasture conditions. Those selected were uniform and appeared to be of desirable types, but since the cow is the final judge, we can't be sure. Still, we hope there are some that will prove palatable to the cow. At the same time they must produce more grass than the strains now found in our pastures, especially during the summer months. The men responsible for this piece of work, E. J. Wellhausen and R. O. Weibel, have since left our employ.

![Figure 3. A partially leveled spoil area where the slope of the terrace is toward the high wall. This prevents run-off water from cutting gullies back into the level spoil area.](image)

Farming Will Take More and More Fertilizer

Agriculture in West Virginia has reached a state where satisfactory and profitable agriculture cannot be carried on without the application of more and more fertilizer. West Virginia has a climate which is capable of producing high crop yields if adequate fertilization and better soil-management practices are followed. After many trials we can safely say that yields approaching 100 bushels of shelled hybrid corn to the acre could easily be reached by farmers on land suited for corn production in all parts of the state, except perhaps at the higher elevations. But few farmers are getting these yields.

To find out whether such high production is economically possible, E. H. Tyner and J. R. Webb conducted experiments in the Bruceton Mills area of Preston County. Eleven fertilizer mixtures, containing different amounts of nitrogen, phosphorus, and potash, were applied and plowed under for corn at the rate of 1,000 pounds per acre. Outstanding increases
in yields of shelled corn followed. And the fertilizer costs were not pro-
hibitive. The ratio of 1 part nitrogen to 2 parts potash appeared to give us
the most efficient return from nitrogen.

The Never-ending Search for Soil Secrets

Since soils support crops, and crops feed both animals and man, we must
make every effort to understand, to conserve, and to make the right use of
this fundamental source of farm production.

In West Virginia we are studying the different soils by all the means
at our disposal. This means careful field observations, root studies, labora-
tory work, and studies of soil profiles down to bedrock.

Take soil acidity. This is not a simple thing, but is really quite complex,
and it varies among different soils. What soilmen call pH, for instance, is
one way of expressing acidity. Some people seem to think that pH is a
direct indication of lime requirement. We have found, among natural soils
in West Virginia, that one ton of lime will change the pH of some soils as
much as ten tons will change others. The differences are caused by what we
call buffering, and buffering is often as important a property as pH.

When it comes to phosphorus, R. M. Smith, D. R. Browning, and
G. G. Pohlman find that most subsoils and eroded soils are at least as
deficient as surface soils.

Available potash has proved to be quite variable among the various soils
of the state, but it is more abundant than available phosphorus in most cases.

Organic matter is known to be the main source of soil nitrogen as well
as a general soil conditioner. We have found that on most of the upland in
West Virginia, two-thirds of the total supply of organic matter is concen-
trated in the plow layer. In pastures there is twice as much organic matter
at 1 to 1½ inches as there is at 1½ to 3 inches. Thus the plow layer must
be preserved from erosion, or we lose two-thirds of our soil nitrogen, and
other nutrients as well. The concentration of organic matter in the surface
inch of pastures is one reason why pasture soils take in water so readily
and resist surface erosion. It also influences the growth of pasture plants,
and particularly the success of legume seedlings in old sods following
shallow tillage. Treatment with lime and fertilizer increases the total organic
content of pasture soils.

Other properties under study in West Virginia include soil structure,
which is the key to infiltration and erosion and is a good index of pro-
ductivity; soil profile depth, which is one of the most important factors in
the permanent and profitable use of the land; and soil texture, which is the
skeleton for all of the physical and chemical reactions.

Lime It First to Lessen Phosphate Knots in Soil

Quite a bit of phosphorus and potash fertilizer when applied to soil is
fixed in forms which are available to plants only with difficulty. Phosphorus
is more tightly fixed than potash; it represents a considerable loss in dollars annually to West Virginia farmers. This action of phosphorus is influenced a great deal by soil acidity. On acid soils, fixation is much greater than on neutral or sweet soils. Therefore a considerable reduction in phosphate fixation results when a soil is limed. This in turn cuts down the resulting economic losses. The important thing seems to be to do the liming first, long before the phosphate application, in the opinion of E. H. Tyner and J. R. Webb.

Figure 4. Here numerous useful grasses and legumes have become established successfully and quickly on recently stripmined land that has been leveled off. But it took a deal of lime and fertilizer and seed to do it.

Yes, Mine Waters Can Be Made Fit to Drink

Many pasture water supplies in West Virginia have been ruined through the removal of coal from mines. Water issuing from both active and abandoned mines carries too much in the way of soluble sulphates and free sulphuric acid to be palatable to stock.

Treatments of acid water from a sealed mine proved that either quick lime, hydrated lime, or combinations of either with ground limestone (up to 25 percent of the latter) may yield a water satisfactory for livestock. Batch treatment was recommended for farm use in a mimeographed circular prepared and distributed during the drought of 1943. Similar treatment of the mine water has provided spray water for the Station’s Morgantown orchards. Results so far are satisfactory, according to S. L. Galpin.

Disposing of the limey sludge resulting from treatment of acid mine water as top-dressing on pasture land showed no harmful effects. In some instances it appears to have stimulated the growth of grass.

Work is in progress on a self-powered treating plant built to handle 60 gallons of mine water per hour.
Quick Covers for Unsightly Spoil Banks

Favorable coal prices have greatly stimulated the stripmining of coal. This has trenched many miles of hillside pastures and woods in just a few years. The resulting spoil banks are unsightly. Because of their erosiveness and the slowness with which they naturally become covered with vegetation, these spoil banks are a menace to adjacent and downstream valley lands and to reservoirs. The sooner they are covered with the right kind of vegetation, the better for all concerned.

Liming and fertilization are being studied on spoil-bank experimental areas near Shinnston, Reedsville, Morgantown, and Weirton. Different grasses and legumes have also been planted at these locations.

Studies started late in 1943 indicate that, with proper treatment, rapid vegetation is possible. Other plot areas were laid out and planted early in 1944. We learned that where the spoil-bank material does not naturally contain lime, liming is an absolute essential for successful revegetation. Another outstanding observation is that a light mulch of manure or straw greatly increases the chances of establishing stands of grasses and legumes quickly. Applications of a complete fertilizer have been very beneficial, too.

There is urgent need for a change in the present laws regulating strip-mining. We are working on recommendations for changes.

E. H. Tyner, R. M. Smith, and W. B. Sayers are the experimenters in this project.
Fruits and Vegetables

If You're After a Smaller Apple Tree—

In tests by R. H. Sudds at Kearneysville, Jonathan seedlings have been shown to induce large tops for the variety concerned, when the seedlings are budded to Gallia Beauty, Starking, Staymared, or York Imperial. For producing large trees of these four varieties in the Shenandoah Valley, then, Jonathan seedlings are desirable. However, among the 11 seedlings and the 13 clonal rootstocks there may be some that will induce tops of less than standard size, especially of the Starking, Staymared, and York Imperial varieties, on our stronger soils. These should not require heavy pruning to keep the tree of manageable size, and they should be easier for the grower to spray and to pick. Gallia Beauty and Rome Beauty on any rootstock will hardly become too large, no matter what rootstock is used.

The oldest apple trees in the experimental orchard at Kearneysville have completed only their eleventh season, so that the story is not complete—and will not be for some time. The testing of apple-tree rootstocks takes quite a few years but we are gradually getting information of considerable value to the industry. Not only shall we be able to tell the grower what rootstocks should best be employed for certain purposes with several standard varieties. We shall also be prepared to inform him what kinds of rootstocks should not be used for his conditions.

Four Nitrogen Carriers Beneficial to Apple

Four nitrogen carriers—Chilean nitrate of soda, sulphate of ammonia, cyanamid, and Uramon—were applied to mature York Imperial apple trees located in a commercial orchard near Martinsburg. The experiment was begun in 1936 and was finished in 1944. The fertilizers were applied to the soil, under the spread of the branches, at the rate of 7 pounds of nitrate per tree per year, or its equivalent in any of the other carriers.

There were no significant differences in yields or in tree growth for the 8-year period. Any of the four nitrogen carriers is satisfactory for use in apple orchards in West Virginia, with certain precautions in the case of cyanamid, sulphate of ammonia, and Uramon. Cyanamid should be applied in autumn only and spread over the entire square of soil occupied by the tree, not merely in narrow rings under the branches; this is necessary to avoid cyanamid injury, which occurred twice during the experimental period. With the sulphate of ammonia and the Uramon, applications of lime should be made as required to maintain that degree of soil acidity which will permit the growth of bluegrass or whatever soil cover is desired. This will amount to an equal weight of ground limestone in the case of the sulphate, and about three-quarters of a pound for each pound of the Uramon.

Figure 5. Apple trees which have served their usefulness and are on the downgrade should not be kept another season. They are a liability and should be rooted out.

Figure 6. A young orchard like this one thrives when it is properly fed and fertilized and when the ground under it is properly clothed. Here ample organic matter is being produced among vigorous, widely spaced trees.
Do You Prefer Cross Cultivation of Strawberries?
A planting of Premier, Catskill, and Red Star strawberries was made by W. H. Childs to study the effect on yields of spacing plants 1 1/2 feet apart in the row at planting time as compared to spacing them 3 feet apart. Certain growers in the Ohio Valley contend that the 3-foot spacing permits cross cultivation with a horse most of the season and it lessens hand labor considerably without decreasing yields.

A very cold late spring in 1943 killed some strawberry plants and caused others to start very slowly, thus placing the wider spacing of plants at a greater disadvantage than would ordinarily be the case. Results from the first harvest season show yields roughly 16 percent less for Premier, 22 percent less for Catskill, and 33 percent less for Red Star in the wide spacing. The harvest was about one picking earlier for the wider spacing. Let me point out that results for a normal season might be considerably different. Field experiments like this one are always at the mercy of the weather.

