Comparison of

Soil Moisture Regimen in Lysimeters

with that on adjacent watersheds

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CONTENTS

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COMPARISON OF THE SOIL MOISTURE REGIMEN IN LYSIMETERS WITH THAT ON ADJACENT WATERSHEDS[1]

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INTRODUCTION

The weighing monolith lysimeters at Coshocton have been useful in evaluating the accretion, depletion, and storage of soil water. By the use of the nuclear soil moisture probe, the moisture content throughout the soil profile can now be determined with a reasonable degree of accuracy. This measurement of soil moisture has provided a means of checking the accuracy of consumptive use values obtained by the weighing lysimeter. In this comparison, previously reported,[3] the weighing lysimeter and the nuclear soil moisture probe were found to check very closely. It is therefore now possible to establish whether the soil moisture regimen in lysimeters is, or is not, comparable to that on adjacent watersheds. This knowledge should be useful in conducting water budget studies of small watersheds as an aid in evaluating their hydrologic performance.

Although the lysimeter is a useful tool in many respects, it cannot be expected to precisely duplicate soil and water conditions in an undistrubed soil. The side walls of the lysimeter box prevent lateral movement of water to or from the adjoining soil volume. The bottom of the lysimeter prevents contact of the lower part of the lysimeter profile with the bedrock beneath. Surface runoff is restricted to the area of the lysimeter only. With these limitations in mind, the Coshocton lysimeters were planned to simulate natural conditions as nearly as possible. The purpose of this paper is to present information showing the extent to which the soil-moisture regimen in lysimeters approaches the regimen of adjacent natural watersheds.

PROCEDURE

Three watersheds are represented, each of a certain soil type of particular origin and each with a lysimeter adjacent to it. Information on the lysimeters and their respective watersheds is tabulated on the following page.

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[1] Contribution from the Watershed Technology Research Branch, Soil and Water Conservation Research Division, Agricultural Research Service, USDA, Coshocton, Ohio, in cooperation with the Ohio Agricultural Experiment Station, Wooster, Ohio. Grateful acknowledgment is made of the assistance of R. E. Youker, D. B. Wall, and W. W. Bentz in the collection and tabulation of the basic data and to J. L. McGuinness, Analytical Statistician, and L. L. Harrold, Supervisory Hydraulic Engineer, for valuable suggestions given.

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[3] McGuinness, J. L., Dreibelbis, F. R., and Harrold, L. L. Accretion, depletion and storage of soil water. Presented at Geologists Workshop, Charlottsville, Va., June 1960 by McGuinness; and at the Hydrology Workshop, New Orleans, October 1960 by Dreibelbis. 19 pp.

Lysimeter No.	Y101D	Y102C	Y103A
Adjacent watershed No.	102	109	123
Soil type	Muskingum silt loam (sandstone origin)	Muskingum silt loam (shale origin)	Keene silt loam (shale origin)
Slope .... percent	20	13	6
Rotation	Permanent grassland	4-year rotation, corn, wheat, meadow, meadow	4-year rotation, corn, wheat, meadow, meadow
Cover in 1960	Birdsfoot trefoil	Alfalfa, red clover, timothy	Alfalfa, red clover, timothy
Date cover established	1957	1958	1958
Area of lysimeter ... acre	0.002	0.002	0.002
Area of adjacent watershed .... acres	1.26	1.69	1.37
Access tubes on lysimeter .... number	1	1	1
Access tubes on watershed .... number	5	6	7

Watersheds

The watersheds in this study represented the same soil type as the lysimeter. The slope, aspect, land use, and soil management plan were essentially the same as for the lysimeter. More detailed descriptions of the watersheds are given in "Monthly Precipitation and Runoff for Small Agricultural Watersheds in the United States." [4]

Lysimeters

The lysimeters are of the monolith type, 0.002 acre in surface area with a profile depth of 8 feet. Provision was made on each lysimeter for collecting percolation and runoff in the lysimeter pits, where the collector tanks are equipped with automatic recorders. Weight records adjusted for runoff and percolation provided data for evaluating precipitation and changes in soil moisture storage. The weights were automatically recorded every 10 minutes with a sensitivity of 5 pounds, equivalent to 0.01 inch water. Evapotranspiration and condensation-absorption were determined from these weight records. Brief description of the vegetative cover on lysimeters and their respective watersheds is given in the above tabulation. More detailed descriptions of the lysimeters and of the recording and processing of their data appear in a U.S. Department of Agriculture publication.[5]

[4] United States Agricultural Research Service (USDA). Monthly precipitation and runoff for small agricultural watersheds in the United States. 61 pp. 1959.

[5] Harrold, L. L., and Dreibelbis, F. R. Evaluation of agricultural hydrology by monolith lysimeters. 1944-55. U.S. Dept. Agr. Tech. Bul. 1179, 166 pp. 1958.

Soil Moisture

The neutron method of determining soil moisture was used to evaluate the soil moisture content for the complete soil profile except in the upper 7 inches, where blocks of Fiberglas-gypsum were used.[6,7]

The neutron equipment used consisted of the Model P-19 probe and Model 2800 Scaler manufactured by the Nuclear Chicago Corporation.[7] The access tubing was a thin-walled metallic electrical conduit, 1.61 inches inside diameter. These tubes were driven to the depth of the bedrock on each of the three weighing lysimeters. The bottoms of the tubes were sealed after installation with a snug fitting rubber stopper and hydraulic cement. One access tube on each watershed extended down to a depth of 8 to 9 feet. Other access tubes extended to a 4-foot depth, which could fairly well represent a 54-inch profile. The areal distribution of the tubes was planned so that the entire watershed area (1.25 to 1.69 acres) was fairly well represented. A sketch of the relative location and elevation of the various access tubes in Watershed 102 is shown in Figure 1. For all watershed locations, the tube lowest in elevation is called the "A" tube, with elevation of the sites progressing alphabetically.

A field calibration curve was developed by taking bulk density and gravimetric moisture determinations in a meadow field and comparing with neutron counts taken at the same depth.

Because the probe does not give accurate indications of moisture near the soil surface, Fiberglas-gypsum blocks were used to indicate the moisture content of the upper 7 inches of soil. Calibration curves for both the neutron method and the Fiberglas-gypsum blocks were developed to express moisture in percent by volume. This facilitated conversion to inches of water.

Beginning April 11, 1960, about once a week during the growing season determinations of soil moisture were made on the lysimeters and watersheds. During periods when moisture conditions were changing rapidly, readings were taken two or three times a week. Probe readings were taken on the adjacent watershed immediately following those taken on the lysimeter.

Concurrent readings were also taken on these lysimeters and their adjacent watersheds on 10 dates in 1959.

RESULTS

Comparison of soil moisture distribution within the profile

Soil moisture values obtained at various depths in each access tube on Watershed 102 were plotted together with the corresponding values obtained on the adjacent lysimeter Y101D. Such comparisons were made for each date readings were taken in 1960. A typical example of such a comparison appears in Figure 2. The data represent readings taken on June 10 just prior to rainstorms amounting to over 4 inches on June 11, 12, 13, and 14,

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[6] Youker, R. E., and Dreibelbis, F. R. An improved soil moisture measuring unit for hydrologic studies. Amer. Geophys. Union Trans. 32: 447-449. 1951.

[7] Mention of products and manufacturers does not constitute their endorsement by the U.S. Department of Agriculture over others that are not mentioned.

