Pennsylvania Soil Survey

The First 100 Years

by

Joseph J. Eckenrode
and
Edward J. Ciolkosz

Agronomy Series Number 144

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Contents

Introduction

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. We hope that this publication will help archive this information for future soil scientists in the National Cooperative Soil Survey. It also compliments two previous attempts to document some soil survey history of Pennsylvania (Ciolkosz et al., 1998, and Ciolkosz et al., 1999).

PreSoil Survey

This year we celebrate the 100th anniversary (1899-1999) of the USDA Soil Survey Program. However, long before the first soil surveyors started work, pioneer settlers in Pennsylvania were taking inventory of the soils and other resources. This was noted in many early pioneer writings describing the newly settled lands of the early 1700's. In the history of Franklin County, M'Cauley (Bates, 1887) quoted an earlier historian, (Day), who described the Cumberland Valley of 1730-60 as follows: "The land was without timber, covered with a rich, luxuriant grass, with some scattered trees, hazel bushes, wild plums and crab apples. It was then generally called the "barrens". The timber was to be found on or near the water courses, and on the *slate soil*. This accounts for the preference given by the early Scotch-Irish settlers to the *slate lands* before the *limestone lands* were surveyed or located. The slate lands had the attractions of wood, water courses and water meadows, and were free from *rock* at the surface. Before the introduction of clover, artificial grasses, and the improved system of agriculture, the hilly limestone land had its *soil washed off*, was disfigured *with great gullies*, and was sold as unprofitable for a trifle by the proprietors, who sought other lands in Western Pennsylvania."

Even though the pioneer settlers of early Pennsylvania recognized the importance of soil types and erosion, little was done to inventory or map them as evidenced by the comments of M'Cauley (Bates, 1887) in his description of the soils in Franklin County. His comments follow: Much of the greater part of the land in our county is limestone. The limestone lands east of the Conococheague are well watered, fertile, and in a high state of cultivation. They are estimated at one hundred and eighty thousand acres. Along the base of the South mountain, and between it and the limestone lands, is a strip of territory from one to two miles wide, known as the "pine lands," which for the most part is said to be equal for fertility and certainty of product to any in the county, and is estimated to contain twenty thousand acres. It is composed of sand, mixed with clay, and water-worn pebbles. West of the Conococheague the slate lands prevail, mixed however, here and there with limestone. They are estimated at one hundred and sixty thousand acres, and are not generally so fertile as the limestone, but more easily cultivated, and abounding in pure streams of water, and in luxuriant meadows. The experience of late years leads to the conclusion that these lands when generously treated with lime, or other fertilizers, are as desirable and as productive and renumerative, all other things considered, as the higher priced lands of the limestone regions. The mountainous districts, on the eastern and western boundaries of the county contain about one hundred and twenty thousand acres of land, much of it quite valuable because of its excellent timber, and other large bodies of it very valuable because of the inexhaustible quantities of iron ore contained in them.

The First 50 Years

We can see in the historical records that the early settlers noted the soil type, the stoniness and the vegetation of the land they were settling. But it was not until the latter part of the 1800's that real interest developed to the point that the United States Department of Agriculture (USDA) convinced the United States Congress that an inventory should be made of the nation's soils and their production potential. As a result the Soil Survey, as we know it today, was born.

The soil survey program began in the United States in 1899, under the USDA Division of Soils, directed by Milton Whitney (Gardner, 1998). The first soil surveys were concerned mainly with soils in the tobacco producing areas and their ability to produce either filler or wrapper type tobacco. It appears that tobacco was the main cash crop of the times and one of the most valuable agricultural crops, even in areas that no longer produce significant amounts of tobacco. The first areas to be surveyed in 1899 were the Connecticut River Valley area of Connecticut and Massachusetts, along with areas in Cecil County, Maryland, The Salt Lake Valley of Utah, and the Pecos Valley of New Mexico. From the very first, surveys were done in cooperation with state experiment stations, land grant universities and other local agencies. This cooperation arrangement between the USDA, state universities, and other agencies is known today as the National Cooperative Soil Survey. The data in Table 1 indicates that this cooperation existed in Pennsylvania, since the inception of the soil survey. The cooperation for the first half-century consisted mostly of the contribution of soil scientists and personnel from the nonfederal cooperating partners to do field work. Since the 1950's, in Pennsylvania, this cooperation has been predominantly through the Soil Characterization Program at Penn State University (Ciolkosz et al., 1998) and financial contributions from various state and local agencies to support field staffing.

The first soil survey in Pennsylvania was made in Lancaster County in 1900, and published in 1901 (Table 1). It covered about 270 square miles in the tobacco growing area of the county. The report consisted of just over 22 pages (5 ½"x 8 ½") of text, tables and photos of the area. The report was accompanied by a colored map 28 ½" x 24 ¼" at a scale of one inch equals one mile. The map had seven soil series with ten mapping units and one "meadow" land type. Due to the mapping scale, delineations were quite broad with some as large as six miles wide by fourteen miles long. Even though this first survey seems quite primitive by today's standards, it was quite an undertaking at the time. It appears that only one person, Clarence W. Dorsey, did the mapping, and he completed it in one summer. Transportation was likely by horse and buggy, and topographic maps were not available. Apparently the Lancaster County Commissioners did have suitable base maps available for Mr. Dorsey to use.