What Cover Under the Apple Tree?
After the sixth season it is still too early for yield data from orchard trees subjected to different cultural practices and soil nutrients. Yet the various legumes and non-legumes used as sods have indicated several things of value to the commercial apple growers of the Eastern Panhandle.

Korean lespedeza is not adapted for use in orchards on the limestone soils, which are so superior for apple growing. This plant species cannot compete with weeds and bluegrass on our better soils, although it will do so successfully on poor, shaly soils, according to the investigator, R. H. Sudds.

Ladino clover—a large type of Dutch white clover—is outstanding as a low-growing legume which thoroughly protects the soil from erosion and water loss. It adds nitrogen and apparently competes very little with the food and moisture supply of the apple trees. However, Ladino seedlings are not able to compete with grass and weeds on our Hagerstown soil series as well as on less fertile soils.

Dwarf sweet clover has resulted in an excellent sod of lessened competition with the trees, as compared with the full-sized or standard type of sweet clover. It is easy to get a good stand of this legume. Dwarf sweet clover can be mowed in dry weather to check its growth if necessary. This way it can still maintain a good legume sod.

Crown vetch, a legume new to orchard use, was promising. A long-lived sod was expected to result—one which might outlast alfalfa by several years. Although crown vetch will endure heavy shade, low soil fertility, a fairly high degree of acidity for a legume, and severe abuse resulting from necessary orchard operations, it is very difficult, if not impossible, to secure an adequate stand. Hence crown vetch is no longer thought of as a legume sod former for orchard use.

While bluegrass sod, plus added mulch spread under the branches of the trees, has shown excellent possibilities, it has demonstrated the absolute necessity of securing better-than-average mouse control.
Safe Coloring of Apples from the Outside

For a number of years now, our chemists have gone into the matter of trying to color apples from the outside. So far they have come into real results. Many trees have by now received thiocyanate sprays annually over a 5-year period. There is no evidence that the spray has any cumulative harmful effect either on the fruit or on the foliage. In spite of the fact that in some years the foliage of some trees has been burned more or less severely, still no ill effects in either foliage or blossoms and fruit have been observed in following years.

In the laboratory, analyses by R. B. Dustman show that the red and the green sides of partly colored apples differ somewhat in their composition. Spraying with thiocyanate reduces the dry matter as well as the sucrose and acidity of the fruit. In the case of Rome Beauty, however, after four months in storage the sprayed fruit actually had a higher sugar content than similar fruit not sprayed with this treatment. Also, the sprayed fruit seems to hold up somewhat better in storage, with better keeping quality than unsprayed fruit.

It is a pleasure to report that much interest and considerable inquiry from outside the state has been shown in the progress of this work.

The Newer Knowledge of Feeds and Foods

One of the newer projects undertaken by the department of biochemistry is on hemicellulose of feeds and foods. V. B. Fish is in charge of this work. The so-called nitrogen-free-extract portion of feeds and foods is a complex group containing many constituents about which our knowledge is short. Hemicelluloses and pectic substances are very widespread in the plant kingdom, perhaps ranking next to cellulose in distribution and abundance as structural materials. Satisfactory methods for their isolation and quantitative determination are not yet available. Lacking also is an understanding of their role and importance in the diet of animals and man.

Yes, Apples Aren't Alike in Their Vitamin C Content

According to the nutritionists, apples are a fair source of vitamin C. But—which apples?

Our chemists had a hunch that there might be a difference in the vitamin C content among the varieties of apples. They also believed that this content might vary from the time the apple is picked until it is eaten. To test their theory, they took three bushels each of Grimes Golden, Delicious, Stark- ing, Stayman Winesap, Rome Beauty, and York Imperial. First they tested all these apples for vitamin content, then put them in cold storage. Two months later they tested again for vitamin content. There was a drop in content in the case of each variety, but there was considerable variation among the varieties. That was as expected, but R. B. Dustman and V. B. Fish were not satisfied with the low readings received from the tests. They thought this might have been due to waiting a while after picking before the first tests were made.
All these apples were brought into Morgantown from Eastern Panhandle orchards.

To check further on their theory, the chemists started to use apples grown in the University orchard at Morgantown. This gave them the chance to test the fruit very soon after picking and to put it immediately into the proper storage temperature. Here are the results and values obtained for freshly harvested fruit of 13 varieties: Red Duchess, 20 milligrams of ascorbic acid in 100 grams of fruit; Duchess, 15.4; Grimes Golden, 14.8; Stayman Winesap, 14.5; Jonathan, 10.7; Golden Delicious, 10.0; Rome Beauty, 9.2; Melba, 8.5; York Imperial, 8.4; Wealthy, 8.0; Wagner, 7.7; Maiden Blush, 7.4; McIntosh, 6.9.

They found further that there is little or no loss of ascorbic acid (or vitamin C) as long as the apples stay on the tree, but that losses after picking may be considerable, even in a short period, and especially so if they are stored at ordinary cellar temperatures. Rome Beauty and York Imperial were the only varieties that did not lose the vitamin rather rapidly when stored at 36° to 40° F. for periods of 3 to 30 days.

So, after a long season of rest, in a cellar not very dry and not very cool, when apples have shrunken and when they get that leathery feel and taste like anything but apple, there can be precious little if any vitamin C left in the fruit.

**We Are Reaching for an Outstanding Blueberry**

The blueberry project is beginning to reach the point where R. S. Marsh and W. H. Childs can expect some results of interest. A breeding program is necessarily slow since we must first select outstanding wild plants and establish them at the experimental farm. Then crosses must be made between these plants and named varieties. Finally the seeds must be planted and the plants grown to the point where they will bear fruit.

A fine group of native plants is now fruiting at the Horticulture Farm, and over 4,000 hybrids have been set out, either at the farm or at the greenhouse. A few of these fruited for the first time in 1944. No superior berries appeared in that year, but it should not be very long before we can hope for some outstanding blueberries which will be suited to West Virginia conditions.

Attempts made in 1944 to find a simple method of propagating these plants by cuttings were unsuccessful. This phase of the study will receive increased emphasis in the future.

**Continuous Varietal Tests of Small Fruits**

Variety testing of small fruits was carried on as usual at Morgantown. Since 1942, W. H. Childs has had under test new plantings involving 16 varieties of strawberries, 14 of raspberries, 4 of gooseberries, 3 of currants, and 11 varieties of grapes.
The only new strawberry variety that seems to be destined to find a place in West Virginia plantings is the Red Star. It is quite late and has proved to be far superior to Gandy and the other late varieties previously recommended.

In a comparison of Red Lake, Wilder, and Perfection currants, Red Lake has considerably outyielded the other two varieties.

The Glendale gooseberry has been the most vigorous grower and heaviest yielder to date. Poorman produces considerably larger berries. Fredonia and Downing have been definitely inferior to these two.

We have found no black raspberry to equal the Cumberland. Bristol is slightly larger and better in quality but does not yield quite as well at Morgantown. Potomac has been distinctly superior to the other purple raspberries tried.

**Top Your Primocanes Promptly at 20-24 Inches**

Our fruitmen have made a study of the importance of topping black raspberry primocanes promptly when they reach the recommended height—20 to 24 inches. Some were topped as soon as they reached 20 to 24 inches, while others were permitted to reach heights of 30 to 34 inches, 40 to 44 inches, and 50 to 54 inches. All were cut back to 18 inches. Measurements were taken of the amount of lateral growth made, the diameter of the cane, and yields.

W. H. Childs found that greater lateral growth and yields were obtained when the primocanes were topped promptly at 20 to 24 inches. The longer they were permitted to grow before being topped, the greater was the decrease in lateral growth and yields. As compared to the 20- to 24-inch group, yields were 20 percent less when the primocanes were permitted to reach 30 to 34 inches, 40 percent less when they reached 40 to 44 inches, and 67 percent less when they reached 50 to 54 inches. Wind breakage and loss of laterals from winterkilling was considerably less also for canes when topped at 20 to 24 inches. Since many farmers do not top their black raspberries promptly, this experiment gives a measure of the loss they are incurring by such oversight.

**We Now Prefer Sebago to the Sequoia Potato**

Some 3,200 seedlings of 21 family lines of potato from the U. S. Department of Agriculture have been planted at Reedsville in Preston County for selection purposes. Twenty-five of the most desirable varieties are being tested by K. C. Westover in replicated trials. All this work is necessary if we are to find a variety of the tuber which will perform with profit to the grower and with satisfaction to the eater.

In last year's trials, a seedling which has been named "Potomac" by the Maryland Station has outyielded all varieties. It seemed to be even less affected by insects and diseases than Sequoia, and it was definitely less subject to soil rots. Cooperators in different parts of the state tell the same story about this new variety.
Two years ago we sang the praises of Sequoia. This potato is high-yielding but it has a tendency to get off shape, overly large, and hollow and to rot badly in the ground. It is losing in favor rapidly. Sebago seems to be taking its place. This variety is not consistently as high yielding as Sequoia, but it is more acceptable to the trade and is less susceptible to soil rots on the heavier and wetter soils. There is a possibility that we shall recommend Potomac and Sequoia and Sebago to gardeners and growers having inadequate facilities for disease and insect control.

**Rye-and-Vetch Is Good After Early Cabbage or Tomato**

The continuous cropping of either early cabbage or early tomatoes, followed by a rye-and-vetch cover crop, has yielded as well as any 2-year or 3-year rotation tried in this experiment, which has been carried on over several seasons. This may mean that in truck-crop production not much is gained when the longer rotations are used. However, crop yields were greater in the longer rotations, and this suggests that such rotations are better adapted to farming schemes in which these crops are handled as field crops (for canning or processing). Cabbage did better after sweet clover, while rotations including red clover were more beneficial to the tomato yields, in K. C. Westover’s observation.

