A History of Soil Science in Indiana 1816-1966

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This paper tries to draw a picture of the ideas and knowledge of people, within a very broad, inclusive concept of the subject, the region and the times.

In general, HISTORY consists of past events about which a historian tells a story based upon information which is available, and selected to reflect his impressions. Actual historical facts were in the past so the story depends upon oral, pictorical and/or written evidences, and, at best, fails to be full and exact because sources of information may be biased or even non-existent.

SCIENCE is defined as organized knowledge, and knowledge is vital only in the human brain where it affects the thinking and actions of men. It may be passed on, directly or indirectly, from generation to generation. Words in written material are just inert symbols of "canned" knowledge which may become active only in the mind of a reader—often with meanings different from those of the writers.

From prehistoric times SOIL has been "the earth's surface which grows plants" and was considered mainly as a factor in farming. That is still true, but there have been many modern additions and variations in the concept of "soils."

For convenience this discussion recognizes three general periods based largely upon the amounts and kinds of sources of information. First, there was the pioneer time up to about 1850. Then came an intermediate period up to about 1900. From 1900 to the present was a time of vast expansion, with current indications of a beginning of a great new era.

Pioneer Period

Obviously the beginings of "soil science" antedated the 1816 statehood of Indiana. However, no attempt will be made to evaluate evidence from mound builders or even from practices of Indian inhabitants, who chose sites for their gardens, villages and trails according to the nature of the ground.

In practice the ideas of "ground, land or soil" were much the same and soil knowledge was scattered through agricultural lore and records.

Pioneers were infiltrating the Indiana territory long before the 1795 treaty when Indians first ceded land in southeastern Indiana. By 1809 the US government had acquired title to lands below a line passing roughly from Fort Recovery, Ohio, past Greensburg to Brownstown and thence northwest near Rockville.

No doubt the early settlers learned something from the Indians and also brought knowledge from their previous homes which made up the body of their information, which they combined with their own observations of local conditions. In those days most of the people were on or close to the land and probably all were more or less familiar with the prevailing ideas of what made land, or soil, good, fair or poor for their uses. Information about the soil knowledge of the early days may be found in the writings of individuals, in books or periodicals, and in the field notes of the General Land Office.

The GLO field notes record observations along every section line so were a systematic sampling of all the land. They give a view of the