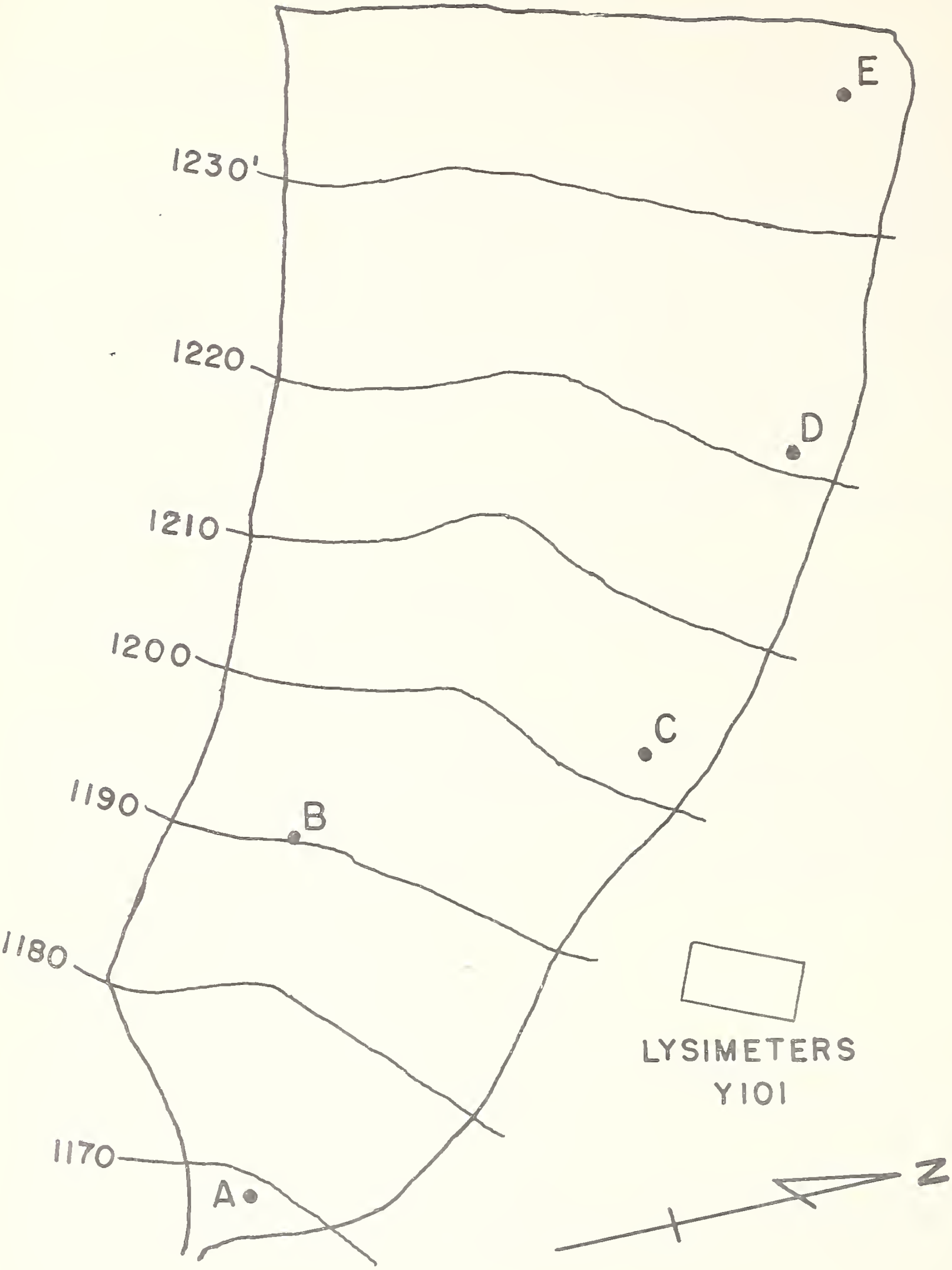

Figure 1.--Relative location and elevation of access tubes on Watershed 102.

and readings taken just after the storms. Before and after the storms, moisture distribution in the lysimeter profiles agreed fairly well with that of the watershed profiles down to the 48-inch depth. Below the 48-inch depth, the lysimeter had a lower moisture content than the B location of its respective watershed, for all of the dates sampled.

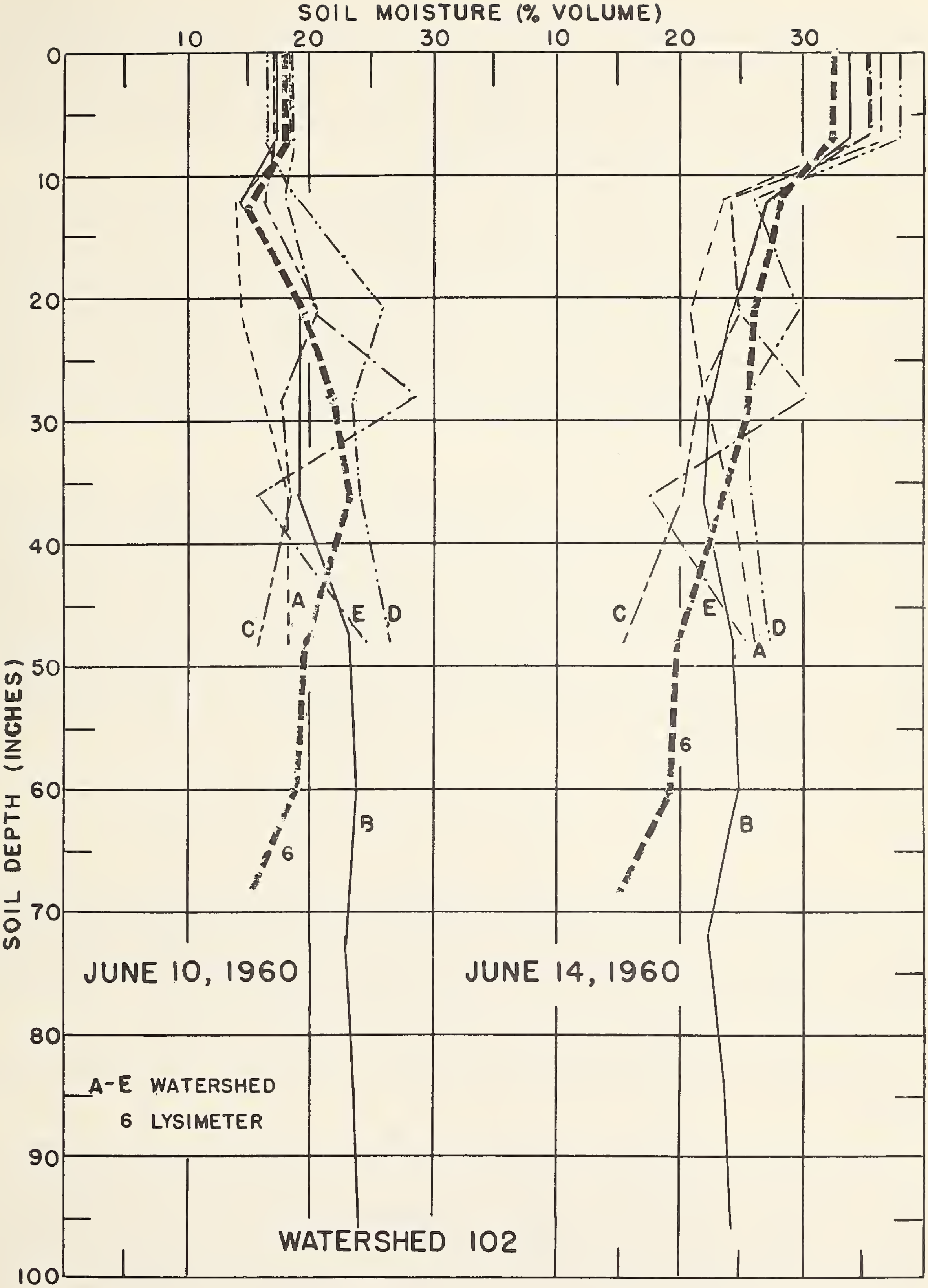

Figure 2.--Profile soil moisture distribution, Watershed 102 and lysimeter Y101D, 1960.

In Figure 2 the variation in moisture distribution of the various profiles in the watershed is of particular interest. Each location represents the moisture status of that specific site on the watershed. Access tube at site D showed consistently higher moisture content below the 12-inch depth for each date sampled. The distinct changes in the curve for tube E reflect the marked profile changes at this location. Sandstone rock was encountered in the 30-to-36-inch zone at site E, resulting in a consistently lower moisture content in that zone. The abrupt changes in these curves reflect soil heterogeneity, so common to the subsoils of the Muskingum series.