**A Cropping System for the Low-income Farmer**

At Arthurdale, which is now known as the Reedsville Experiment Farm, in Preston County, K. C. Westover has carried out a 10-year project with rotation fertilizer treatments as they affect potato yield. Here the aim has been to work out suitable cropping systems and fertility practices which would enable the low-income and the subsistence farmer to raise early potatoes every other year. At the same time he could produce other crops such as vegetables and hay and green manure crops, which he might need for home use. In 12 different treatments we found the best results from potatoes which received 800 pounds of an 8-16-16 fertilizer applied in the row, followed by a rye green-manure crop the first year and by soybeans, removed for hay, the second season, followed in turn by a rye cover crop, turned under for potatoes.

The second best treatment from the standpoint of yield was potatoes, receiving 600 pounds of an 0-8-8 fertilizer in the row, followed by rye the first year, followed by soybeans and rye the second season, both of them being plowed under for the next potato crop.

As to the most economical treatment, that depends on the need the farmer has for the hay crop.
Figure 7. Beef cattle are the mainstay of West Virginia’s farm economy.

Beef Cattle and Sheep

Good Silages Without Preservatives from Oat and Hay Crops

A few years ago corn was used in the crop rotation on the Animal Husbandry Farm. The land used for cropping was subject to severe erosion when in corn. The rotation was changed to a grassland type of farming and, since the corn crop was grown for silage, other crops are being studied to take its place. At present a legume-grass mixture is used for the hay crop and, when reseeding is necessary, oats is used as a nurse crop. Both oats and the legume-grass mixtures made excellent silage with molasses as a preservative.

During the past two years E. A. Livesay, B. H. Schneider, A. H. VanLandingham, and C. E. Weakley, Jr., studied the legume-grass mixture and oats from the standpoint of preserving these materials as silage without a preservative. Two 100-ton silos were used. Small experimental silos were also filled with these materials, both with and without a preservative, and a detailed chemical study was made, including digestibility studies with steers. Feeding trials were made during the winters of 1942-43 and 1943-44, with bred cows the first winter and yearling steers the second winter.

Very satisfactory silage was made from both the legume-grass mixture and the oats, without using a preservative. No appreciable difference existed when molasses was used, as long as the moisture content of the materials was from 60 to 70 percent of the total weight at the time the silos were filled.
Each silage proved palatable and gave excellent results as a roughage for wintering bred cows and yearling steers. The results indicate that legume-grass silage and oat silage are about equal in value when used as the basal portion of rations for wintering such animals.

No difference in the coefficient of digestibility could be detected when molasses was used. In other words, the total digestible nutrients in the case of both the legume-grass silage and the oat silage were about equal, with or without molasses as a preservative. (Molasses was used at the rate of 60 to 70 pounds per ton in the legume-grass silage, and 40 to 50 pounds in the oat silage.)

The total digestible nutrients in both silages are slightly lower than in normal corn silage. Yet the digestible protein in oat silage is 50 percent more, and in the legume-grass silage 100 percent more, than that found in normal corn silage. This fact makes these silages much closer to normal corn silage in actual feeding value than the total nutrients would indicate.

The results of this project have encouraged a number of farmers to invite the leaders of the project to their farms for information at the time of filling their silos.

**Best Results from Early Lambing and Creep Feeding**

After eight years of trials with early and late treatment of market lambs for gastrointestinal parasites, J. H. Rietz and C. V. Wilson have come to the conclusion that little or no measurable benefit was derived from the treatment of these lambs earlier than the usual weaning time of 4 to 4½ months of age. Early lambing and creep feeding gave the best results from the trials. The objective was to have as many lambs as possible ready for market before the pasture dries up, the heat becomes intense, and the fly nuisance excessive. All lambs that are to be placed in the feed lot, we believe, should be treated when they are weaned.

The treatment used in these trials was either a 1½ percent solution of copper sulphate, or a mixture of equal parts of a 1½ percent solution of copper sulphate and a 1½ percent solution of nicotine sulphate (Black Leaf 40). The dosage was graduated from 1 to 2 ounces, depending upon the age and weight of the lambs. Thrifty lambs at 6 weeks received one ounce. Older lambs 4 to 4½ months old got a dose of 2 ounces. We found these treatments equally effective under the conditions at the Experiment Station.

**Lambs Do Equally Well on Stacked and Mow Hay**

In my last Epistle I reported that during two years of experiments, Burch H. Schneider and A. H. VanLandingham were unable to detect any difference in the condition or growth of lambs fed on stacked hay or hay stored in a mow.

This time, after a third year of work, the scientists were able to show again that well-stacked and mow-stored hay are equal, as far as growing lambs could demonstrate in comparative feeding trials.
Alternating haycocks or windrows were stored in stacks and in the hay mow, and the losses in dry matter were measured. Losses in storage in the stack hay, when carefully stacked and handled, did not exceed the mow hay by more than 4 percent in any year. In some stacks losses were less than 1 percent greater than in the mow. This is an economic matter which should be considered whenever the building of a hay barn is projected.

Figure 8. Healthy, well-fed sheep are an asset to the farm, whether grown for wool or mutton.

A Review of 20,000 Digestion Trials

At the request of the Committee on Animal Nutrition of the National Research Council, research on the digestibility of feeds is being conducted by Burch H. Schneider, Helen Pavlech, and a group of clerical workers. This is a study and tabulation of all available digestion experiments that have been published anywhere since such experiments were first begun.

During the past 80 years, some 2,500 articles and books have been printed in which original digestion experiments have been recorded. In these publications, which are written in 17 different languages, are contained the results of over 20,000 digestion trials for approximately 2,000 feeding stuffs. Someone, somewhere, is always wanting to find out about the feeding value of some product of the farm, forest, or feed mill that is new to him but about which some experimenter at some time and in some part of the world has already provided an answer.
This huge compilation will give experiment station workers and practical feeders a source to which they can turn for information about any material of which the digestibility by any farm animal has been determined. These investigations also will be useful in studying the various factors that cause animals to digest more or less of certain nutrients in feeds.

**Avian Leukosis-complex Continues Mysterious**

In this work an attempt was made to determine the relationship of leukosis-complex (range paralysis) and reproductive disorders. That may be a significant factor in the solution of the problem.

More than 1,000 birds were autopsied by J. H. Rietz. Disease-producing bacteria were isolated from 742 birds. Staphylococci and colon organisms represented 88 percent of the cultures isolated. The evidence obtained here does not support the theory that any one specific organism is essential in causing reproductive disorders.

Chemical analyses were found to be of definite value in differentiating between egg material and pus found in the body cavity of the birds. Not enough work has been conducted to determine the extent and exact nature of the relationship of avian leukosis-complex and reproductive disorders.

**How Much Phenothiazine and Salt for Parasites?**

No single anthelmintic has had so much research done with it as has been done with phenothiazine, and there is much yet to be done, according to J. H. Rietz and C. V. Wilson.

For 11 months a flock of 28 ewes had access to a mixture of 1 pound of phenothiazine to 14 pounds of salt. The lambs from these ewes also had access to this mixture from the time of birth until weaned. The average consumption of the mixture for the period was 0.53 pounds per ewe per month.

The control of stomach and intestinal worms was satisfactory in this flock during this period of time. No other treatment was given. The parasite egg count in the feces was low. Of the parasite eggs present only a small percentage proved to be viable.

The last fecal examination failed to show the presence of tapeworms.

Recommendations for the phenothiazine salt mixtures for the control of internal parasites of sheep have ranged from 1 to 9 to 1 to 19.

No definite conclusions can yet be drawn from these trials because of the small number of sheep and the short period of time used.
In Poultry Rations, Soybean Oil Meal Is Satisfactory Protein

Two control lots and two experimental lots of New Hampshire chicks, 300 to the lot, were grown at the Reymann Memorial Farms by T. B. Clark and C. J. Cunningham on rations containing different levels of soybean oil meal. The control lots were fed a regular starting ration containing fish meal, meat scraps, and soybean oil meal. One of the experimental rations contained no fish meal; the other carried neither fish meal nor meat scrap. In both of these rations the difference in protein was made up with soybean oil meal.

Removing the animal protein from the ration reduced the growth rate to 12 weeks of age in both sexes and increased the pounds of feed per pound of gain, but there were only slight differences in the weights of the pullets and in the feed efficiency at 20 weeks of age. The results suggest that because of the variability in feeds, starting rations should contain some animal protein. But in growing rations, soybean oil meal will replace animal protein satisfactorily, even when pullets are grown in confinement.

Continuing this study with layers, one series of pullets was started in November and the other in March. One lot in each series was fed a laying mash containing 10 percent meat scrap and 13 percent soybean oil meal. The second mash contained 5 percent meat scrap and 20 percent oil meal. The third mash contained no meat scrap and 28 percent oil meal.

The average yearly egg production was about the same for all lots of pullets. The percentage hatchability of fertile eggs was about equal from the three rations, but the percentage of salable chicks was lower from the all-soybean oil meal mash. These results show that when properly supplemented with vitamins and minerals, soybean oil meal is satisfactory as the sole protein supplement in the laying mash. For high hatchability, as for rapid growth, some animal protein such as meat scrap or fish meal should be included in the breeding mash.

The More the Sources of Protein, the Better

In poultry rations, it is best to have your protein from several sources. Practical poultry rations always contain a large percentage of cereals which provide about one-half the total protein in the ration. According to some investigators, the proteins supplied by these feeds are lacking in both quantity and quality for maximum growth and production.

A. H. VanLandingham, T. B. Clark, and B. H. Schneider have conducted balance trials with chickens, and their research does not confirm that statement as to quality. In fact, the proteins supplied in our basal rations of yellow corn and gluten meal, or yellow corn and wheat standard middlings, or whole wheat and wheat standard middlings—these proteins were utilized
more than the proteins in samples of meat scrap and menhaden fish meal studied. What's more, the cereal proteins were found about equal to the proteins of soybean oil meal.

Our researchers are convinced that the value of protein feeds depends as much on the basal ration as on the protein supplement used.

