Pennsylvania Soil Survey History

by

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Contents

CHAPTER 1

Introduction

by

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This publication celebrates the centennial (1899-1999) of the United States Cooperative Soil Survey Program and documents some historical aspects of the soil survey history of Pennsylvania. In 1986, Dr. Robert Cunningham et al. (1986), prepared a Penn State Agronomy Series (No. 90) publication which was a collection of papers by a number of authors on various aspects of the soil survey in Pennsylvania. That publication did not get wide distribution and is reproduced in this publication as Chapters 3-8. In addition, Chapter 2 has been added to document the initiation and development of the Penn State Soil Characterization Laboratory. The laboratory was the original focus of the Basic Soils Inventory Program within the Penn State Agronomy Department and has contributed greatly to the Cooperative Soil Survey Program in Pennsylvania. In Pennsylvania, the Cooperative Soil Survey Program includes the USDA Natural Resources Conservation Service (NRCS), formally the USDA Soil Conservation Service (SCS), the Pennsylvania Department of Environmental Resources (now the PADEP), the Pennsylvania Department of Agriculture, and the Penn State University College of Agricultural Sciences.

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Cunningham, R. L., G. H. Lipscomb, E. J. Ciolkosz, H. W. Higbee, A. H. Paschall, and R. S. Long. 1986. Pennsylvania State University Agronomy Series 90.

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CHAPTER 2

Pennsylvania Soil Characterization

by

Edward J. Ciolkosz[1], Robert L. Cunningham[2], and Joseph J. Eckenrode[3]

Introduction

The soil characterization program in Pennsylvania was a joint effort between the USDA Soil Conservation Service (SCS), now the USDA Natural Resources Conservation Service (NRCS), the Pennsylvania Department of Environmental Resources (now the PADEP), the Pennsylvania Department of Agriculture, and the Agronomy Department of Penn State University. At the national level (United States), soil characterization studies were initiated in the mid 1950's in response to the development of, at that time, a new soil classification system (Soil Taxonomy, 1975) and the need for quantitative laboratory data for classification in this system. In its early development, Soil Taxonomy did not have a name and was called an approximation (approximation 2, 3, etc.). The classification system was only published twice. The first time under the title, The Seventh Approximation (Soil Survey Staff, 1960) and then in 1975 under the title, Soil Taxonomy (Soil Survey Staff, 1975). Parts of the system have been updated with a series of publications entitled, Keys to Soil Taxonomy (Soil Survey Staff, 1998). A publication of the complete updated system is scheduled for 1999. For more information on the development of Soil Taxonomy, please see Cline (1979), Forbes (1986), and Brasfield (1984).

Laboratory data on field samples of soils were also necessary to understand the genesis of various soils and to predict the behavior of soils when managed with different techniques. Although soil characterization studies did not duplicate "soil testing services" for fertilizer application recommendations, the data collected complimented our knowledge of soils.

Sampling

The first soils characterized in Pennsylvania were sampled in Lancaster County (1955), Chester County (1956), and Erie County (1956) by SCS personnel and analyzed in the SCS laboratory in Beltsville, Maryland. At about that time, it was decided that a laboratory should be set up at Penn State. The initial agreement was that Penn State would furnish the space and the SCS would staff the laboratory. This apparently did not work out, and Dr. Roy Matelski was hired by Penn State to set up and run the laboratory. Prior to Matelski's arrival, a garage at the soil erosion plots at the edge of the Penn State campus was converted into a laboratory (Dr. Lou Kardos supervised the set up of the lab). Also, at this time, Carl Engle and Ervin Mason were hired to be laboratory technicians.

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The first Pennsylvania counties sampled by the Penn State Basic Soils Inventory Soil Characterization lab were Carbon (1957) and York (1957). Sampling and analysis continued through 1990. The sampling was the most extensive from the late 1950's to the early 1970's (Table 1). From 1957 until 1971, the sampling was done on a county basis in conjunction with the SCS (now NRCS) soil survey program. The soil sampling was done primarily to provide morphological, physical, chemical, and mineralogical data for the classification of the soils for the SCS soil mapping program. The soil sites sampled were selected as "modal" for their soil series (central concept of the soil series). Often the modal site did not reveal the modal soil as usually this was the first backhoe pit ever dug into the soil to show its morphology. From 1969 on, in addition to sampling for classification purposes, some sampling was also done on a topic basis; for example, landside soils and minesoils. These soils may have come from a number of counties which had been previously sampled (Ciolkosz and Thurman, 1994). Starting in the mid 1970's, more special studies and graduate student studies were integrated into the sampling; and for most of 1982 and all following years, the sampling was for thesis work or special studies and not directly for soil classification purposes. After 1990, no additional pedon samples were collected by Penn State laboratory staff or students. In addition to the full pedon sampling and analysis, during the first half of the 1970's, a large number of partial samples were collected and analyzed in the Penn State lab. Partial samples are complete pedons or just a few of the horizons within a pedon in which a limited number of analyses were run on the samples. Typically particle size and base saturation were determined on partial samples for classification purposes. Morphological (profile) descriptions were written for all pedons sampled including partial sample pedons.

Additional Pennsylvania sites were sampled by the NRCS from 1989-1993 and analyzed by their laboratory in Lincoln, Nebraska, and by the SCS (NRCS) (Table 1) for the USDA EPA as a part of their acid rain Direct/Delayed Response Project (DDRP) in 1985 and 1988 (Church, 1989) (Table 1).

Personnel

Dr. Roy Matelski joined the Penn State Agronomy Department to supervise the laboratory in April of 1957. Dr. Matelski was a native of Wisconsin and received his Ph.D. degree from Michigan State University. Prior to being hired by Penn State, Dr. Matelski was a faculty member of the Agronomy Department at the University of Nebraska. Dr. Matelski retired from Penn State September 1976 (died in 1986). Dr. Matelski was the Penn State Soil Characterization program director during his tenure at Penn State. During his tenure, there was a major expansion of faculty associated with the characterization program. An early emphasis of the soil characterization program was an extension effort. Dr. Milford Heddleson assisted other extension specialists in adult education programs focusing on the importance and use of soils survey information in the use and management of land. Upon Milford's retirement, Dr. Ray Shipp continued the extension program until his retirement. Dr. Rick L. Day is presently part extension with the program. The following faculty were hired to conduct the analysis of

Table 1. Listing of pedons and number of counties sampled by year. Data includes sites sampled by Soil Characterization Staff, NRCS staff for DDRP Acid Rain Study, and NRCS independent sampling.

	Number Sampled			Number Sampled	
Year	Pedons	Counties	Year	Pedons	Counties
1954	2	1	1975	9	5
1955	12	1	1976	2	2
1956	25	2	1977	21	6
1957	36	2	1978	20	5
1958	57	5	1979	14	4
1959	44	6	1980	12	3
1960	15	2	1981	19	3
1961	26	4	1982	21	7
1962	30	3	1983	20	4
1963	31	3	1984	--	--
1964	44	4	1985	23*	5*
1965	42	4	1986	--	--
1966	40	4	1987	4	1
1967	35	3	1988	3 + 93*	2 + 14*
1968	41	4	1989	2 + 1**	2 + 1**
1969	38	4	1990	7 + 3**	1 + 2**
1970	28	4	1991	16**	5**
1971	22	8	1992	--	--
1972	22	8	1993	10**	3**
1973	19	3			
1974	39	12			
			TOTAL	948	

* DDRP acid rain sampling
** NRCS independent sampling

soils and the interpretation of the accumulated data: Bob Cunningham and Roger Pennock in 1964 (Cunningham retired in 1991 and Pennock in 1990); Gary Petersen in 1965; Dick Ranney in 1966 (Ranney died in 1972); and Ed Ciolkosz in 1967. When Bob Cunningham was hired, he assumed most of the duties of sampling and running the lab; and when Dick Ranney was hired, he assumed many of Cunningham's responsibilities with regards to the running of the lab. Cunningham resumed these duties after Ranney's death until Ciolkosz assumed them in 1984. The laboratory support people in the 1950's and early 1960's were Carl Engle and Ervin Mason. They were replaced by Dick Pletcher and Dick Williams. In the late 1970's, the thrust of the lab changed with the replacement of Pletcher and Williams in 1979 by Dick Cronce as the lab director. At this time, the lab was moved from the renovated garage at the erosion plots to the third floor of Armsby Building. Cronce left to go to work with Wright Associates in February of 1987 and was replaced as lab director by Bob Dobos in April of 1987. Dobos in turn went back to work for the SCS in June of 1991. During Dobos' tenure as lab director, the lab was moved from Armsby Building to Room 464 Agricultural Sciences and Industries Building. The last lab

director was Nelson Thurman, who served from January 1992 until June of 1994. After Thurman left, the director's position was collapsed by a short-sighted department head; and the laboratory was closed down. In addition to the faculty listed, Dr. Leon Johnson participated in the early years primarily by interpreting the clay mineralogy of the < 2 μm material. This continued until the latter 1960's when Ed Ciolkosz took over those responsibilities.

Publications and Database

Initially the data (site, horizon, and laboratory) were published as mimeograph reports. The SCS handled the site and horizon data, and the soil characterization laboratory produced the lab reports. When Dr. Petersen joined the staff, he initiated the computerization of the laboratory data calculations and a computer data sheet output for the lab data. As a part of this trend and the arrival of new faculty members, a more formal publication outlet was started--this was a series of data reports published as Penn State Agriculture Station Progress Reports (Table 2). These reports started with the mid-1960 samplings and continued until the early 1980's. In addition, an Agronomy Department Series publication (No. 25, 1972) was published, which included all the data gathered prior to the publication of the progress report series (Table 2). These publications were distributed to all land-grant university libraries and many are still available from the Penn State Agronomy Department. These reports included both the field (site and horizon) and the lab data with a brief discussion of the meaning of the data.

The published soil survey report for many Pennsylvania counties included a section on laboratory data. This section was prepared by characterization staff, reviewed, and published by the SCS. Although the SCS imposed some limitations in format, the staff of the Basic Soils Program presented the data in several formats. Nearly all the published soil survey reports include a section on characterization data with some interpretation of the data.

In the mid 1980's, the SCS developed a computerized field data program for the collection and output of data. This system was comprised of forms and codes for the various site and horizon data collected. The Penn State lab decided to input their field data into their system and contracted with the NRCS laboratory in Lincoln, Nebraska, to do so. Dick Cronce provided the leadership to do this task. Following this effort, it was also decided to integrate the field and laboratory data into a PC computer database (the lab data had previously been stored on a mainframe computer at Penn State). This was no small task and took a number of years involving the collaboration of both soil scientists (mainly Ed Ciolkosz) and a computer programmer. The database system was completed in 1992 (Ciolkosz and Thurman, 1992); although complete, it still needs some updating with respect to soil classification and some other data fields. The database contains 800 pedons of data characterized by the Penn State lab (Ciolkosz and Thurman, 1994). The database also contains 116 pedons of Pennsylvania data collected by the SCS for the DDRP Acid Rain Study (Church, 1989) and 32 additional pedons collected by the NRCS after the Penn State lab closed. This brings the total number of pedons in the database to 948. None of the data from the partial samplings is included in the database. Presently, no further additions to the database are planned.

Table 2. Listing of published soil characterization data for Pennsylvania.