A similar situation is found respecting the access tube data of Watershed 109 and those of lysimeter Y102C (Fig. 3). Tube F showed a consistently lower soil moisture content than any of the other tubes, including that of the lysimeter. Tube F was located near the top of the watershed, where the soil was shallower in depth and where the opportunity for subsoil drainage down the slope was likely to be greater than that received from upslope areas. Figure 3, a comparison of the profile soil moisture distribution in lysimeter Y102 with that in Watershed 109, gives data for readings taken before and after a storm of 2.24 inches. Before and after the storm, all the sites on the watershed but one showed a higher soil moisture content than the lysimeter. Moisture in the lysimeter was higher after the storm, except below the 36-inch depth. The moisture distribution curves reflect, to a large extent, the soil profile characteristics of the watershed and the location of the sites, as in the previous comparisons.

This reflection of soil profile characteristics and location of sites in moisture distribution curves is also apparent in a comparison of the data from Watershed 123 with lysimeter Y103A (Fig. 4). The curves represent a Keene silt loam profile on June 7 and 15. Rainfall between these two dates amounted to 4.6 inches. Tube A showed a consistently lower moisture content in the top 21 inches but a higher moisture content than the other tubes at the 48-inch depth. The contrast shown between the lysimeter and the watershed profiles varied from date to date. The one on June 7 is typical of most of the records obtained from April 19 to June 7. Following the rainy period, the lysimeter profile was closer to the average of the watershed. Distinctive hydrologic characteristics of the various horizons in the profile are quite evident in the Keene soil. At the 48- and 60-inch depths in the profile, the lysimeter soil was consistently lower in moisture than the soil on the watershed. This is discussed in the section "Seasonal soil moisture fluctuations of watersheds and lysimeters," p. 10.

Comparison of amounts of water in lysimeters and in watershed soil profiles

The amount of water held by watershed soils was not exactly the same as that held by the lysimeter soils. The deviation was affected by soil type, as well as by soil moisture level. By taking the 0-to-54-inch profile, five, six, and seven replicates could be used to represent average conditions for Watersheds 102, 109, and 123, respectively. The average moisture content of the profiles in each watershed was compared to that of the lysimeter profile adjacent to the watershed for 37 sampling dates in 1960 (Fig. 5).

Comparison of the correlation curve with the curve of equal values indicates a considerably greater range in moisture content of lysimeter soils for each of the three comparisons.

Muskingum silt loam over sandstone with a birdsfoot trefoil cover (Watershed 102 and lysimeter Y101D) gave the best agreement between a watershed and lysimeter. The Keene silt loam over shale with a second-year meadow cover (Watershed 123 and lysimeter Y103A) showed the poorest agreement between lysimeter and watershed. The lysimeter values were consistently lower than those for the watershed on all dates sampled. The Muskingum silt loam over shale with a second-year meadow cover (Watershed 109 and lysimeter Y102C) was intermediate in agreement. At low moisture most of

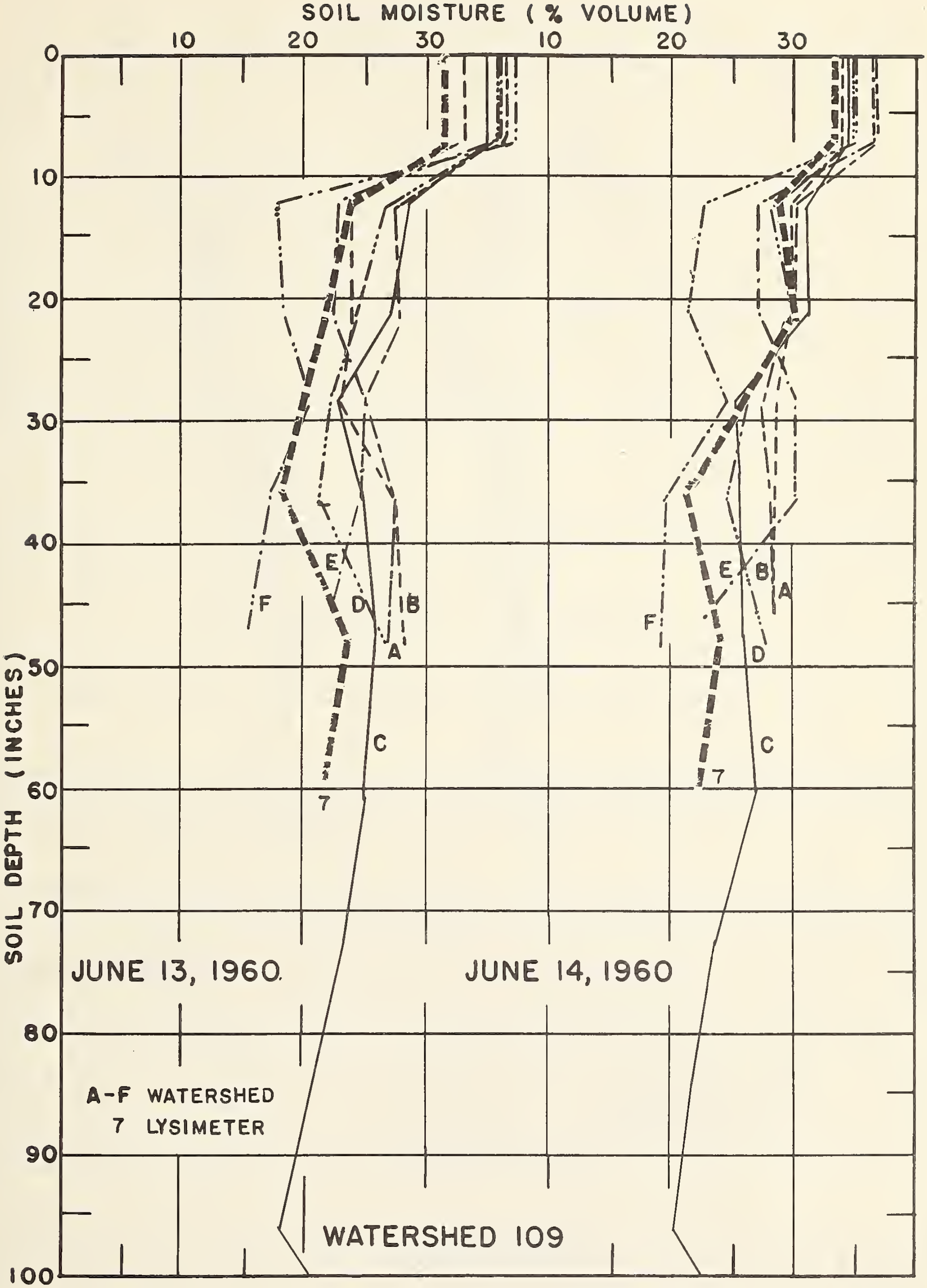

Figure 3.--Profile soil moisture distribution, Watershed 109 and lysimeter Y102C, 1960.