On July 1, 1901 the Division of Soils was reorganized and given more status in the USDA by elevating it to the Bureau of Soils (Gardner, 1998). The field season of 1901 in Pennsylvania covered the tobacco growing area of the Lebanon area, which was adjacent to, on the north side of the Lancaster area mapped in 1900. The Lebanon area survey covered about 190 square miles in Lancaster, Lebanon, and Dauphin counties. The map and report were published in a format similar to the Lancaster area report (a part of the annual report to congress) by the Bureau in 1902 (Table 1). These annual reports consisted of a large volume containing all of the reports completed in the United States for the previous year. Some of these volumes

Table 1. USDA Pennsylvania Soil Surveys (USDA, 1991). The list contains the names of people, both USDA and Penn State, known to have worked on the surveys. Many of the early survey publications are relatively scarce. As part of the centennial celebration, a collection of most of the surveys, along with other soil survey material will be placed in the Pennsylvania Soil Survey Archive in the Pattee Library at Penn State University for future reference.

Year Published	County or Area	USDA Personnel	Penn State Personnel
1901	Lancaster	Clarence Dorsey	
1902	Lebanon	W.G. Smith	
		Frank Bennett, Jr.	
1904	Lock Haven	J.O. Martin	
1905	Adams	Henry J. Wilder	
		H.L. Belden	
1906	Montgomery	Henry J. Wilder	
		A.T. Strahorn	
		W.J. Geib	
1907	Chester	Henry J. Wilder	
		Thomas A.Caine	
		W.J. Geib	
		William T. Carter, Jr.	
1909	Johnstown	Charles J. Mann	
		Howard C. Smith	
1910	Berks	W. J. Geib	
		E.L. Worthen	
		J.C. Britton	
1910	Centre	Charles N. Mooney	
		Charles F. Shaw	
		Lawrence A. Kolbe	
		Hugh H. Bennett	
		Risden T. Allen	
1910	North West	Henry J. Wilder	Charles Shaw
		Gustavus Maynadier	
1911	Erie	Gustavus Maynadier	
1911	Washington	F.S. Welsh	D.K. Sloan
		Floyd S. Bucher	
1911	South West	Henry J. Wilder	C.F. Shaw
1912	South Central	C.F. Shaw	W.G. Ross
		W.G. Byers	
1913	Bedford	C.J. Mann	W.E. Gross
1913	Bradford	Percy Wood	J.M. Mckee
			L.M. Skemp
			W.B. Nissley
			J.B. Dickey
1913	North East	C.F. Shaw	J. M. McKee
			W.G. Ross

Table 1. Continued. USDA Pennsylvania Soil Surveys (USDA, 1991). The list contains the names of people, both USDA and Penn State, known to have worked on the surveys. Many of the early survey publications are relatively scarce. As part of the centennial celebration, a collection of most of the surveys, along with other soil survey material will be placed in the Pennsylvania Soil Survey Archive in the Pattee Library at Penn State University for future reference.

Year Published	County or Area	USDA Personnel	Penn State Personnel
1914	Lehigh	William Carter	
		J. A. Kerr	
1914	South East	C.F. Shaw	J.M. Mckee
			W.G. Ross
1914	York	J.O. Veatch	
		Lewis A. Hurst	
		Gustavus Maynadier	
1916	Lancaster	B.D. Gilbert	Earl Moffitt
		W.B. Cobb	J.F. Fox
1917	Blair	J.O. Veatch	Harry P. Young
			H.P. Cooper
1917	Cambria	B.B. Derrick	David Wimer
		A.L. Patrick	
1919	Clearfield	R.A. Winston	H.P. Cooper
		R.W. McClure	D.C. Wimer
1919	Mercer	E. B. Deeter	W. Irvin Galt
		R.A. Winston	
1924	Adams	Hugh H. Bennett	A.L. Patrick
1925	Greene	S.O. Perkins	A.L. Patrick
		M.W. Senstius	Fred G. Merkle
1928	Lycoming	E.H. Stevens	C.B. Manifold
		B.H. Hendrickson	C.G. Degen
			A.L. Patrick
1929	Tioga	B.H. Hendrickson	K.V. Goodman
		R.T.A. Burke	R.C. Smith
1929	Wyoming	B.H. Hendrickson	K.V. Goodman
		R.T.A. Burke	R.L. Smith
		Mark Baldwin	
1931	Indiana	R.T.A. Burke	J.L. Hasterman
		C.S. Simmons	Richard Marshall
		W.J. Latimer	C.H. Atkinson
1938	Franklin	Howard W. Higbee	R.S. Long
		R.R. Finley	J.C. Bryant
1938	Wayne	C.S. Simmons	C.H. Atkinson
			L.A. Brown
1939	Armstrong	R.T.A. Burke	L.J. Yohn
		S.O. Perkins	O.C. Lewis
			C.H. Atkinson
			L.A. Brown