Date	Reference
1968	Characteristics, Interpretations, and Uses of Pennsylvania Soils: Dauphin County. Petersen, et al. Penn State Agr. Expt. Sta. Prog. Rept. 306.
1969	Characteristics, Interpretations, and Uses of Pennsylvania Soils: Northampton County. Cunningham, et al. Penn State Agr. Expt. Sta. Prog. Rept. 295.
1970	Characteristics, Interpretations, and Uses of Pennsylvania Soils: Warren County. Ciolkosz, et al. Penn State Agr. Expt. Sta. Prog. Rept. 306.
1970	Characteristics, Interpretations, and Uses of Pennsylvania Soils: Huntingdon County. Ranney, et al. Penn State Agr. Expt. Sta. Prog. Rept. 300.
1971	Characteristics, Interpretations, and Uses of Pennsylvania Soils: Armstrong County. Cunningham, et al. Penn State Agr. Expt. Sta. Prog. Rept. 316.
1972	Characteristics, Interpretations, and Uses of Pennsylvania Soils: Bradford County. Ranney, et al. Penn State Agr. Expt. Sta. Prog. Rept. 320.
1972	Characteristics, Interpretations, and Uses of Pennsylvania Soils: Bedford County. Ciolkosz, et al. Penn State Agr. Expt. Sta. Prog. Rept. 323.
1972	Characteristics, Interpretations, and Uses of Pennsylvania Soils: Bucks County. Petersen, et al. Penn State Agr. Expt. Sta. Prog. Rept. 324.
1972	Characteristics, Interpretations, and Uses of Pennsylvania Soils: Butler County. Cunningham, et al. Penn State Agr. Expt. Sta. Prog. Rept. 326.
1972	Laboratory Characterization Data and Field Descriptions of Selected Pennsylvania Soils. Cunningham et al. Penn State Agronomy Series No. 25 (All data prior to publication of the Agr. Expt. Sta. Series).
1974	Characteristics, Interpretations, and Uses of Pennsylvania Soils Developed from Cherty Limestone Material. Ciolkosz, et al. Penn State Agr. Expt. Sta. Prog. Rept. 341.
1974	Characteristics, Interpretations, and Uses of Pennsylvania Soils Developed from Colluvial Materials. Cunningham, et al. Penn State Agr. Expt. Sta. Prog. Rept. 344.
1976	Characteristics, Interpretations, and Uses of Pennsylvania Soils Developed from Redbeds and Calcareous Materials. Ciolkosz, et al. Penn State Agr. Expt. Sta. Prog. Rept. 355.
1977	Characteristics, Interpretations, and Uses of Pennsylvania Soils Developed from Acid Shale. Cunningham, et al. Penn State Agr. Expt. Sta. Prog. Rept. 362.
1983	Characteristics, Interpretations, and Uses of Pennsylvania Minesoils. Ciolkosz, et al. Penn State Agr. Expt. Sta. Prog. Rept. 381.

Special Studies

The soil characterization laboratory program offered many opportunities for additional studies. These generally took two forms. The first was a use of the collected samples for additional or specialized study. This was possible because during sampling a large bulk sample (2-5 liters of < 2 mm material) was taken from each horizon, and only a small subsample was used in the characterization analyses. The remaining sample was stored in a storage facility on the Penn State campus. These samples continue to be available for special studies. The second was the use of the site for additional studies. The best example of this type of study was the soil percolation work done by Roy Matelski (Matelski, 1975). In this study, one to eight percolation holes were dug around the characterization site and measurements were made. In Matelski's publication (Matelski, 1975), only maximum, minimal, and mean data are presented. The complete data for each of the percolation holes are available in the Penn State Characterization database (Ciolkosz, 1998) for 345 sites. A large number of soils were characterized as special studies. For example, eight sites were characterized in support of a study on the radon in Pennsylvania soils, and a large number of sites were sampled in support of the genesis of Pennsylvania soils, e.g., Carter (1983), Hoover (1983), Waltman (1985), Cronce (1988), Waltman (1988), and Pollack (1992). In addition, a number of soil monoliths were taken from many of the characterization sites for display and educational purposes. These monoliths have been distributed throughout the state.

Additional Computer Technology and Land Analysis Laboratory

Computers were also adopted in managing the spatial (map) data of soil surveys. The staff of the Basic Soils Inventory were quick to recognize the potential of the storage and retrieval of map data. Each mapping unit delineation had many soil property attributes useful in land use planning and management. Making these data available to non-soil scientists was a similar goal as the extension staff of the 1970's when educational meetings on the "use of soil surveys" were conducted.

The interest and use of computers exploded as the storage capability and spatial management programs expanded. An early model PC (personal computer) was programmed to store and retrieve soil survey information in the mid-1980's; a very limited and cumbersome system in comparison with the equipment and technology used and developed by the Penn State Agronomy Department's Land Analysis Laboratory of today. This Laboratory, founded by Robert Cunningham and Rick Day in the late 1980's, has expanded from its early beginnings into a major input to the current soil survey in Pennsylvania. Completed soil survey maps are digitized in this lab under the supervision of personnel of the USDA-NRCS (John Hudak and Tim Craul) and Rick Day. This arrangement has been in place for several years and has improved the cooperative efforts in soil survey.

Presently, extension programs and resident education courses are training students to use the latest technology to improve the utilization of all the soils information collected through the Basic Soils Inventory program as well as Pennsylvania soil survey. The future will initiate even greater activity in investigating additional characteristics to provide data to land planners and

managers. Prescription farming, watershed modeling, and water resource management are only a few programs that depend heavily on soils data. Early personnel involved in the use and development of computers in soil survey include Doug Henry, hourly wage help; Dr. Petersen's graduate student—Doug Miller; Chris Sacksteder, first computer scientist hired by the Agronomy Department and supported primarily by the Basic Soils Inventory Program.

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Pollack, J. 1992. Pedo-geomorphology of the Pennsylvania piedmont. M.S. Thesis, Penn State Univ.

Waltman, W. J. 1985. The stratigraphy and genesis of Pre-Wisconsinan soils in the Allegheny Plateau. Ph.D. Thesis, Penn State Univ.

Waltman, S. W. 1988. The genesis of prairie soils in northwestern Pennsylvania. M.S. Thesis, Penn State Univ.

CHAPTER 3

Introduction for Penn State Agronomy Series No. 90[1]

by

R. L. Cunningham and G. H. Lipscomb[2]

These papers (Chapters 4-8 in this publication) have been contributed by the authors to establish the history and activities associated with the evaluation of the quality and quantity of soil resources in Pennsylvania. The comments from the retired soil scientists who have contributed greatly to our knowledge of Pennsylvania soils were requested and we thank them for their contributions. Others involved with the soil survey who chose not to write a chapter were Dr. Roy P. Matelski who directed the University's activities in soil characterization from 1958 to 1978. He contributed much to the program. He was good at maintaining and expanding the funding for the program. He led soil sampling expeditions that were fondly referred to as Matelski's "Army." His interest in soil monoliths and field percolation rate testing produced teaching tools and important data that are often requested. Dr. Matelski mapped soils with the Mobile Crews of the 1940s in the Dust Bowl of eastern Colorado. He had many experiences in soil survey.

Mr. John J. Noll also mapped soils in early times as indicated by Jerry Paschall. He was also state soil scientist in Pennsylvania through the years when the new taxonomy was being tested and adapted.

Another soil scientist who has contributed considerably to Pennsylvania soil survey was F. Glade Loughry who was state soil scientist with SCS before John J. Noll. Glade assisted Mr. McKeever and directed the survey activities in the state during 1945 through 1966. He also became the lead soil scientist with DER upon retiring from SCS and formulated many of the requirement policies for non-agricultural uses of soils.

Chapter I briefly discusses the committee structure that is still active today in guiding soil survey committee activities in the state. Dr. Ciolkosz had prepared a brief history for a 1979 conference.

Professor Higbee lectured to the Soil Genesis and Morphology Group in 1981 and his remarks were organized into Chapter III.

Chapters IV and V reflect some thoughts by Jerry Paschall and Dick Long who have had a close association with the Soil Survey program in Pennsylvania.

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[1] This is the introduction of Agronomy Series No. 90. It introduces the material that is reproduced as Chapters 4-8 of this publication, and is reproduced here without any changes.

[2] Professor of Soil Genesis and Morphology, Pennsylvania State University and USDA-SCS State Soil Scientist.

CHAPTER 4

Soil Survey Committee History[1]

by

Dr. Robert L. Cunningham and G. H. Lipscomb[2]

Discussion during the 1985 joint meeting of the Soil Survey Advisory and Administrative Committees pointed out a need to document the origination and activities of these committees.

The listing of county soil surveys, the surveyors, and date published between 1900 and 1958, given at the end of this report. illustrate the personnel responsible and progress in evaluating the soil resources of the state. Many of these surveys were made in 1 or 2 field seasons and were published at various scales, a common one being the 1:62,500 scale of a USGS 15 minute quadrangle sheet. Soil mapping units were broadly defined. The history of the county development, crop yields from census data, and climatic data were usually included in these reports with the generalized descriptions of the soils.

Reconnaissance soil surveys of five regions of the state were done by Charles F. Shaw from about 1910 through 1914. Mr. Shaw was apparently hired during the summer by USDA to survey soils while teaching and researching at Penn State during the academic year. The Agronomy Department files contain his Experiment Station Bulletin 132, "Soils of Pennsylvania," published in 1914. An 8 1/2 x 11 inch soils map was accompanied by 35 pages of text.

Of historical interest, Hugh H. Bennett assisted in mapping Adams County and was also the inspector for the Southern Region when Cambria County was mapped. There are few records indicating the roles of the College with respect to the surveys, apparently personnel from both agencies participated equally in the survey. Austin L. Patrick was an early scientist with the College and worked closely with Bennett. Dr. Fred G. Merkle, who was the initiator of the University Turf program, worked with Patrick in mapping Green County. Howard Wm. Higbee began surveying in Pennsylvania in 1938 for the UDSA in Franklin County. Richard S. Long was his assistant in both surveys and Dick Long continued with the USDA in Pennsylvania while Howard Higbee began his career at Penn State through the planning of the Union and Clarion County soil surveys of the mid 1940's.

In the late 1940's, Higbee invited representatives from Extension, Ag. Economics, Forestry, Biological Science, Geology, and Ag. Education to deliberate the scale, mapping units needed, and purpose of the surveys. At this time, there was considerable flexibility in the scale and format of soil inventory information. New York state was publishing county soil survey reports on large sheets (4 by 5 feet) with descriptive and interpretative information on the back. Several of these are on file and Jefferson County was most often cited as a good example.

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[1] Reprinted from Penn State Agronomy Series No. 90. 1986.

[2] Professor of Soil Genesis and Morphology, Pennsylvania State University and Pennsylvania USDA-SCS State Soil Scientist.

Correspondence dated March 7, 1947, from Professor Higbee to Department Head H. K. Wilson, requested $12,157 to finance the first year of a five-year program to make a soil map of the state at a scale of 1:315,800 (1 inch = 5 miles). He indicated there was no information in 40 counties. He would use Marbut's concepts in designing the mapping units. In 1949, a request from College of Agriculture Dean Jackson to University President Milholland supported Agricultural Research Project 792 that requested $77,600 to inventory land resources in the state. These funds were to come from the State Soil Conservation Commission.