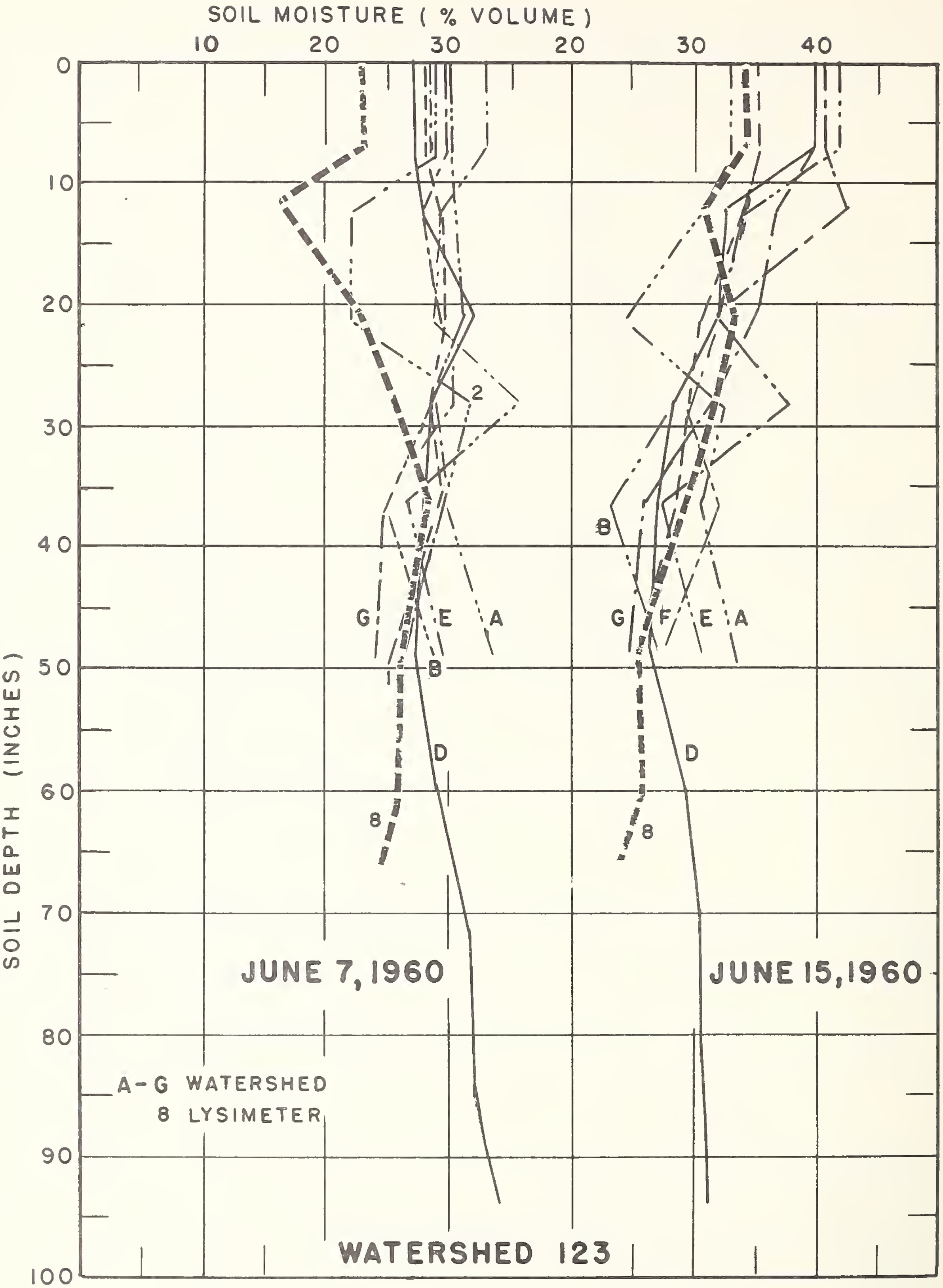

Figure 4.--Profile soil moisture distribution, Watershed 123 and lysimeter Y103A, 1960.

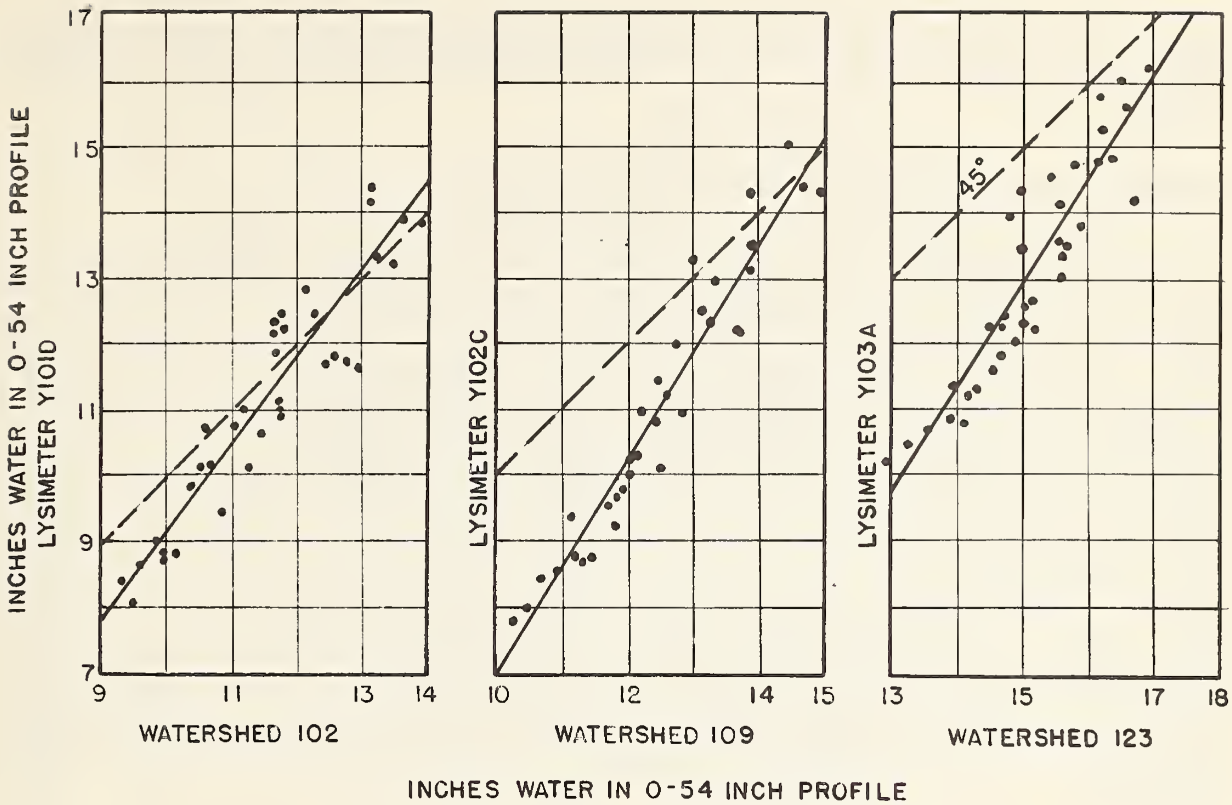

Figure 5.--Inches of water in a 0-to-54-inch profile for three lysimeter-watershed comparisons, April 11 to December 28, 1960.

the horizons indicate lower moisture in the lysimeter than on the watershed. Only one deep access tube was placed on each watershed, but this one tube provided a comparison of the profile to 72 inches with that of the lysimeter. The correlation was similar to that of the 54-inch profile on every date.

It appears that the soil moisture content affects the correlation of lysimeter water content with that of watersheds. At the higher moisture contents, soil of lysimeter Y101D showed values equal to or higher than those of the watershed soil. At lower moisture values, the lysimeter soil contained less water, in both the 54- and the 72-inch profile. For Watershed 109 and lysimeter Y102C, the values also showed a close agreement between the two areas at high moisture levels of the lysimeter, the contrast of greater moisture in the watershed being evident at the low moisture levels. Only three values indicated a higher moisture content on the lysimeter, and these were close to the line of equal values. For Watershed 123 and lysimeter Y103A, the watershed soils were consistently more moist than the lysimeter soils, even at the higher levels of lysimeter moisture. In this comparison also, moisture content affected the correlation as in the two previous comparisons, though in less degree. For all three comparisons, the lysimeter moisture content approached that of the watershed at high moisture levels, while at low moisture levels the contrast in most instances was greater.

Soil type apparently exerts some influence on these relationships. On a soil with impeding layers in the profile, as the Keene silt loam, the contrast in moisture relationships between the lysimeter and the watershed appeared to be greater, at least in the 54-inch profile. Comparable data were obtained also in 1959 for lysimeters Y102C and Y103A--on 10 and 9 dates, respectively, June 18 to October 28. In both cases, the lysimeter soils were lower in moisture than the watershed soils. As in 1960, the Keene soil showed a greater contrast between lysimeter and watershed. Perched water tables were frequently found in early spring in the Keene soil, but on the well-drained Muskingum soil no such perched water tables were found. In the well-drained Muskingum soils, moisture relationships on the lysimeter more nearly approached those of the watershed than in a soil with impeding layers in the profile.