**Alfalfa Leaf Meal May Be Good Source of Riboflavin**

Riboflavin is a vitamin important for the growth of chicks. T. D. Runnels, T. B. Clark, and A. H. VanLandingham tested four levels of dehydrated alfalfa meal—3, 6, 9, and 12 percent—in a basal ration low in this vitamin. With the ration used, a 3 percent level of alfalfa meal apparently supplied all the riboflavin the chicks needed. We now know that absence or prevention of curled-toe paralysis is a sure sign that the riboflavin requirements have been met.

Alfalfa leaf meal apparently is as efficient as other supplements for this purpose. When we increased the level of the meal up to 12 percent, the growth rate was not increased; neither was the feed efficiency lessened. These results indicate that as a riboflavin supplement, a 3 percent level of high-quality alfalfa leaf meal is enough. If the price is reasonable, it can be used up to 12 percent of the ration as both a riboflavin and a protein supplement.

**Figure 9. Is soybean oil meal, when used as the only protein supplement in the laying mash, a satisfactory pinch hitter for the more costly animal proteins? Our research seems to bear this out.**

**Immature Silages for Hatchability in Chicks**

It is a well-known fact that many grasses and legumes when cut at an early stage and dried are good sources of carotene and of riboflavin. How well these vitamins are preserved in silages from such crops is being studied in our chemical laboratories. At the same time, feeding trials are under way by T. B. Clark, A. H. VanLandingham, and C. E. Weakley, Jr.

The effect is being studied of feeding alfalfa, red clover, and immature oat silages, made in 50-gallon drums, on growth of chicks and pullets and on egg production and hatchability. Chicks were unable to consume sufficient quantities of the silage to prevent curled toes. This indicated lack of riboflavin.
In growth trials with pullets, oat silage did not increase growth or decrease the amount of feed consumed. Results from five lots of pullets show that silage made from oats or red clover did not increase egg production.

While the results are not consistent, these silages did on the average increase hatchability even when fed with a ration containing all the known factors for good hatchability. Silage darkened the yolks only slightly when 2½ pounds daily was fed per 100 layers.

**What Substitute for Bone Meal?**

Two experiments have been conducted by T. B. Clark, C. E. Weakley, Jr., and A. H. VanLandingham to determine how available is the phosphorus in defluorinated superphosphate, as compared with that in bone meal and in meat scrap, for bone development in chicks.

Now, the availability of the phosphorus in this type of superphosphate is lower than that in steamed bone meal or in other standard phosphorus supplements. Yet superphosphate when properly defluorinated may be used to help meet the increased needs of chicks for phosphorus. The results suggest that less bone meal is actually required than is generally used. Also, the amount of phosphorus in meat scrap, when fed at a 2 percent level in the ration, along with adequate vitamin D, will provide normal bone development in chicks.

**For Long Life and High Production in White Leghorns**

We continue to work toward the development of good livability and high egg production in the Station flock of S. C. White Leghorns. During the 1942-43 season, E. T. Wightman and E. N. Moore started 718 pullets in the laying pens and of these, 543, or 76 percent, were alive at the end of a 365-day laying period. The average production, based on the original number of birds housed, was 173 eggs.

This represents an increase in livability of more than 10 percent over the previous season (66%) and an increase of almost 10 percent over the average of the three previous years (67%). Egg production (173 eggs) also was better than the previous year (164) but slightly less than average for the three previous years (176).

The 718 pullets were daughters of 11 sires and 78 dams. Livability of daughters of individual sires ranged from 82 to 56 percent, and livability of daughters of individual dams ranged from 100 percent to zero. Six families, each having seven or more daughters, had 100 percent livability. So far, several family lines have been developed in which high livability has been carried through two or three generations.

These results lead us to consider the possibility of selective breeding as a means of reducing mortality in the laying flock. If we continue to select breeders from such families, and allow the better families to multiply, the experiment should result in a higher average flock livability and at the same time maintain high average egg production.
Cracked Grain Reduces Pasting-up in Chicks

Many broiler producers follow the practice of feeding cracked grain alone the first three or four days of the chick’s life, followed by broiler mash to prevent “pasting-up” or constipation. To study this method of feeding, C. J. Cunningham and T. B. Clark grew 12 lots of New Hampshire chicks to 12 weeks of age at the Reymann Memorial Farms in Hardy County. Six lots were fed cracked grain the first 3 days and then were fed starting mash. The other 6 lots were fed starting mash from the first day.

The results were not consistent, probably because of variable brooding conditions. But the feeding of cracked grains in general did reduce to a negligible amount the “pasting-up” observed the first two weeks. The total mortality up to 12 weeks of age was not affected by the method of feeding, and the mortality credited to “pasting-up” was negligible. Feeding cracked grain alone the first 3 days had little effect on body weight, since all comparable lots were about alike in average body weight at 12 weeks of age.

Should We Restrict Feed to Pullets on Range?

This Station has found that rearing turkeys on a grass range reduced the feed consumed. But in the case of pullets it is doubtful that a material saving in feed occurs when they have access to all the mash and grain they will consume. We can effect a saving in feed cost if we reduce the quality of the mash, since the pullets can get vitamins from small quantities of green, palatable grass. But to decrease the total amount of feed consumed, pullets apparently must be forced to eat grass and insects and so restrict their feed intake. To determine the effect of this procedure on growth and the later performance of the pullets, an experiment by C. J. Cunningham and T. B. Clark is under way at the Reymann Memorial Farms.

By restricting the grain and mash feeding to certain periods of the day, we were able to reduce the amount of feed consumed during the growing period. But this practice resulted in lower average body weight of the pullets when 24 weeks old. The restricted lots consumed more feed than the unrestricted lot after being placed in the laying pens; this offset the feed saved during the growing period. The methods of restricting the feed apparently had little influence on egg production, since the average production up to seven months was alike for all lots.

The work is being continued to determine if a practical method of restricting feed to pullets on range can be worked out—a method that will have a beneficial effect on the pullets and at the same time reduce feed costs.

Hatchability Improves When Turkeys are Crossbred

Continuing with the study of crossbreeding in turkeys, reciprocal crosses have been made using the Broad Breasted Bronze with the standard Bronze, Bourbon Red, Black, and Beltsville White varieties. In most crosses an improvement in body conformation resulted when the Broad Breasted Bronze variety was used as one of the parents.
A summary of five years' results from this study showed T. B. Clark, T. D. Runnells, and E. A. Livesay that, in general, crossbreeding did not increase fertility. It did, however, result in an increase in hatchability, the average increase being 8 percent of the fertile eggs set and 11 percent of the total eggs set for the varieties tested. According to popular opinion, crossbreeding increases livability in poult's, but this study showed that the livability of the crossbred poult's was no higher than that of the purebreds up to four weeks of age. It was shown also that the Broad Breasted Bronze poult's lived as well as those of the other varieties.

![Figure 10. Left, the Beltsville White turkey; right, the Broad Breasted Bronze. Crossing these varieties produces a medium-sized turkey and in some cases increases hatchability.](image)

In actual practice, Broad Breasted Bronze toms are used on hens of the other varieties. The practice was found to be satisfactory in these studies. This variety is generally regarded as being lower in fertility and hatchability than the other varieties. Mating the Broad Breasted Bronze toms with the standard Bronze hens or with hens of the white-feathered varieties will result in a Bronze feather pattern and should increase hatchability above that for the low-hatching strains of the Broad Breasted Bronze.
Dairy Cattle and Dairying

Our Dairy Herds Are Tops

The Experiment Station's dairy herd of Ayrshire cattle is unsurpassed by any station herd in the country. And it enjoys an enviable international position among Ayrshire herds. During 1942 this herd was the highest-producing herd for its size in the country, with an average of 11,555 pounds of milk testing 4.35 percent and carrying 502 pounds of butterfat. In 1943 the average was 11,079 pounds of milk testing 4.31 percent with 478 pounds of butterfat. The herd has been officially classified for type, has a higher score than any other college Ayrshire herd, and ranks among the top dozen herds of the breed for good type. This herd has also been given the coveted Constructive Breeder Award by the Ayrshire Breeders' Association for having carried out a breeding program that resulted in a combination of splendid type and outstanding production. G. A. Bowling is the project leader.

The Holstein and Jersey herds of the College of Agriculture have made exceptionally good showings during the past biennium, too. In 1942 the Holstein herd average was 11,103 pounds of milk testing 4.1 percent and 455 pounds of butterfat. In 1943 it averaged 11,454 pounds of milk testing 3.8 percent and 435 pounds butterfat. This herd has two production leaders for the state. One cow set a new state record for milk production. The herd has been officially classified for type with a score of 0.835, which is considered very acceptable.

The Jersey herd has made steady progress and ranks quite well with the college Jersey herds throughout the country. Last year it qualified for the Constructive Breeder Award of the American Jersey Cattle Club because of its high rating for both type and production. In 1942 the herd averaged 8,530 pounds of 5.38 percent milk with 459 pounds of milk. A year later the average was 7,944 pounds of milk testing 5.54 percent and 440 pounds of butterfat.

While the difficulty of securing the right kind of feed and satisfactory dairy farm labor has caused a slight decrease in production in the Experiment Station and College herds, they are doing their bit in the war effort. At the same time they are pointing the way to better production for all dairy herds in West Virginia.

An Open Secret in Breeding for Better Production

If dairy cows multiplied as rapidly as fruit flies, and if we had facilities for taking care of all of them, in a few short years we could have a fairly complete picture of the way milk and butterfat production and body conformation in dairy cattle are inherited. Since it takes nearly four years to produce a generation of dairy cattle, however, the task of learning the details of the genetics of dairy cattle is of long duration.

