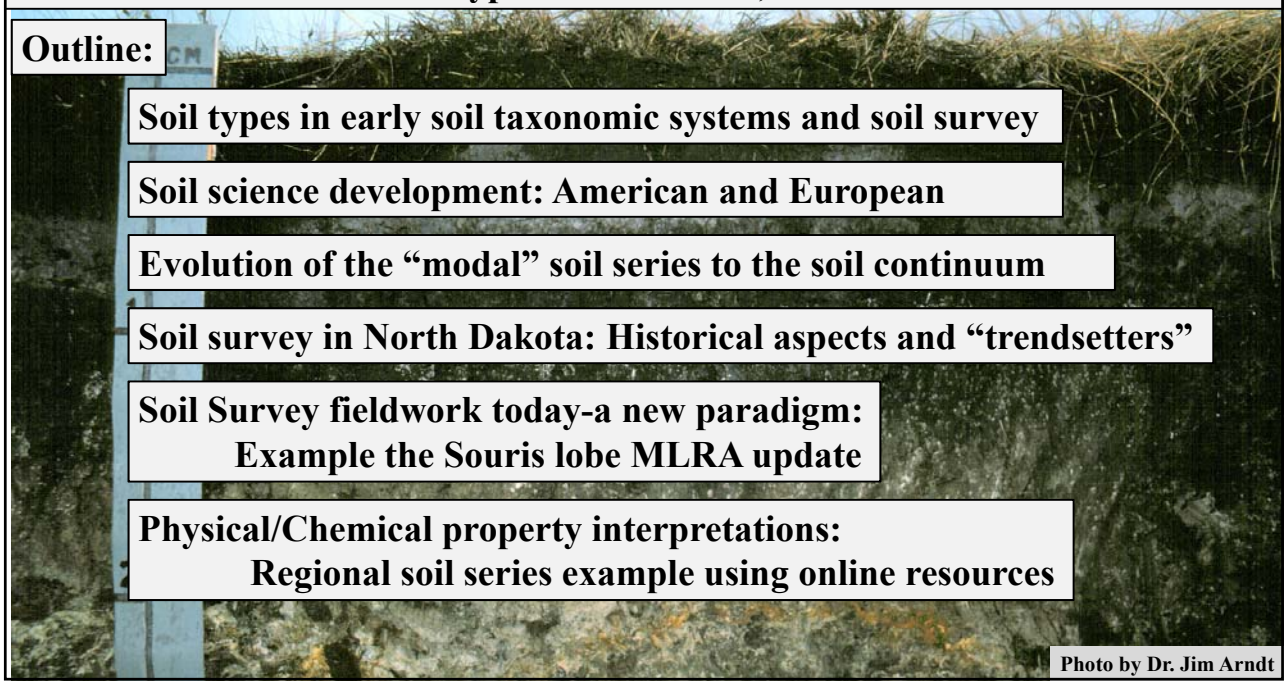
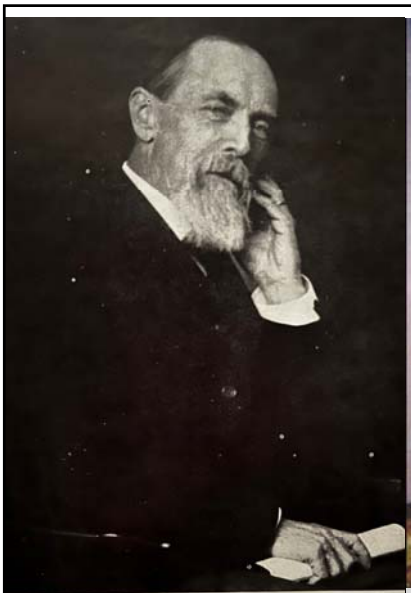
The difference between soil type and soil series; or is there a difference?

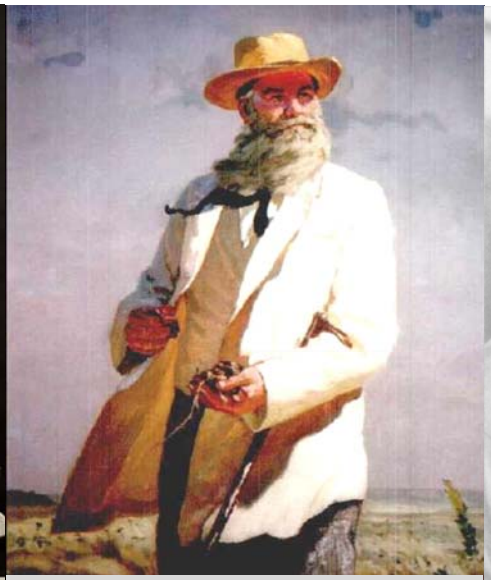


Outline:

- Soil types in early soil taxonomic systems and soil survey
- Soil science development: American and European
- Evolution of the "modal" soil series to the soil continuum
- Soil survey in North Dakota: Historical aspects and "trendsetters"
- Soil Survey fieldwork today-a new paradigm:
  Example the Souris lobe MLRA update
- Physical/Chemical property interpretations:
  Regional soil series example using online resources

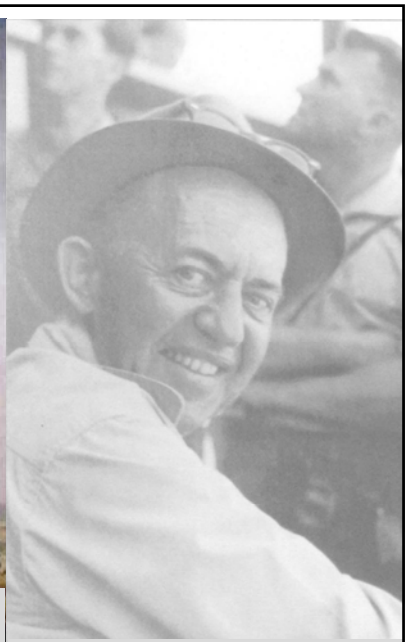
Photo by Dr. Jim Arndt





"Soil -the fourth kingdom of nature"

Vasili Vasilievich Dokuchaev



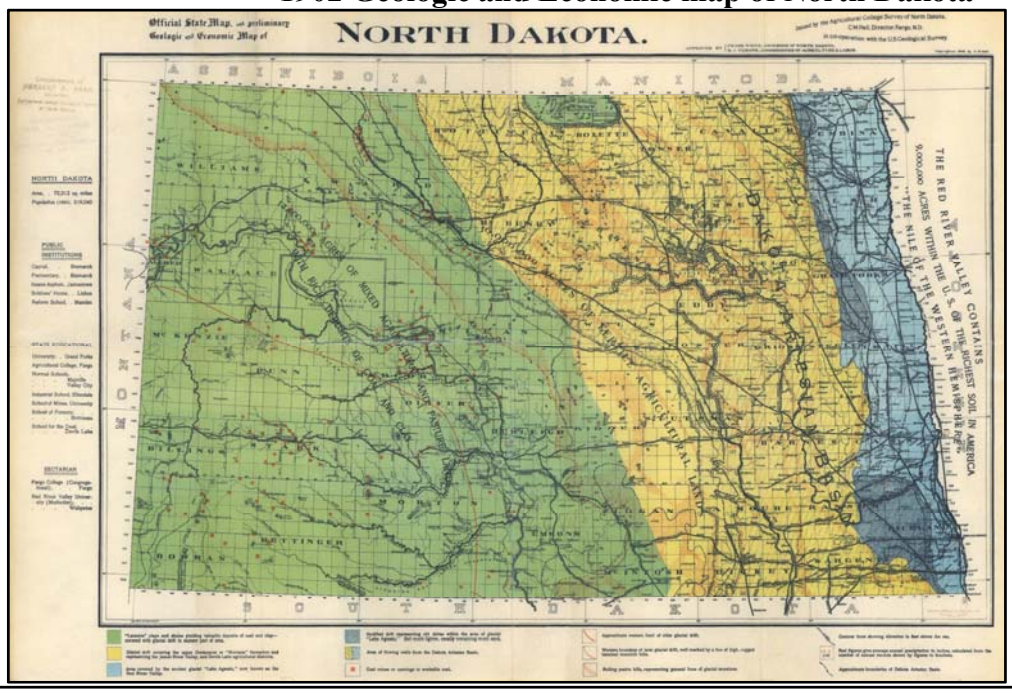
Dr. Roy Simonson, soil pit in Romania-8th Int. Cong Soil Science