Influence of watershed site upon soil moisture fluctuations

Soil-moisture values were plotted for four access tubes in Watershed 102 at five depths in the profile for the growing season beginning in April 1960. The fifth tube (A) was not included in the average so that its influence could be evaluated. The data appear in Figure 6. Although there is variation in moisture content indicated by the four access tubes, the trends of soil moisture are in general fairly much the same at the several locations. The average moisture contents of the four locations and the moisture of site A are compared to the moisture contents of lysimeter Y101D (Fig. 7). The watershed average of the four locations compares very closely with the lysimeter in the 12-, 21-, and 28-inch depths. At the 36-inch depth the lysimeter values were higher, at the 48-inch depth lower, than the watershed values during most of the season. Data for site A located at the foot of the watershed near the flume shows the influence of this location on the moisture relationships. In the 12-inch depth, although it is somewhat lower, it varies little from the others. In the lower depths the most striking feature of this location is the abrupt rise in moisture following periods of accretion. During the period June 10 to 14, more than 4 inches of rain fell. The sharp rise at the 36- and 48-inch depths at site A presents the possibility that lateral flow from points above contributes to this large increase, for the watershed average and the lysimeter show no such magnitudes of accretion. It suggests that soil-moisture relationships on the lower part of the watershed may be entirely different from those on the upper or middle part of the area, particularly in the lower soil depths.

Seasonal soil moisture fluctuations of watersheds and lysimeters

Averages of soil moisture computed at the same five profile points for all of the access tubes in each of the three watersheds were plotted for the period April to December 1960 (Figs. 8-10). Corresponding values for the particular adjacent lysimeter were also plotted on these graphs. (For descriptive information of these watersheds and lysimeters, see tabulation, p. 2.)

The data for Watershed 102 and lysimeter Y101D appear in Figure 8, together with daily rainfall data for the period. In the 12-inch layer the lysimeter values are somewhat higher most of the time. However, the depletion of moisture is greater on the lysimeter than on the watershed, not only in the 12-inch layer but in all the lower layers. It is especially pronounced in the 48-inch layer; this is in sharp contrast to the watershed that exhibited little moisture change throughout the season. As the vegetative cover is essentially the same on both areas, the removal of water by evapotranspiration is also likely to be the same or nearly so. The sharp contrast in the depletion curves, particularly in the 48-inch layer, indicates the possibility of accretion from lateral flow on the watershed.

Soil moisture for Watershed 109 and for lysimeter Y102C are compared in Figure 9. In the 12-inch layer the agreement is fairly close throughout the season except on June 6. The grass was cut on the watershed on June 1 but on the lysimeter not until June 6, which accounts for the earlier drop in the moisture curve of the lysimeter. The lysimeter moisture is higher in the 21-inch depth but depletes more rapidly than the moisture at such depth in the watershed. In the 28-inch depth the values are in close agreement up to August. In the 36-inch depth the lysimeter is consistently lower. For all depths in the profile, the 48-inch depth in particular, it appears that the lysimeter moisture curve has a greater downward trend than the watershed soils.

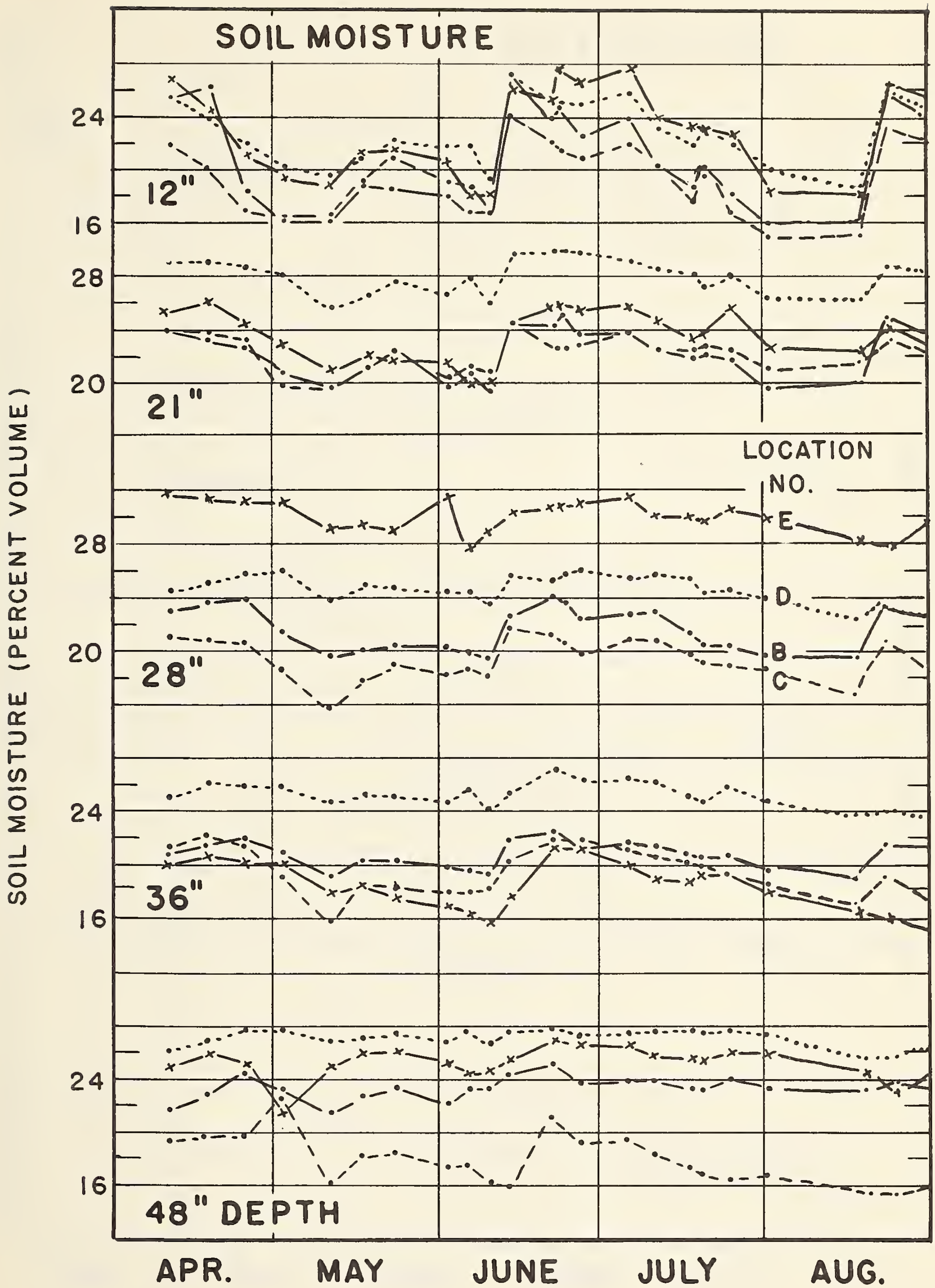

Figure 6.--Soil moisture fluctuations at locations B, C, D, and E on Watershed 102, 1960.