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1944	Huntingdon	Howard Higbee	Austin L. Patrick
		S.R. Bacon	L.A. Brown
		R.T.A. Burke	N.P. Tedrow
			R.S. Long
			C.H. Atkinson
1946	Bucks	R.T.A. Burke	R.K. Craver
		James Thorpe	B. Alderfer
		E.C. Dunkle	
1946	Union	S.R. Bacon	Alfred Boileau
		David Taylor	Gerald Yoder
1947	Fulton	Howard W. Higbee	
1954	Crawford	S.R. Bacon	Howard W. Higbee
		R.T.A. Burke	J.K. Thornton
			D.K. Wolff
			S. Van Day
			C.S. Bryner
			Gerald Yoder
1955	Montour and Northumberland	David C. Taylor	L.G. Yearick
		S.R. Bacon	
1958	Clarion	F.G. Loughry	Carl Baures
		Boyd Patton	Donald Leer
			Harold Donner
			James Sheetz
			J.B. Prettyman
			A.L. Patrick, Jr.
			Lewis Ilgen
			J.R. Lauback
1958	Potter	K.V. Goodman	Leonard Yearick
		John Tedrow	
		R.W. Stem	

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Year Published	County or Area	USDA Personnel
1959	Lancaster	John Carey
		R.K. Craver
		T.C. Bass
		Robert Cruikshank
		I.L. Martin
		B.J. Patton
		J.D. Sheetz
		John Sykora
1960	Erie	David Taylor
		Joseph Beard
		John Anderson
		August Branding
		Delvin Fanning
		Donald Gardner
		Richard Hopkins
		Joseph Krivak
		Wayne Maresch
		Frank Myers
		Alexander Ritchie, Jr
		E.J. Schermerhorn
		Robert Thompson
1962	Carbon	Glenn Fisher
		Raymond Mattern
		Robert McCombs
		Joel Norgren
		Atlee Rebert
1963	Lehigh	John Carey
		Michael Yaworski
1963	York	Donald Hersh
		E.Z.W. Compy
		Kenneth Craver
		L.E. Espy
		George D. Martin
		Robert Smith
		Robert Young
1963	Chester and Delaware	Merrill Kunkle
		F.D. Blest
		Jean Dewey
		F.A. Gansz
		R.P. Zimmermen
		R.A. Young
		John Carey
		H.W. Hannigen
		H.W. Busch
		Nicholas Hallowich
		D.D. Pettinato
		Leroy Pomeraning
		James West
1964	Jefferson	John Zarichansky
		Walter Steputis
		J. Robert Cerutti
		Horace Harwell
		Lester Seglin
		James Hixon
1966	Clinton	Walter Steputis
		Ralph Matticks
		Robert Zimmerman
		Robert Henry
1967	Adams	Reginald Speir
		Robert Grubb
		Richard Long
		Donald Leer
		John Meier
		Richard Weaver
		Reginald P. Partenhei
1967	Columbia	Paul Parrish
		Warwick Tinsley
		Robert Zimmerman
		Robert Craver
		Robert Cruikshank
		W.R. Byrne

Table 1. Continued. USDA Pennsylvania Soil Surveys (USDA, 1991). The list contains the names of people, both USDA and Penn State, known to have worked on the surveys. Many of the early survey publications are relatively scarce. As part of the centennial celebration, a collection of most of the surveys, along with other soil survey material will be placed in the Pennsylvania Soil Survey Archive in the Pattee Library at Penn State University for future reference.

Year Published	County or Area	USDA Personnel
1967	Montgomery	Robert Smith
		Jack Levitan
		Lester Seglin
		Edward Tompkins
		John Zarichansky
1968	Indiana	Jay Weaver
		Joseph Ruffner
1968	Westmoreland	David Taylor
		Norman Churchill
		Craig Losche
		Samuel Mentzer
		Jay Weaver
1969	Pike	David Taylor
		Percy Billings
		Glenn Fisher
		Gene Trapp
1969	Fulton	Norman Churchill
		Cleo Wildasin
		R.W. Long
		L.R. Staley
		D.M. Hersh
		H.W. Hannigen
1970	Berks	Frank Ackerman
		John Carey
		Milton French
		William Hannigaan
		Herbert Hooper
		William Houck
		Raymond Mattern
		Earl Reber
		Edward Ropel
		David Taylor
1971	Mercer	Darrell Grice
		Robert Grubb
		Orin Jaquish
1972	Dauphin	Merrill Kunkle
		Garland Lipscomb
		Richmond Kinnard
1973	Fayette	Frank Kopas
1973	Susquehanna	Earl Reber
		Percy Billings
		Douglas Pease
1974	Northampton	Larry Staley
		E.A. Tompkins
		T.J. Bushong
		H.J. Hixon
1975	Bucks and Philadelphia	Edward Tompkins
		Albert Backer
		Barrie Wolfe
1975	Franklin	Richard Long
		Larry Staley
1975	Venango	Norman Churchill
		Donald Hipes
		Franklin Ackerman
1977	Armstrong	George Martin
		John Haagen
1978	Huntingdon	Edward Merkel
		Thomas Craft
		Gerald Yoder
1979	Crawford	Michael Yaworski
		Dean Rector
		Joseph Eckenrode
		Ernest Jensen
		Robert Grubb
1981	Allegheny	Raymond Newbury
		David Belz
		Robert Grubb
1981	Blair	Edward Merkel
		Donald Hipes
		Thomas Craft
1981	Centre	William Braker
		Gerald Richard
		Glenn Herrold
1981	Lebanon	Donald Holzer
		Merrill Kunkle

Table 1. Continued. USDA Pennsylvania Soil Surveys (USDA, 1991). The list contains the names of people, both USDA and Penn State, known to have worked on the surveys. Many of the early survey publications are relatively scarce. As part of the centennial celebration, a collection of most of the surveys, along with other soil survey material will be placed in the Pennsylvania Soil Survey Archive in the Pattee Library at Penn State University for future reference.