Dr. Charles Edwin Kellogg at North Dakota Agricultural College in the early 1930s

Dokuchaev's final classification of soil types in 1900

Zones	1. Boreal	II. Taiga	III. Forest-steppe	IV. Steppe	V. Desert-steppe	VI. Aerial or desert-zone	VII. Subtropical /tropical forests
Soil types	Tundra (dark brown soils)	Light gray podzolized soils	Gray and dark gray soils	Chernozem	Chestnut and brown soils	Aerial soils, yellow soils, white soils	Laterite or red soils

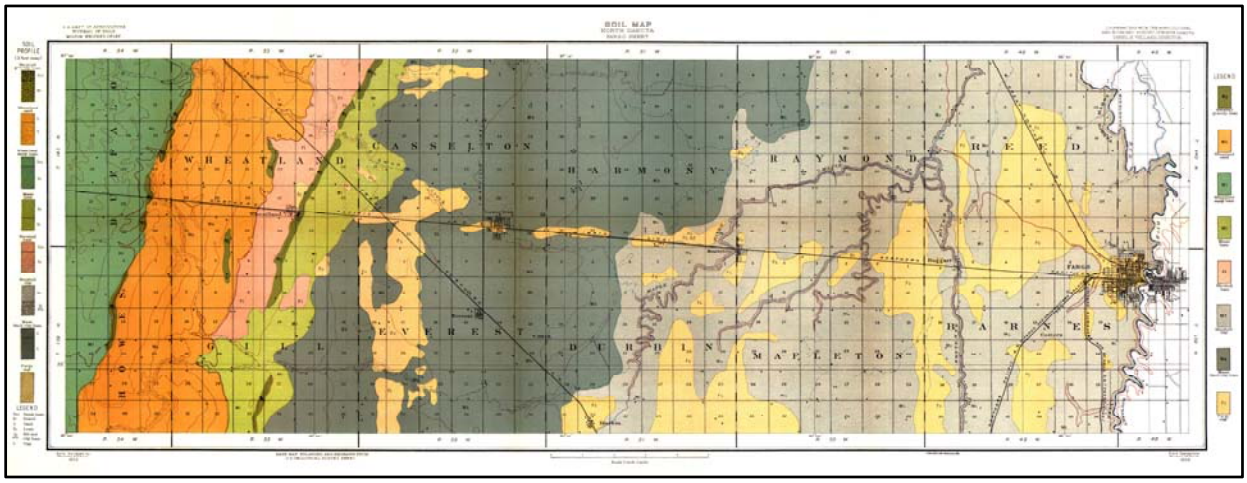
1902 Geologic and Economic map of North Dakota



The RRV contains 9 million acres of the richest soil in America
"The Nile of the western hemisphere"

Soil survey of the Fargo area, USDA, Bureau of Soils , 1903
The ND Legislature appropriated monies for an agricultural and economic survey in 1902

The gray delineation in the center of the survey area was named Miami black clay loam, the pale green unit on the west was Miami loam



1909 NDAC College Catalogue listing for the Geology major

Geology

The soil is the basis of agriculture. On it all industries of any importance in North Dakota depend. Soil is rock that has been broken up by natural agencies so that it has become capable of furnishing the plant food necessary for the nourishment of plants. Geology is therefore vitally related to agriculture, since it is the science that deals with the material on which all agriculture rests. The soil is the greatest geological specimen

Student planting individual seeds in the biological breeding garden.

1906 Soil survey of the Carrington area-both Foster & Griggs Counties

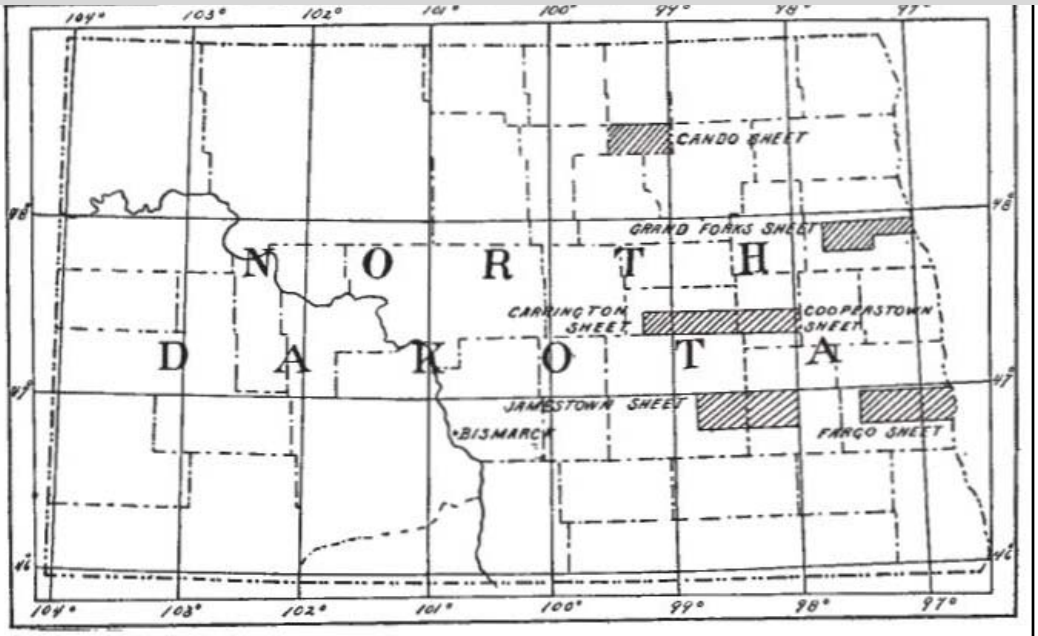


FIG 1.—Sketch map showing location of the Carrington area, North Dakota.