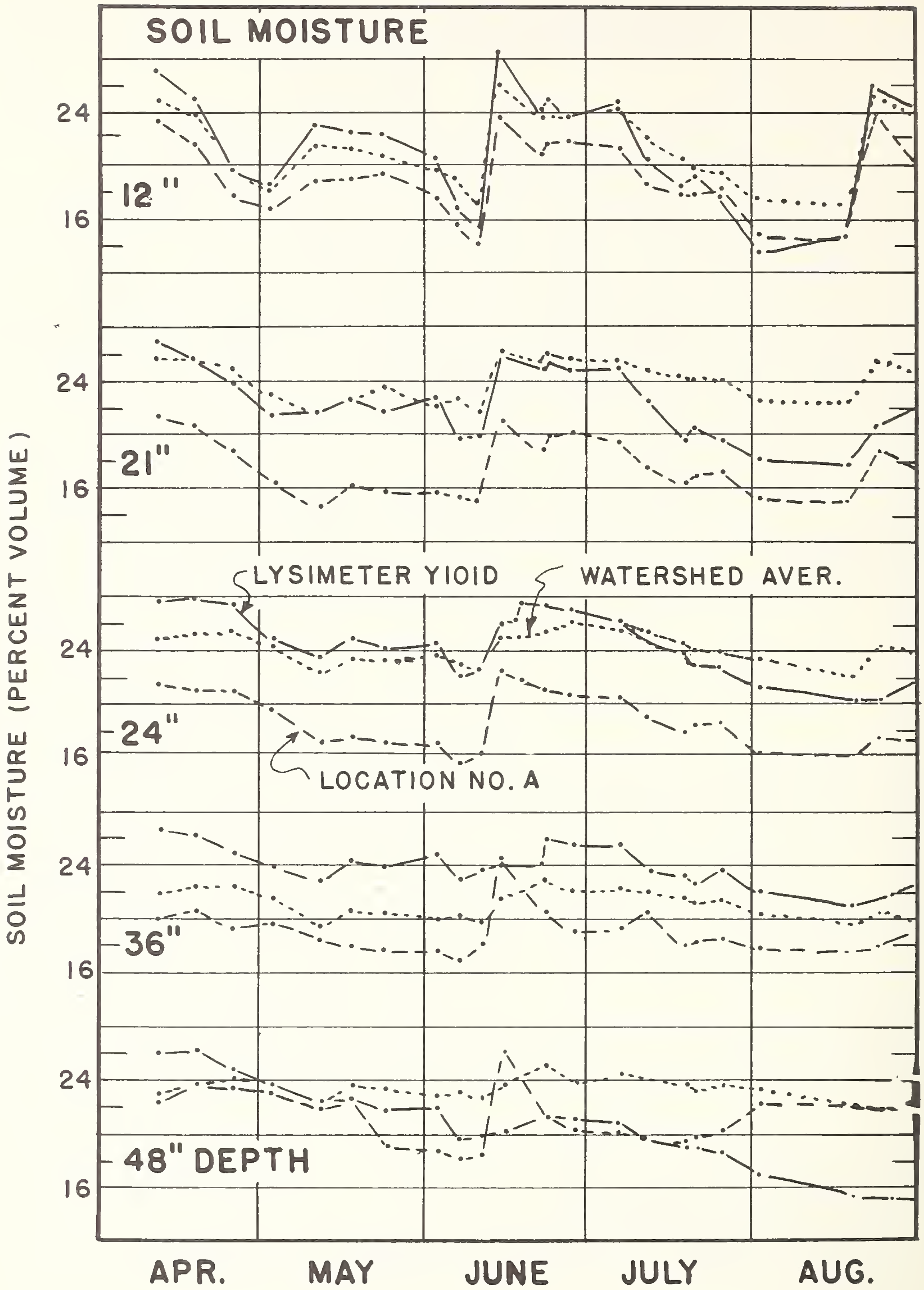

Figure 7.--Soil moisture fluctuations on lysimeter Y101D, on average of four locations on Watershed 102, and on location A on 102, 1960.

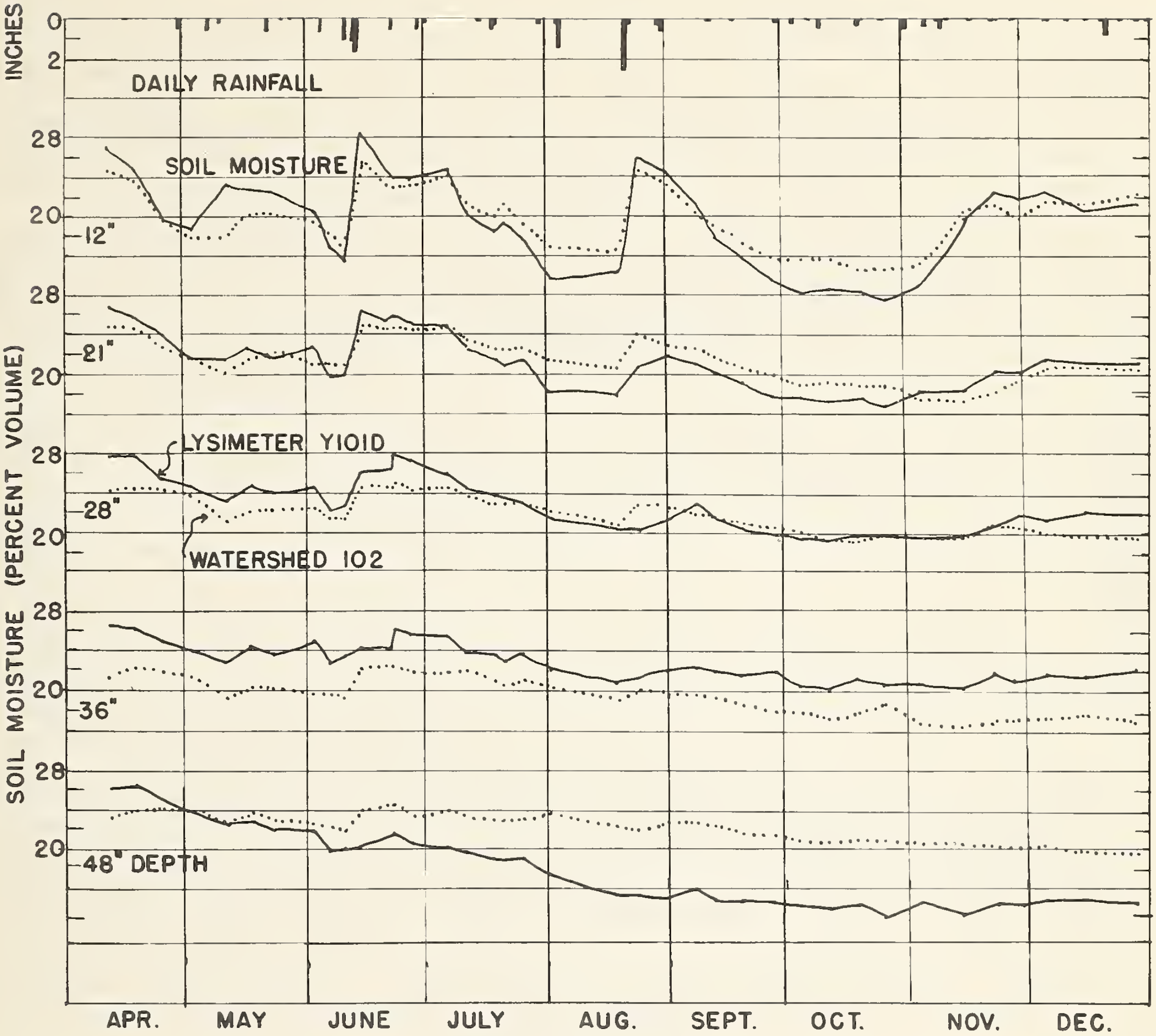

Figure 8.--Soil moisture fluctuations on lysimeter Y101D and on Watershed 102, average of five locations, 1960. (Birdsfoot treefoil cover.)