Year Published	County or Area	USDA Personnel
1981	Juniata and Mifflin	William Farley Gerald Yoder Garland Lipscomb
1981	Luzerne	R. Dennis Bush William Braker Joseph Hallowich Gary Martin Joseph Eckenrode Robert Grubb Donald Holzer Clifford Kohler Garland Lipscomb George Martin
1981	Monroe	Garland Lipscomb
1981	Tioga	James Rayburn William Braker
1982	Beaver and Lawrence	Robert Smith William Braker Ned Ellenberger John Greenawalt Robert Grubb Joseph Hallowich Raymond Newbury Robert Smith Barry Wolfe
1982	Lackawanna & Wyoming	Joseph Eckenrode Donald Holzer Edward Sautter Samuel Browning
1982	Schuylkill	Frank Kopas David Belz
1983	Greene and Washington	Daniel Seibert Jay Weaver R. Dennis Bush David Belz Dean Rector Joseph Hallowich Robert Grubb
1983	Somerset	Michael Yaworski Earl Reber George Martin Daniel Seibert Dave Belz William Farley Reginald Speir
1985	Cambria	William Farley David Yost David Belz Daniel Seibert
1985	Lancaster	Boyd Custer Edward Merkel Michael Yaworski William Knight Donald Holzer
1985	Montour	Joseph Eckenrode Paul Parrish Boyd Custer Donald Holzer
1985	Northumberlanc	Joseph Eckenrode Paul Parrish Clifford Kohler Joseph Hallowich Robert Grubb
1985	Snyder	Joseph Eckenrode Paul Parrish Bruce Derr
1985	Union	Joseph Eckenrode Gerald Yoder John Haagen
1985	Warren and Forest	James R. Cerutti Michael Yaworski Norman Churchill Alex Topalanchik

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Year Published	County or Area	USDA Personnel
1985	Wayne	George Martin
		Charles Dennis
		Robert Malmgren
		Gary Martin
1986	Bradford and	Robert Grubb
	Sullivan	Gary Otis
		Sylvester Eckart
		Gerald Latshaw
		Donald Holzer
		Robert Malmgren
1986	Cumberland	John Zarichanisky
	and Perry	John Greenawalt
		Garland Lipscomb
		Leslie Lanyon
1986	Lycoming	Clifford Kohler
		Ned Ellenberger
		William Knight
		Paul Parrish
1987	McKean	Norman Churchill
		Paul Parrish
1988	Clearfield	Joseph Hallowich
		Alexander Topalanchi
		Ernest Jensen
		William Braker
		Ned Ellenberger
1989	Butler	Robert Smith
		Ivory Egypt
		William Knight
1993	Cameron and	Frank Kopas
	Elk	Albert Backer
		James Cerutti
		John Haagen
		William Knight
1998	Bedford	William Knight
		Ned Ellenberger
		Robert Dobos
		John Hudak
		Edgar White
		Reginald Speir

included the maps bound in the volume, and others included the maps in a separate folio. Congress mandated that seventeen thousand copies of the annual report be published. Three thousand copies were for the use of the Senate, six thousand for the House of Representatives, and eight thousand for the Department of Agriculture.

The next area to be surveyed in Pennsylvania was the Lock Haven Area. It was surveyed in 1903, and again was a tobacco growing area. However, this report was published separately as an individual soil survey in addition to being included in the annual report to congress. The 1903 field work was published in 1904 (Table 1). Earlier that year congress mandated that a separate report be published for each survey, and that five hundred copies be furnished to each Senator, two thousand for each Representative of the congressional district(s) in which the survey was made, and one thousand copies for the Department of Agriculture.

In 1904, the first “County” soil survey in Pennsylvania was done in Adams County. Nearly all future soil surveys were made on a county or multi-county basis, with the exception of the Johnstown area in 1909 (Table 1), and five reconnaissance surveys (Northwest, 1911;

Southwest, 1911; Southcentral, 1912; Northeast, 1913; Southeast, 1914; Table 1). The format of the soil surveys continued the same through 1922. In 1923 the department started issuing soil surveys by a dated series year and number. This continued through the Jefferson County report of the 1960 series, number 19, published in 1964. With the issuance of Clinton County in 1966, soil surveys have been dated only by the year of publication. Some additional soil surveys were conducted by Penn State University Professor Howard Higbee as a part of a state soil mapping program he ran during the 1940's and 1950's (see Ciolkosz 1998 for a listing).

In 1927 the USDA Bureau of Soils and the Bureau of Chemistry were combined to form the Bureau of Chemistry and Soils (Gardner, 1998). Little changed in the content and detail of the surveys after the combination of the two Bureaus. However, in the 1930's there was a growing demand for more detail to be shown on the soil maps. This was partly done to compete with the newly formed Soil Erosion Service (SES) which conducted projects on individual farms, and on erosion projects at experiment stations. The detail on the Bureau's maps was gradually increased to show more information. However, even though aerial photos were available for some counties during this period, published surveys did not use a photo base. This was apparently done for an economic reason, and possibly for national security reasons.