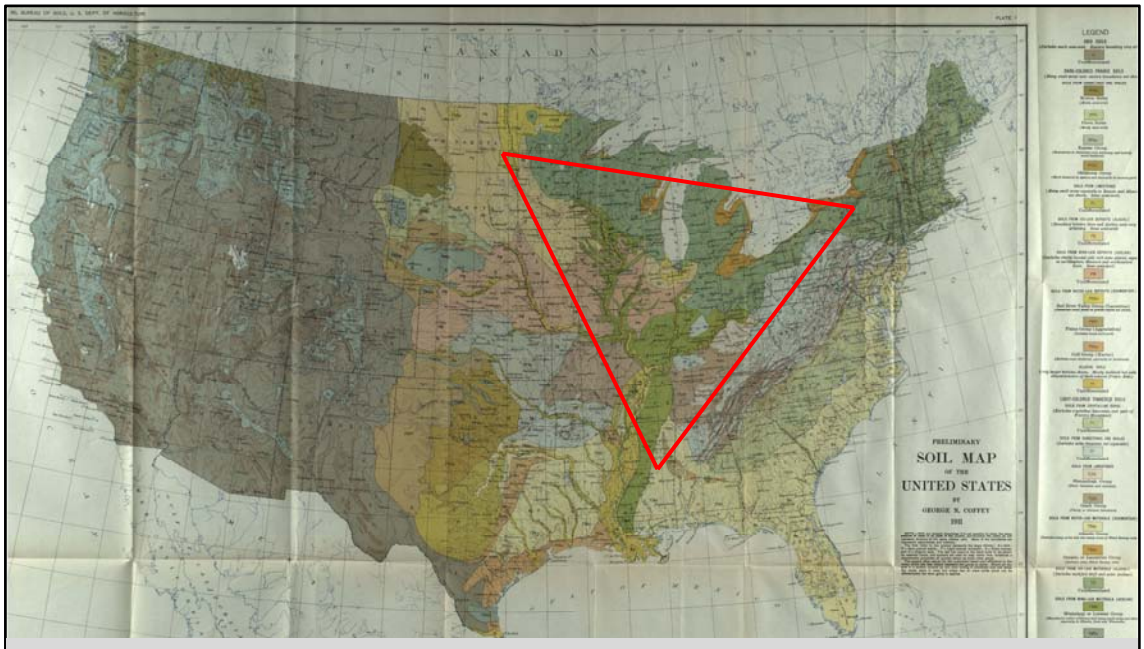
1906 Soil survey of the Carrington area-both Foster & Griggs Counties

"Twelve distinct types of soils were recognized and mapped in the Carrington Area. The following table shows the name and extent of each:"

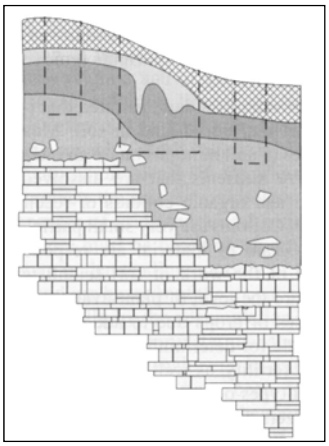
Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Marshall silt loam	240,128	50.2	Marshall fine sand	4,096	1.0
Marshall loam	114,560	26.3	Wabash clay	3,328	.9
Clyde loam	24,768	5.5	Hobart clay	2,496	.7
Marshall stony loam	23,936	5.2	Marshall gravelly loam	1,920	.5
Marshall fine sandy loam	21,696	4.9	Wabash loam	1,536	.4
Meadow	16,064	3.2			
Carrington clay loam	6,272	1.2	Total	460,800	

The word *series* is not used at all in the 12 descriptions of type- but the word *phase* is- the six Marshall types are all *phases*!

Wabash clay (& loam) *phases* mapped in the Sheyenne floodplain- imported name from the eastern rivers no doubt



G. N. Coffee, U.S. Dept. Agric. Bureau of Soils Bulletin No. 85 (1912) p. 7-4



The earliest soil concepts and classifications were based on rock!

So the regolith image here contains the soil, but all regolith is NOT soil!

"Some writers especially geologists, use the term soil in its broadest sense to include all of this mantle or regolith …. but the agricultural meaning is much more restricted. Although the soil consists largely of degenerated rock this material must be acted upon by life in some form before it becomes a true soil…..

The soil may, therefore, be considered as the superficial mantle….. acted upon by organic agencies and mixed with varying amounts of organic matter, furnishing conditions necessary for the growth of plants……

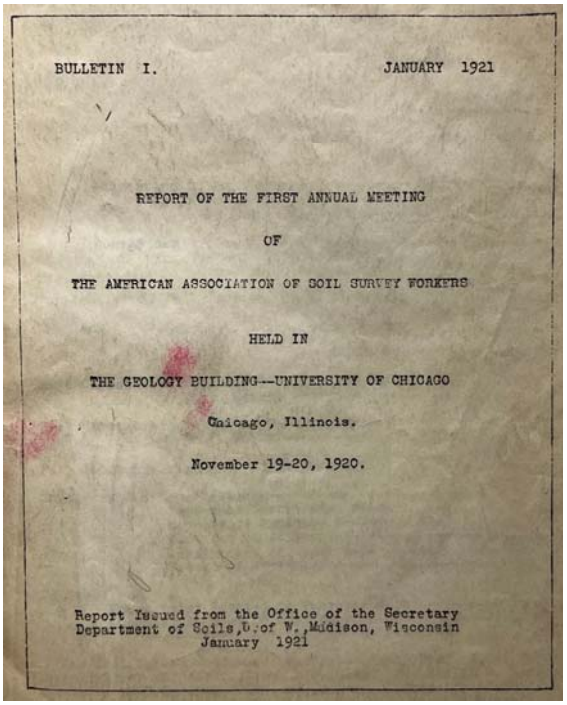
the soil is an independent, natural body, a bio-geological formation, differing essentially from the rock which underlies it.

It is the one great formation in which the organic and inorganic kingdoms meet and derives its distinctive character from this union" (p. 8).

Coffey, G. N. 1912. A study of the soils of the United States. U. S. Department of Agriculture, Bureau of Soils, Circular No. 85.

Inagural bulleting of the American Association of Soil Survey Workers University of Chicago! November, 1920

The wonderful thing about a soil survey party (and of course, there is a Party Leader) is talking to each other in the field and the office about what you are learning-
Boy did these guys chatter after the presentations



BULLETIN I. JANUARY 1921

REPORT OF THE FIRST ANNUAL MEETING

OF

THE AMERICAN ASSOCIATION OF SOIL SURVEY WORKERS

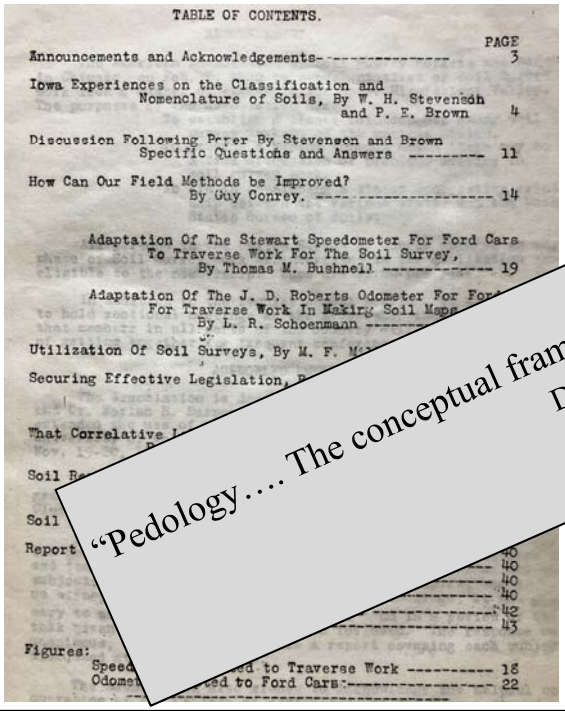
HELD IN

THE GEOLOGY BUILDING--UNIVERSITY OF CHICAGO

Chicago, Illinois.