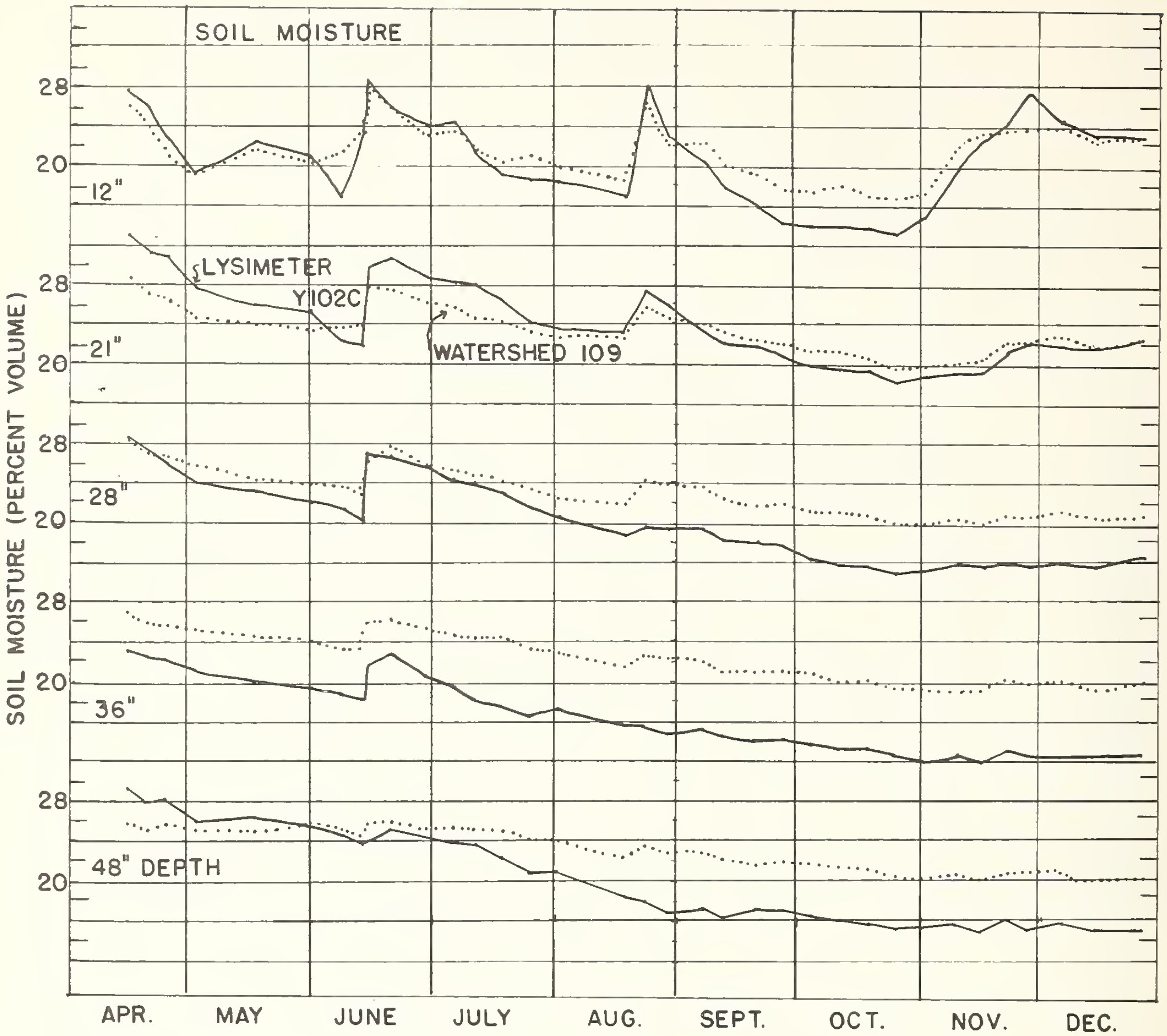

Figure 9.--Soil moisture fluctuations on lysimeter Y102C and on Watershed 109, average of six locations, 1960. (Second year meadow cover.)

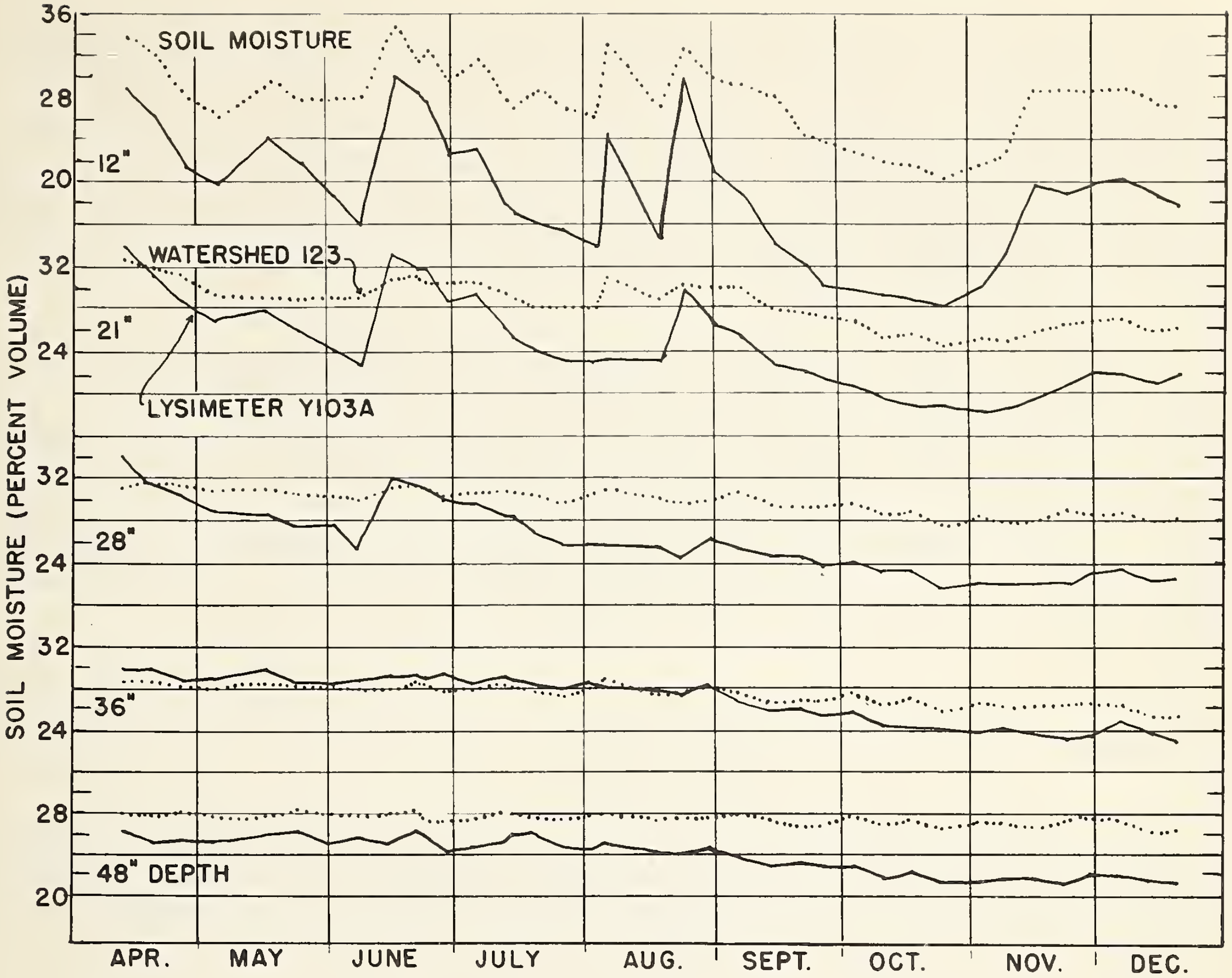

Figure 10.--Soil moisture fluctuations on lysimeter Y103A and on Watershed 123, average of seven locations, 1960. (Second year meadow cover.

The data for the Keene silt loam of Watershed 123 and of lysimeter Y103A are given in Figure 10. In this soil type the moisture regimen is somewhat different from that in the well-drained Muskingum soils. The Keene silt loam consists of a mottled silty clay loam at the 21- and 28-inch depths and grades into a heavy silty clay at the 36- and 48-inch depths. This silty clay is high in colloidal content and swells when wet, making the profile almost impermeable at this depth. This relatively impermeable layer serves as a deterrent to root penetration. The moisture curves in Figure 10 reflect these profile characteristics. In the 36- and 48-inch layers both lysimeter and watershed curves are essentially horizontal, indicating little or no moisture extraction from this depth on either area. Little or no root penetration extends into or beyond these heavy silty clay layers, as reported previously.[8]

At the 21- and 28-inch depths the lysimeter moisture content at the beginning of the period is higher than that of the watershed, but at the end it is lower. The moisture extraction by plants being approximately the same on both areas, the higher moisture content on the watershed indicates the possibility of moisture replenishment from lateral flow, an impossibility in the lysimeter. At the 28-inch depth the watershed moisture curve is essentially horizontial; but for the lysimeter there is a pronounced downward trend throughout the period excepting June 10 to 14, when over 4 inches of rain fell. Because of the relatively impermeable layer at the 36-inch depth, any accretions from lateral flow would logically occur much closer to the surface than on the well-drained Muskingum soils, where accretions were most pronounced at the 48-inch depth.