Mr. Walter Gumbel, State Conservationist in 1945, urged detailed soil surveys be made to inventory the extent of soil erosion. His conservation needs assessment indicated that 94% of PA needed conservation. Only 2 million acres of PA was mapped and only 6 conservation districts existed in 1945.

The Postwar Planning Commission for the state urged an inventory of land resources prior to the creation of the State Soil Conservation Commission in the late 1940's. The State Council of Farm Organizations resolved on December 17, 1954, that comprehensive soil surveys were necessary, fundamental information and went on record in support of an adequate soil survey program and would assist in securing adequate financial support.

In 1958, a 10-year program was launched to complete the basic inventory of soil resources in Pennsylvania. This program provided that the U.S. Dept. of Agriculture and the State of Pennsylvania would share equally in the total cost, estimated at 5 million dollars for the completed job. The Soil Conservation Service of the U.S. Dept. of Agriculture carried the responsibility for the federal share, and the Dept. of Agronomy at the Pennsylvania State University was designated as the responsible state agency.

The state's share of this program was begun with an initial appropriation of $70,000 in May, 1957 made to the Pennsylvania Dept. of Agriculture, which in turn transferred the funds to the University for use by the Dept. of Agronomy. Three staff members were added to the department's faculty to carry out the new work: Dr. R. P. Matelski, professor of soil technology; Carl F. Engle, instructor in soil technology; and Ervin Mason, soil physics technician.

The U.S. Soil Conservation Service operated the field parties that surveyed the land and made the detailed soil maps that show all essential conditions of both surface and subsoil for all land in each area. The Agronomy Department operated the soil characterization laboratory in support of the field work and assisted in defining the soil unit and in preparation of the written reports. The costs of preparing the maps for printing, and printing of both the soil maps and the descriptive reports, were included in the share to be borne by the state. For the biennium (1959-60), $200,000 of state funds were required yearly to keep the program on schedule.

With soil surveys completed for only 20 of its 67 counties in 1958, Pennsylvania was behind all other northeastern states. The basic inventory of soil resources was needed for practical agriculture and forestry, for all research on crops, pastures, and forests, for soil conservation programs and flood control projects, for highway construction, and for all other land uses. Because of the importance of this program to Pennsylvania, the University has made the entire resources and facilities of the Agronomy Dept. available for this soils inventory,

according to Dr. Howard B. Sprague, head of the Department. Use was made of research findings on mineralogy, soil physics and chemistry, soil structure, and soil management to make the basic soils Inventory of lasting value.

Early in the 1960's, an Ag-industrial Adjustment Conference was held at the University. A 1961 Science in Agriculture publication was devoted to this discussion. Dr. H. F. Sprague was a featured speaker on soil resources and land use. he spent considerable time and effort researching this topic. His notes contained an interest and fervor that led him to chair a committee to study the "Development and Use of Soil Survey." He was concerned that so little had been published about the soils of the state. He could not find enough information for land use decisions or for agronomic management recommendations. He had tried to use soils data to determine the direction and emphasis of the Department's research and extension goals. He found a huge void and immediately began efforts to develop a "Basic Soils Inventory." The members of the "Soil Survey Development and Use" Committee were Dr. J. H. Eakin, Agronomy Extension; Dr. R. P. Matelski, Soil Survey; R. Ruble, SCS State Resource Conservationist; Dave Unger, Department of PA Agriculture; John Bergstrom, Erie Co. Extension; Mr. Byrnes, farmer; Mr. Meyer, farmer, Mr. Gerald Bullock, Chairman of PA Association of Conservation Districts, and Dr. Sprague, Chairman of the Committee and also Department of Agronomy. This committee met several times discussing the kind of soil survey information needed and the means of developing the survey. There was concern about extension management services, zoning, taxation, and also personnel to collect laboratory data and to train adults in the need and use of soil survey information. The recommendations of the committee in 1961 were to develop soil maps and soil interpretations for every PA county, that a Basic Soils Inventory to collect lab data be established and maintained; and that an Extension Agronomist be hired to initiate and carry on a Soil Survey Educational Program for the state. Funds mentioned were $250,000/year for 8 years with $35,000/year for the last 6 years for "Basic Soils Inventory." Continued interest by Dr. Sprague, the PA Association of Conservation Districts, and SCS led to a 1962 contract between the State Soil Conservation Commission, SCS, and Penn State University to develop soil survey information as visualized by Dr. Sprague early in 1950.

Secretary of Agriculture, L. H. Bull, appointed a committee in 1964 to again study the soil survey program. Members of this committee were R. M. Davis, Assistant State Conservationist, SCS; M. R. Heddleson, Penn State; Boyd Kinzley, State Conservation Commission; F. G. Loughry, State Soil Scientist; R. P. Matelski, Penn State; and C. F. Hess, Dept. of Ag. Chairman. The committee discussed acceleration of the soil survey and training programs. A recommendation resulted to seek more financial support for the soil survey. A second recommendation was to establish a Soil Survey Advisory Board which was to be essentially an extension of the present committee (as appointed by Secretary Bull) with the responsibilities to periodically review the soil survey program and to make recommendations, which if followed, should result in the improvement in the quality and quantity of soil survey information.

The minutes of the first meeting of the Soils Administrative Committee held August 9, 1957, In the SCS offices of Harrisburg were distributed to each of the signators of the memorandum of understanding pertaining to the soil survey of PA as well as to members of the Advisory Board. Administrative Committee members were Ivan McKeever, State Conservationist; Dr. Leland H. Bull, PA Secretary of Agriculture; Dr. M. A. Farrell, Director of

PA Agricultural Experiment Station; Thomas H. Patton, Director of the PA Ag. & Home Economics Extension Service; and Dr. Russell E. Larson, Dean of the College of Agriculture. The committee chairman was Ivan McKeever who was to serve for two years. A Soils Congress for 1968 was suggested. This Congress was finally held in 1972.

The first meeting of the Soil Survey Advisory Committee was October 13, 1967, with Milford Heddleson as chairman. Matelski, Noll, and Hess were also present. The minutes indicated a lengthy discussion about the soil survey progress and procedures. January 24 was agreed as the next meeting date.

The two committees were jointly held in 1972 after meeting separately at various times. The State Conservation Commission was transferred from the Dept. of Ag. to the Department of Environmental Resources in 1971. The Soil Survey meetings were often scheduled on the same day as the PA State Soil Conservation Commission meeting because of the commonality in membership. The agendas of these meetings reflected the original charge to the advisory board: to periodically review the soil survey program progress and quality and to make recommendations that would improve soil survey information for the state. Funding was always an agenda item. Through the 1970's and 80's, the advisory committee was the most active. The interest of the Department of Agriculture waned because of their loss of the Conservation Districts to DER. DER's interest was keen during Goddard's tenure as Secretary as he strongly believed in obtaining the best land resource information possible to accomplish the many tasks within his department. The University's representation at the administrative level fell from 3 to 1 when Dean Beattie took the responsibility of Research Director and Extension Director. The Associate Deans were involved to a lesser extent than the original Directors; however, Tom King was active with the Conservation Commission. The advisory committee lost some of its impetus when Dr. Heddleson moved into administrative duties. The original extension thrust of training and education in soil survey was partly becoming accomplished and secondly was receiving a low priority from county extension staff.

Soil Survey Administrative Committee Members

State Conservationist
SCS

Walter Gumbel	1941-46
Ivan McKeever	1947-68
Mel Davis	1969-72
Benny Martin	1972-75
Graham Munkittrick	1976-83
Jim Olson	1983-present

Secretary
DER

Maurice Goddard	1971-76
Clif Jones	1977-78
Peter Duncan	1979-81
Nick DeBenedictus	1981-present

Secretary
PA Dept. of Agriculture

Bill Henning	1960-64
Leland Bull	1964-71
Snyder	1971-79
Pen Hallowell	1979-85
Richard Grubb	1985-present

Deans, Directors
University

Jackson	1946-63
Russ Larson	1964-72
David McClay	1972
Jim Beattie	1973-83
Sam Smith	1983-85
Lam Hood	1986-present

Soil Survey Advisory Committee Members

State Soil Scientist

Glade Loughry	1945-66
John F. Noll	1966-70
Gerald Latshaw	1971-75
Art Kuhl	1976-81
Garland Lipscomb	1981-present

Bureau of Soil and Water, PA Dept. of Agriculture Executive Secretary, DER

Charles Hess	1962-1971	PA Dept. Ag.
Walt Peechatka	1972-1981	DER
Paul Swartz	1981-present	DER

Agronomy Research

Howard Higbee	1948-57
Roy Matelski	1958-78
Bob Cunningham	1978-present

Agronomy Extension

Milford Heddleson	1964-76
Ray Shipp	1976-present

Agronomy Department Heads (were not members of the committee)

Wilson	1942-55
Howard Sprague	1956-64
Walt Thomas	1965-69
Jim Starling	1969-85
Dan Fritton	1985-86
Al Turgeon	1986-present

Year	County	USDA Surveyors	PSC Surveyors
1900	Lancaster	Clarence A. Dorsey	
1903	Lock Haven	J. 0. Martin	
1904	Adams	Henry J. Wilder H. L. Belden	
1907	Johnstown	Charles J. Mann Howard C. Smith	
1910	Centre	Charles N. Moones Charles F. Shaw Lawrence A. Kolbe Hugh H. Bennett Risden T. Allen	
1910	South Central	Charles F. Shaw V. C. Byers	W. G. Ross
1911	Bedford	Charles J. Monn W. E. Gross H. H. Bennett	
1911	Washington	F. S. Welsh F. S. Bucher	D. K. Sloan
1912	Lehigh	William T. Carter, Jr. J. A. Kerr Hugh H. Bennett	
1912	Southeast	Charles F. Shaw	J. W. McKee W. G. Ross
1912	York	J. O. Veach Lewis A. Hurst Gustavus B. Maynadier Hugh H. Bennett	
1913	Bradford	Percy O. Wood	J. N. McKee L. M. Skemp W. B. Nissley J. R. Dickey
1913	Northeast	Charles F. Shaw	J. W. McKee W. G. Ross

Year	County	USDA Surveyors	PSC Surveyors
1916	Lancaster	B. D. Gilbert W. B. Cobb	Earl F. Moffitt J. F. Cox
1917	Blair	J. O. Veach	Harry P. Young H. P. Cooper
1917	Cambria	B. B. Derrick A. L. Patrick	David C. Wimer
1919	Clearfield	R. A. Winston R. W. McClure	H. P. Cooper David P. Wimer
1919	Mercer	E. B. Deeter R. A. Winston	W. Irvin Galt
1923	Lycoming	E. H. Stevens B. H. Hendrickson	C. B. Manifold C. G. Degen Austin L. Patrick
1924	Adams	H. H. Bennett	A. L. Patrick
1925	Green	S. O. Perkins M. W. Senstius	A. L. Patrick Fred G. Nerkle
1929	Tioga	B. H. Hendrickson R. T. A. Burke	K. V. Goodman R. C. Smith
1929	Wyoming	B. H. Hendrickson R. T. Avon Burke Mark Baldwin	K. V. Goodman R. L. Smith
1931	Indiana	R. T. Burke C. S. Simmons W. J. Latimer	J. L. Hasterman Richard Marshall C. H. Atkinson
1932	Franklin	Howard William Higbee R. R. Finley Mark Baldwin	R. S. Long J. C. Bryant
1936	Bucks	R. T. A. Burke James Thorpe	R. K. Craver B. Alderfer E. C. Dunkle
1938	Wayne	C. S. Simmons	C. H. Atkinson L. A. Brown