November 19-20, 1920.

Report Issued from the Office of the Secretary
Department of Soils, Univ of W., Madison, Wisconsin
January 1921



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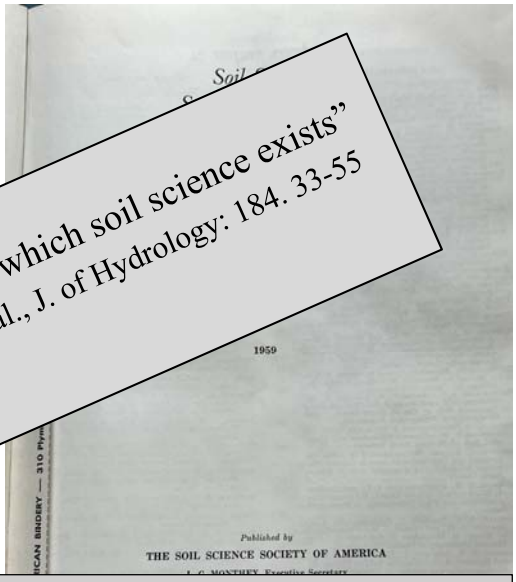
1936, a merger between the Soil Survey Workers Assoc. and the Soil di

"Pedology…. The conceptual framework upon which soil science exists"
Don Nielsen et al., J. of Hydrology: 184. 33-55



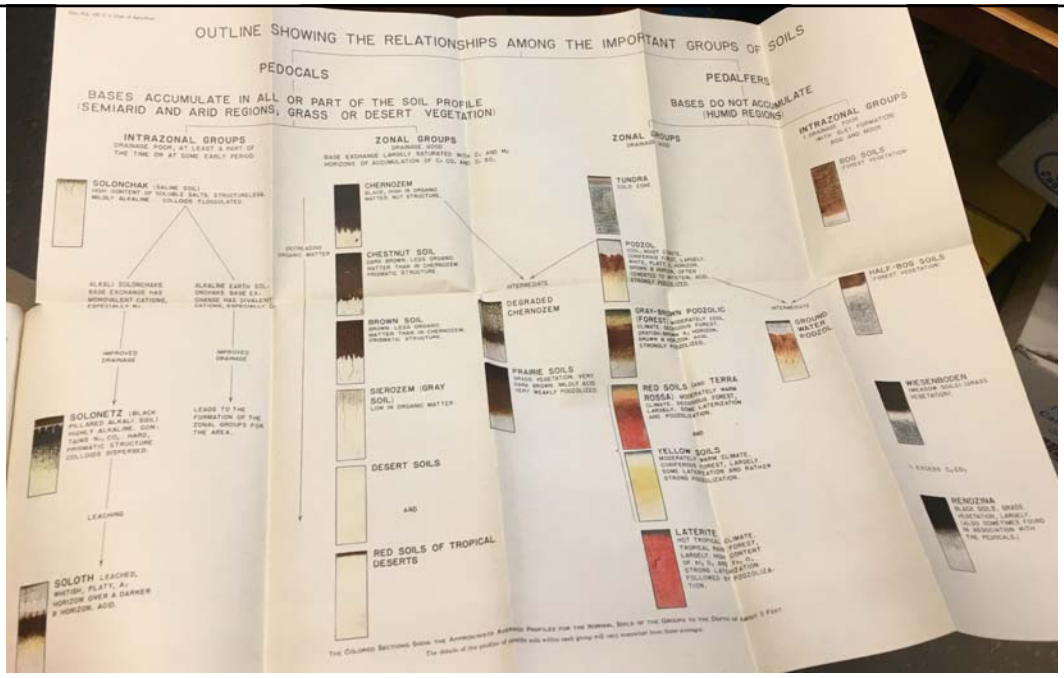
1959

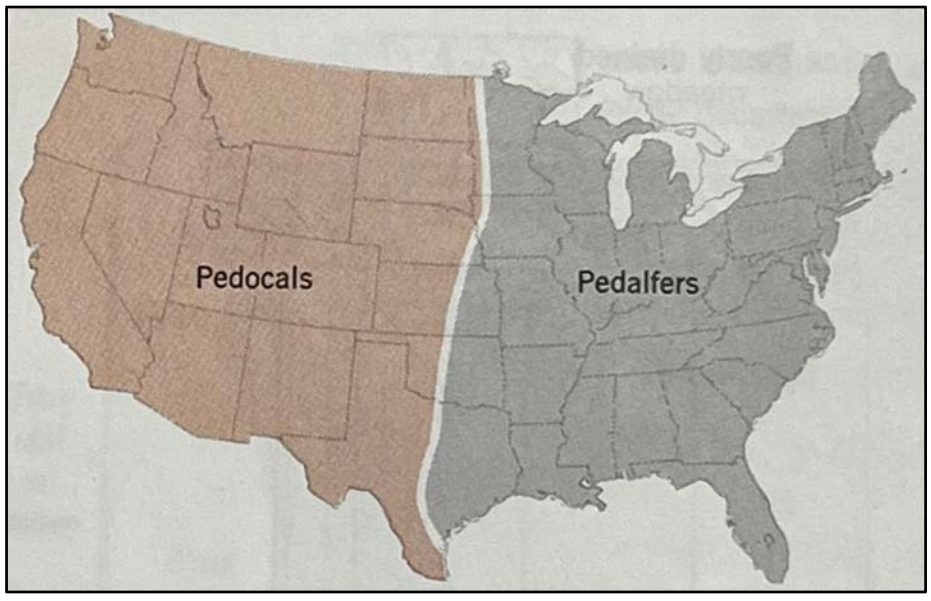
Published by
THE SOIL SCIENCE SOCIETY OF AMERICA

Simonson, Roy W. 1959.
Outline of a Generalized Theory of Soil Genesis.
Soil Sci. Soc. Am. J. Volume 23, Issue 2:152-156.

"The excursion reached Fargo in an early morning rain, the first of the trip….
Locally, there has been <u>some accumulation of alkali</u>, insufficient to produce what we know as alkali land; but sufficient to cause a modification of the soil profile by causing the development of a heavy plastic B horizon….such soils are merely <u>incipient</u> alkali soils"

First Int. Congress of Soil Science, 1927


OUTLINE SHOWING THE RELATIONSHIPS AMONG THE IMPORTANT GROUPS OF SOILS
PEDOCALS
BASES ACCUMULATE IN ALL OR PART OF THE SOIL PROFILE (SEMIARID AND ARID REGIONS, GRASS OR DESERT VEGETATION)
PEDALFERS
BASES DO NOT ACCUMULATE (HUMID REGIONS)
INTRAZONAL GROUPS
ZONAL GROUPS
SOLONCHAK
SOLONETZ
SOLOTH
CHERNOZEM
CHESTNUT SOIL
BROWN SOIL
SIEROZEM (GRAY SOIL)
DESERT SOILS
AND
RED SOILS OF TROPICAL DESERTS
DEGRADED CHERNOZEM
PRAIRIE SOILS
TUNDRA
PODZOL
GRAY-BROWN PODZOLIC (FOREST)
RED SOILS AND TERRA ROSSA
YELLOW SOILS
LATERITE
GROUND WATER PODZOL
BOG SOILS
HALF-BOG SOILS
WIESENBODEN
RENDZINA


Pedocals
Pedalfers

"the Russian workers had already shown that the soil is a product of process rather than of material and is, therefore, a developing body rather than a static one. They allied the soil to life rather than to death."