By the late 1920's, soil erosion was being recognized nationwide as a very serious problem (Fig. 1). Congress allocated $160,000 in 1929 for the USDA to conduct soil erosion investigations. The same year soil erosion experiment stations were set up under the Bureau of Chemistry and Soils, in cooperation with the Bureau of Agricultural Engineering.

In 1933, the newly elected Roosevelt administration recognized the need for erosion control nationwide by establishing a temporary agency in the Department of Interior by the name of the Soil Erosion Service (SES). An allotment of five million dollars was made to the department for erosion control projects on public and private lands. The Director of the new agency was H.H. Bennett who had worked with the Bureau of Chemistry and Soils.

The first work of the Soil Erosion Service (SES) consisted of the establishment of 40 erosion experiment stations around the United States. One of the stations was number 23, located at State College, in cooperation with the Pennsylvania State College. Dr. A.L. Patrick was in charge of the project in 1934 (Fig. 2). One of the first erosion projects conducted at the Penn State station was the construction of erosion control plots and a collection system to measure the runoff and erosion of various cultivation methods and soil cover. The site was used for research for years and is currently being used by the Turf program in the Penn State Agronomy Department.

Many new soils majors were hired by the newly created SES to map soils on the project areas. However, the five million dollar allotment was exhausted by 1935 and a new appropriation was needed to continue the work. There apparently was a lot of political maneuvering for funds in those days and H. H. Bennett wanted to go back into the Department of Agriculture. Thus, the SES was discontinued and on April 27, 1935, and a new agency, the Soil Conservation Service (SCS) headed by H.H. Bennett, was formed in the Department of Agriculture. Personnel from the SES were transferred to the new agency. The same year

Fig 1. This profile shows the sediment buildup on top of the original topsoil on Hagerstown soil on Penn State property in 1934. The two white lines in the bottom of the profile indicate the original topsoil. This pit was described by Dick Long (Long, 1983) in his CCC memorabilia in the CCC History of the 29th issue of "THE PENNSYLVANIA BUGLE," the newsletter of the retired SCS employees. It was this type of erosion that lead to the formation of the SCS and the soil survey program we have today.

Fig 2. Austin Patrick – Director of Soil Erosion Service Station number 23 at Penn State, 1934.

Fig 3. Glade Loughry – first State Soil Scientist for Pennsylvania (Table 2).

Charles Kellogg was appointed as head of the Division of Soil Survey in the Bureau of Chemistry and Soils.

The newly formed Soil Conservation Service (SCS) was a much larger agency than the SES had been. The SCS had projects in every state and had a need for soil scientists to map the projects. Many of the soils men in the Bureau of Chemistry and Soils moved to the new agency. The SCS mapping consisted of detailed mapping for the erosion projects and farm plans for farmers enrolled in the erosion control program. Crooked Creek (Steele and Mowery, 1940), in Indiana County, was one of the first projects in Pennsylvania. Glade Loughry and Jake Noll worked on the Crooked Creek project. Glade's home farm was in the project area. In addition to Glade and Jake, numerous other soil scientists were working in Pennsylvania under the direction of Gordon Steele. They were Dick Long, Jim Wise, Kenneth Carver, Gerald Mowery, Lester Espy, Merrill Kunkle and Everett Leadbetter.

The SCS in Pennsylvania also administered a number of Civilian Conservation Corps (CCC) camps from 1935 to 1942 (Long, 1983). Most of these camps were involved in erosion control projects on private land. Soil maps were required prior to the start of these projects. Jake Noll commented on not being able to keep up with the demand for soil maps for the CCC projects because plane table maps had to be made first. He trained several CCC boys to make

plane table maps in order too keep up with the projects. At the same time the Bureau of Chemistry and Soils was still busy doing complete county surveys, but at a very slow pace.

On September 19, 1935 the Northeast Office of the SCS (Region 1) was established in Williamsport, Pa. with A.L. Patrick designated as the Regional Conservator. Glade Loughry was transferred there as assistant to Joe Snyder, the Regional Soil Scientist. Arnold Bauer was also an assistant to Joe Snyder. At this time there were no state offices in the SCS.

In 1938 the Bureau of Chemistry and Soils was abolished and the work of the Division of Soils was transferred to the Bureau of Plant Industry. Also, in 1938 the Regional Office of SCS was relocated to Upper Darby, PA, and William Latimer was the soil correlator. In 1938, the USDA also published the Yearbook of Agriculture, "Soils and Men". This was the first year that the publication was of a "topical" nature and not just an annual report of agency activities.

Although historical records indicate that Walter Gumbel was State Conservationist in Pennsylvania in1941 (Davis, 1984), state offices were not officially established in the SCS until 1942. Even then they were not very active in the administration of the programs of SCS until a reorganization in 1945. The reorganization gave state offices more administrative power. At this time Glade Loughry was appointed as the first State Soil Scientist (Table 2; Fig. 3). Apparently the first state office was in State College, as Glade Loughry indicated that he

Table 2. Pennsylvania State Soil Scientists.