Year	County	USDA Surveyors	PSC Surveyors
1939	Armstrong	R. T. Avon Burke S. O. Perkins	L. J. Yohn O. C. Lewis C. H. Atkinson L. A. Brown
1939	Crawford	S. R. Bacon R. T. A. Burke	Howard W. Higbee J. K. Thornton D. K. Wolff S. Van Day C. S. Bryner Gerald Yoder
1942	Montour	David C. Taylor S. R. Bacon W. J. Latimer	L. G. Vearick
1942	Northumberland	David C. Taylor S. R. Bacon W. J. Latimer	L. G. Yearick
1944	Huntingdon	Howard Wm. Higbee S. R. Bacon R. T. A. Burke	Austin L. Patrick L. A. Brown N. P. Tedrow R. S. Long C. H. Atkinson
1946	Union	S. R. Bacon David Taylor	Alfred Boileau Gerald Yoder

CHAPTER 5

The Soil Survey of Pennsylvania[1,2]

by

Dr. Edward J. Ciolkosz[3]

The Pennsylvania State University and the United States Department of Agriculture Soil Conservation Service (USDA-SCS) are the main cooperators in the National Cooperative Soil Survey of Pennsylvania. This cooperation extends almost since the inception of the soil survey program in the United States, and the remainder of this presentation will focus on the chronological evolution of the soil survey program in Pennsylvania (a chronological sequence of events is given in Table 1).

Table 1. Chronological Sequence of Events in the Soil Survey Program of Pennsylvania.

Penn State		USDA Soil Survey	
Penn State established as the Farmers High School.	1855		
Name changed to The Agricultural College of Pennsylvania.	1862		
Penn State named landgrant school for Pennsylvania.	1863		
Name changed to The Pennsylvania State College.	1864		
Pennsylvania Agricultural Experiment Station formed.	1887		
		1894	Division of Soils formed in the USDA; Milton Whitney, head.
		1899	First soil surveys by the Division of Soils.
		1901	Division of Soils upgraded to the Bureau of Soils (USDA).

[1] Presented to the Pennsylvania Soil Survey Conference at the Penn State University on February 28, 1979.
[2] Reprinted from Penn State Agronomy Series No. 90. 1986.
[3] Professor of Soil Genesis and Morphology, Agronomy Dept., Penn State University.

Table 1. (Continued) Chronological Sequence of Events in the Soil Survey Program of Pennsylvania.

Penn State		USDA Soil Survey	
Dept. of Agronomy formed in the School of Agriculture; J. W. Gilmore appointed head, Charles F. Shaw hired.	1907		
Frank D. Gardner appointed head of Agronomy Dept.	1908		
Charles F. Shaw leaves Penn State for the Univ. of California	1913	1913	Curtis F. Marbut appointed scientist in charge of Soil Survey in the Bureau of Soils.
Austin L. Patrick hired by Agronomy Dept.	1919		
		1928	Bureau of Soils changed to the Bureau of Chemistry and Soils.
Howard Higbee hired by Agronomy Dept.	1935	1935	Soil Conservation Service formed in the USDA; Hugh H. Bennett, chief; Marbut passed away; Charles E. Kellogg appointed as head of Soil Survey.
Austin L. Partick leaves the Agronomy Dept. and joins the SCS.	1937		
		1939	Soil Survey transferred to the Bureau of Plant Industry, Soils and Agricultural Engineering.
		1952	Soil Survey activities of the Bureau and the SCS are consolidated in the SCS under Charles Kellogg.
Roy Matelski hired by Agronomy Dept. to establish the Penn State Soil Characterization Laboratory.	1957		
Bob Cunningham and Roger Pennock hired by the Agronomy Dept.	1964		
Gary Petersen hired by the Agronomy Dept.	1965		

Table 1. (Continued) Chronological Sequence of Events in the Soil Survey Program of Pennsylvania.

Penn State		USDA Soil Survey	
Howard Higbee retired	1966		
Dick Ranney hired by the Agronomy Dept.	1966	1966	First known mention of the term "The National Cooperative Soil Survey.
Ed Ciolkosz hired by the Agronomy Dept.	1967		
		1971	Charles Kellogg retired; Bill Johnson named Deputy Administrator for Soil Survey.
Ray Shipp hired by Agronomy Extension; Dick Ranney passed away.	1972		
Roy Matelski retired	1976	1976	Klaus Flach appointed Assistant Administrator for Soil Survey.
Dick Cronce hired by Agronomy Dept.	1979		

Early Penn State History

The Pennsylvania State University (Penn State) has a long standing association with Agriculture. The establishment by the state of an institution to improve Agriculture through the scientific education of future farmers had been urged for years by the Philadelphia Society for the Promotion of Agriculture and later by the Pennsylvania State Agricultural Society which it helped organize in 1850-51. Because of this urging, Penn State was established in 1855 by the state as the Farmers High School of Pennsylvania. The school had many offers of land for its location site. The Board of Trustees accepted the offer of 200 acres of land and an option to buy 200 more acres from General James Irvin of Centre County. In addition, the offer included a $10,000 pledge from Irvin and the citizens of Centre and Huntingdon counties. The reason Penn State was originally called a high school was that there was a feeling that farmers might be prejudiced against the word college--it being a place where boys only contracted idle habits. Although established in 1855, the school was first opened on February 16, 1859, with 69 students present. The recognition of the Farmers High School as a college did not come until May 2, 1862, when Penn State's name was changed to The Agricultural College of Pennsylvania.

The Agricultural College of Pennsylvania was established as the land grant college of Pennsylvania on April 1, 1863. This establishment was a response to the Federal Morrill Act of 1862 which donated public lands to states (Pennsylvania got 780,000 acres) to provide colleges for the benefit of Agriculture and the Mechanic Arts (Engineering). Penn State is the only land grant school in Pennsylvania (many southern states have two land grant institutions). The name of the Agricultural College of Pennsylvania was changed on January 26, 1874 to the Pennsylvania State College, and the Agricultural Experiment Station was formally established in 1887. The experiment station was formed under the Federal Hatch Act of 1887 which provided funds for original research or experimental verification of work for the agricultural industry of the United States. Although this was the first official experiment station in Pennsylvania, experimental work in Agriculture had been conducted at Penn State since its first years as the Farmers High School. The Agriculture and Home Economics Extension Service was established at Penn State under the Federal Smith-Lever Act of 1914. Under this act, the Cooperative Extension Service's major function is to aid in diffusing among the people of the United States useful and practical information on subjects relating to Agriculture and Home Economics and to encourage the application of this information.

The last major name change at Penn State occurred on November 14, 1953, when the Pennsylvania State College was renamed The Pennsylvania State University. A point of interest here is that after Penn State's status was changed from a College to a University, a move was started to change the name of State College (the borough in which Penn State is located). This movement was stopped when a referendum to change the name of State College was defeated in 1954. In response to the defeated referendum, the University opened its University Park postal substation on February 22, 1955, in the Hetzel Union Building, and henceforth, all mail going to the University is addressed to University Park, PA 16802. It is interesting to note that at this time, Milton Eisenhower was the President of the University and his brother Dwight was the President of the United States.

Soil Survey

In 1894, Milton Whitney was hired as the head of the newly formed Division of Soils of the United States Department of Agriculture. Whitney in 1899 started the soil survey of the United States. These surveys were at a scale of 1 inch to the mile (1:62,500; the scale of the 15' USGS topographic maps) and of four areas of the country (Cecil Co., Maryland, Connecticut Valley, Salt Lake Valley, and Pecos Valley). The first soil survey in Pennsylvania was done in Lancaster county (the NW quarter of the county). Three other areas (Johnstown, Lock Haven, and Lebanon) were also surveyed in the next few years on an area basis. (See Table 2 for a listing of USDA Pennsylvania Surveys.)

The National Cooperative Soil Survey is not a new concept. Whitney in 1900, in his first report of the field operations of the soil survey, stated "whenever possible, it has been the policy of the division to work in close cooperation with the state experiment stations, the state geological surveys, boards of Agriculture, or other local institutions. This cooperation, so far as it has been carried out, has proved mutually satisfactory and beneficial to the local institutions and to this division."

Table 2. Pennsylvania Soil Survey by the USDA**.

*1904	Adams	*1914	Lancaster
1967	Adams	1959	Lancaster
*1939	Armstrong	*1900	Lancaster Area
1977	Armstrong	*1901	Lebanon Area
*1911	Bedford	*1912	Lehigh
*1909	Berks	1963	Lehigh
1970	Berks	*1903	Lock Haven Area
*1915	Blair	*1923	Lycoming
*1911	Bradford	*1917	Mercer
*1946	Bucks	1971	Mercer
1975	Bucks and Philadelphia	*1905	Montgomery
*1915	Cambria	1967	Montgomery
1962	Carbon	1955	Montour and Northumberland
*1907	Centre	1974	Northampton
*1905	Chester	1969	Pike
1963	Chester and Delaware	1958	Potter
1958	Clarion	*1908	Reconnaissance and Northwestern
*1916	Clearfield	*1909	Reconnaissance Southwestern
1966	Clinton	*1910	Reconnaissance South Central
1967	Columbia	*1911	Reconnaissance Northeastern
1954	Crawford	*1912	Reconnaissance Southeastern
1972	Dauphin	1973	Susquehanna
*1910	Erie	*1929	Tioga
1960	Erie	*1946	Union
1973	Fayette	1975	Venango
*1938	Franklin	*1910	Washington
1975	Franklin	*1938	Wayne
1969	Fulton	1968	Westmoreland
*1921	Greene	*1929	Wyoming
*1944	Huntingdon	*1912	York
1978	Huntingdon	1963	York
*1931	Indiana		

*Out of print; not available for distribution.

**The surveys from 1900 to the late 1940's were at a scale of 1:62,500 (1" = 1 mile). During and after the late 1940's varying larger scales were used (1:24,000; 1:31,680; 1:15,840; 1:20,000).

Although Whitney strongly encouraged cooperation, apparently, there was very little from Pennsylvania until the Agronomy Department was organized as a unit of the School of Agriculture in 1907 at Penn State. At this time, Charles F. Shaw, who worked for the Bureau of Soils from 1905 and apparently part time till 1913, was hired as a faculty member in the Penn State Agronomy Department. One year later, Frank D. Gardner, also from the Bureau of Soils

(from at least 1899), was hired as the head of the Agronomy Department. Shaw was very active in Soil Survey until 1913 when he left Penn State for the University of California. From 1913 until November 1919, cooperation continued between Penn State and the Soil Survey. During these years, the Agronomy Department continued to furnish some men (research assistants, mainly graduate student) as Shaw has done to help with the survey. In November 1919, the Agronomy Department hired Austin L. Patrick. Patrick, like Gardner and Shaw, had worked for the Bureau of Soils (from 1912). Patrick was the Soil Survey leader at Penn State until Howard Higbee joined the staff in September 1935. Patrick, like Shaw, was very active in Soil Survey, and he also furnished research assistants for the survey. Patrick left Penn State in June of 1937 to work for the SCS. Higbee, like his predecessors, also worked for the Bureau of Soils. He worked for the Bureau for five years (1930-35) prior to joining Penn State. Higbee worked closely with the Federal Soil Survey until about 1940. At this time, he embarked on a state mapping program, and his maps were published by the Pennsylvania Agricultural Experiment Station (see Table 3). Although he embarked on a separate mapping program, Higbee furnished assistants, primarily undergraduates to work on the federal survey from the time he arrived at Penn State until 1952. In 1952, when the Bureau Soil Survey was combined with the Soil Survey of the SCS, in the SCS, this cooperation was discontinued because of the switch of the Soil Survey from a county to a farm mapping program.