During the 21 years of the breeding experiment that has been in progress with the Reymann Memorial herd of Ayrshire cattle, we have learned much
Figure 11. Cacapon Lindy VI, an outstanding proved sire of the Ayrshire breed. Bred and developed in the Reymann Memorial herd of the Experiment Station, he is one of the herd sires used in a project on the transmission of milk and butterfat percentage and of body conformation in dairy cattle.

that is helpful in breeding better dairy stock. This herd has been improved to the place where it has been recognized as the highest-producing Ayrshire herd of its size in the Nation. Here G. A. Bowling and D. N. Putnam have demonstrated that this high position can be reached by the use of properly selected proved sires. Breeding efficiencies of dairy sires of various ages have been determined, and normal growth rates for Ayrshire cattle have been established. These facts, with others, can be used to advantage by farmers in building up their herds.

But so far, the studies of dairy-cattle breeding have been largely of the demonstration type. The job of determining the fundamentals that underlie the art of breeding is yet to be done. It is a job that only experiment stations can complete, and it may take many generations of men and cows. In West Virginia, we are on the way.

Short Cuts from Long Tables on Dairy Records

The most serious limitation in studies involving dairy-cattle breeding in any one herd is the shortage of animals on which we may base observations. By overcoming this obstacle we can save many years of costly effort in exploring the field of heredity. G. A. Bowling and D. N. Putnam are attempting to do just that through a cooperative project with the National Ayrshire
Breeders’ Association. This association has turned over to us—to West Virginia—over 100,000 unselected records collected over a period of years from 250 different herds. These records are all on punch cards, and they can be sorted and tabulated by machine.

This Experiment Station has established itself in a place of leadership in this type of work. The results to date have been very gratifying. Methods of predicting the transmitting ability of young bulls have been developed. Shortcuts in the proving of sires have been recommended, and the effect of age on the butterfat percentage in milk has been determined.

On work of this sort, however—and patient, painstaking work it is—we can go no further than available moneys and short personnel will permit.

**Thyroprotein—Boon to Dairy Cows?**

Perhaps we are on the threshold of a new development in dairy-cattle feeding. Two groups of 3 Holstein cows were fed 15 grams daily of iodinated casein with thyroid activity for 4-week periods in a reversal feeding trial. The experiment covered a period of 13 weeks. The cows were in the sixth to eighth month of lactation and were producing from 30 to 40 pounds of milk a day at the beginning of the experiment.

Milk production rose from 5 to 20 percent, and the total fat production from 25 to 50 percent. During the first four weeks of feeding this iodinated casein, the fat content of the milk was increased by 0.47 to 0.98 percent above the fat content at the beginning of the experiment. When this special material was discontinued for four weeks, and then fed for a second 4-week period, the fat content at the end was increased by 0.90 to 2.03 percent above the fat content of the milk at the start.

Even though this material will cause an increase in milk and fat production, further experimental work is needed to determine the effect of this new drug when fed for longer periods of time. If it should be found to have no harmful effect upon dairy cattle when fed throughout complete lactation periods, it might be used to stimulate milk and butterfat production, particularly among medium- or low-producing cows. A. H. VanLandingham, H. O. Henderson, and C. E. Weakley, Jr., are the experimenters in this project.

**Mastitis Need not Follow High Production**

In my last Epistle to the Farm, in 1942, I pointed out that neither the make-up of the concentrate ration nor the rate of grain feeding seemed to have any bearing on the development of mastitis. This study has been continued by A. H. VanLandingham, H. O. Henderson, and C. E. Weakley, Jr., to get information on the rate of milk production as related to the development of mastitis. It is common belief among dairymen that only their best cows are affected with this disease. Results indicate that high production doesn’t necessarily result in the development of mastitis. Medium producers seem just as likely to develop the disease as high producers. The linking of mastitis with the high producers is probably because the better cows are
OLDER COWS, WITH LARGE UDDERS SUBJECT TO INJURY, OFTEN DEVELOP MASTITIS AND BECOME SPREADERS

STREPTOCOCCI STAPHYLOCOCCI
INFECTIVE AGENTS

EXCESS VACUUM
UNCLEAN MACHINE CUPS
WET HAND MILKING
UNCLEAN PREMISES
FLIES
MOST YOUNG COWS ARE MASTITIS FREE BUT MAY BECOME INFECTED AS A RESULT OF TEAT OR UDDER INJURIES OR UNCLEANLINESS OF THE PREMISES OR MILKING METHODS

NORMAL HEALTHY UDDER

Figure 12. The mastitis cycle in dairy cows.
kept in the herd for a longer time, and thus have a greater chance to develop it than poor producers which are more likely to be culled after a few lactations. The greater mammary development found in good mature cows also makes it more likely that mechanical injuries can happen to the udder. Such injuries may predispose the udder to the development of mastitis.

Does mastitis cause a change in the chemical composition of the affected milk? The answer is “Yes.” Mastitis may be diagnosed by a study of the composition of the milk produced by the four quarters of the udder. The organisms causing the disease were not found invading all four quarters of the udder at the same time. Individual quarters function as separate units, and healthy and affected quarters may exist side by side. Milk from normal quarters in a diseased udder is no different from milk produced by udders showing no signs of mastitis, and so is altogether safe.

We Are Making Progress in Off-flavors of Milk

There is a project on off-flavors of milk which was started only 10 years ago, but it has been quite productive of results. During this period no less than 14 scientific reports have been published dealing with many phases of the nature, causes, and methods of prevention of oxidized flavor. I think it is well to point this out because such reports go far toward acquainting the whole field of dairy science, as well as the commercial trade, with an important piece of work being done at this Experiment Station.

I won’t go into the technical details of this piece of research. Suffice it to say that many individual factors may be involved in whether or not milk is subject to the development of this off-flavor. Our chemists (W. C. Brown, R. B. Dustman, and F. C. Olson), report, however, that it is now reasonably well established that among many components which make up milk, what we call phospholipids are the portion affected when oxidized flavor develops.

Figure 13. Left, general appearance denotes the thrifty, vitamin-fed white rat; right, an undernourished rat showing vitamin B deficiency.
Plant-disease and Insect Control

New Organic Spray Substitutes May Surpass Originals

The threatened shortage of metallic fungicides containing copper, mercury, and other materials needed for military purposes has stimulated the investigation of organic substitutes. J. G. Leach and C. F. Taylor have tested several of these extensively in West Virginia. They have been found very satisfactory for dusting seeds to control damping-off and certain other diseases. Some of these organic compounds also have given excellent results when used as sprays or dusts for the control of diseases like early blight of tomato. The use of these organic materials has contributed to the war effort by releasing other materials for military use. Since many of these new organic compounds appear to be better in many respects than the metallic compounds for which they are being substituted, it is likely that after the war they will be used more and more extensively.

Fixed-copper Sprays Give Better Control of Cherry Diseases

The sour-cherry spray schedule developed during the past six years has greatly improved the control of cherry leaf spot. Two sprays of lime-sulphur solution after bloom, followed by fixed-copper sprays before harvest and by Bordeaux mixture or fixed copper after harvest, have given excellent results. A fixed-copper spray before harvest has given excellent control of brown rot of the fruit. Bordeaux mixture may be substituted for the fixed copper before harvest, but it tends to reduce the fruit size and, consequently, the total yield.

A number of organic compounds have been tested as apple sprays. In the 1943 tests, Fermate, in an equal number of applications, gave us a control of apple scab equal to that of flotation sulphur. Phenothiazine failed to give satisfactory protection against scab in these tests. C. F. Taylor is the leader in this project.

Cause of Apple Measles not yet Known

“Measles” is a destructive disease of the apple, especially severe on Stark's Delicious, which is a variety of great economic value in this state. The disease is called “internal bark necrosis” but is more commonly known as “measles” by the orchardists. It has irregular, dead, brown-colored pockets of tissues scattered throughout the interior of the bark. The trees sometimes become diseased and die shortly after they are planted. However, most of them linger on for many years and bear apples, although their productive capacity is greatly lessened.

Although extensive research has been conducted by Anthony Berg and Genevieve Clulo at this Station for a number of years, the cause of the disease has not been determined definitely. We have, however, found that the disease is not due to any parasitic organism, and since it is more severe in certain orchards in a given area, it may be due to an unbalanced mineral relationship.
In the past two years several hundred apple trees have been planted in orchards where this trouble is most prevalent. Many chemicals and fertilizers are being applied to various lots of these trees in an effort to discover a corrective treatment. Samples of leaves, bark, and wood collected from these trees at various intervals during the growing season are being analyzed to see if there is any difference in the mineral intake of the healthy and the sick trees. We have noted that the leaves and bark of severely diseased trees contain very much greater quantities of certain mineral elements than those of the healthy trees grown on the same soil. Large numbers of trees are also being grown in the greenhouse, in soil taken from an orchard where the disease has been very severe. These trees are subjected to different treatments in the search for corrective treatments, and to establish the cause of the disease.

The diseased bark is also being studied under microscope, to determine what tissues are being affected and what structural changes take place during the course of the disease. A knowledge of these changes will help in diagnosing the disease and in distinguishing it from other diseases with similar symptoms.

**Stripe Smut—A Destructive Disease of Pasture Grass**

In our studies on the improvement of bluegrass as a pasture crop, a fungus disease known as stripe smut shows up as the most destructive disease of bluegrass in pastures. Smut is often the cause of pasture failures during

![Figure 14. Left, bluegrass affected with stripe smut, a destructive pasture disease; right, a healthy plant.](image)
the hot weather in midsummer. In some pastures more than 50 percent of the bluegrass plants are affected with smut. Infected plants are stunted and often die in dry weather.

Further experiments have shown that some bluegrass plants are not affected with smut because they are resistant to the disease. One of the problems in bluegrass improvement is to locate the resistant plants and test them for their value for pasture use. In order to identify the smut-resistant strains, it was necessary to find some way of inoculating large numbers of plants artificially with smut, so that the susceptible ones could be eliminated. This has not been an easy task, but through extensive experiments J. G. Leach has worked out a satisfactory method. Experiments are now under way testing promising selections and eliminating the plants susceptible to smut. As a result it will be possible to assure that any improved strains of bluegrass put out for use in pastures will be resistant to that ailment.