Curtis F. Marbut, 1934

So the USDA chose a scheme based upon soil characteristics as stressed by Coffey in 1912 and Marbut in 1922:

Dr. Marbut's mature philosophy on soil surveying:
"Describe the soils as you find them. Get the facts first and philosophize about the genesis of the soil later. Soils must be studied and classified as soils, not as geological products, climatic products or from the point of view of anything outside the soil itself"

from Kellogg's Eulogy in 1935
Science 82: (2125, September 20): 268-270

Pivot to soil series
In 1920 Marbut listed eight soil profile criteria necessary to define a soil unit:

- **Number of horizons in the profile**
- **Color of the various horizons**
- **Texture of the horizons**
- **Structure of the horizons**
- **Relative arrangement of the horizons**
- **Chemical composition of the horizons**
- **Thickness of the horizons**
- **Geology of the soil material**

"The most important field unit in mapping is the soil series; soils with essentially the same color, depth, and structure of the horizons of the profile-the series were given geographic names taken from the location where they were first found; Norfolk, Hagerstown, Barnes, Miami, Houston were important early soil series." p. 8
"Within the soil series are soil types, defined according to the texture of the upper part of the solum"-

Below that level was the soil phase; moderately eroded, saline, channeled, and many others that specifically affect soil management!

From C. E. Kellogg. 1936. Development and significance of the great soil groups of the United States.

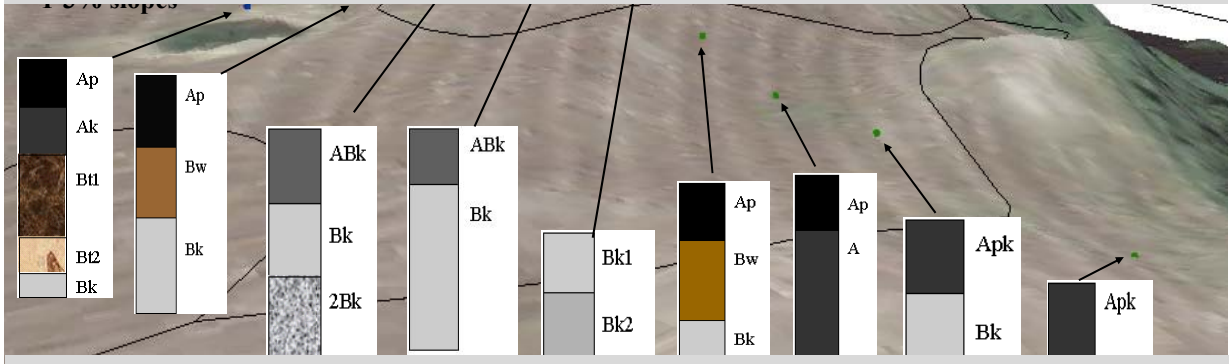
Soils defined as pedons and linked into the soil continuum through polypedons

Simonson's concepts of Additions, deletions, transfers, and transformations are operative in three dimensional space

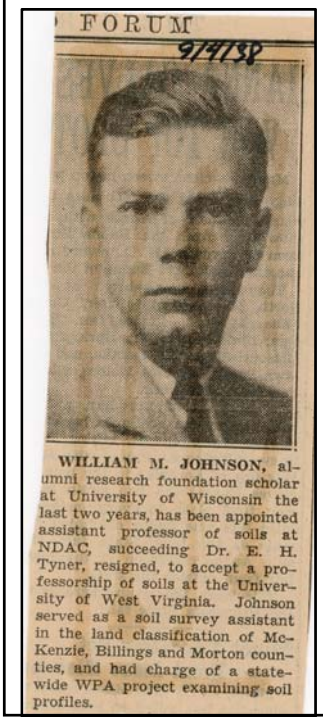
Simonson's stated in this article that "as soil series are now being defined in the U.S.A., they are classes of soils with limited ranged in morphology and composition and with the same history of horizon differentiation."

Simonson, R. W. 1964.

Catena studies near Minnewaukon, ND on Fine-loamy till: Proving the "identity" between soils and slope., i.e. a *catena*. The DEM is visible in the gridded pattern at lower left of image



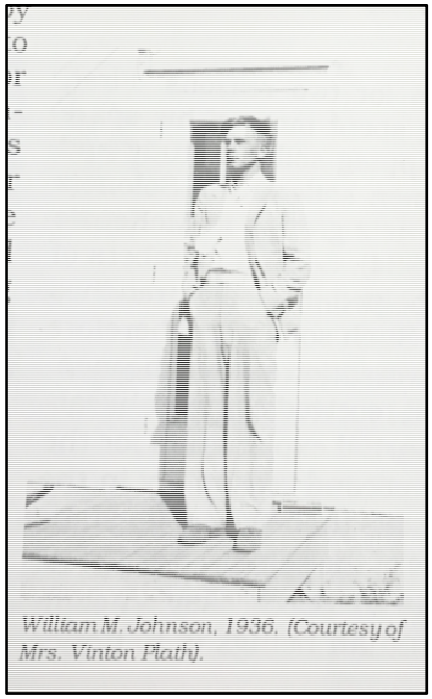
"Pedology, the conceptual framework upon which soil science is based, integrates and quantifies the formation, morphology and classification of soils. Pedologists study soil development and identify distribution patterns of soils and soil properties across the landscape." **D. R. Nielsen et al. 1996. Journal of Hydrology 184:35- 55**



FORUM

9/9/38

WILLIAM M. JOHNSON, alumni research foundation scholar at University of Wisconsin the last two years, has been appointed assistant professor of soils at NDAC, succeeding Dr. E. H. Tyner, resigned, to accept a professorship of soils at the University of West Virginia. Johnson served as a soil survey assistant in the land classification of McKenzie, Billings and Morton counties, and had charge of a statewide WPA project examining soil profiles.



William M. Johnson, 1936. (Courtesy of Mrs. Vinton Plath).

N.D. Man Given High USDA Post

William M. Johnson of the USDA Soil Conservation Service has been selected as Deputy Administrator for Soil Survey, SCS Administrator Kenneth E. Grant announced. He succeeds Dr. Charles E. Kellogg, pioneer soil scientist, who retired after a 37-year career with the Department of Agriculture.

Johnson

6-11-71

Johnson, 55, assumed his new post effective June 1, moving from his previous position as Assistant Deputy Administrator for Soil Survey.

Born in Alexander, N. D., Johnson lived and worked on a North Dakota wheat farm during his youth. He received his B. S. degree in agriculture from North Dakota State University in 1936, an M. S. degree in soils from the University of Wisconsin, and an M. S. degree in meteorology from the California Institute of Technology.

He was assistant professor of soils at North Dakota State University from 1938 until 1943.

Dean Walster's Retirement Party at the Graver Hotel 1954

CLINTON A. MOGEN

. . . pedologist, scholar, teacher, photographer and friend of Montana's soils and landscapes.

A real mapper out in the field:
Note that Mr. Wright is holding a photo sheet that he is using as his "base map"; delineations are made as investigations are verified, the mapper <u>follows</u> the established county SS legend:
Soil *consociations*, *associations*, *complexes*, and *miscellaneous land types* ect.
(why was "acremaker loam" such a common expression in soil survey parties?)

