SOIL SURVEY, CLASSIFICATION, GENESIS, AND MORPHOLOGY[1]

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What was the first thing the astronauts did when they landed on the moon? They took so-called "soil" and rock samples. From a soil scientist's viewpoint, the landing on the moon was an extension of our soil survey and classification programs here on earth. Indeed, some of the people who worked on the specimens collected on the moon were trained by soil scientists of the W.S.U. Department of Agronomy and Soils.

Everyone has a stake in our soil resources. Realization of this develops when soil resources are insufficient to sustain all of our uses such as food production, forestry, and recreation. We want fertile lands to produce the food. We want to protect the soils of our farmlands, our forests and parks from the damaging effects of erosion and misuse, for without proper soil conditions all of these are endangered - including humans.

Highway engineers want to know the nature of the soils and soil materials to support the highway network. Foresters want to know the nature and distribution of soils so they can plan where to grow and/or intensify forests and where to construct roads to serve forest management and harvesting.

Rural developers want to know on what soils they can plan for human waste disposal, whether for individual families with septic tanks, or rural communities requiring a unitized sewage disposal system, or indeed, a

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metropolis hard pressed for soils to digest the sludge from it's sewage treatment plants that must not be returned to streams.

It is all these needs, for example, and countless others, that the W.S.U. Soil Survey, Genesis, and Morphology Program has striven to serve since the beginning of the University. Even before the turn of the century, the Experiment Station chemists Fulmer and Fletcher (1894) were analyzing the soil samples from representative, though unnamed, unidentified, soil areas of the State.

The scientists of the soil survey, genesis and morphology scientists W.S.U.'s Agronomy and Soils Department developed an outstanding competence in understanding the nature and properties of Washington soils and in serving the needs related there to. Theirs is an enviable record! The program grew to meet these varied needs and did very, very well--considering the limited resources available to meet these voracious needs.

The program of soil survey on the land was started by the Federal Government's Bureau of Chemistry and Soils in the early 1900's. First surveys in Washington were in the Yakima and Walla Walla River valleys. Island County was surveyed in 1905. Reconnaissance soil surveys were conducted by 1910 in northwestern and southwestern Washington. By 1920, Stevens, Benton and Spokane Counties, and the Quincy and Wenatchee areas were surveyed. In 1920 a reconnaissance survey was made of the Columbia

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[3]Dates in parenthesis refer to the date of the volume of Agronomy and Men--later named, THE AGRONOMIST-- which carries, in a department newsletter form, yearly historic reports from which information cited was drawn.

Basin area of Central Washington where there was an excellent prospect for development of irrigation - realized by the Grand Coulee Dam Reclamation Project of the thirties and forties. (60-61)[3]

State participation in the survey program became significant through some early, neighborly cooperation (personal communication with Dr. S. C. Vandecaveye, 1983). In the early thirties, the Head of the Soils Section, Dr. Vandecaveye, lamented to his next-door neighbor, George Gannon, the crying need for state support to the soil survey program and hence for more vigorous state leadership in the program. Mr. Gannon was a member of the State Legislature and he sold that body on this need for state support. He drafted a bill and obtained its passage--just one of the many things banker, legislator, alumnus George Gannon did for the University and the State. Dr. L. C. Wheeting was placed in charge of this enlarged State project and worked closely with the Federal program then under the U.S.D.A. Bureau of Plant Industry.

By 1950, eleven surveys had been completed. But the completion meant only that the field work and narrative write-ups had been accomplished. There was a severe bottle neck in getting these soil survey reports published. So slow was the publication process that it was projected to be 60 years before these eleven would all be published and available for use by the public. As Soil Scientist, Karl Baur, of the University's Western Washington Experiment Station quipped, "Some of the coastline and river-bank soils would have succumbed to geologic erosion and have disappeared before these maps were published." Fortunately, increased funding and better federal facilities permitted expediting of the printing process so it required only twenty years to get these reports published.

By 1960 nearly eight million acres of Washington had been covered by

the cooperative Federal-State surveys using a taxonomic system of soil classification. Nine million acres had been covered by the Soil Conservation Service surveys (interpretive mapping - soils were differentiated and mapped as utility groups rather than taxonomic units). Semi-detailed soil surveys had been conducted on nearly a million acres, and reconnaissance surveys of forest lands depicting the land characteristics, had been conducted on ten million acres.