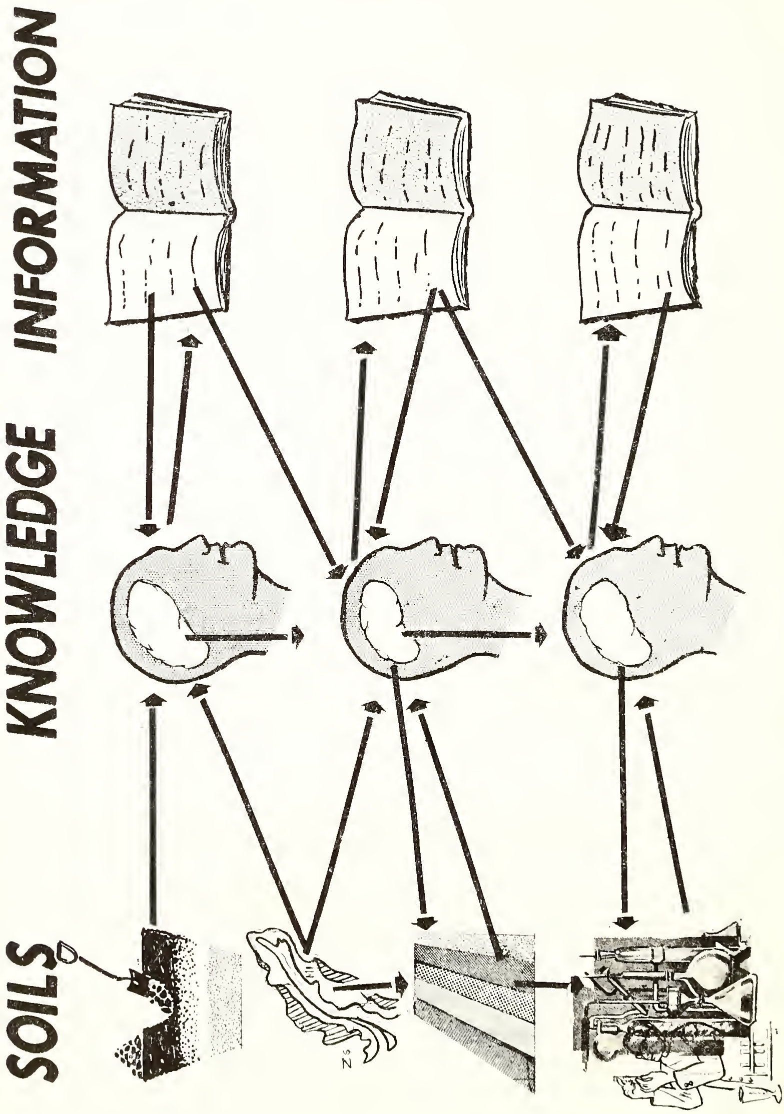

Figure 1. illustrates the credo of this paper that soil science is derived from patterns and profiles of soils in Nature, from experiment fields and from laboratories; and that the knowledge resides in living minds, being transmitted direct from mind to mind or indirectly through written records.

thinking and the vocabularies of the times and contained much valuable information, but are not as good as they might have been because of some serious flaws. For instance, the primary, paid job of surveyors was to run lines, and land description was incidental. Their qualifications for soil classifications were fortuitous and varied, as shown by their notes which range from almost nothing to some very good observations. The GLO administration did not guide the field work with uniform terminology, definitions of land classes, or inspection of results. Comparisons of land notes do not consistently show the similarities or differences in the soil character. The records of tree species *are* rather reliable and vegetation generally was considered a good indication of the kind of soil.

The GLO notes of T4N, R7E, made in 1806 used these terms:

Topography—flat, level, low flat, rolling, hilly, bottom.

Quality—1st, 2nd, 3rd rate; fair, rich, good, wet.

Vegetation—beech, oak, poplar, sugar, gum, ash, hickory, sycamore, elm, spicewood, brush.

These words were used in many different combinations, although some features were associated more frequently.

The field notes for T4N, R5E, which is near the township given above, have about the same descriptive words with some additional terms such as—steep, high hills, ridges, knobs; second bottom; thin; good for rye, oats, irish potatoes; vegetation, pine, chestnut, cherry, dogwood, hackberry, briars and whortleberry.

People used to think there was something the matter with land which did not grow trees and used the term "barrens" in southern Indiana where growth was sparse. However, field notes also recorded "barrens" in Tippecanoe county as well as "prairie" where the soils all are of good quality. In the Kankakee basin the lands described as "first, second or third rate" are quite different from those with the same ratings in other parts of the state.

It is also true that, in the dense forests of large parts of the state, the surveyors could not see more than a few yards from their traverse lines, so actually observed only a small part of the total land area and missed some features. However, the GLO information must have been helpful in many cases although settlers sometimes just seemed to wander on until they found some place which suited them. In those days they wanted well-drained land with water available from springs or streams. Woodland was preferred because of the need for material for houses, fences and firewood. Later on, settlers were attracted by tales from the frontiersmen, reports by promoters and speculators, and by the writings of travelers who often described a rosy future for the new lands which actually had the hard realities of the wilderness at that time.

Most early settlers in Indiana were born and raised in more eastern regions and were part of, and acquainted with, the civilization which had developed during 200 years of English-speaking occupation of the east. It is fair to assume that they shared the knowledge of the day which could be considered "soil science." However, at any time there is a definite connection between knowledge and education. The educated people have a lot of knowledge or sources of information which the illiterates could not share, although the unschooled might learn much from experiences which the schoolmen did not have. This sort of class difference caused some learned people to try to educate others, which was appreciated by some illiterates, while others scorned the "book larnin" and resented the attitude of superiority by some educated people.