Table 3. Pennsylvania Soil Surveys* by Howard Higbee.

Adams Co. (unpublished, surveyed about 1940, just eastern part, 1:24,000)
Clinton Co. (unpublished, surveyed in the late 1940's, 1:24,000)
Columbia Co. (unpublished, surveyed in the 1950's, 1:24,000)
Cumberland Co. Soil and Forest Topographical Map 1956 (1" = 1 mile)
Dauphin Co. (unpublished, surveyed in the 1950's, 1:24,000)
Fulton Co. Bulletin (1947), Soils Map 1943 (1" = 1 mile)
Juniata Co. Soil & Topographic Map 1954 (1" = 1 mile)
Lebanon Co. Map (1961) limited number printed (1:31,680)
Mifflin Co. Forest (Topographic) 1950 , Soil Map 1949 (1" = 1 mile)
Perry Co. Forest (Topographic) and Soil Map 1954 (1" = 1 mile)
Snyder Co. Forest (Topographic), Topographic and Soil 1957 (1" = 1 mile)

*Maps and Bulletin were published by the Pennsylvania Agricultural Experiment Station.

The next major change in the Soil Survey started with the establishment of the Penn State Soil Characterization Laboratory in 1957. Roy Matelski was hired in April of 1957 to head up this program. Other staff members hired to assist in the Soil Survey Program were Bob Cunningham (March, 1964), Roger Pennock (September, 1964), Gary Petersen (August, 1965), Dick Ranney (July 1966), Ed Ciolkosz (August, 1967), Ray Shipp, Agronomy Extension (September, 1972). Howard Higbee retired in June, 1965. Although he was officially retired, Higbee was retained for some months to finish the soil resource map of Pennsylvania he started prior to retirement.

This brief presentation is a first attempt to summarize the activities of the Soil Survey of Pennsylvania. Possibly in the future a more complete presentation will be attempted.

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CHAPTER 6

Soil Survey Synopsis[1,2]

by

Howard W. Higbee[3]

Personal History

Born in 1899 in Kansas tall grass cow country, Howard W. Higbee attended Kansas State Agricultural College and completed a B. S. degree in 1928. He worked on soil survey during the summers of 1926, 1927, and 1928 in five counties in Kansas, some with E. W. Knoble, a former Missouri football player who displayed great artistic talent in creating soil maps. Howard learned what the soil map should look from Soil Scientist Knoble. In September, 1928, Howard joined Cornell University as a research assistant and left Cornell with an M. S. in 1930 to map soils in Kentucky for the USDA-Soil Survey under Dr. C. F. Marbut. For five and one half years, assignments were to Mercer, Fayette, and Callowa counties, Kentucky; Washington, Indiana, Cass counties, Texas; and Franklin and Huntingdon counties, Pennsylvania. The above assignments offered experiences to study soils in several states and work with many of the leaders in soil survey during this period. In the winter of 1931, Howard assisted Dr. Marbut in the development of the U. S. Soils Atlas. The summer of 1933 was spent with three other soil scientists in Washington to develop a "U. S. Land Resource Map" for F. D. Roosevelt (never published).

Professor Higbee joined Penn State at the invitation of Austin L. Patrick on September 1, 1935. At first, He taught Agronomy 6 and Soil Survey. He surveyed the soils of Fulton, Mifflin, Juniata, Perry, Cumberland, Snyder, and Lebanon counties and the Penn State Agricultural Experiment Station published maps of these Pennsylvania counties. Unpublished surveys included Dauphin (1:24,000), Columbia (1:24,000), Clinton, Centre, Bedford, and part of Adams.

The "Land Resource Map of Pennsylvania" was developed from 1962 to 1966 and published in 1967. One is now in Pattee Library Hall of Fame. The map was printed by the A. Hoen and Co. of Baltimore. This map assembly now has the highest distribution of any "sold" PSU publication. The distribution of the land and stream maps range from 250 to 2,850 per month. It is also available in the new Agriculture Administration building.

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[1] Presented January 4, 1981, at Soil Genesis and Morphology Research Meeting.
[2] Reprinted from Penn State Agronomy Series No. 90. 1986.
[3] Emeritus Professor of Soil Technology

"Higbee's Criss-Cross Trials"

In the American Soil Survey 1926-1966

1926 Summer season - Labett and Dauphin Counties, Kansas

1927 Summer season - Wilson and Cherokee Counties, Kansas

1928 Summer season - Crawford County, Kansas

1928 - 1929 Winter - Cornell University: Graduate Research Assistant

1929 Summer season - Mercer County, Kentucky. In charge of survey.

1929 - 1930 Winter - Cornell University: Research Assistant

1930 Summer - Fall - Mercer Co., KY and Washington, Co., Indiana*
(*First air photography used for soil survey mapping.)

1931 Winter season - Washington, C. C. Compiled and assembled all the chemical data for Dr. Marbut's Atlas "Soils of the United States."

1931 Summer - Fall - Fayette Co., KY (Blue Grass Country) *MillionaireHorse Farms.(*Fast women and beautiful racehorses)

Field classification of soils based on phosphorus content.

U.S.A. Field testing was by colorimetric Diengee's colorimetric phosphorus testing method.

1931 Winter season - Cass Co., Texas Soil Survey. A sad assignment. All sand and pines in the east Texas coastal plain.

1932 Summer season - Franklin Co., Pennsylvania Soil Survey - 62,500 scale.

1933 Summer season - Huntingdon Co., Pennsylvania - 3:62,500 scale.
Note: Called to Washington to serve as a four man team to evaluate, classify, and assemble first soil inventory of the soil of United States - % Dr. Marbut by order of President Franklin D. Roosevelt.

1934 Completed soil survey - Huntingdon Co., PA - Scale 62,500.

1935 Winter/Spring - Jefferson Co., TN A. T. V. A. assignment.

1935 Summer Season - Calloway Co., KY A. T. V. A. assignment.

1935 August - That is when the "bomb" fell and the end of USDA Soil Survey for Higbee. Higbee resigned August 31, 1935.

Higbee's Soil Auger Trials in Pennsylvania 1935 to 1966

1935 August THE SURPRISE: Dr. Austin L. Patrick called Higbee, then in Kentucky, and asked if Higbee would be interested in a job at Penn State. Result: Higbee came to Penn State on September 1, 1935 and from thereafter so remained until October 1, 1966, when the "Old Soil Surveyor" got orders to "GET OUT AND STAY OUT." No longer of any use to Penn State, so it was "OUT."

1935 - 1966 The job was a mix of soil surveys and teaching. Below is a summary.

1. First it was teaching the course Agronomy 6, Winter seasons. Later the Agronomy 416 course. Class size up to nearly 50 students from all over campus, plus a few professors.

2. Summer season soil surveys. After 1962, it was a state soil map.

1936 Crawford County, Pennsylvania

1937 - 1960 Fulton County, PA - 1-62,500 Published map in color.

Mifflin County, PA - 1-62,500 Published map in color, also Forest Cover map in color.

Juniata County, PA - 1-62,500 Published map and cover in color.

Perry County, PA - 1-62,500 Published map and cover in color.

Cumberland County, PA - 1,62,500 Published map and cover in color.

Snyder County, PA - 1-62,500 Published map and cover in color.

Lebanon County, PA - 1-62,500 Photo reproduced in color and mounted in plastic. First of its kind in the USA. A new creation.

Counties Surveyed But to Date Remain Unpublished

Dauphin County, PA. Scale 1-24,000. A very detailed soil map and forest cover.

Columbia County, PA. Scale 1-24,000. A very detailed soil map.

Clinton County, PA. Scale 1-62,500. A generalized soil map.

Centre County, PA. Scale 1-62,500. A fairly detailed soil map.

Bedford County, PA. Scale 1-62,500. A fairly accurate soil map, updated.

Adams County, PA. Scale 1-24,000. A rather detailed soil map of eastern half of Adams County.

This concludes Higbee's county surveys in Pennsylvania.

3. Throughout the years 1935 - 1960, Higbee joined with the USDA Soil Inspectors Correlators in the reviews of all counties being surveyed in Pennsylvania. All soil survey legends and classifications or correlations for all Pennsylvania soils surveys were in agreement with the USDA soil correlations as of date of the surveys or publications.

1960 - 1966 Then came the ?BIG CHANGE?. From Dr. Lininger, then director of PA Agricultural Experiment Station, there came the request to Higbee to do a "Soil or Land Resource Map" of the entire state of Pennsylvania. This was one horrible charge to do. It involved hundreds of "soils." The hundreds of problems of map cartography and assembly; the hundreds of problems involved in the creation of "soil groups" having similar characteristics. The worst of all, to put them on a map where no future change or correction was at all possible was a real burden. After thousands of reviews and final assembly, the "Land source Map of Pennsylvania" came into being in the year 1967. Without any reservation, whatever, the creator can make the statement: "No state in the United States has a soil map that even comes close to its equal." It was published by the A. Hoen and Co., Baltimore, Maryland, the only publishers in the United States with the capability to publish a map of such detail. Yes, and to that statement can also be added, "There will never be another of its detail or quality published for the state of Pennsylvania."

The above "Land Resource Map of Pennsylvania" is at present, and has been for over ten years, the most popular publication of all publication "sold" by the University. Distribution rate for the Land Resource Map and Stream Map ranges from 200 up to 2,800 per month. Now that the A. Hoen and Co has gone into "bank bust," there may never again be republication of the above maps. That means that the "Land Resource Map of Pennsylvania" may soon be a "collectors item."

1966 - 1981 After being kicked out in 1966, the old soil surveyor parked the soil auger for the last time. One being a soil auger made of durelanium from the wrecked graff zepplin that went down in flames in New Jersey. Yes, there's a lot of memories, but in retirement, they are worthless.
So long----------Howard William Higbee.

The American Soil Survey 1905 to 1980

People Involved:

Milton Whitney, USDA, Washington, DC
Frank D. Gardner, USDA, then to Penn State around 1906 ± .2
Charles F. Marbut, Missouri University - Geologist

Regional Inspectors to 1936

Mark Baldwin, N.E.U.S. - Chief Correlator
H. H. Bennett, S.E.U.S. - Inspector
Macy Lapman, Far West - Inspector
Tommy Rice, Midwest - Inspector
Charles E. Kellogg, Michigan; Wisconsin; N. Dakota. (Communist -% Karl Marx et al.)
Arrived in Washington in 1933 ± to head up the U. S. Soil Survey.

