This Article Should Accompany Vifquain's Thesis. CMW.

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WELLINGTON BRINK, EDITOR

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Front Cover: Home gardens profit from soil conservation measures. Cultivation across the slope, mulching, and other standard erosion-control practices are being ever more widely adopted for growing vegetables, berries, and other crops for the home table. The photograph introducing this issue was made by George Pace. The smiling young lady is Miss Betty Sue Medlin of RFD 4, Milan, Tenn.

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EARLY MEASUREMENTS OF RUN-OFF AND EROSION

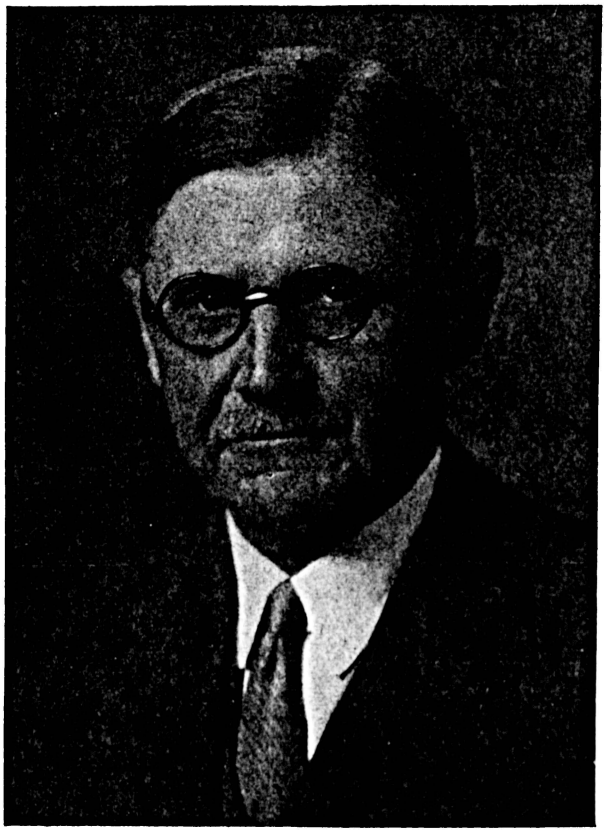
By M. F. Miller, Dean Emeritus, College of Agriculture, University of Missouri

The first plots laid out at the Missouri Experiment Station for preliminary trials in measuring run-off and erosion losses.

AT THE last annual meeting of Friends of the Land, in St. Louis, I was asked to tell something of the early work in measuring runoff and soil erosion losses at the Missouri Experiment Station. Since this brief talk created considerable interest, it seemed that it might be worth while to publish such a statement, largely for its historic value.

There seems to be little doubt that the first measurements of runoff and erosion losses from a field soil, under different cropping and cultural systems, were made at the Missouri station. Another early investigation by C. L. Forsling,[1] started in 1915, on two range areas in Utah, was designed to determine the influence of the intensity of grazing on runoff and erosion losses. These two investigations were inaugurated close to the same time but under quite different conditions, one dealing with cropped land and one with range land. The first report from the Missouri investigations appeared in 1923 and the first from the Utah investigations in 1931. However, before the detailed investigations at the Missouri station were inaugurated, certain preliminary trials were carried out and it is primarily with this preliminary work that this paper deals.

The first attempt to measure runoff and erosion losses at Columbia was inaugurated in 1915. A soils student, R. W. McClure, was assigned the special problem of measuring these losses from a small area of bare soil with a grade of approximately 4 percent. The plan was exceedingly simple. A curbing of 1-inch boards surrounding this area was set in the ground, with an opening at the lower side emptying into a small catchment basin. After each rain McClure dipped out the



Dean Miller.

[1] U. S. D. A. Technical Bulletin 220 (1931).

accumulated water and soil and determined the quantity of each. While the trial was continued for only about 2 months, during the latter part of the spring semester, the results proved very interesting. It was shown that such measurements could be made without great difficulty and it was, therefore, decided to carry the plan further as soon as opportunity offered.

The year following McClure's simple preliminary trial, a graduate student, R. W. Vifquain [2] was assigned a thesis problem dealing with water penetration, runoff, and evaporation, along with measurements of eroded soil. In this investigation the runoff and erosion measurements comprised the major part of the plan and proved the most interesting and most fruitful of results. Mr. Vifquain was a careful worker, well suited to this sort of work. The plan which was developed revolved around the influence of surface cultivation on water penetration and on water and soil losses. The purpose was to measure not only runoff and erosion but the depth of moisture penetration resulting from each rain. It was hoped also, through the penetration study, along with a study of water losses from a free water surface and from a lysimeter, to obtain data regarding evaporation losses from the soil. This attempt proved largely abortive.

The plan, as finally evolved, provided for four parallel strips (5½ by 91 feet) running up and down a slope having a grade of approximately 4 percent. The soil was Shelby loam, although it contained slightly more silt and somewhat less organic matter than is typical for this type. Each of the four strips or plots was surrounded by a curbing of 1-inch boards sunk into the soil with about 3 inches extending above the soil surface. The lower ends of the two inside strips emptied on a galvanized iron platform leading to a concrete catchment basin in which the water and soil accumulated. The two outside strips were left open at the lower ends and were used entirely for determining the depth of moisture penetration, after rains, by sampling to a depth of 4 feet.

One strip in each set was cultivated frequently with a hoe. The other strip was uncultivated but was kept free from weeds by carefully shaving the surface with a sharp hoe whenever necessary.