It is a matter of conjecture what percentage of the people actually are more or less acquainted with the "going" soil science of any period, but certainly part of the relatively few educated persons of pioneer times were not especially interested in soils, and a large percentage of the farmers had relatively little schooling, which limited their ability to read and understand anything like soil chemistry, etc.

A fairly large amount of soil ideas may be found in the books and periodicals of the early days. A limited sampling of that material shows that there was considerable repetition of several kinds of statements. There were numerous reports of personal experiences on home farms with various crops, types of management, drainage, etc. There was considerable argument about different theories, or about ways of doing things. There were discussions of the proper kinds of schools and schooling for agriculturists. Usually they favored a sort of boarding school on a large farm where the students did the work under the supervision of the farmer. One writer advocated having a science instructor from one of the "learned professions, law, theology or medicine," with medicine being preferred because a doctor should know a little more chemistry. The cash expenses, profits and benefits for both students and school were estimated.

Drainage was discussed in considerable detail as to kinds of soils, the kinds and costs of drains and the benefits obtained. Some articles were essays or lectures on the chemistry of soils, fertilizers, soil classification, etc.

Actually it is probable that years of research could yield a fairly complete, detailed story of the evolution of many facets of soil science. For instance, there was the growth of the list of elements recognized in soils: their quantities, their derivations and transformations; their roles in soil fertility or toxicity; their parts in soil formation and correlations with other factors of the landscapes, etc. The different men who contributed to soil science might be cited and their discoveries, mistakes and controversies would be a part of the record. However, the time and space available will not allow any such treatment, and the knowledge in the early forms is of little use now, although the pioneer scientists certainly deserve credit for their work which led to more and more advances.

In lieu of attempting the impossible task of analyzing all of the available past information, a few illustrations of concrete statements are cited and reports are given of the views of various people on the state of knowledge of their days. Obviously these illustrations may not be a fair sample; the chronology may be imperfect; and quotations out of context may not give a true picture of the beliefs of the authors, but this still seems to be the best way to handle this historical exploration. Some facets mentioned will be classification, chemistry, characteristics, management, lyceums, proposals, etc.

An early outline of kinds of soils by de Gasparin was roughly:—

I. Organic
 Fresh
 Acid (by litmus test)

II. Mineral
 Siliferous—saline, vitriolic
 Siliceous—(no fizz with acid)
 Lime and magnesia carbonates—chalks, clays, marls, loams.

There were comments, the meanings of which are not clear, that there are no "faultless descriptions" and "analyses are not good guides."

A somewhat similar scheme states that there are 4 kinds of earths —siliceous, aluminous, calcareous and humus. If the soil were shaken up with water the siliceous would settle out first; if acid were added to the remainder it would remove the calcareous part. The quality of soils was related to the proportions of components as follows:—

Quality	Parts of components			
	Sil	Al	Cal	Humus
Rich	2	6	1	1
Good	3	4	2½	½
Middling	4	1	5	Few atoms

A "Geonomical table"—nature of earths.

1. Siliceous—predominantly			2. Aluminous—predominantly		
Si	Al		Al	Si	
Si	Ca		Al	Ca	
Si	Al	Ca	Al	Si	Ca
Si	Ca	Al	Al	Ca	Si
3. Calcareous—predominantly			4. Humus—predominantly		
Ca	Si		H	Si	
Ca	Al		H	Al	
Ca	Si	Al	H	Si	Al
Ca	Al	Si	H	Al	Si

This table looks like an exercise in logic rather than an arrangement of observed kinds of soils.

Also there were lists of kinds of soils according to a complete range of textures from the finest clays to sands and coarser sizes. Colors were used in another listing of soils, and topography, geography, etc., were given to help groupings for different kinds of crops, land uses and practices. Thus it appears that early students of soils had something like almost all of the modern facets of the field.