M. Robert Wright using a soil probe manufactured by Miner Machine Co. Denver, CO. These were probably the first probes used in the state.

Soil Survey <u>interpretive</u> data

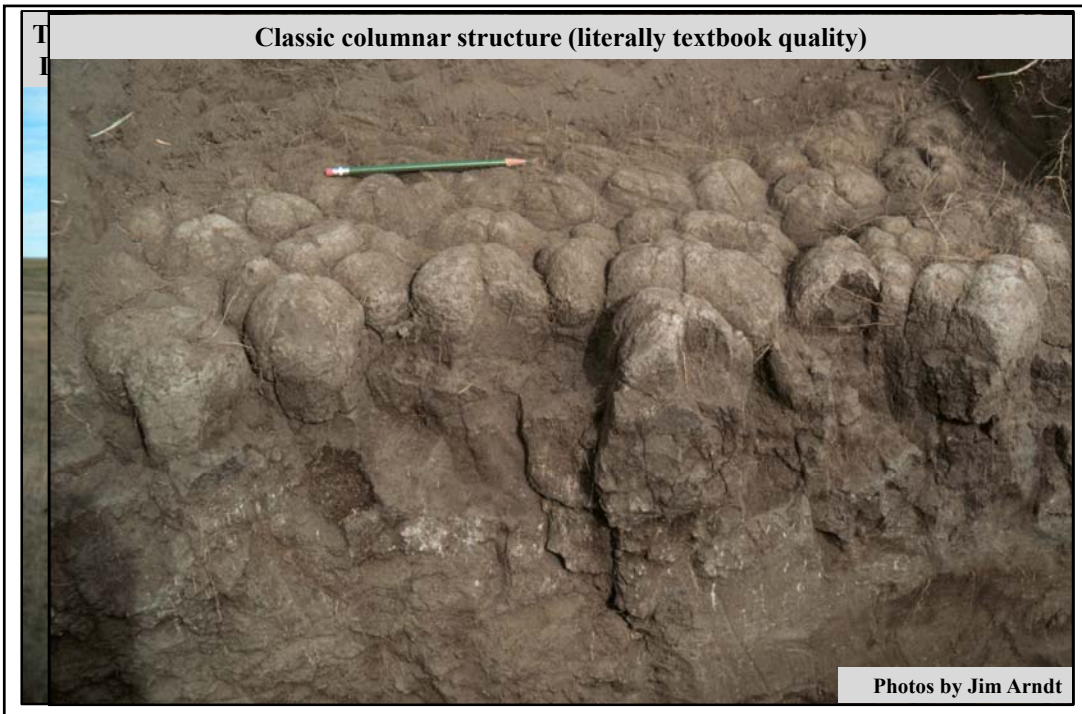
EMMONS COUNTY, NORTH DAKOTA 145

TABLE 11.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated]

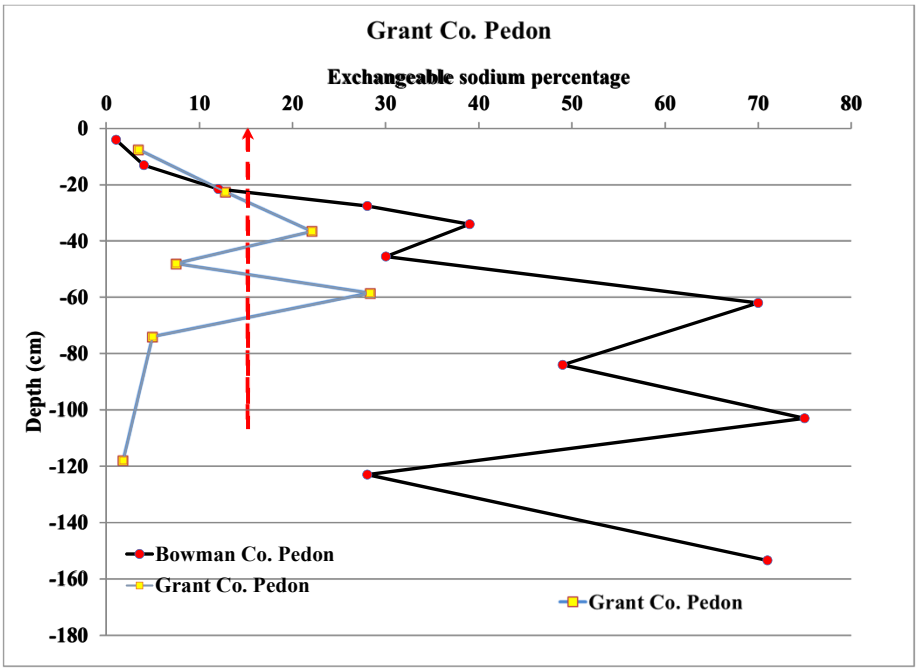
Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
3--- Regan	Severe: floods, wetness.	Severe: wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Poor: wetness.
6B--- Niobell	Severe: percs slowly.	Moderate: slope.	Slight---	Slight---	Poor: excess sodium.
8--- Heil	Severe: percs slowly, wetness, floods.	Slight---	Severe: too clayey, wetness, floods.	Severe: floods, wetness.	Poor: too clayey, wetness, excess sodium.
9--- Tonka	Severe: wetness, floods, percs slowly.	Severe: wetness, floods.	Severe: wetness, floods, too clayey.	Severe: wetness, floods.	Poor: too clayey, wetness.
10--- Parnell	Severe: floods, wetness, percs slowly.	Severe: floods, wetness.	Severe: floods, wetness, too clayey.	Severe: floods, wetness.	Poor: wetness, too clayey.

Classic columnar structure (literally textbook quality)

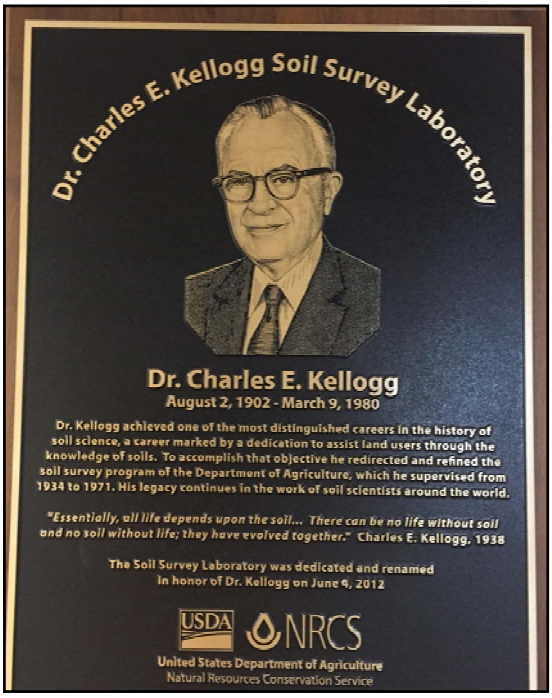


Photos by Jim Arndt

The Characterization efforts, both morphologic & physical/chemical (and mineralogic sometimes), drive soil interpretations!