**Hot-water Treatment Helps Control Grain Smuts**

Loose smut of wheat and of barley are among the most destructive diseases of these crops in West Virginia and often cause losses as high as 20 percent of the crop. The two diseases are carried inside the grain seed and can be controlled satisfactorily only by a hot-water treatment. This treatment is too complicated and takes too much equipment for general use by the farmer. The most practical method of control is through the production of smut-free seed, by a few growers of certified seed. We have tried to control this disease in West Virginia by promoting the production and use of certified seed. But the lack of any suitable equipment for applying the hot-water treatment has made the control program only partly successful, J. G. Leach and A. D. Longhouse report.

The Department of Plant Pathology, in cooperation with the section of Farm Mechanics and with the Department of Agronomy and Genetics, has devised a hot-water treating machine in which the temperature of the water and the time of the treatment can be controlled accurately. We plan to place these treating machines in suitable places in the state. Any grower of certified seed may send his seed there and have it treated so that this crop will be free of loose smut. The seed produced by these growers will then be available to any farmer in the state. If the farmer will plant only certified seed, produced in this way, he can be reasonably sure that his crops will suffer no appreciable loss from smut.

**To Stop Tip Blight, Control Thrips!**

Tip blight of tomato is a destructive virus disease. It was discovered for the first time in West Virginia about four years ago. The disease is most destructive on young tomato plants grown in greenhouses for transplanting in the field. When infected plants are transplanted they die prematurely and produce little or no edible fruit. The growing tip of the affected plant is the
first to become diseased, but the sunken, brown streaks soon spread to all parts of the plant.

According to J. G. Leach and A. Berg, this disease was found to be the same as or similar to one known for several years on the Pacific coast but not previously recorded from the East. It also was transmitted in the greenhouse only by a small insect known as "thrips." In one greenhouse where the disease was causing much damage, a spray program which proved effective for control of thrips was devised, and when the insect was brought under control, the disease also disappeared. The experiments demonstrated conclusively that the disease could be stopped by controlling the thrips. These measures will be of great value not only to the grower of plants for sale, but to the Victory gardeners who have often lost their tomato crop as a result of planting plants infected with tip blight.

Probing Secrets in Vitamin Assay

Since the importance of vitamins in the human diet has been recognized, it has become important to know the vitamin content of many foodstuffs. Prolonged feeding tests on pigeons, rats, and guinea pigs were used by the early investigators to determine the vitamin content of a food. These tests often took months to complete.

For several years L. H. Leonian and V. G. Lilly have been studying the vitamin requirements of many yeasts, molds, and bacteria. These tiny forms of life require vitamins, just as you and I. Many of these organisms failed to grow on synthetic mediums unless the proper vitamins were added. Since the growth of the test organisms in many cases was in proportion to the amount of vitamin added, they could be used to determine quickly the vitamin content of a food.

The accuracy of the tests can be increased by using the right kind of organism. During the past two years, extensive studies have been made on the determination of the members of the B-complex vitamins. These studies have dealt with the proper choice of test organism to be used and with the conditions under which the test is best made. The fungi mentioned have been found to be very sensitive; in some cases a few parts per billion of a given vitamin will permit growth of the yeast or mold. Thus the conditions under which the tests are carried out must be carefully controlled, if errors in the determination are to be avoided.

To Conquer Some Diseases, Get After Insect Carrier!

Insects cause much injury by feeding directly on our crop plants. Many of them also cause indirect injury by transmitting fungi and bacteria that cause diseases. The injury caused by such insects is often overlooked, and special study is often necessary before one can understand the relationship of the insect to the disease which it spreads.

An example of such a relationship is that between the green stinkbug and the yeast spot of lima beans. It has been known for several years that
the spotting of the lima beans and the premature dropping of the pods is due to infection with a yeast fungus that is linked with the feeding of the stinkbug. Just how that bug transmits the yeast, and how the yeast fungus lives over the winter, has not been known.

Figure 15. This is the disease of lima bean which is transmitted by the green stinkbug.

This relationship has been studied in West Virginia by J. G. Leach, who learned that, contrary to the belief by some observers, the yeast did not live over winter in the body of the insect. Instead, each generation of stinkbugs must get contaminated with the fungus by feeding on some infected material somewhere, before it migrates to the bean plant. The discovery and destruction of these sources of infection for the stinkbug may offer some possibility of controlling the disease of yeast spot.

Insect Proved Guilty of Spreading Purple-top Wilt of Potatoes

Our studies over several years on the potato disease known as purple-top wilt (or bluestem) have proved conclusively that it is caused by the aster-yellows virus. That virus is transmitted to potatoes by the aster leafhopper. The virus has a long incubation period in the potato; therefore the disease does not appear until late in the summer. Because of this long period, early potatoes escape with little or no injury, while late potatoes may be greatly reduced in yield and quality.

J. G. Leach has found, too, that infection must take place fairly early in the season in order to produce injury. For this reason it would be necessary only during early stages of growth to protect the potatoes from the insect.

Although no satisfactory method is now known for controlling the leafhopper that spreads the virus, some of the newer insecticides may be effective. Until we know some satisfactory means of controlling the insect, late potatoes grown in West Virginia will not yield as well as they should, and many of them will be internally discolored at the stem end.

What we have learned so far about the cause of the disease, and about the habits of the leafhopper that spreads it, offers for the first time a satisfactory
explanation for the distribution of the disease in certain northern areas of the United States and at the higher altitudes in West Virginia and neighboring states.

Unlike other virus diseases of potatoes, purple-top wilt is not perpetuated through the tubers, but tubers from infected plants give weaker plants than those from plants not so infected.

**Extreme Methods Today Reduce Tomorrow’s Problem**

The codling moth continues to harass the experimenter as well as the apple grower. Costly sprays have been found necessary to keep moth populations down, but each year there is a hangover which starts the insect all over again, come next spring.

At the West Virginia Station, in experimental orchards in the Eastern Panhandle, two severe methods have been tried. In one orchard with a heavy infestation, the moth was virtually wiped out by “de-fruiting” in one year. In this way the insect was simply starved. In the following year, no cover sprays whatever were applied, yet a crop of first-class apples was marketed.

In another heavily infested orchard a very strong spray was applied. This was extremely effective in eliminating the pest, but it was entirely too expensive to carry out every year.

It may prove that if such a program (de-fruiting or extra-strong spray) is applied once every three or five years, a very simple spray program will be required, and no residue problem will be encountered during the in-between years. And if such a scheme is satisfactory from the commercial point of view, then we will have gone a long way toward solving this problem of the codling moth.

**Insects Will Move in Where Conditions Are Right**

After a season’s hard work in growing a grain crop, the farmer hopes to store that grain and keep it for the appointed time of use.

But insects are ever on the prowl and, granted the right conditions of heat and moisture, they will move in.

Keep your storage temperatures low, and your insect problem will be greatly lessened. Too, if your grain has first been dried thoroughly, it has a much better chance of surviving the winter, pest-free.

* * *

Why is it that, in some years, some insects are much more numerous than in other seasons? And how do some insects take several years to build up large numbers, while others show a sudden increase in a single year? These questions are very complicated. To answer them, we must give intensive study to the insects and to the parasites which prey on them. Let me illustrate: The locust leaf beetle has been increasing steadily for three or four years. The bagworm has behaved in much the same way. And the fairly new alfalfa spittle insect has built up tremendous populations in a period of four years.

[39]
Climate may have much to do with these developments, and natural enemies may serve to check the insect. If we constantly make the proper observations, we may in time be able to predict the outbreak of this pest and that.

In fact, we now employ short-time predictions to indicate the optimum dates for applying sprays, for planting certain crops to "dodge" the maximum injury by certain pests, and for the timing of certain cultural practices designed for insect control.

We Keep Constant Vigil for New Poisons for Insects

The Experiment Station keeps constant lookout for possible spray materials which will aid the fruit grower in his pursuit of a clean abundant crop. Hence new materials, combinations, and schedules of application occupy the time and energy of our entomologists. In the process, many sprays show up which prove to be less satisfactory or more costly than established sprays. Here we serve by keeping the grower informed. Then again, we come across other materials which show promise but which still lack some of the properties of an acceptable insect killer. In such cases the manufacturers go along by modifying the stuff. Or they may improve their conditions of manufacture and so make their product more available, or cheaper. Of course, during the War we can't expect much in that direction, but we can look forward with assurance to postwar supplies of the good new materials, at a price which the orchard industry can afford.

This project also concerns itself with minor insects which may flare up at any time, to the grower's grief. At one time, the pistol case-bearer threatened to become a serious pest. Thorough research and prompt action brought it under control. Today the long-established plum curculio and even the apple aphid are feared much less than they were just a few years ago. Today modern spray schedules tend to prevent outbreaks which might have occurred before the improvement in materials, in methods of application, and in timing went into effect.
Farm Economics

Livestock-marketing Agencies in Review

The sale of livestock is still one of the largest sources of cash farm income in West Virginia. A good many changes have taken place in livestock marketing in the past 10 years. When you think of the possible influence on livestock sales practices of such factors as improved roads, greater use of motor trucks, and growth of auction sales, the necessity for looking into the operating policies followed by various agencies that solicit the business of farmers becomes quite clear.

Figure 16. Where county and area cooperative livestock marketing associations were operating in 1942.

We have issued a bulletin which considers the influence of these factors on the organization and operation of these agencies. M. A. Abrahamsen, the author, dwells on characteristics of local slaughter house operation; operating methods of local dealers; an appraisal of the efforts of cooperative associations to better their service to farmers; and the development, organization, and operating practices of livestock auctions. From the standpoint of the farmer who is interested in the market services performed by the various agencies, in their efficiency of operation, and in possibilities for improvement in business methods, definite conclusions and recommendations are offered.

Bulletin 312, "Livestock Marketing Agencies in West Virginia," goes in detail into all these matters. It is available on request.