Glade Loughry 1945 – 1966	Arthur D. Kuhl 1975 – 1981
John J. Noll 1966 – 1972	Garland H. Lipscomb 1981 – 1995
Gerald J. Latshaw 1972 – 1975	Edgar A. White 1995 - present

reported there when first appointed. This is reasonable because State College had been the center of SCS activity since the early thirties. It appears that the state office was transferred to Harrisburg sometime in late 1945 when Ivan McKeever reported as the new State Conservationist.

In 1942 the Bureau of Plant Industry was assigned the responsibility of all soil correlation of all USDA projects including SCS conservation mapping. At this time SCS mapping was confined to individual farms participating in erosion control projects and other SCS projects. However, at this time, conservation districts were becoming more active and the number of farms participating in conservation district erosion projects covered much of some counties. The SCS conservation mapping was at greater detail than the county soil mapping being done by the Bureau of Plant Industries. The SCS mapping also showed erosion classes and land use.

In 1941 the first Civilian Public Service Camp was assigned to the SCS in Pennsylvania. Conscientious Objectors (CO's) were assigned to work in these camps by the selective service in lieu of military service (USDA, 1970). During their six year tenure only 15 of these camps

operated nationwide. The Pennsylvania Camp was located at the present day Howard Nursery of the Pennsylvania Game Commission. First operated as a CCC camp by the SCS, the Howard Nursery was a plant materials center, then a CO camp during the war, and an SCS plant materials center again before being turned over to the Game Commission for $1 about 1957.

The Second 50 Years

In 1952, a major change was made in the way the soil survey program was conducted. All soil survey work by the USDA was consolidated and responsibility for the entire program was given to the SCS. This included all mapping, classification, interpretation, laboratory services, map compilation and nationwide publication. The Plant Industries Division of Soil Survey was then abolished.

This reorganization did not set well with some universities and individuals that had been involved in the Division of Soils program up to that point. This included Howard Higbee at Penn State University. The senior author (J. J. Eckenrode) took Professor Higbee's soil classification course the last semester that he taught at Penn State and heard much about the political struggle between the SCS and Penn State for dollars in the early years. Whoever stepped on Howard's toes in the past was considered a "communist" by him (see Higbee, 1998). In fact, Mr. Higbee started almost every class by degrading the SCS and Glade Loughry with remarks about how they describe soil color and rock fragments. Mr. Higbee did not ascribe to the use of the Munsell color book. He was from the "old school" and chastised some students for using a Munsell color book during a field trip one day.

After being assigned the responsibility of the entire soil survey program, the SCS shifted from making individual conservation plan soil surveys and land use maps to making a complete county soil survey. It can be said that this began the "modern era" of soil surveys in Pennsylvania and across the nation. From 1899 until this time a number of agencies, both state and federal, had some of the financial pie to do soil survey work. The consolidation of soil survey activities (and funding) into the SCS program was a hard pill for many to swallow.

Potter County was one of the first counties of the "modern soil surveys" to be published (1958). However, it is the only modern survey to be published on plane table paper and not aerial maps, even though most of the county was mapped on aerial photography. Part of the reason may have been that remote areas of the county were mapped on topographic maps. Clarion County, also published in 1958, was published on aerial photography. To date, Potter County remains the only county survey in Pennsylvania not printed on aerial photography. The lack of funding assistance to upgrade the survey to date has prevented this survey from being updated.

The first fifty years of soil survey concentrated on the gathering of crop production data, especially tobacco. By the post WWII era there was a demand for more detailed soils information in the soil surveys. Information such as "urban development" information was in demand. Prior to this time, only crop suitability information was collected in the field. There was also a need to collect information for a new soil classification system that was being developed. This system was later named Soil Taxonomy (Soil Survey Staff, 1975, 1998).

By 1958, only two of the 67 counties in Pennsylvania had published "modern" soil surveys. Pennsylvania was behind most other states with their soil survey program. Both state and federal agencies recognized the need to speed up the soil mapping program. A ten year plan was developed to accelerate the mapping (see Cunningham and Lipscomb, 1998). This need also included gathering laboratory soils information through a soil characterization program. Both state and federal funds were used to accelerate the soil survey program. This "Cooperative Soil Survey" effort by the SCS, Penn State University, Pennsylvania Department of Environmental Resources (PADER) and numerous county governments resulted in a large increase in the number of personnel involved in the soil survey.

Dr. Roy Matelski came to Penn State in 1957 to supervise the soil characterization laboratory and conduct field investigations (see Ciolkosz et al., 1998, for a discussion of the Pennsylvania Soil Characterization program). Over the years 948 pedons have been sampled and analyzed (Ciolkosz, 1999) (Fig. 4). These data have created a very valuable resource on which to base soil survey interpretations and to classify soils.

During the acceleration of the soil survey program the number of field soil scientists in the SCS increased dramatically, with a high of nearly 70 soil scientists in the late 1960's (see the comments by soil scientists who worked at this time on the soil survey in Ciolkosz et al., 1999) (Figs. 5, 6, and 7). As the mapping progressed and more counties were completed, the number of soil scientists decreased. A number of soil scientists transferred to other states and many of the original soil scientists hired when the SCS was formed, retired.

By the late 1970's, counties were being completed faster than they could be published. As a result, a soil map compilation facility was established in the Lewisburg Soil Survey Project Office. It was directed by Dennis Bush, with Vic Prokop as a cartographic technician (Fig. 8). The Lewisburg Federal Penitentiary contracted some of the early compilation work. Eventually many Bucknell University students were hired to do in house compilation. The facility eventually moved to State College and is currently located on the Penn State Campus in a working agreement with the Department of Agronomy's Land Analysis Laboratory. Numerous Penn State students are employed at the facility.