Now, guess you all should know, Penn State's Soil Survey men:

Charley Shaw, Penn State - later to California
Austin L. Patrick, Penn State to U. S. -SCS - 1935.
The "Cow Poke" - Higbee, Penn State - 1935 - 1966.

Note: Under Frank D. Gardner and Charley Shaw, there was a very aggressive soil survey program in Pennsylvania. On Frank D. Gardner's retirement things changed. All department ads since that date have been plant breeders, geneticists, ex-army officers, plant scientists, etc. Result - Pennsylvania Soils Survey became the scape goat for soil survey funds. The Soil Survey budget was all too often robbed to buy tractors, seed corn, and what have you. Results - BLA - BLA Soil Survey.

U. S. Soil Survey Schemes and Classification Systems:

In the beginning, the USDA Soil Survey grew out of what might be considered the geological survey. In fact, soil survey and soil classification are an "EARTH SCIENCE."

The very first soil surveys were: (1) the Pecos Valley in New Mexico. Frank D. Gardner, soil surveyor was from Illinois; (2) the Lancaster and Lock Haven areas in Pennsylvania. These surveys were initiated to help solve crop growing problems for tobacco in PA. Soon thereafter, all soil surveys were on the county unit basis.

Soil Survey Evaluations and Classifications - 1905 to 1920 ± 3 years, included the following:

1. Mode of soil material accumulation: Residual, alluvial, colluvial, glacial, aeolian, coastal plains, marine, etc.
2. Derivative of the soil material, the kind of geologic rock or mineral materials. Limestones, shales, glacial drift, wind deposits, volcanic ash, granites, schists, slates, etc.

3. Soil color: Soil coloring materials, organic, mineral, salts, etc.
4. Soil Texture: Sands, silts, clays, etc. Very important both physically and chemically.
5. Drainage: Water storage, internal drainage, surface erosion, water movement within the soil, etc.
6. Soil reaction: First on basis of acid, neutral-alkaline, salt content, etc. Later the electrode potential EMF or pH.
7. Soil use: Crops, forest, grassland, desert, etc.
8. Topographic environment: Flats, rolling hills, mountains, etc.

Soil Evaluations and Classification Schemes - 1920 to 1835. Under Dr. Marbut and his concepts relative to soil characteristics and classification.

After studying Russian, Dr. Marbut discovered that the Russians were classifying soils on the basis of climatic environment. It was then that he began to see how the Russian system of soil classification would fit into the schemes of soil classification here in the United States.

After extensive trial and error, efforts to employ the Russian system of soil classification to the soils of the U. S. were side tracked. Dr. Marbut decided that the system, as a whole, would not work but some of its evaluations could be included in the U. S. soil classification system. In the end that which was used was mainly terminologies.

In Russia, the climatic and rainfall lines are more or less parallel. In the U. S., they are more or less at right angles. So, for the U.S., it was a much more difficult situation. However, the effects of rainfall, vegetation, climatic seasons, etc., were employed in Dr. Marbut's final publication "Soil of the United States," a beautiful USDA Atlas, very accurate for its time, was published for the U. S. personnel with high capabilities in today's U. S. Soil Survey just do not exist. I might add that all the chemical data in Dr. Marbut's atlas was evaluated by one Howard W. Higbee in the early 1930's.

As a result of Dr. Marbut and his staff, the soils of the U. S. were classified in broad categories and sub-categories or groups, depending up broad and master characteristics common to a large number of soil series included in each group. At no time was "SOIL SERIES" and/or "SOIL TYPE" dropped from the USDA soil classification system from the day "one."

During Dr. Marbut's time with the USDA Bureau of Chemistry and Soils, many counties in the U. S. were surveyed and published in multi-color county unit maps together with a written report "Description and use of the soils."

The Pennsylvania Soil Survey

1906 - 1966

The first two areas that were soil surveyed were in the Lancaster and Lock Haven vicinities to search for potential land for tobacco production.

Personnel at PSU included Prof. Gardner from Illinois (land of Lincoln and most productive soils in U. S.). Gardner mapped soils In Pecos Valley of New Mexico, in horse and buggy days, using plane table and special odometer that has now been donated to the Pasto Agriculture Museum. Dr. Charles Shaw, in cooperation with the USDA Soil Survey personnel, made the Reconnaissance Soil Surveys of Pennsylvania in the early 1900's. He went to California in about 1916 $\pm$ 5. Many early USDA soil surveyors got their start in Pennsylvania under Patrick and Shaw. Patrick left the USDA-SCS in 1935. H. W. Higbee arrived at Penn State in 1935 teaching in winter and surveying in summer. Early efforts by Higbee emphasized the need for State Soil Survey. Prof. Higbee was dedicated to improving our knowledge of Pennsylvania soils from both a "field" and "laboratory" perspective.

The U. S. Soil Survey People

Milton Whitney influenced Gardner. Marbut was a Missouri geologist in soil survey. U. S. Soil Survey inspectors were Baldwin in NE, Bennett in South, Rice in Midwest, and Lapman in West. In 1929, Higbee applied for work, took a four (4) hour long exam and submitted a 30 page thesis. Only two (2) in the U. S. passed and H. W. Higbee had the highest grade. Higbee's first USDA Soil Survey assignment was Mercer County, Kentucky -Summer of 1929. It was a beautiful area.

Kellogg became the new chief of Soil Survey in 1933-34, through politics. Bennett and Kellogg competed for soil surveyors. The best surveyors transferred to SCS. Bennett got dollars while Kellogg got pennies in appropriations. Kellogg assigned Higbee to TVA with big promotion promise! The promise was worthless. Higbee transferred to western Kentucky, by political maneuvers from Kentucky, where work was to be done. In 1935, Higbee came to PSU at the invitation of Patrick and retired in 1966.

Today's Soil Survey lack accuracy and quality because:

1. Poor guidance and training of surveyors.
2. Inept inspectors.
3. Too much emphasis in on selling SCS. Too much emphasis on slope, erosion, cover, with not enough emphasis on soils.
4. Rusty soil augers in SCS pick-up trucks clearly indicates some soil surveyors rarely used the soil auger to examine soils. This is a very sad situation.

Hugh Hammond Bennett - Arrives

Soil Classification 1935 to 1960 ±: The USDA Soil Conservation Service arrived.

Along about 1932, there began a real division of the U. S. Soil Survey when Hugh Hammond Bennett, an inspector at the time, became intensely interested in saving the nation's soil resources. Through terrific effort and publicity, plus the "dust bowl," Bennett obtained a huge appropriation to set up the Soil Conservation Soil, then in the Department of Interior.

Bennett being an ardent soil surveyor immediately put into effect "Farm Unit" soil surveys involving "SOIL-SLOPE-EROSION-COVER." This type of mapping, I believe, prevails to this date - 1981. Soil correlations were from and by, the "Soil Survey." The soil correlations never caught up with the SCS soil mapping program.

When Mr. Marbut retired (1933 ± 2), it was then that through politics, Dr. Charles E. Kellogg arrived to "ram rod" the USDA Soil Survey. It became even worse when Kellogg, through sneaky methods, brought in as inspectors his North Dakota students. That really wrecked the morale of the soil survey personnel. Both soil surveyors and inspectors either resigned or transferred to Bennett's Soil Conservation Service, often at much higher salaries.

Eventually the Soil Conservation Service, under Bennett, swallowed up the Soil Survey. It was then that Kellogg had to either "stoop" or "get out." He "stooped" but never gave up his communistic beliefs and/or attitudes (% Karl Marx). Then what? By some hook or crook, Kellogg got support to do a "WORLD SOIL MAP," sitting in Washington. That was when he cooked up the damnedest lingo-twisting soil classification scheme ever. Worst of all was that he succeeded in forcing it on the U. S. after Bennett died. It would never have happened if Bennett had lived to this day.

Later Soil Mapping Techniques:

As the SCS soil mapping caught up with the mapping of the "Farm Unit" types of mapping, it was then that the U. S.-SCS, through Washington pressures, began to map soils on the county unit basis. At first, the soil surveyor in charge of the "county unit" survey was for the most part one of the older and experienced soil surveyors originally trained under Dr. Marbut. At times, the states would also hire and supply less experienced soil surveyors to cooperate in the county unit soil surveys. Most of the soil surveys made under these circumstances proved to be rather accurate and reliable surveys. In Pennsylvania, some of the counties were--Union, Northumberland, Potter, Erie, Westmoreland, and possibly one or two others.

The soil survey systems involving Soil-Slope-Erosion-Cover created an excessive mapping or cartographic burden in delineations on the maps. All this required 4-inch to the mile maps. Generally air photos were available as base map material. Then as the older soil surveyors retired their long time experience was no longer available. Then the SCS began hiring new and inexperienced soil surveyors, and worst of all, they were often put in charge of a county unit to be surveyed. As a result, the problems of soil survey "know-how," the problems of map

delineations, plus SCS sales obligations, etc., arose. The actual study and evaluations of soils became sadly neglected in all too many areas. The writer actually observed soil augers in SCS pick-up trucks that had accumulated over three months rust coatings. In one county, one SCS soil surveyor even took on a part-time job rather than do full time soil survey work but got full time soil survey pay until fired. A lot more could be added but will be omitted.

Later, but not least, was the effect of Kellogg's "DOODLIN' SOIL CORRELATORS" who sit in Beltsville and decide how to wreck the work of the field soil surveyor by re-correlating, re-combining, changing, and/or what have you.

Result - the final published maps are never as the soils were mapped in the field. All too often, the SOS farm planners don't use the published maps, they use the original field surveyors or copies of the original field maps, if at all available.

Soil Maps and Publications

1905 to 1935 All soil maps were by plane table surveys and wheel assuring equipment. If available, U. S. G. S. Topographic maps were often used as base maps for the soil survey maps or mapping.

1935 to 1940 It was in this age that air photos became the mapping base for soil maps. As a matter of inclusion, the first air photo mapping done in the U. S. was in Washington County, Indiana, as sponsored by Tom Bushnell, State Soil Scientist-Indiana. This writer was involved in the initiation of that first air photo soil mapping technique - year 1930. The Indiana Air Photos were SINGLE LENSE CAMERA PHOTOS % Indiana National Guard Development as of that year.

Note: The TVA of the Tennessee Valley - 1934 had the valley photographed by what was then called five lens air photo cameras. That was a political decision and a complete flop. In that steep country, the wing photos showed only one side of a hill or mountain. A real political BLUNDER, typical of all too many politicians.

1950 to 1980 During this period, nearly all soil survey publications were published on air photo copies or as air photo mosaics or similar fuzzy black and white photo background Imagery. Result, a miserable mess in 50 far as clarity and delineations were or are concerned. To find a specific farm or place on such a publication is worse than trying to solve a jig-saw puzzle. In actuality, no average person will take time to use such a mystifying mess.

The Future of Soil Survey

If the future of the Soil Survey is to become a reliable source of detailed soil information, first there has got to be a terrific upgrading of the quality and reliability of the soil survey personnel. No soil survey can be any better than the quality and reliability of the man in the field.

Next: There needs to be a whole sale overthrow of the soil correlation "DOODLERS" who sit in Beltsville and proceed to wreck, through correlation, even the best of soil surveys.