Clays were described as "greasy, unctuous, may be kneaded, glisten, hold water on the surface, make water muddy, settle slowly, cold, soft when wet; when dry, hard, lumpy, crack, hard to break, no luster, soft dust, absorb water, stick to tongue, workable only a short time, obdurate, ticklish to manage; occurs in deep masses, on flats, and esturies."

Sands, when wet, are firm, harsh, grating, plow easily, work easily; when dry, are soft, yielding, blow; good for bulbs; warm; in deep masses.

Soil means to the geologist the upper crust with a substratum of subsoil; to a botanist it is what supports plants; to people, what they walk on; in agriculture, it is the plow depth. One diagram showed that the plow depth might include only the natural surface soil, or it might mix natural surface and subsoil. Subsoils were known to affect the overlying surface soils.

Descriptive terms include stiff, heavy vs. light; free; deep or thin; hungry; grateful; kindly, sick, sharp, deaf (with too much vegetable matter), soft, spongy (carried on bosom of plow), porous, close, retentative, fine, easy, smooth, etc. Yellow and gray mean clayey; gray means moors; black means deaf and inert; browns mean sharp, grateful, kindly; red = prolific. Subsoils, or part not plowed, are party colored and may injure soils above.

People were aware of relationships to climate such as vertical zonation and lattitudes; that mould does not accumulate in the tropics; that soils vary with the underlying rocks. They considered the "diluvium" as "Noahian deluge" deposits over bed rock. They wrote of soil formation by decomposition of rocks, admixture of organic matter and the chemical action of air, rain, frost and wind.

They considered soils as mixtures and made mechanical analyses by sedimentation. They knew that soil was usually from 60% to 95% silica and thought it had no direct influence on plants although some believed that silex helped to "glaze" the straw of grain plants. They knew the silicates of potash and soda; that alumina was part of clay and it had no direct chemical effect; that iron protoxide affected colors and was injurious to plants; that iron peroxide was found in soils; that essential elements from soils found in ashes of plants included magnesia, potash, sodium, sulphur, chlorine, phosphorous, carbon and nitrogen. They knew that lime left soil in solution as a bicarbinate. Water problems were recognized. "Stagnant" water affected fertility and tilth; brought subaquatic plants; trees get hard bark and parasites; roads get soft; ditches are splashy; air is damp; ice damage in winter; have insects in summer. They saw need to determine the source of water and knew about capillary attraction. They studied artificial drainage by wedge, plug or mole; by furrows in fields; by small drains in grass; by boring down to porous substrata; by use of turf, stones, larch tubes and burned tile.

In Europe there were some beginnings of schooling for agriculture and people had some acquaintance with the work of Liebig, Davy, etc. Some proposed subjects were meterology, electricity, hydrostatics, hydraulics, weather, botany, vegetable physiology, geology, subsoils, drainage, climate, chemistry and mechanics.

Writers often disagreed strongly with the views of others. We find assertions that "agriculture is a science" in the *Cultivator*, a publication of the New York State Agricultural Society, in 1838. The announced purpose of the society was "to improve soils and mind." It was said that about 5000 farmers out of a total of 250,000 had access to agricultural papers. That paper reached Indiana, as is shown by contributions by Solon Robinson, "King of the Squatters in Lake County."

Another publication stated that Indiana University, in 1838, did not have courses "suited to the needs of Hoosier farm boys." They taught "mental and moral philosophy, belles lettres, languages, natural philosophy, mathematics, civil engineering and law."

In 1830 a reference stated that "soil assumed the rank of exact science recently . . . based on experience and observation . . . and use of Baconian method." Also, "soil is a compound and very complex species of matter of infinite variety."

There were numerous other illustrations of the thinking, in which there was no real break in development as they passed into the second period.

Intermediate Period (cir. 1850 to 1900)

The status of knowledge varied from place to place and views of pioneer times persisted locally along with the beginnings of some newer ideas. Strong contradictions were made.