Soil moisture records before and after storms

Soil moisture data were obtained before and after a few storms to account for the disposal of all precipitation, both on lysimeters and their adjacent watersheds. Such data are not readily obtained, because it is difficult to obtain moisture data just prior to rainfall. However, one such record was obtained on Watershed 109 and lysimeter Y102C, Muskingum silt loam, just prior to and after a 2.24-inch storm on June 13 and 14 (Table 1).

First an accounting was made at each of the six access tube sites on the watershed. Five of these tubes extended down to a 48-inch depth. The bottom reading was applied to a depth 6 inches below; a 0-to 54-inch soil moisture profile was thus computed for each location. The increase in soil moisture after the storm of June 13 and 14, 1960, referred to as accretion in Table 1, plus the runoff for the storm period as evidenced by the watershed gage, should equal the moisture supply, a rainfall of 2.24 inches. For site A the access tube gain was 0.84 inch. This amount added to a 0.23-inch runoff totaled 1.07 inches, which was 1.17 inches less than the measured rainfall of 2.24 inches. Other locations showed various amounts ranging from 0.19 to 1.18 inches for the 54-inch profile. The average of all six tubes on the watershed was 0.66 inch short of that of the rain gage. On lysimeter Y102C, the gain in soil moisture in the 54-inch profile was 2.13 inches with a runoff value of 0.09 inch. This accounted for a total of 2.22 inches, only 0.02 inch less than the rain gage. The lysimeter thus gave a good accounting of what became of the rain falling upon it.

Several reasons could account for the lack of a good balance on the watershed. First, the runoff value of 0.23 inch was the value obtained at the outlet of the flume. At various other points on the watershed it could well have exceeded that value. Second, percolation below the depth of moisture measurement was not determined. Third, lateral flow could influence these values. At some points more water could have flowed out of this area

[8] McGuinness, J. L., Dreibelbis, F. R., and Harrold, L. L. Accretion, depletion and storage of soil water. Presented at Geologists Workshop, Charlottsville, Va., June 1960 by McGuinness; and at the Hydrology Workshop, New Orleans, October 1960 by Dreibelbis. 19 pp.

TABLE 1.--Soil moisture balance before and after a 2.24-inch storm, June 13-14, 1960, Watershed 109 and lysimeter Y102C

Location		Soil depth	Soil moisture (inches)			Runoff (inch)	Total (inches)	Balance (inches)
			Before[1 3]	After[2 3]	Accretion			
Watershed 109	Tube A	0"-54"	15.08	15.92	0.84	0.23	1.07	-1.17
	Tube B	0"-54"	14.03	15.85	1.82	.23	2.05	-.19
	Tube C	0"-54"	14.51	15.34	.83	.23	1.06	-1.18
	Tube D	0"-54"	13.88	15.14	1.26	.23	1.49	-.75
	Tube E	0"-54"	13.41	15.21	1.80	.23	2.03	-.21
	Tube F	0"-54"	10.84	12.35	1.51	.23	1.74	-.50
	Avg...	0"-54"	13.62	14.97	1.35	.23	1.58	-.66
Lysimeter Y102C......	....	0"-54"	12.22	14.35	2.13	.09	2.22	-.02
		0"-72"	16.06	18.27	2.25	.09	2.34	+.10
Watershed 109	Tube C	0"-72"	18.90	19.82	.92	.23	1.15	-1.09
		0"-108"	26.25	27.70	1.45	.23	1.68	-.56

[1] On lysimeter Y102C records taken 12:56 to 1:15 p.m. June 13. On Watershed 109 records taken 11:14 to 2:30 p.m. June 13.

[2] On lysimeter Y102C records taken 8:53 to 9:18 a.m. June 14. On Watershed 109 records taken 9:19 to 10:56 a.m. June 14.

[3] Rain began 3:29 p.m. June 13; ended 5:40 a.m. June 14.

TABLE 2.--Soil moisture balance before and after a 2.33-inch storm, August 3-4, 1960, Watershed 123 and lysimeter Y103A

Location		Soil depth	Soil moisture (inches)			Runoff (inch)	Total (inches)	Balance (inch)
			Before[1 3]	After[2 3]	Accretion			
Watershed 123	Tube A	0"-54"	14.61	16.28	1.67	0.11	1.78	-0.55
	Tube B	0"-54"	14.80	16.40	1.60	.11	1.71	-.62
	Tube C	0"-54"	13.50	15.69	2.19	.11	2.30	-.03
	Tube D	0"-54"	14.13	16.28	2.15	.11	2.26	-.07
	Tube E	0"-54"	15.56	17.80	2.24	.11	2.35	+.02
	Tube F	0"-54"	14.94	17.36	2.42	.11	2.53	+.20
	Tube G	0"-54"	13.88	16.72	2.84	.11	2.95	+.62
	Avg...	0"-54"	14.49	16.65	2.16	.11	2.27	-.06
Lysimeter Y103A......	....	0"-54"	12.27	14.18	1.91	.03	1.94	-.39
		0"-72"	16.82	18.57	1.75	.03	1.78	-.55
Watershed 123	Tube D	0"-72"	18.99	20.60	1.61	.11	1.72	-.61
		0"-108"	28.81	30.54	1.73	.11	1.84	-.49

[1] On lysimeter Y103A records taken 8:50 a.m. to 9:12 a.m. August 2. On Watershed 123 records taken 9:31 a.m. to 11:20 a.m. August 2.

[2] On lysimeter Y103A records taken 9:05 a.m. to 9:33 a.m. August 5. On Watershed 123 records taken 9:35 a.m. to 1:20 p.m. August 5.

[3] Rain began 6:15 a.m. August 3; ended 7:47 p.m. August 4.

than moved into it. This is particularly true of the sites on the upper part of the watershed. Fourth, the rainfall measured at the gage could have been different than that falling at any one of the access tube locations.

Data for the moisture balance on Watershed 123 and lysimeter Y103A, Keene silt loam, are given in Table 2 for a 2.33-inch storm on August 3 and 4. Data for each of seven access tubes are available for the profile depth to 54-inches. Data for three of the access tubes balanced within 0.07 inch. The 7 access tubes averaged 0.06 inch less than the total storm. For the lysimeter it was 0.39 inch less. The moisture records were taken on the morning of August 2, and rainfall began on August 3, There was, of course, some evapotranspiration from the areas between the time of the first reading and the beginning of the storm period that would account for some loss of moisture. Also, rainfall did not continue throughout the day of August 3; this likely resulted in additional removal of water by evapotranspiration, estimated from lysimeter records as 0.36 inch. If this estimate is correct, the accounting on the lysimeter would be 0.36 inch less, or 0.03 inch less than the measured rainfall. On the watershed the deviation would be correspondingly affected.

SUMMARY AND CONCLUSION

The foregoing comparison of the soil moisture regimen in lysimeters with that on adjacent watersheds has hydrologic implications that have an important bearing on soil and water conservation research. The problem of water yields is a common one in the field of soil conservation. How can we best obtain information on water yields? Can it be supplied from data obtained on small plots and applied to larger areas by use of an area factor? The data in this paper indicate the extrapolation from small areas to larger ones is not that simple. Such factors as soil profile characteristics, position and elevation on the slope, soil moisture levels, and the possibility of lateral flow must be considered in making these extrapolations.

Soil moisture regimen in lysimeters is not always the same as that on small watersheds. The extent of deviation varies with soil type and with moisture content. The regimen on a well-drained soil, such as the Muskingum silt loam, more nearly approaches that of the watershed than it does on a soil with impeding layers in the profile, such as the Keene silt loam. Lateral flow on the watershed may account for much of the deviation. In accounting for disposal of precipitation the lysimeter gave a more adequate opportunity for checking than the watershed did, but the disposal indicated may not be the natural one.

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