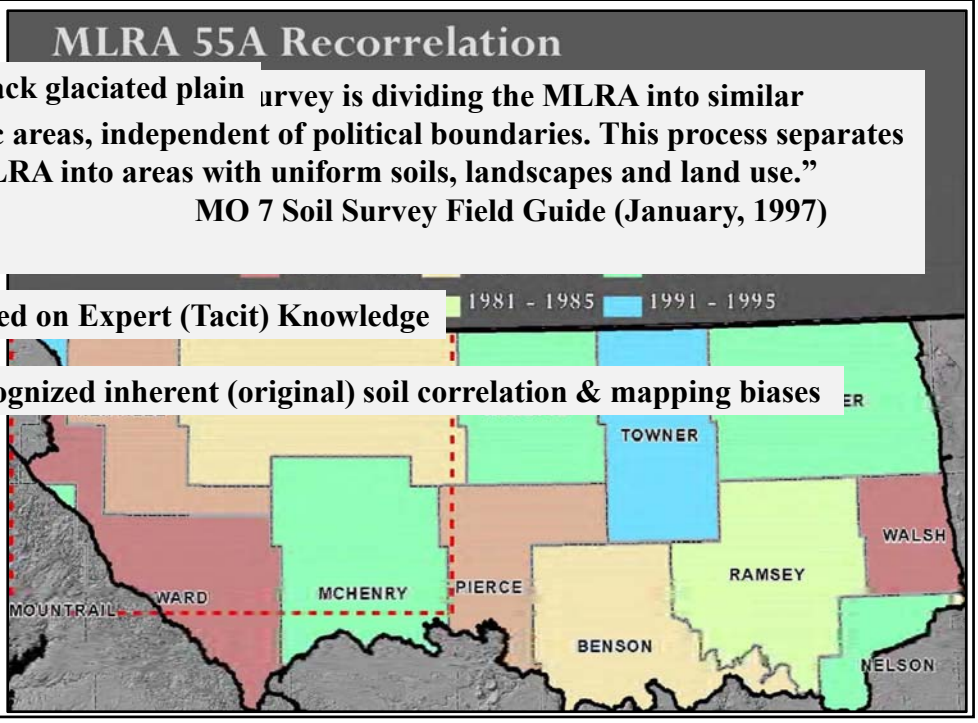


The facility is <u>where</u> all this data is run for the National Cooperative Soil Survey is in the Federal Building in Lincoln, Nebraska



55A-The northern black glaciated plain **urvey is dividing the MLRA into similar physiographic areas, independent of political boundaries. This process separates a complex MLRA into areas with uniform soils, landscapes and land use."**

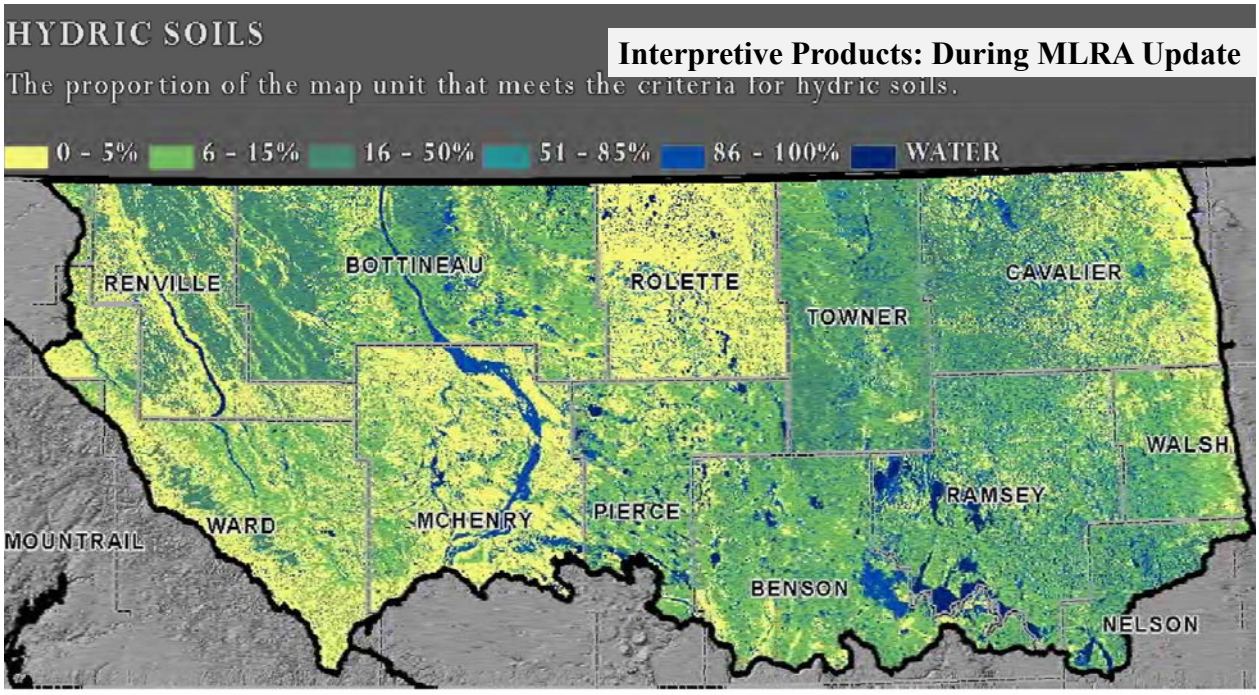
MO 7 Soil Survey Field Guide (January, 1997)



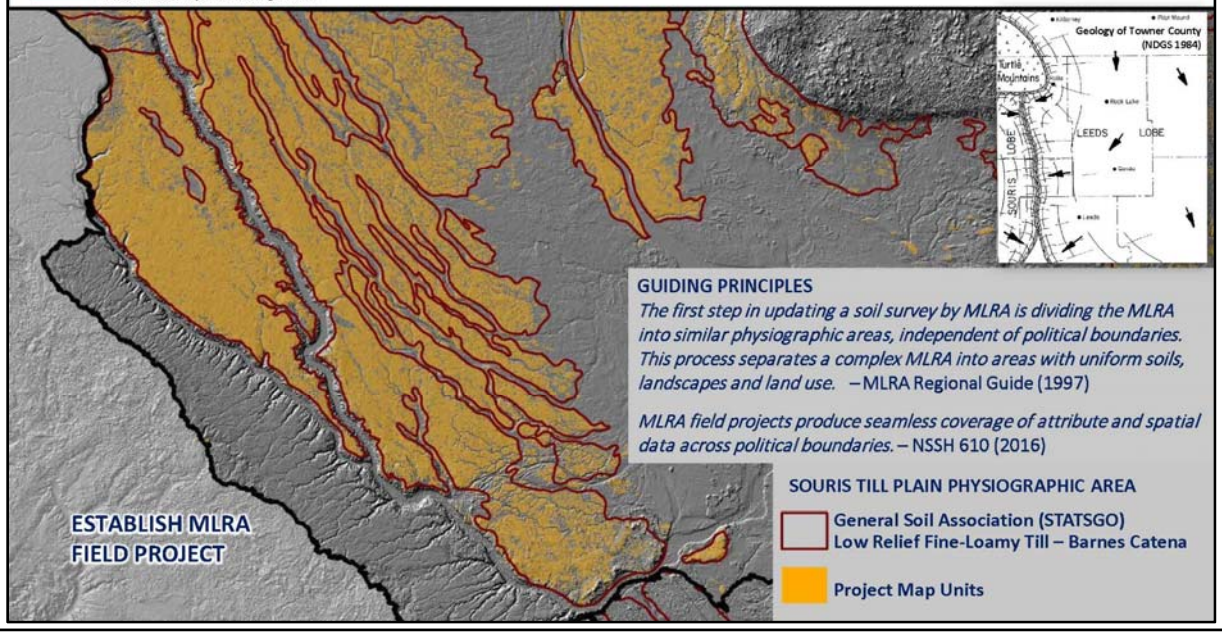
Efforts based on Expert (Tacit) Knowledge

Efforts recognized inherent (original) soil correlation & mapping biases

Interpretive Products: During MLRA Update



MLRA 55A General Soils map showing distribution of the Barnes catena
The Souris lobe SDJR update project



Many problems w/ mapping fine-loamy till landscapes south and west of the Turtle mountains- Hamlet was mapped there early on, established in Renville C[illegible]n 1972. It is a "wetter cousin" to the Barnes series.