In 1845 a speaker in Laporte County had stated "Formerly to read and write, and maybe to add and multiply was deemed sufficient education for the sons of farmers . . . but now another spirit has awakened—farmer believe that the mind of man was not given to him for naught. . . . The rocky paths of Geology and Mineralogy have many a traveler among the sons of agriculturists . . . they will reach the very arcana of Nature and be enabled to bring her vast resources to bear on the cultivation of the earth . . . these discoveries . . . are being understood by the enlightened farmer. Already, in many places, with the aid of science, perfection has been attained . . . to drive from competition all who adhere and follow the old exploded notions of our forefathers. These results are almost entirely traceable to the efforts of our agricultural societies." A Farmers' Encyclopedia said "All the old scores of our once wise but now ignorant forefathers are now cancelled and a new account opened with the public and posted up to the latest dates."

However in 1857 one writer said "there is no such thing as a Science of agriculture," which might be related to experience in sending 5 pounds of soil with $5 to New York to get De Burgs No. 1, or Jenkins Grand Restorative, or Smith supercelestial rejuvenator. Another writer agreed that Agricultural Science was "quackery and humbug" but did think that farmers do "need to know . . . and should have many observers, schools, chemistry labs, and experiments . . . and gradually evolve a science."

The gap between farming and urban people was reflected in printed items as "sweet Mary, sigh not for the city where vice and folly dwell" and words of a youth "when we see the city boys with their white hands and unsoiled linen calling us hayseeds and country jakes it makes us cast our eyes down on our coarse boots and pantaloons and rough coats, yet . . . we are the most independent, no matter what they say. Indiana is proud of her farmer boys. She keeps up such an institution as grand old Purdue" for us.

The strong flavor of emotion and idealism in early writings gave way to a trend towards more down-to-earth, practical and concrete discussions.

In 1851 the Indiana State Board of Agriculture was established with enough financial and public support for it to function, although earlier efforts had failed. The SBA annual reports tell a revealing story of events from then until about 1898.

County and other local agricultural societies were organized all over the state. State fairs, as well as county fairs, were held at which agricultural produce, stock and equipment were exhibited. Soils did not get much attention. Sometimes there were simple descriptions of the soils on which prize winning crops were grown. County society reports described their local soils in terms of native vegetation and productive quality. A Carroll County report said that Agriculture has improved by science over farming by rote, and will improve more. In Clay County they advocated a survey of agricultural and mineral resources.

The first agricultural college was established in Michigan in 1857. Geology had been included in SBA reports but was separated in the 1860s. However, Richard Owen said that soils should be collected and analyzed. Earlier Prof. Emison had advocated that soil samples be collected from every county, with notes on the drainage, slope, exposure, extent of drift, mineral manures, peat, marls, limestone subsoils, cultivation statistics and agricultural regions. Farmers were to send in the samples mixed from all parts of a field and tell whether it was virgin or unmanured; and give the land elevation. There were to be soil analyses to tell the physical and chemical nature of the soils. This proposal was not implemented.

The availability of information is shown by the report of the Shelby county society that their library contained the following:—*Indiana Farmer*, the *Cultivator*, the *Plow*, the *Horticulturist* (NY), *Prairie Farmer* (Ill), *Penn Farm Journal, Dollar Farmer* (Ky), *Loom and Anvil, Ohio Agriculturist, Western Horticulture Review* (Ohio), *Journal of Agriculture* (Mass), *American Farmer* (Md), *Farmers Companion, Farmers Instructor, Practical Farmer, Treatise on Agriculture, Farmers Dictionary*, Allens *Agricultural Chemistry*, Morrels *American Shepard*, Johnstons *Agricultural Chemistry*, Nortons *Agricultural Chemistry, The Principles of Science applied to Domestic and Mechanic Arts, Manufactures and Agriculture, Farmers Encyclopedia of Agriculture*, Colemans *European Agriculture*, Stephens *Farmers Guide*, and other books on livestock, fruits, etc. In 1853 that county society had 67 members and the president said that about ⅗ of the land was too wet and unimproved; that poor transportation for farm products was limiting progress; that there was "too much turbulent interest in party politics and the remaining hindrance to the attainment of development of the agricultural capacity of the county is the want of intelligence and system in the conduct of farming operations, and this mainly the result of the degraded view of their occupation by farmers generally."