Soil surveyors of the future must be real SOIL SCIENTISTS with a lot of field experience to back it up. They should be entirely relieved of all SLOPE-EROSION-COVER mapping. Transfer all SLOPE-EROSION-COVER mapping to the farm planners, maybe then they would become better planners.

If the Beltsville bureaucrats can't be bent, then the states better gear-up like Illinois to do the job. With land prices, farm land, ranging from $11000 to $4,000 per acre, it is high time that all soil surveys be as accurate and detailed as is humanly possible to make them. Accuracy is a MUST.

County unit maps should be published in detailed color, separations with all roads shown in appropriate colors. We now live in a "COLOR WORLD" and future soil resources maps must be in multicolor if they are to ever become usable by people who in the future will be "VERY BUSY PEOPLE" and who will want the answer very quickly and without confusion.

Future Soil Resource Inventories Should Provide:

1. Detail soil mapping on suitable scale for the areas.

2. Mineral evaluation of the accumulated soil material. Why were the rock or mineral materials so important in plant nutrition evaluations?

3. The source of soil material and transportation mechanism.

4. The physical characteristics - texture, structure, porosity, permeability, etc.

5. Soil reaction - acid, neutral, alkaline, salt content, and/or EMF, pH, etc.

6. Soil organic content, its source, type of vegetation, etc. Amount and color.

7. Surface and internal soil drainage, porosity, permeability, water storage, water supplying power to plants, often determined by soil depth or plant rooting depths. Extremely important.

8. Total soil depth to bedrock, to hard pans, ground moranic glacial till, etc.

9. Soil structure conditions, stability, depletions etc.

10. With time and demands, many more factors will be required to meet the demands of specific crops, forests, grasslands, etc. Much more will be needed in the way of physical and chemical evaluations as related to plant growth requirements. Yes, slope and erosion are important but should be left off basic soil survey maps.

Some Sarcastic Remarks

Having known Hugh Hammond Bennett, as a co-worker, officed by him, played poker with him and his wife, made several field trips with him, I believe I have the capacity to make the following statement: If Hugh Hammond Bennett was to climb out of his grave today and see what goes on in the USDA Soil Conservation Service, I am sure that he would fire 85% of the entire staff for non-competence, lack of reliability, and/or just being downright deadbeats. How do I know? On one of Bennett's field inspections in Kansas, when Bennett was inspecting Crawford County, soil survey progress, he got out of the car and demanded to see the field map for the area. He looked at it and said to the surveyor "We are going to walk across this mile and check your soil boundaries." After the mile, Bennett looked the surveyor in the eye, tore up the field map, and said, "You will map the whole area over on your own time." Then he emphasized, "If you don't, then you will be fired."

H. H. Bennett just would not tolerate inaccurate soil survey work. He himself worked from ten to twenty hours a day to start with SCS. He was no loafer and would not tolerate loafing of any kind.

Now for the ending - 1982. H. W. Higbee.

CHAPTER 7

Thoughts and Remarks

About

Soil Survey and Pennsylvania[1]

by

A. H. (Jerry) Paschall[2]

The early soil classification was based primarily on mode of origin as residual or transported by wind, water, or glacier. Geologists were the leaders in this early work, so a geology bias is natural. The basis of classification was always changing and still is. Nature of parent rock and the underlying rock soon became a part of the system.

The "parent rock" designation in the older surveys had much to do with construction engineers accepting and using soil surveys. Our latest classification relegates the parent or underlying rock to merely a phase designation. That is correct for the system but the phase concept is often omitted from surveys and so may limit use of the survey, especially in areas where construction work is prominent.

Geologists, were not only the early soil surveyors for Prof. Frank D. Gardner, Head of the Agronomy Dept., when I was in college from 1921-1925, but they did survey work about 1902.

It has been said that the Soil Survey of the U. S. will never be completed for there are changes introduced every twelve years that will make resurveys desirable.

I can recall major changes being made about 1924, 1935, and again in 1948. The 1948 change was not complete when I retired in 1969. We were still perfecting the "Seventh Approximation." And 1969 is when I quit trying to keep up with the classification system.

In the early days, the problem of base maps was a big one. USGS sheets were used when possible, others were Post Office Route Maps or Property Ownerships Maps. In many cases, the surveyor had to make his own base map using a plane table and alidade. He measured distance by pacing, using a counter on a buggy wheel or a special odometer on the front wheel of an automobile. These plane table base maps were needed in many areas up until the time aerial photograph came into common use around 1930.

The use of aerial photos for soil mapping was given a big push by T. M. Bushnell of Purdue University about 1927 when he had some experimental flying done on a strip between Chicago and West Lafayette, Indiana. This was to see what time of the year was best for

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[1] Reprinted from Penn State Agronomy Series No. 90. 1986.

[2] Former Northeast Regional Soil Correlator, SCS, Upper Darby, Pennsylvania

showing the soils. Later the thing that determined the best time for this work was when there were cloudless days and no snow on the ground.

Dr. A. L. Patrick, who taught Soil Survey when I was in college, was a firm believer that using a plane table base was an excellent teaching tool. So all students in his Soil Survey class had to prepare a plane table base map and map the soils on a section of the Hort Farm. That plane table base map idea paid off for one of his students.

In the early twenties, there were about 60 soil surveyors in the U. S. Most of these were in the Bureau of Soils. Many of the surveyors were Penn State graduates or from Earlham College, Richmond, Indiana. The class of 1924 of Penn State furnished five men to the work. Four of these were in the federal staff: Charlie Sirrinons, Deacon Smith, Pony Lesh, and Jim McKean. Jim left to become a county agent after one year. Bart Oliver went to the state of Ohio but he left there after one year to go home to farm. I replaced Bart in 1925. Simmons, Smith, and Lesh all remained with the Bureau of Soils through their working life. Lesh was quite adept in the use of the plane table so he got moved about to those areas eding plane table base maps. He died while still active.

The soil surveys were made and published under the direction and supervision of the Soil Survey Division of the Bureau of Soils. The states were cooperators wherever they had staff. California and Illinois did not participate in the survey program but ran their own surveys, each with a different procedure and method.

The federal surveyors were usually the Chief of Party. They worked in the northern states in the warmer seasons of the year and in the southern states in the colder times. Overall, supervision of the survey party was furnished by the inspectors for the bureau. The inspectors had assigned areas and were experienced in the soils of the area. There were four of them when I started in 1925. Mark Baldwin in the glacial soils of the Midwest and Northeast, H. H. Bennett in the residual soils of the Midatlantic and Southern states; Tom Rice in the Midwest and Prairie soils; and Macy Lapham in the far West. The book Criss-Cross Trials by Macy Lapham gives a good idea of how these inspectors got around their assigned areas.

The inspector for a survey was present when the survey was set up and was responsible for the mapping units recognized at the start of the survey. He was supposed to make two or three visits to the area while the survey was in progress and thus makes sure that the mapping units were in line with established standards or set up new units to meet special conditions. The inspector also made the final review of the survey and set up the units to be recognized in the published survey. He worked with the party chief on descriptions of the soil series and soil types or phases to be recognized. The Head of the Soil Survey Division reviewed these recommendations and approved or disapproved them. He was the final authority on the legend and on the series, types and phases to be recognized.

Where the states had survey leaders on their own staff, he participated in all inspections and in the final legend recommendations. There were some extensive debates on the final legend that finally appeared in the published report. Most states wanted the soil series recognized and to

be defined to represent more specifically their local conditions. These debates often ended in the recognition of a phase separation.

The International Congress of Soil Scientists sparked the first major shift in the US soil classification. Before that, kind of parent material, color, and texture of surface and subsoil were dominant features. At that meeting, a paper by the Russian Soil Scientist, K. D. Glinka on the "Great Soil Groups of the World Development and Their Development" completely changed the emphasis in soil classification. The soil became an entity unto itself. Parent material was unimportant except that it might be recognized as a phase separation.

Dr. C. F. Marbut translated Dr. Glinka's paper from German. (I have two dates for this translation and don't know which is correct for I left my copy behind when I retired. The dates are 1917 and 1927. The year 1927 was the time of the meeting of the First International Congress in Washington.)

The great soil group concept was adopted in the US and the ABC horizon, designation became part of the language of all soil surveyors. Prior to that time some surveyors were reluctant to use them although the designation had been known since the early twenties. Up to the twenties you heard more about parent rock and the seven soil provinces and six soil regions than about the ABC horizons and great soil groups.

Dr. Marbut retired from the soil survey in the early thirties and was succeeded by Dr. C. E. Kellogg. The Bureau of Soils had been changed to the Bureau of Chemistry and Soils with A. G. McCall as the head. I don't have the dates for these changes but they did produce some changes in the operation of the soil survey. Dr. Kellogg did not assume the work of doing the correlation of soils at the top level but assigned that to one of the former field inspectors. Dr. Mark Baldwin was Chief of Correlations. The idea of the centralization of correlation in the Washington office was maintained.

Dr. Kellogg was a stickler for uniform and correct use of words and ideas so he initiated the SOIL SURVEY MANUAL, Misc., Pub. 274 published in 1937. This was revised and reissued in 1951 as U. S. Dept. of Agriculture Handbook No. 18, and then in 1962 prepared a supplement replacing pages 173-188.

The Soil Survey Manual was a desirable addition. It did much to standardize terms and procedures.

The establishment of the Soil Erosion Service by Hugh Hammond Bennett (Soil Survey Inspector under Marbut for the southern states; Ed Hem took over Bennett's inspections) in the Interior Department (1933-34) brought about a great increase in the demand for soil surveyors as that agency had the policy that all planning work for erosion control be based on the soil. The Watershed Demonstration Projects, starting in 1934, started the race for soil surveyors. I was in Ohio, and we had a project at Zanesville before Pennsylvania got its Indiana Project. Ohio really made a raid on Penn State graduates. We grabbed all we could get that had any experience, a total of six, and then set up a training center for new graduates in June. We got Jake Noll and

Jim Wise from Pennsylvania. Later we had to be kind hearted and send some of them back to be a nucellus for the Indiana Project.

While under the Dept. of Interior, the personnel were not under Civil Service but were appointed from "Friant's List." That list was political and you needed the endorsement of a good democrat to get on it. Our congressman for the Zanesville area was a good democrat but he was also a good congressman and would place any one we requested on the "Fraint's List." Because James A. Farley and Eleanor Roosevelt got appointments through political pressure, Harold Ickes automatically vetoed such an appointment.

Late in 1936, the Soil Erosion Service was transferred from the Dept. of Interior to the Dept. of Agriculture. It became the Soil Conservation Service. All personnel of the Soil Erosion Service were blanketed into the Civil Service. From then on, all personnel had to be secured through the Civil Service. The service was increasing the number of soil surveyors so the list of eligibles was soon exhausted. Civil Service could not keep up with demand of exams so a new system was devised.

Under the new system, the Civil Service gave the task of grading the applicant over to the regional soil scientist of the agency involved. The Civil Service furnished guidance to the regional soil scientists involved. This exam consisted of checking the experience or education of the applicant. If an applicant had two or more years of experience with a state survey, he was assured a top grade provided he had some college level education, although he did not need a degree. A Penn State graduate in Agronomy and a boy raised on a farm were also assured a top grade unless he made the mistake of listing his college courses and failed to list one of the courses considered as qualifying. Only 12 semester hours of credit were required to qualify. Later in the forties, the task of grading papers for the Civil Service was given over to the state soil scientists.