As more counties were published, storage became a problem. An estimated 25 year supply of surveys are printed for each county. Most county offices have little storage available so most of the thousands of surveys were stored in private storage near Harrisburg. In 1982, most of these surveys were destroyed by a fire in the storage facility (Lipscomb, 1985). A few copies were salvaged. This loss prompted a reprinting of a number of counties, especially those that had just been published. Since that time the soil surveys have been stored in smaller groups in various locations.

The "last acre" of soil mapped in Pennsylvania occurred in Bedford County in 1987, and the report was published in 1998. Rob Knight was the project leader and Ned Ellenberger a project soil scientist. This completed the once over mapping of Pennsylvania.

Fig. 4. "Matelski's Army" collecting soil samples during a characterization project.

Fig. 5. From left to right: Jake Noll, Glade Loughry, Roy Matelski, and Dave Belz examining soil during a field review.

Fig. 6. Gerald Yoder (left) and Paul Parrish, mapping soils in Northumberland County, 1976.

Fig. 7. From left to right: Jake Noll, Glade Loughry (in pit), unidentified, Bob Smith describing a soil pedon.

Fig. 8. Dennis Bush instructing a cartographic technician at the Lewisburg Map Compilation Center in 1981.

In 1994, the SCS was renamed the Natural Resources Conservation Service (NRCS), and at the present time there are nine NRCS soil scientists in Pennsylvania. Five are located in project offices, three in the State Office and one in the Map Compilation and Digitizing Center at Penn State. Rob Knight and Alex Dado are located in Greensburg, PA. John Chibirka is located in Leesport, Ned Ellenberger is in Bedford, and Jake Eckenrode is located in Lamar. Tim Craul is at the Penn State Map Compilation Center. Ed White is the State Soil Scientist in Harrisburg with staff members John Hudak and Panola Rivers on the staff there.

Currently the field staff is mostly working on updates of counties around the state. The digitizing center is involved in a project to completely digitize the state over the next several years. Plans are being made to complete this project as quickly as resources permit.

Tools of the Trade

Most of the first tools used to investigate soils in the field have not changes much over the first 100 years. Early soil scientists used the spade and probably an auger made by the local blacksmith. The rock hammer has also been a "must have" tool for those out in the field mapping soils. The first fifty years or so saw the soil scientist using the plane table to develop the base map for the survey (Fig. 9). Although aerial photography was around and used to a limited extent as early as the mid-twenties, it was not used much in Pennsylvania until after World War II.

Fig. 9. This photo shows Richard (Dick) Long using a plane table to make a soil map. He is using an abney level to measure slope. The photo was taken about four miles northeast of State College in May 1934.

There were no real good guides for describing soil color until the late 1930's when a soil color chart with a limited number of color chips was developed (Simonson, 1993). The Munsell Color Book for describing soils did not come into wide use until the 1950's.

For the most part soil mapping consisted of walking across the landscape and making observations of the soil types on the landscape and recording the information on a base map. Early surveys likely did not traverse the landscape on foot as much as later surveys, but likely traversed the areas by travelling roads with the horse and buggy and observing road cuts, railroad cuts and plowed fields in the spring. This type of observation was adequate for the type of soil maps being developed at the time. Later, pickup trucks came into use (Fig. 10).

Early soil surveys were concerned mostly with evaluating soils for their ability to produce tobacco and other crops and not for interpretations that we make today. As a result there was no need to look as deep in the soil profile as we have done in the last half of the century. As the need developed to make deeper observations and interpretations, we were still limited because of the hand tools available and the time and resources necessary to dig deep pits. It was not until the backhoe became a common "tool" available to the soil scientist, that we began describing soils as deep as they really are. Because of the limitation of hand tools, tens of thousands of acres of moderately deep Dekalb soils were mapped in the state during the late forties and fifties. These soils are currently being described and reclassified as deep Hazleton soils, because of the ability to dig large pits in a short time and at a low cost. These type of pits have greatly expanded our knowledge and understanding of the soils on our landscapes.

In the late forties and early fifties, the move from plane table maps to the use of aerial photography gave a big boost to the soil mapper in the field. Then in the late 1970's, the availability of color infrared photography was another boost to the soil scientist in making soil surveys. The color infrared photos, if taken under leaf off conditions, are valuable for making photo interpretation of the soil and evaluating features such as soil moisture.

Slope of the land was first measured with the use of the abney level. This involves holding the instrument with one hand and moving the level bubble with the other hand while sighting on a specific spot on the landscape. In the early 1970's, the clinometer replaced the abney level for most soil scientists. This compact device requires only one hand to hold while sighting the slope.

In recent years other field tools for investigating, mapping and interpreting soils have come on to the scene and are being used more and more. Ground penetrating radar units and the electromagnetic induction meters are proving quite useful in making soil investigations that do not disturb the soil such as digging a soil pit. Although not suitable for use on all types of soil conditions, these tools are very valuable resource when used in conjunction with other conventional soil survey tools and methods.