The SBA reports contained many essays and speeches by educated men on many topics with more or less soil information. They discussed plowing and drainage to "restore land" and cited cases of land "wearing out." Meterological records by months were given for 1852 to 1857. The SBA sent Congress a resolution in favor of the Morrill act.

In 1867 the report mentions recognition that "diluvium" is a function of continental glaciation. The Department of Geology and Natural Resources was split off of the Agricultural field, but in 1880 the State Geologist said that soil was the greatest natural resource and pleaded for money for soil surveys.

The SBA reports tell of many ideas and demands for an agricultural school which finally resulted in the founding of Purdue University. Even after the land grant money was authorized, some wanted to use it for the common schools, or to save it for the future, or to make a branch of Indiana University, or to divide it between IU and the several denominational schools.

The beginning of Purdue was slow and vacillating. About 1872 the SBA report showed "the agricultural college" as a fortress-like building which never was built. In 1874 the plan was for three terms each year with courses in agriculture, chemistry, geography, geology, meterology, analysis of soil, land drainage, irrigation, mechanical cultivation of the soil, origin of soils, manures and artificial fertilizers, farm operations, astronomy, mental philosophy, moral philosophy, languages and engineering subjects.

Besides the teaching, Purdue developed research which helped support better instruction, and published the results in bulletins and circulars. About one fourth of some 80 publications before 1900 had something to do with soils and had titles such as fertilizers, chemistry, experiments with various crops, improvement of unproductive black soil, etc.

For years the SBA reports contained reports from Purdue officials and professors as if the college was more or less responsible to the Board. Also there was no "extension" as such, but the Farmers Institutes led by Professor Latta were very active and helped form a strong bond between Purdue and the rural community. (Incidentally over half of the population was classed as "rural" until about 1900) The local meetings had programs in which the soil part was largely reworking of questions of drainage, fertilizers, cultivation and exhaustion, but in general there was more and more interest in other phases of rural life, with speakers giving their individual ideas and experiences. Imperfections in knowledge of the times are suggested by remarks about "Miasmic vapors exhaling from the swamps give ague, diarrhoea and typhoid" and "fallow hurts soil." Also there was discussion of plowing along hillsides to prevent washing, with recognition of soil erosion and ways of combatting it long before the modern conservation movement. Schooling became almost universal so that the farming population could read and use the published information.

Modern Period. 1900 to Present.

The events in this period are largely in continuation of ideas which originated long ago, but which take on a new look, or get new emphasis, or a few new offshoots. In spite of great progress the role of soils in agriculture is less than its role and increased importance in other fields of interest. In agriculture the relative interest in soils may be inferred from the fact that about 30 out of 670 Purdue bulletins and 18 out of 390 circulars issued after 1900 have to do with soils, and they mostly dealing with fertilizing crops.

Work in technical soil science is indicated by the research reported in Ph.D. theses since 1943. Of these, 24 are concerned with fertility, 15 with clays, 8 with water, 22 with chemistry, 2 with loess, 9 with physics, 4 with profiles, 2 with microorganisms, 1 with roads, 2 with erosion. Some M.S. and B.S. theses dealt with soil types and bacteria, soil types and iron and manganese, antagonistic microorganism in muck, potash and phosphorus in forest soils, genesis of 7 soil types, and culture affecting soil physical conditions. There also have been considerable numbers of technical papers in soil journals.