Nothing Better Than Lime and Phosphorus for Pastures

If farmers just once limed and fertilized half their pasture and did nothing to the other half, there would be such a difference in results that they would remember it for many years to come.
The full benefits of pasture treatment are not seen until at least the second year after treatment. F. D. Cornell took measurements of improvement practices on a practical farm basis in Upshur County and the results of these studies were published as a Station bulletin (Bul. 304).

These studies showed that where applications were heavy enough to increase the lime and phosphorus content of the soil materially, the increases in yield ranged from 68 to 79 percent. Farmers estimated that the carrying capacity of these pastures was raised between 80 and 90 percent. Not only were yields better, but the quality and kind of vegetation changed too. Legumes and desirable grasses did noticeably well, while undesirable grasses, weeds, and bare space declined. Also, the increases in production were well distributed throughout the pasture season and were not confined to flush periods, as is sometimes assumed.

The Cost of Producing 100 Pounds of Milk

About ten years ago our economists made a study of the cost of producing milk in the Charleston area. In that project L. F. Herrmann visited each of 20 representative dairy farms at regular intervals, weighed and tested the milk, weighed the feed, and kept a detailed record of all expenses and receipts. As a result it was possible to state the cost of producing milk in terms of both dollars and physical input. And a formula was devised by which the cost of producing milk could be estimated at any time, by applying current prices to the physical inputs involved.

In the summer of 1943 W. W. Armentrout visited 13 of the farmers who had been included in the 1935 study. This was reported in Bulletin 281 of the Experiment Station.

From this late survey we conclude that during the present period feed costs are 143 percent, and labor costs are 160 percent of what they were found to be in 1935. All other costs, we think, run about the same. The actual figures are as follows:

Cost of feed and pasture rose from $1.32 in 8 years to $1.89 per 100 pounds of milk; cost of labor, from 43 cents to 69 cents. All other costs amounted to 22 cents in both periods. The total cost for producing 100 pounds of 4 percent milk was $1.97 in 1935, and in 1943, $2.30. By applying the formula suggested and pointed out in Bulletin 281, we arrive at the figure of $2.72, which is not far off the actual finding of $2.30 for the cost of producing 100 pounds in 1943.

Streamlining the Transportation Practices

The impact of the War has brought to light many points of weakness in our marketing system. Emphasis in agricultural production has changed, and technical developments in production, transportation, and distribution have come to the fore. The government is playing an increasingly important part with regard to policies of domestic and world trade. All these factors are making their influence felt in the farmer's market place.
M. A. Abrahamsen's study gives attention to three phases of marketing problems that have come about as a result of the War. These include milk assembling and distribution, livestock trucking, and marketing of surplus garden products. We already have published material on the first of these problems (Mimeo. Cir. 47). In it we point out that consolidation of routes, elimination of much individual hauling, and pooling of truck resources so as to provide for the hauling of supplies back to the farm—all these would result in increased efficiency in assembling milk. We believe, too, that mileage could be cut about 30 percent by that procedure, and that service could still be maintained at previous standards.

Figure 17. A representative auction barn in the Mountain State.

When it comes to distributing milk, every-other-day delivery, selling more milk wholesale, especially to stores, dropping parts of routes, and discontinuing service to scattered customers—all these actions would do much to reduce the excessive duplication in milk-delivery service which prevailed at the outbreak of the War. By the same token, the necessary mileage required for effective milk distribution could be reduced by one-fourth to one-third.

A War Food Production Goal in Every County

In 1943 W. W. Armentrout and D. M. Keyes collected basic information in all farming counties and analyzed it to find out how West Virginia agriculture could use its resources to best advantage in contributing to America's war food production program. The report was submitted to the U. S. Department of Agriculture and to the West Virginia Agricultural War Board. These agencies are charged with establishing war food production goals in the state and the counties. Production goals in 1944 were similarly worked out, based on recommendations in the 1943 report and on total needs. This project continues each year of the War.
Conservation and Good Management Can Go Hand in Hand

In studies covering a five-year period and carried out in cooperation with the Federal Soil Conservation Service it was demonstrated that soil-conservation practices are consistent with good management. Now the emphasis of this project has shifted to an individual farm basis. Much work was done by E. C. Weitzell and D. M. Keyes with farmers in Conservation Districts in helping them to work out a desirable organization plan in which good management and desirable conservation practices would go hand in hand. Records from farms in each area were analyzed and presented so that each farmer could compare his results with the average and with the best in his area. Thus he could see, by direct comparison, in which of the factors he was lacking. This procedure has been a great help in bringing about worthwhile adjustments.

We Must Guard Against Sudden Pressure on Land

Since the Farm Labor Program has been taken over by Agricultural Extension, we have not done any work on the current farm-labor problems. We have assembled some data from secondary sources and have advised with the Extension personnel in charge of the program.

Our work in 1944 has been to attempt to estimate the post-war labor situation and how it may affect agriculture. The leader of this project, W. W. Armentrout, has served on a State Planning Board Committee whose function it is to devise plans for meeting the post-war employment situation. That committee is making an estimate of the situation likely to shape up. It is also studying national plans for meeting the situation and suggesting a desirable program at the state level.

Many farm workers from West Virginia have been drawn into war industry plants. If large numbers of these should return to the state after the end of the War, and without industrial employment, the pressure on the land will be tremendous, and our gains in conservation will be quickly wiped out. West Virginia must make every effort to forestall such a calamity!

New Problems in the Economics of Apple Production

We have under way a long-time study relating to the economic phases of successful orcharding. Preliminary findings were reported in the Epistles for 1940 and 1942, but new problems keep coming up, and study has been expanded to consider them. For instance, at the request of the West Virginia Horticultural Society a study was made of apple-production costs and returns for 1943.

M. A. Abrahamsen reports that most growers have been operating in the red during the past decade; even the favorable years since 1941 have no more than offset the unsatisfactory market conditions prevailing in many previous years.

And we have given attention to problems of apple-tree depreciation. This item has often been neglected in appraising orchard operations. Yet it repre-
sents a real cost, amounting yearly to $8 to $10 per acre on trees now in production. It is to the long-time interest of apple producers that the importance of orchard depreciation become fully recognized and that accounting practices be set up in such a way as to measure these costs definitely.

The Problem of Living on Forest Land

The forests of West Virginia have been exploited in a manner not very different from the way certain subsurface resources have been mined. Large tracts of land having no particular use except for forest production, together with a dense population that depends on the land for a living, present problems in readjustment. In order to raise the low level of living in forest areas where mining and other industries are not developed, without constant public subsidies, there are two, or a combination of two, choices: (1) to develop forest operations of a type that will provide full employment for the people; and (2) to fit the people for and to provide employment opportunities in this and other areas, in order to relieve the subsistence pressure on land resources.

On the strength of close study in the heart of West Virginia, E. C. Weitzell and L. F. Miller make these observations:

In general, the practices of forest operators have been inconsistent with long-time forest production.

The man-to-land ratio is relatively high, and relief makes up a large portion of family income.

About half of the land in the two counties (Nicholas and Webster) is owned in tracts of 500 acres or more.

Little progress has been made towards adopting programs of forest improvement and development.

The evaluation of resources indicates a forest growth large enough to justify continued private ownership.

There are two major factors which must be considered in pointing the way towards forest conservation for this portion of the Appalachians: (1) the people and (2) the land.

More complete finishing of rough lumber than is now done in many cases, together with development of other industries in the area, may provide employment for some of the excess population.

If private owners do not accept and practice desirable policies of resource development and conservation, it will be imperative that public control and regulation of forest land be provided.

This study will be useful when it comes to post-war planning.
Forestry

For a Self-governing Timber-management Crop

Cooperative management of timberland has been a major project of the Forestry division ever since that division was organized in 1937. Always the object has been to find an inexpensive way for landowners to get reliable and skilled forest-management service for land to which they are not able to give personal supervision. "West Virginia Forest Products Association" was the name given to the non-profit, semi-public organization growing out of that project. It has now been reorganized and is made up entirely of somewhat self-governing units operating in 16 counties of the state.

The agencies in this state which are concerned with forestry depend on this new organization to carry out plans in private forest management. Such plans are made by farm foresters for owners who are unable to give their timberland the necessary supervision. In this way, owners of large tracts

Figure 18. A managed woodland after a mine-prop cutting, where the best straight, sound trees are left to grow and protect the soil.
can go directly to this cooperative organization for complete service in forest management.

The practical result of this far-reaching piece of work is that now, all timberland owners in West Virginia can get expert forest management and so increase their production of wood scientifically. W. C. Percival and F. W. Besley have observed that such an organization can manage timber-cutting operations satisfactorily at the cost of about $1.03 per 1,000 board feet where sales are made of cruised stumpage. Where sales are made on a log-scale basis, the cost runs around $1.89 per thousand.

**Lime, Fertilizer, and Reseeding Will Restock Barren Land**

Eroded soils are a serious problem for the land, regardless of whether that land is used to grow agricultural crops or timber.

For a number of years we have been trying various methods of treating badly eroded soils to get them back into production. A barren area at Wardensville that was limed, fertilized, reseeded, and protected now has a good cover on all areas. Redtop, tall oat grass, sweet clover, and *Lespedeza sericea* have been outstanding. Alfalfa and bromegrass in combination also seem to have promise. Trial plantings in Harrison County also show that lime, fertilizer, and reseeding with a good mixture of grasses and legumes will bring completely barren land back into productive use. On this area, birds-foot trefoil shows promise, according to R. M. Smith and G. G. Pohlman.

![Figure 19. Lime, fertilizer, and reseeding convert smelter-fume damaged land from a completely barren condition to one with a good grass and clover cover having a productive use as pasture.](image-url)
Trial plantings made on some of the hard shale soils in Grant and Hardy Counties seem promising. Most of these shales are not very acid, but they need phosphorus and are low in humus. They also suffer badly from drought. Disking or spring-tooth harrowing when the ground is thoroughly moist appears to be all that is needed to prepare a seedbed for grasses and legumes. After seeding they need an application of manure, straw, or old hay to prevent erosion and to conserve moisture until the new seedlings become established. But farmers will have to protect such land from overgrazing and do only light mowing, until the plants are well established.