When soil conservation districts, formed under individual state laws, became numerous, the Soil Conservation Service shifted to a regional office set up. The head of the regional office was the administrative head of the work. He was provided with a technical staff to supply guidance to the workers on the demonstration projects and in the newly formed conservation districts. The formation of districts brought about a rapid increase in the demand for soil surveyors.

The start of World World II brought about a rapid decrease in the supply of soil scientists. Soil surveyors on the rolls at the start of the war were given automatic exemption from the draft. Any new surveyors were not given this exemption. I believe this automatic exemption from the draft was a ploy by the military to keep the surveyors from being under the control of the draft boards. Soil surveyors were a good source of people trained in the interpretation of aerial photos. So while there was no draft, anyone who could pass the physical exam was able to get a commission in the Army, Navy, or Air Force. Our staff in the Midwest lost about eighty men that way.

During the war period, we could not do any block mapping and sometimes could not keep up with the farm planners. We had but twenty-three to cover eight states.

In the late thirties, the SCS introduced the idea of showing soil, slope, erosion, and land use on the maps. Also as a means of interpreting the maps, they brought Land Capability classes into the picture. The first four classes represented increasing degrees of difficulty to be encountered in using lands suitable for farming. The last four classes were for land not considered suitable for farming but should be kept in permanent vegetation. The system was shown in a Department of Agriculture Handbook on "Physical Land Survey." (I don't know the number or full title of the handbook and did not keep a copy when I retired.)

The land grant colleges were always involved in the SCS surveys, either as actual members of the survey party or as consultants. This was particularly true where there were block surveys and the areas were being completed for publication. Cooperation between the SCS and the Bureaus of Chemistry and Soils Survey Division was not as smooth working as that with the states.

The position of state soil scientist was established at the end of the war. Large states had a full time man. The smaller states often had to share the position with another small state.

The end of the war also brought renewed activity to the soil survey laboratories, three of them, East, Midwest, and far West. Much of this laboratory work involved particle size distribution and base saturation. We looked to the states for research on clay minerals, chemical composition, and related material.

A revision of the soil classification was initiated in the late forties. This system went through many trials and changes. Each change was termed an approximation. Each approximation was tested against field mapping conditions and each was altered for the next issue. They were working on the seventh approximation when I retired. I thought it would be a good one. I retired in 1969.

In 1952, the Soil Survey Division of the Bureau of Chemistry and Soils were combined with the Soil Conservation Service. This brought about many changes. The regional set up was dropped. The emphasis was placed on the state and Washington levels. However, the engineering units were retained as service groups to aid the state staffs. The cartographic units were also retained. Other technical specialists were located at various state offices but were to be available for assistance in adjoining states.

The Soil Survey Division was directed from Washington and had inspectors scattered throughout the states. The inspectors in the field made the initial correlation but the final approval came from Washington. This worked well for a time, but with states adding men, and more areas being prepared for publication, more assistance was needed so correlators were added to the state staff. This might be the state soil scientist or a special man for the work. The state correlators work was reviewed by the field inspectors. Final correlation rested with the Washington office.

As the publication of soil surveys increased, the inspector's staff was increased. He was given an assistant for the correlation work, also a specialist on use of survey information, and one to guide the writing of survey reports.

In 1964, it was decided that things would function more efficiently if all technicians for a given area were in one central location. In the Northeast that meant a move to the Philadelphia area--Upper Darby to be specific.

The forest service set up their own soil survey in the early fifties. They also participated in those of the Dept. of Agriculture, for example, in the Upper Peninsula of Michigan. In their surveys in the national forests the surveys included special studies on tree growth. This made their survey work attractive to the research-minded surveyor.

One of the items give to new surveyors by the old-timers was that: "If you lost a field sheet, you replaced it at your own cost." I can't vouch for the truth of that statement but it leads to an anecdote.

While I was in college, I did several kinds of jobs to earn a little money even being a babysitter. Dr. Patrick once asked me to be a "sitter" for him one night. When I arrived at his house at the requested time, he took me to the den and showed me a planetable case full of maps. These were the field sheets for a county survey. His instructions were: "If the house gets on fire, throw that case of maps out the door far enough to be out of danger, then take care of the kids."

CHAPTER 8

Soil Survey Comments[1]

by

R. (Dick) S. Long[2]

I feel a soils man needs the necessary equipment to do most of the work encountered in all phases of the job: 1" soil auger with handles covered with rubber to eliminate coloration of hands, also ground electric fence while stepping over same; three inch bucket auger to get larger sample of soil profile, 5' length handle; two handle post hole digger; digging irone clay shovel; sharp shooter or short handled shovel about 16" long blade with 4" width to dig easily, use in shallow soils high In coarse fragments; punch auger has limited use because of coarse fragments; mason hammer or geologist hammer; abney level; munsel color chart; pH test kit; acid bottle; first aid kit with snake bite kit; .3 mm pencil (mechanical) necessary degrees of hardness for dry to moist weather; geology maps where available; aerial maps with carrying case, soils legend.

Temperature should influence what soil areas to work. When hot weather occurs and soil is dry, I try to map in areas where soils are shallow and use a sharp shooter. When soils are normal or above normal in moisture, the deeper soils are much easier to bore into. When coarse fragments are encountered, the auger can work past some. When temperatures are below freezing, woodland, where leaf build up reduces freezing of the soil, can be worked in cleared land fence rows or heavy or thick vegetation. First thing in the morning, dew creates wet conditions, so map plow fields or check area along roads. Make use of road cuts, all kinds of excavation.

Today soils information is used more widely than ever. Deep backhoe probes of 3' to 10' has shown that soil varies considerably In structure and permeability. I have noticed in shale country, where two drainage ways are opposite each other at the crest of the hill, drainage is a problem at the crest. Practically all drainageways, even though minor, will have mottled subsoil. In cherty limestone soils, I have always encountered a fragipan-like layer that in many instances has faint mottles with low permeability. The crest appears ok but moving down the slope say 10-15%, and then slightly beneath area of 6-8% with steeper slopes on down, the 6-8% area has a fragipan-like subsoil material.

In working in areas where the acid shales are adjacent to limestone soils, we have a mixture of calcareous shales. It is this area where a wide variation of texture of entire profile and wide range of drainage and permeability occurs. Colluvial soils are where we have sandstone and shales (acid) worked down over shale or limestone, and the major portion of these areas will have a fragipan with slow permeability as a problem. In some cases, mottling is hard to observe but when soil is high in moisture, like in spring, this soil when excavated will break along ped surfaces. This is where the mottles can be observed as the thickness of mottles is about skin deep. When the depth of this colluvial deposit Is 18-24", the fragipan is usually absent.

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[1] Reprinted from Penn State Agronomy Series No. 90. 1986.

[2] SCS Soil Surveyor in Pennsylvania 1932 to the present.

The continued use of abney level to determine the slopes trains one to judge a slope before checking with the abney. In woodland, one will find your estimate of a slope is lower than it actually is.

Banks or exposed cuts that are several years old will not give you a true picture of structure and drainage unless you dig it out and expose fresh cut. The soil could be much shallower than you realize especially in shale or soils that are shallow.

Public relations are important. Publicity about the survey is done before the start of the work and while in progress. In the field, the individual is trespassing in the eyes of the land owner. When everyone knows the surveyor is mapping, make it a point to explain what he is doing. When grain fields are nearing maturing, stay out if possible or perform work by walking the rows and doing the work when not too noticeable.

If possible, I do most of the mapping around farm buildings during the normal lunch hour, so that you finish that area and when the land owner hears the dog barking you are about done and you can explain what you are doing. Larry Staley and I were given advance notice not to be caught on this particular farm as owner may run us off with a shotgun. We planned to work the farm from each end and finish towards the buildings. We were finishing the soils work on a small watershed in Perry County when Larry was seen first and run off with a tongue lashing. I saw the owner coming for me in a beat-up pickup truck so I made it a point to be just off his property and stopped to bore in the soil when he arrived. He started in on me. I kept my mouth shut till he blew off steam. I listened to his problems and agreed with him and got him talking about other things. I told him I lived on a small farm and milked 30 cows. He asked where and I told him. He asked me if I ever heard of so and so. I told him yes and gave him a run on what I knew. We continued talking, then I mentioned I had to be going. He offered to drive me out to the road where we had parked our truck. When I tried to get out, the door was hard to open; he jumped out and opened it for me. I waved good-bye to him. Larry was sitting in the truck taking it all in, dumbfounded!

It doesn't pay to take the offensive in explaining what you are doing. I think a soil scientist should have a good background in Agronomy. It can be very useful when asked questions like why certain crops are not doing well. Some knowledge of trees and shrubs and where they are normally found growing can be helpful.

I was on a dairy farm in the coastal plains of Maryland, checking soil with a herd of guernsey milk cows when I looked up and saw a bull snorting among the cows. I made for the fence and just cleared the fence about two jumps ahead of the bull. The farmer met me with a shotgun. He was going to salt the bull. He said he had a heifer herd to catch in heat and had turned the bull out. I explained what I was doing and then he told me he was having trouble keeping alfalfa. He said the second year the stand was poor. I checked the soil and it was a deep loamy sand similar to Vanderlip. It was Evesboro series. I asked him how he started the stand. He said the pH test called for 500# lime and a certain amount of fertilizer. He used 500# of hydrated lime and phosphorus and potash. I explained the sandy nature of the soil required a very small amount of lime to raise pH but on his soil it also leached out fast and the soil became very acid in a short time. Also the fertilizer leached more rapidly because of a lack of clay or

colloidal material. I told him to use about 1 ton of ground limestone or ground oyster shell which ever he could get the cheapest and to split fertilizer application to several times a year. Lime should be checked every two years. He followed me around the farm. He asked me what a particular grass was, and I told him it was cheat, and he said the county agent called it orchard grass. I came across a clump of orchard grass and told him about the advantage of it sometimes giving a fall cutting that is about 8-12" high in leaves which is excellent for calf feed.

With my knowledge of Agronomy and soils, I made him feel the soil survey was of some value. Many times observation of crops can indicate shallow soils in south central and eastern Pennsylvania. Growing conditions give clues about the expected soils. Know something about available water capacity and storage of fertility. With increased cost of producing crops, shallow soils lack enough available water and fertility to produce enough to make a profit even on a good year. It might be better to grow crops that make the most of their growth when dry hot weather is not a problem, that is in fall, winter, spring. Crops and rotation methods of planting, also seed bed preparation, depend on soil. All of these suggestions will most likely be mentioned in a final soil survey report. Example: two five foot deep soils, both have the same total water storage. One soil may have 1/3 of water available for plants and the other would have 2/3 of water available for crops. I have observed this condition in the field with clayey soils versus silty soils.

Knowledge of the weakness of each soil and how it can be supplemented so it could be profitable for specific crops should be included as one of the main jobs in gathering information about soils. Field observation carries more weight, as this is what the individual accepts, especially when results are done as we say down on the farm. The soil scientist is usually confronted by a land owner and cannot convince him how the soil survey will be of value to him; the land owner usually looks upon the survey as a waste of taxpayer's money because it will benefit only a few growers.