In 1901, the U.S. Bureau of Soil started soil survey in Indiana with a soil map of Posey county, and covered 10 counties by 1908, when the Indiana State Geologist continued somewhat similar work until Federal and state cooperation began and continued until 1919. Thereafter, there was cooperation between Purdue AES and various Federal agencies up to the present with shifting relationships. During this period most Indiana counties have been mapped once and some more than once, and many individual farms have been mapped and planned separately.

The basic concept of Soil Survey is that fairly distinct "kinds" of soils can be recognized, described and outlined on maps, and that they can be "classified" which merely means arranging groupings of the kinds according to their characteristics. There are many ways of doing this but first kind must be "identified." That is a mental operation by soil students who judge how to break the continuous spectrum of Nature up into segments. Some say that there is no such thing as a "species" in the flora or fauna, and the idea is applicable in the PEDA—a collective name for soil types. The "units" depend upon definitions and with more and more knowledge the definitions become more and more precise and the idea of a type more limited until, if carried to the ultimate, it would go back to just one point in the spectrum. To be useful the whole process must be stopped at a stage where the units may be *recognized* and used in correlations or applications, although there may be ranges within the species, soil areas may contain inclusions of minor types.

Soil types are given individual names usually related to the locality where first established, and they are grouped several ways. Most common, distinct types have had local or popular names such as "sugar land, slashland, bogus, or gumbo" etc. The soil survey names may be considered "technical," but there have been efforts to create a "scientific" classification and nomenclature something like that of Botany and Zoology. In all cases the results depend upon the definitions of the smallest units, and the characteristics selected to group them into higher categories. Some guiding theory is needed like evolution in Biology, and "genesis" has been used by some soil scientists.

In soil science it has been believed that each unit is a function of its parentage, environment and age, or of its parent material, climate, native vegetation, water regime and time—which is one of the ways the idea is stated. In any event, the natural soil is the "skin of the earth" with each kind occuring in more or less separate microlandscapes, each of which is an individual geodetic location.

Soil type areas are concrete, three dimensional bodies, each characterized by its surface pattern (land form and area outline) and its profile, with the number, thickness and arrangement of its layers. Each layer, or horizon, is defined by its color, texture, consistence, structure, and physical, chemical and biotic nature. The complete nature of a soil is embodied in its morphology and setting of each area in reference to the rest of Nature—as a function of the past; in dynamic equilibrium at present, and as a basis for future interactions.

Knowledge of different kinds of soils which can be recognized facilitates all work in which soils are factors. Anything learned about an area of one kind can be used more or less in other areas of the same kind, or on related kinds, if the facts relating them are significant in the interactions. For instance, different soils with similar drainage characteristics can be considered together in drainage plans. The general principle applies through a series of relationships ranging from simple bearing power to complexities of land valuation.

Modern soil science has developed highly specialized fields in which the workers know more and more about narrower facets, with so much total information that one scientist who knows about most of his own area may know little about the facts and theories of another branch. The whole group may have an enormous amount of information—not all digested and coordinated as needed by teachers. Research people often are more interested in the fringe of the unknown, than in the established truths.

Within agriculture the fertility people still study the uses of the standard ingredients such as lime, nitrogen, phosphorous, and potash in all kinds of forms and combinations on all kinds of soils, under all kinds of conditions, crops, placement, etc. They also study many other elements which may be involved in plant nutrition or plant composition. They use radio-active tracers to work out the exact mechanisms of what happens in the soils.

Soil physicists study the complications of water movement, structure consistence, tilth, etc. Sometimes the study is strictly fundamental with the use of soil material being incidental, or it may be in connection with machinery for working the soil, etc.

Basic information about the physical and chemical properties of soils is used outside of agriculture in engineering, as with roads, air strips, building foundations, dams, etc. Purdue has had Ph.D. theses in engineering on photointerpretation, ground water, partly frozen soil, clay consolidation, soil variability, chert and shale, earth dams, sandy soil, water and organic matter.