This experiment goes to show that erosion can be reduced and that a satisfactory ground cover, including good-quality grass, can be reestablished. When it comes to planting trees on such soils, Torkel Holsoe finds after five years that some species make satisfactory survival and growth. These include Virginia or scrub pine, black locust, and red pine. Sassafras, tree of heaven, hybrid poplar, and red oak did not do well on these poor soil plots on shale land in Hardy County.

**Bluegrass Thrives Under Black Walnut**

There can be no question of the value of the walnut in encouraging the better grasses. Kentucky bluegrass is found under almost 100 percent of standing walnut trees, often to the exclusion of other grasses. This is true even when the surrounding areas are largely given over to brome-sedge and poverty grass. Black walnut trees exert a profound and usually a beneficial influence on the soils with which they come in contact.

It can now be stated that no important forestry species is held back by black walnut. In fact, if you are thinking of restocking your farm woodlot, I would suggest including the planting of this species of walnut.

On the other hand, evidence is building up that in many cases apple trees, tomatoes, potatoes, alfalfa, and some other crops are held back or completely destroyed when they are growing too near walnut trees especially where their roots intermingle. M. G. Brooks's observation in many counties of the state bears this out, although he has come across occasional exceptions.

**Encourage Wildlife With a Positive Game Program**

Many West Virginia farm owners enjoy hunting and fishing. So do their families. On selected farms in the Tygart Valley Soil Conservation district, M. G. Brooks and R. F. Dugan are carrying out standard game-management practices. From time to time the results are checked by game censuses, records of kill, and other data. These practices include spot planting to provide food and shelter, letting food areas remain in fields of grain, planting of patches of game food, planting of game lanes, planting of shrub quarters, and like measures to encourage game to settle.

There is also a later development which has great promise. This is the building of a series of farm ponds. Some of these have already been fertilized and stocked. And soon they should be available for fishing. The water in
these ponds is being tested regularly to determine how much food is present, how much additional fertilizer is necessary, and other steps in management.

In Barbour County, on Pleasant Creek, some 2,500 acres are being set aside for a farm game cooperative area, if the State Conservation Commission approves. This area will be managed for hunting under the best possible principles and practices of game management.

From this experiment our foresters hope to determine the effect that proper wildlife practices will have on areas where there is no control of hunting but where wildlife practices are in operation; also on areas where hunting is rigidly controlled. These results will be checked against similar areas where there has been no program to encourage wildlife.

The Heavier the Wood, the Greater the Shrinkage

Our native yellow poplar is a tree easy to grow and lends itself to many commercial uses. That is why we chose this hardwood for a study of density and shrinkage in their relation to each other and to conditions of tree growth.

H. D. Erickson finds that, as the number of rings per inch increases, the density of the wood becomes less. Now, perhaps, this is contrary to what you would expect. Yet he finds that a faster-growing tree results in greater shrinkage across a flat-sawn board. Generally speaking, the heavier the wood, the more the shrinkage.

Toward an All-year Debarker for the Woodlot

Our foresters, in cooperation with the Department of Farm Mechanics and with the College of Engineering, are making an attempt to build a machine that will successfully debark the pulpwood from hardwood at any season of the year. Such a machine would allow farmers to harvest or to improve their woodlots in the slack season and to sell peeled pulpwood. Usually the season for cutting pulpwood is only during the peeling season, in the months of May, June, and July. That is a busy time as every farmer knows.

H. D. Erickson and A. D. Longhouse have made some trial runs with a debarker loaned to the University. They have concluded, however, that many modifications and changes are necessary to make this machine operate to the farmer's advantage. A few new ideas have been tried out, but there is still much work to do on this machine. Lack of skilled labor has been a serious handicap.
and finally

In my foreword I spoke of the dire need for conserving water and minerals so that our future may be secure. Now let me say a word about the minerals.

There are many of these which are absolutely essential to health; but of these, two stand out prominently—calcium and phosphorus, copartners in building the main structures of the body . . . I want to say a word about calcium, or lime, as we generally call it.

Of all the elements in the earth's crust, calcium is the most important from the standpoint of the amount necessary to maintain the normal health of animals and of man. Calcium constitutes more than 42 percent of the mineral content of the human body. A similar relationship exists in our food animals. It is evident therefore that both man and animals must have access to considerable quantities of calcium from their earliest development to build the framework necessary to make strong, healthy bodies.

This is accomplished for man by eating foods which are rich enough in calcium to meet his needs. Whether he gets the calcium from plants or animals is perhaps not important. In either case it must be derived from the soil through plants; these are the great intermediaries which can extract this element from the soil and which through their utilization as food by man or animals are transformed through the blood into the bones, the teeth, and other tissues to build and to maintain our bodies throughout life.

In West Virginia the greatest mineral need of land is lime. And the Experiment Station has joined forces with the Agricultural Extension Service, the Agricultural Adjustment Agency, the Soil Conservation Service, and the Farm Security Administration to bring home to the farmer the lesson of putting enough lime on the land.

And that is a tremendous undertaking.

Let's be realistic about the problem. There are some 15 million acres of land in the state. Much of this is forest land and waste land. Only 4 million acres, or about one-fourth of the state's land surface, is in cropland and pasture. All of this needs and deserves lime.

It will take 8 million tons of ground limestone to bring our crop and pasture land to a state of neutrality, or up to par.

After that it will take some 550,000 tons, each year, to keep up the level of neutrality.

As a matter of fact, all we are doing now as a state is to apply about a half million tons of lime to the existing soil each year.

That is as much as our farms lose year after year.

In other words, we now are maintaining a very low standard of soil health. Until we find a way to plaster those 4 million acres with the first 3 million tons, we cannot expect very good crops from our land.

West Virginia stands in danger of losing her heritage of soil through run-off of water and through lack of calcium.

Let us take steps—and soon—to prevent such calamity!

C. R. Orton

[ 50 ]
Changes in Staff and Organization

New appointments within our research staff during the two-year period 1942-1944 include F. W. Besley, associate forester; C. J. Cunningham, assistant animal husbandman; J. D. Downes, assistant in horticulture; C. V. Lowther, research assistant in plant pathology; Paul Lyon, technical aid in agricultural biochemistry; A. S. Margolin, assistant in hill-culture research; Helen M. Pavlech, assistant in animal husbandry; Mary A. Ryan, assistant in plant pathology; W. B. Sayers, assistant forester; C. E. Stockdale, associate agricultural economist; and Myrtle Swanson, assistant in home economics.

Promotions include J. L. Cartledge, associate geneticist; W. H. Childs, associate horticulturist; T. B. Clark, associate poultry husbandman; R. F. Dugan, assistant forester; H. D. Erickson, associate forester; and E. H. Tyner, associate agronomist.

During the same period the following have resigned:

U. G. Bee, assistant in animal husbandry; C. F. Bishop, assistant in plant pathology; W. C. Brown, associate dairy husbandman; Hazel C. Cameron, research associate in nutrition; W. H. Conkle, assistant in horticulture; I. J. Duncan, associate agricultural chemist; D. M. Keyes, assistant agricultural economist; S. A. Lear, assistant in dairy husbandry; J. F. McMurray, assistant in wildlife management; E. A. Marten, associate plant pathologist; L. F. Miller, assistant agricultural economist; E. N. Moore, assistant animal pathologist; F. C. Olson, assistant agricultural chemist; J. R. Webb, assistant in agronomy; R. O. Weibel, assistant in agronomy; E. J. Wellhausen, associate geneticist; E. T. Wightman, assistant poultry husbandman; and C. V. Wilson, associate animal husbandman.

C. F. Bishop, assistant in plant pathology, W. H. Conkle, assistant in horticulture, and C. V. Wilson, associate animal husbandman, are now employed by the Agricultural Extension Service.

Leaves of absence for military service have been granted to or continued for Lowell Besley, associate forester; R. H. Black, assistant in animal husbandry; R. H. Bradford, associate rural sociologist; W. M. Broadfoot, assistant in agronomy; J. B. Byers, assistant in forestry; Torkel Holsoe, assistant forester; L. J. Manus, assistant in dairy husbandry; O. M. Neal Jr., assistant in horticulture; D. N. Putnam, assistant in dairy husbandry; T. D. Runnels, assistant in poultry husbandry; and F. W. Schaller, assistant in agronomy. W. W. Armentrout, head of the department of agricultural economics, has been granted a leave of absence for foreign service with the United Nations Relief and Rehabilitation Administration.

The Department of Agricultural Chemistry has become the Department of Agricultural Biochemistry. Two general fields of chemical work have always existed within the department, and these now receive formal recognition

*Deceased May 6, 1943, after change of employment to the State Department of Health.
as Sections of Plant Chemistry and Animal Chemistry and Nutrition. The nutrition studies with rats formerly conducted by Miss Cameron have now been taken over by Agricultural Biochemistry.

Early in 1944 the State Board of Control acquired from the Federal Housing Authority the dairy farm of the Arthurdale Association at Reedsville, Preston County. This farm of 457 acres has been renamed the "Reedsville Experiment Farm" and brings to four the number of outlying farms operated in West Virginia by the Experiment Station.

**PUBLICATIONS OF THE BIENNIAL 1942-1944**

**BULLETINS AND CIRCULARS**


**MIMEOGRAPHED CIRCULARS**

No. 46. E. J. Wellhausen. Results of hybrid-corn yield trials in West Virginia for 1942. February 1943.
No. 47. M. A. Abrahamsen. Milk assembling and distribution in Harrison County, West Virginia. May 1943.

**WAR SERIES CIRCULARS**


MIMEOGRAPHED WAR SERIES CIRCULARS


TECHNICAL BULLETIN PUBLISHED JOINTLY WITH THE U. S. D. A.


SCIENTIFIC PAPERS