The use of a helicopter to map soils from the air was successfully used in Pennsylvania, in 1975 (Fig. 11). It was used to help map soils on the remote plateau areas in the southwest part of Wyoming County (Eckenrode and Ratcliff, 1975). Large, wooded, remote areas were flown over in the early spring before the leaves came out. Surficial soil features and landscapes were

Fig. 10. Unidentified soil scientist, probably near State College in 1934. The truck is an old Soil Erosion Service vehicle. Photo from Howard Higbee files.

Fig. 11. Jake Eckenrode boarding a helicopter in Wyoming County in March, 1975 to experiment with mapping soils in remote wooded areas from the air. This was a success and is believed to be the first time used .

observed from an altitude of about 200 feet and recorded on aerial photos. Ground truthing of the soil types was done both before and after the aerial mapping. This method has also been used in several other areas in the state. It has proven most useful in areas similar to that where first used.

Another tool being evaluated for assisting in mapping is the use of digitally generated slope maps developed with the computer. At this point their use has been quite limited, but they show a lot of promise as another tool to make better soil maps in the field.

In the next 100 years, there will be undoubtedly be many more tools developed to help the soil scientist make better soil maps in the field. However, after another 100 years, the soil auger and the spade will likely still be a basic field tool for the soil mapper.

The State Soil

As a part of the centennial celebration, a move was started to select a state soil for all fifty states plus Puerto Rico and the Virgin Islands (Muckel, 1999). Presently, all states have selected a state soil. In Pennsylvania, the process was conducted under the auspesis of the Pennsylvania Association of Professional Soil Scientists (PAPSS). A committee, with the help of the membership, selected five candidates (Hazleton, Gilpin, Chester, Duffield, and Hartleton) for the state soil. A ballot of the candidates was sent to all PAPSS members, and in May 1997, Hazleton was selected as Pennsylvania's state soil (Figs. 12 and 13). In fourteen of the states, legislation has been passed to make their state soil the official state soil. As yet, this has not happened in Pennsylvania.

Hazleton is the most extensive soil in the state (2.7 million acres). It is named for the city of Hazleton in east central Pennsylvania. It is found throughout the state and supports mainly forest or pasture land. It is interesting to note that the official Pennsylvania state animal (white tail deer), game bird (ruffed grouse), flower (mountain laurel), and tree (hemlock) are all found extensively on the Pennsylvania state soil (Hazleton).

The Hazleton soil is classified as a Typic Dystrochrept: loamy-skeletal, siliceous, subactive, mesic. Which means it is weakly developed (color B horizon), with a thin A horizon, acid throughout, coarse textured with high rock fragment content, quartz mineralogy, low cation exchange capacity, and found in mid-latitude areas (Table 3). These soils are deep and very deep, well drained, and formed in residuum from acid gray and brown sandstone. They are found on convex upland plateaus, ridge tops, and shoulder slopes. They have a stony or channery surface layer, and many rock fragments in the subsoil, which is typical of many Pennsylvania residual soils. They are underlain by hard, bedded, sandstone bedrock. Prior to 1960, these soils were mapped as the Dekalb soil. The Dekalb is similar to the Hazleton except it is moderately deep (20-40 in) to bedrock. With the use of power equipment (mainly back hoes), it was found that most of the Dekalb soils mapped were really deep to bedrock; and because they had such a high rock fragment content, and in many cases very large fragment, they gave the impression of being moderately deep when investigated with hand tools.

Fig. 12. Typical Hazleton soil profile in a wooded area with the following characteristics: Surface: 0 to 2 inches, dark brown stony sandy loam, Subsurface: 2 to 8 inches, dark gray stony sandy loam, Subsoil: 8 to 10 inches, dark reddish brown channery sandy loam, 10 to 30 inches, yellowish brown very channery sandy loam, Substratum: 20 to 60 inches, light yellowish brown very stony sandy loam, Bedrock: 60+ inches, level bedded gray sandstone.

Fig. 13. Hazleton soil is found on the ridge in the background of the photo.

Table 3. Characterization data for a typical Hazleton soil (Ciolkosz, 1999).

Horizon	Depth	Sand	Silt	Clay	Rock Fragments†	Texture‡	pH	Organic Carbon	CEC	Base Sat
	Inches	Percent						Percent	Meq/100 g	Percent
Oe	2-0	-	-	-	-		4.5	39.3	143.9	10.4
E	0-2	70.0	25.7	4.3	6.6	SL	3.9	1.44	9.8	12.2
Bhs	2-4	57.8	33.0	9.2	3.9	L	4.0	2.29	23.1	5.6
Bs	4-6	47.0	45.1	7.9	21.6	L	4.1	3.13	31.7	3.8
Bw1	6-15	60.9	29.9	9.6	59.5	SL	4.9	0.71	12.2	9.8
Bw2	15-22	57.2	35.9	6.9	63.1	SL	4.8	0.21	8.1	13.6
Bw3	22-32	71.9	18.8	9.3	49.3	SL	4.6	0.19	6.7	14.9
C1	32-43	76.0	14.3	9.7	69.5	SL	4.6	0.09	7.6	13.2
C2	43-56	77.3	13.3	9.4	70.1	-	4.7	0.07	8.0	12.5
R	56-72	Acid Gray Sandstone								

†On a weight basis.
‡SL = sandy loam; L = loam.

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