Starting on the basis of soil erosion, under the leadership of Hugh Bennett, the Federal government has developed the Conservation service, now with very broad and extensive field of activities. They began in 1929 with regional erosion experiment stations; they had demonstration projects worked with CCC camps; set up conservation districts; brought in flood control; war production work; forestry; soil classification and correlation; small watershed work; watershed protection; farm home administration; fish and wildlife; historic base for acreage allotment;

Soil Bank; cropland conversion; long time land use adjustment; rural renewal; and income producing recreation. In most of these activities soil maps and use capability of various soils are used.

In recent years the SCS and other agencies have been active in "Land Judging," the elements of which are much the same as the methods of the Soil Survey in sizing up the soils and interpreting the observed characteristics in terms of soil morphology, classification, adaptation, and needs. By this study rather large numbers of youths and adults have learned much of the technicalities of soil observation, and the total of reasonably expert people has increased, although it still is a small percentage of the population.

Recently soil science has been used in local, state and national planning and zoning. It has helped determine whether septic tanks could be used in housing developments. It has aided land valuation and assessment, farm management, water supply, geography, ecology and terrain intelligence.

Indiana Soil Survey helped pioneer the use of aerial photos in soil mapping and for interpretation of soil conditions, and helped engineers here, and in certain projects in other countries, in using such techniques.

Recent studies at Purdue have made important contributions to soil chemistry from the standpoint of fertility, and the role of clay minerals, which are to soils something like protoplasm is to living matter.

The scope of information now included in or related to Soil Science may be judged by the following. The International Soil Science Society and the Soil Science Society of America have sections on soil physics, chemistry, bacteriology, fertility, genesis and classification, forest soils, conservation, management, technology and climatology. One soil textbook lists topics like genesis, profiles, components, volume, organic matter, water, air, clay, humus, nutrients, fertility, physical properties, colloids, organisms, vapor losses, liquid losses, erosion, air temperature, parent materials, formation, classification, survey, reaction, lime, nitrogen, phosphorus, potash and morphology.

The 1957 yearbook of agriculture mentions fertility, physical properties, plant growth, moisture, chemistry, P,K,S,Fe, Zn, Ba, Cu, Mn, organic matter, toxins, living organisms, nutrients, lime, practices of fertilization, manure, composts, peats, sewage, green manures, cover, crop quality, economics, tillage, alkali, erosion by wind or water, weed control, diseases, irrigation, drainage, classification, surveys, maps, cropping systems, management in climatic or crop regions, pastures, ranges, grasses, legumes, tobacco, rice, field crops, gardens, lawns, vegetables, orchards, forests and windbreaks. In the interactions of all these things the soils are important factors.

Pedology has been a term for Soil Science for over 50 years, but even now few of the public and only part of scientists know it. A book on history of science does not even mention soil science or Pedology which indicates that even professionals may be unaware of the subject, although all people depend upon soils for subsistence. Another encyclopedia of science and technology does discuss soils in relation to certain engineering and agricultural matters, such as those listed above.

Soil Science certainly is interrelated with almost all other facets of Nature such as geology, geomorphology, climate, biology, ecology, topography, and historical factors of landscapes. At any given site the soil characteristics probably sum up and integrate all of the components better than any other one factor. That is, the soil body is a function of the particular materials, environment, circumstances and time of development up to the present. Progress in one field affects the others.

Under human usage the soil environment, such as drainage conditions, often has been changed so changes in the soil bodies are under way, but the rate of change is slow compared with the lifetimes of men so many of the features of soils in their natural condition persist for a relatively long time. Of course, "accelerated erosion" may remove the natural topsoil very rapidly so that the current plowdepth is a modified subsoil or substratum now going through a new cycle of development. Some other treatments, such as heavy fertilization may gradually change the productivity with out much visible change in appearance.

Continuing study is constantly adding knowledge in the field of soil science. Ideas, accepted as true now, are subject to modifications although some basic facts are more permanent. Soil Science is unfinished business, and the current events of today become the history of tomorrow.