Three soil scientists concentrated on STATSGO unit F158[illegible], 0-3% slopes for a field appraisal:

Conclusions:
no Barnes in any of their investigati[illegible]
GOODNESS sakes!
Found enough evidence[illegible] (mottling!)
to establish an *A*[illegible]
So these fi[illegible]d geospatial model.
M[illegible]later, 170 targeted profiles were
e[illegible]map; 90% short and 10% full descriptions,
B[illegible]ists:
As a[illegible]rk campaign, the Souris soil series was established and
1.1 m[illegible]cre recorrelated
(that is[illegible]acre counting works in the modern soil survey!

Now ongoing:
Leeds lobe (2.1 million acres) on Fine-loamy till & the Red River Lobe physiographic units

So, an importance point is the generational change in soil survey nationally; the 1950 and 60s were a time of vigorous activity both in the field federally (the Progressive Soil Survey) and in the research investigations and support by most of the land grant institutions. This was the Pre-FSA era; The number of field soil scientists (and offices) have been reduced markedly over that time nationally. The university Soil testing labs and Soil characterization labs that supported soil survey have also been shuttered!

ALSO-A soil survey is never done- One of the biggest mistakes the Soil Conservation Service ever made was to institute the "Last Acre Ceremony"- it provided a false impression in the minds of the agricultural community.

Physical/Chemical property interpretations: Regional soil series and soil type/phase

In the west river area the ND Soil Survey has had lots of issues with sodium affected soils dealing with quality of the mapping and supporting information.

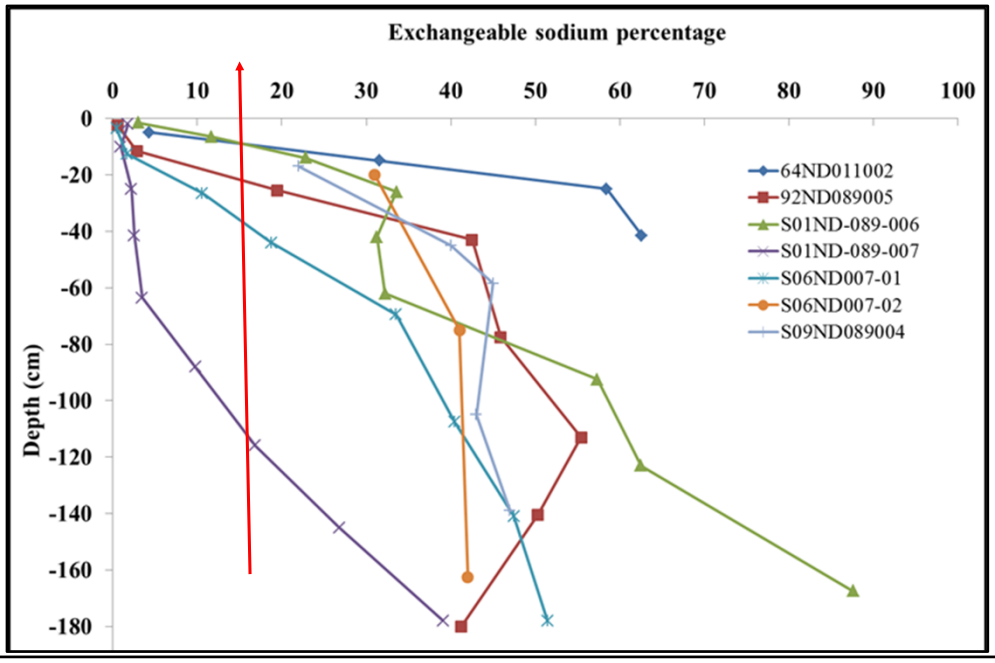
Thompson and Heidt (1988) called for additional field investigations on Typic and Leptic Natriborolls, moderately deep to paralithic beds.

They stated that:
"in adjacent counties and states soils of this nature have been correlated as variants, taxadjuncts, or phases of the Daglum or Rhoades series or have been ignored."

Let's look at the Rhoades series

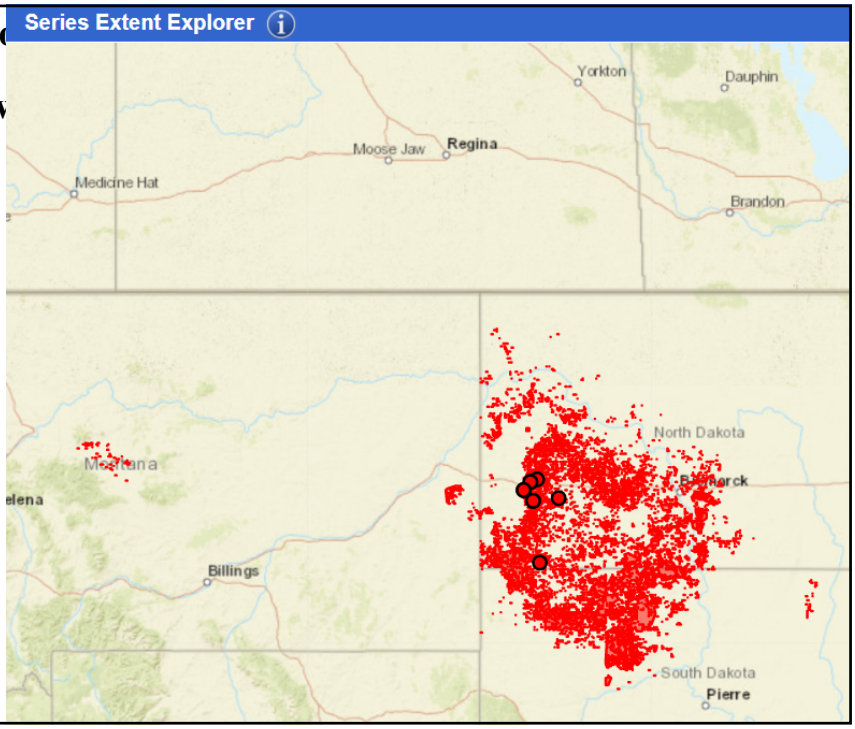
ESP of 9 Rhoades pedons sampled from 1964 to 2009 in western ND

How confident can we be in our interpretations?



Now let's look at the Rh

https://casoilresource.lav



"As soil science gradually grows from nature study to science, it becomes more quantitative. We hope to develop a system of soil classification that reflects the growing precision of the science. It should be based increasingly on the characteristics of the soil, accurately measured, and less on the on our appraisal of the genetic factors themselves."

p. 10, Soil Survey Staff 7th Approximation, 1960

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