After each rain the depth of the water in the catchment basins was measured and cleared of suspended matter by the use of a flocculant. The water was then drawn off, and the soil removed, sampled, and the weight determined.

The measurements were continued through a period of 3½ months, May 1 to August 15, 1916. The results are recorded in the thesis filed by Mr. Vifquain for the A. M. degree in June 1917. They show the marked effect of cultivation, as compared with no cultivation, in causing an increase in the penetration of rainfall, as well as a marked curtailment in the amount of soil eroded. A summary of these results shows that the uncultivated soil lost through runoff, 47.9 percent of the total rainfall of 11.69 inches during the 3½ months period while the runoff from the cultivated soil was only 15.4 percent. Similarly, the soil loss from the uncultivated strip was 424.6 pounds while from the cultivated strip it was only 80.4 pounds.

These simple results are in general accord with those secured through later investigations at a number of the erosion experiment stations in the country. They are of interest as representing the first recorded field measurements of runoff and erosion and as providing a basis for the more extensive and long continued measurements at Missouri and at the erosion experiment stations.

Great credit should be given Mr. Vifquain for his careful work in this first attempt to measure water and soil losses from cropped lands. He was the pioneer worker in this important field which has been extended so greatly during the last 25 years.

The year following Mr. Vifquain's work (1917) a regular experiment station project was inaugurated, the results of which have been widely used. The installation of these plots was on the same site as that used by Mr. Vifquain. The detailed plans for this project were largely developed by F. L. Duley,[3] who was in charge of the operations on the project until 1925 when he left the University of Missouri to join the staff of the Kansas State College. Great credit must be given him for his careful planning and execution of the work during this period. Following Dr. Duley's departure the details of the experimental work were taken over by H. H. Krusekopf [4] who had charge during the latter part of this period of measurements and to whom much credit should be given.

It should be understood that the results of such

[2] Now director of short courses and personnel officer, Division of Agriculture, Iowa State College.

[3] Now with the research division of the Soil Conservation Service, and stationed at the University of Nebraska, where some very important cooperative work is under way.

[4] Professor of soils, University of Missouri.

measurements have their limitations, particularly when applied to ordinary field practices. They usually represent data from only a segment of a longer slope. Their principal value has been that of showing the very wide comparative differences in runoff and erosion losses from land in different crops, rotations, sods, or different types of cultivation. For instance, the Missouri data showed that the annual loss per acre of soil from uncropped, cultivated land was 41 tons, from continuous corn 19.7 tons, from continuous wheat 10.1 tons, from a 3-year crop rotation 2.7 tons, and from continuous blue-grass sod only 0.3 tons. These are spectacular differences and should convince almost anyone that cropping systems and cultural practices, as used by farmers, may exhaust or conserve the soils on sloping lands, depending on the systems followed. While the differences in runoff losses were not so spectacular as those of erosion losses, they were sufficient to show that under proper cropping and cultural systems much can be done in controlling the amount of water leaving a farm.

The results of these measurements of soil and water losses became available just at the beginning of the great upsurge of interest in soil and water conservation due largely to the efforts of Hugh Bennett, and they seem to have served a real purpose. This is an example of a simple investigation, developed somewhat accidentally, that provided much needed information at a time when important use could be made of it.

It may be of interest to those associated with soil conservation activities to know that the original plots laid out in 1917 are still under measurement. However, the plan has been completely revised and is now a study of the management of exposed subsoil as farming land. As a matter of fact, the 14 years of measurements resulted in such wide differences in the amount of soil remaining on the different plots that further measurements under the original plan seemed unwise.

The revised plan was inaugurated after the complete removal of the remainder of the original surface soil from all plots. It included systems of cropping and soil treatments which were thought best adapted to subsoil exposures. The idea was to determine what could be done in building up such lands and to measure the water and soil losses taking place.

The suggestion for this new plan came from some early work done by Dr. Duley at the same time these Missouri measurements were under way. He carried out an experiment on small strips of land from which the surface soil had been removed, as compared with land where the surface soil was still in place. The results of this experiment, running through a number of years, indicated that liberal amounts of lime and fertilizer applied to exposed subsoil brought approximately the same yields of small grain and mixed hay as were produced on the surface soil without treatment. It seemed important, therefore, that experiments be carried out on such eroded land to determine something of the response to treatments.

Missouri has thousands of acres of land that has lost all, or at least much, of its surface soil. The problem is what, if anything, can be done with such lands to bring them into economic production. Much depends, of course, on the nature of the subsoil and the degree of erosion. The tight claypan areas, which have been subject to much leaching, undoubtedly offer less opportunity for improvement than areas with subsoils which are more open and less leached, such as those of the glacial and loessial lands. However, I am of the opinion, that much can be done to bring back to economic production very large areas of the eroded soils of Missouri and other States.

It is undoubtedly of first importance to check the country's soil erosion losses, but it is also important to determine what can be done with those soils which are already badly eroded and which have possibilities of rehabilitation. I sometimes think that we should speak less of soil conservation and more of soil improvement. While it is of course true that soil conservation is the more popular and more appealing term, which doubtless should be retained as the official designation of the over-all soil-improvement activities, it must not be forgotten that mere conservation is quite insufficient for most agricultural lands. While some soil improvement accompanies most conservation measures, the future welfare of agriculture demands the use of widespread and intensive soil-improvement practices. By far the larger part of the agricultural lands of the country show marked deterioration and most of these lands will respond economically to effective measures of soil improvement. One of the real problems is to find means of putting such soil improvement measures into use.