Just as publication of soil survey information is essential before the information can be put to the many potential public and private uses, those who would use this information have to be schooled in its meaning, and application to their problems. The soil survey and classification staff labored mightily to accomplish the latter by way of the county extension agents and information program. It is a gargantuan task - not yet fully accomplished. Of course, neither is the inventorying of the soils yet accomplished. As Warren Starr, professor and head of the soil survey program in the 1950's and 1960's said (60-61), "Future progress of the soil survey and certainly full utilization of the information obtained by the survey will be controlled to a large extent by the progress that can be made in the qualitative and quantitative characterizations that can be accomplished for the soils delineated in the survey."

Starr and Ray Gilkeson, soil scientist and professor in the Department from 1950's - 1980's, did a magnificent job of coordinating and cooperating on soil survey projects and information programs over a span of thirty years. They worked with the Washington State Highway Department to develop interpretation of the soil surveys specifically to benefit the highway engineers. They developed new models of soil survey reports for immediate and specific use, thereby circumventing the great delay

occasioned by the cooperative Soil Survey publications bottleneck. Starr completed the Thurston County special survey report in 1954. It was in great demand. It served very well the interim need not met by manuscripts and maps "in press for years." (53-54)

Starr and Gilkeson worked closely with the timber companies--especially Weyerhaeuser--to assist them in implementing modern survey techniques and nomenclature in their extensive surveys of privately held forest lands. They also worked closely with the U.S. Forest Service to effect a unified coordinated soil survey program for public forest lands.

Gilkeson completed a special soil survey publication for the Columbia Basin area where the project to irrigate a million acres was developing (Gilkeson, 1958)(57-58). The publication filled an especially urgent need.

In addition to inventorying the soils in the field, a tremendous amount of laboratory research is required to begin to understand how and why different soils have the properties that they do. Dr. Henry W. Smith and his host of graduate students contributed much to our understanding of state soils with such studies (for example Lotspeich and Smith, 1953). There is much, much more to be done. These studies have been concentrated heavily in the Palouse for good reason: The area surrounds the University and hence is readily accessible. It is a dominant land area of the state so far as agriculture is concerned and it is a challenging area to provide basic information in soil genesis and morphology. It provides ideal problems for graduate student research (58-59) - an ideal field laboratory! The dominant soils of the area range from Aridisols in the drier regions to Mollisols with strong horizons of lime accumulation (Calcixerolls) and then Mollisols and Alfisols with horizons of clay accumulation (Argixerolls, Haplaxerolls and Haploxerolls with rainfall increasing from seven inches to

around thirty inches on a gradient from seven hundred feet elevation to three thousand feet.

The layers of volcanic ash within the soils of Washington always held a fascination for Dr. Smith and his students. He often lamented the fact that Mt. St. Helens had not favored him with an eruption during his lifetime. He had studies many of the earlier eruption which had given ideal "bookmarkers" of time in the soil profiles of the region, the Crater Lake relic of Mt. Mazama eruption some seven thousand years ago and Glacier Peak eruption about twelve thousand years ago plus several of more recent eruptions from Mt. St. Helens (see for example Smith, Okazaki, and Arstad, 1968). But to Dr. Smith, and his assistant Rose Okazaki, seeing would add a bit of drama to their soil studies related to the geologic input to the soil forming processes. On May 18, 1980, Mt. St. Helens fulfilled his wishes! And he made the most of it! He collected samples of the ash hourly throughout the deluge. He made chemical and mineralogical studies of the ash, viewed the landscape in the aftermath, studied all the reports on this grand geological phenomenon and compiled these data and observations into illustrated lectures that have been presented nationally and heralded as unique in the truest sense. He tells the Mt. ST. Helens story in the most vivid, electrifying, and awe-inspiring manner. His audience is humbled by the realization of the awesome power of the land-forming processes released by volcanoes and of how truly great is creation of this earth. He was the featured speaker and special lecturer one evening at the American Society of Agronomy meeting in Detroit, Michigan, 1980.

Starr, Gilkeson and Smith were dedicated scholars of the soils of the state and of the geological processes that shaped the landscape and

impacted the soils of the area. They studied many aspects of soil formation and distribution in the area as English scholars might study the literature. The history of the cataclysmic geologic processes that have affected the Pacific Northwest is one of the most interesting imaginable. These soil scientists tell that story with amazing clarity and inspiration. To have missed hearing or witnessing these illustrated lectures is to have missed an experience of a lifetime.

Since the native vegetation growing upon the land is a vital part of the soil-forming process, it is fitting to insert a poem here published by Agronomy and Men (1958-59) following Dr. Smith's report on "Soils of the Palouse".

THE LAST OF THE VIRGIN SOD

We broke today on the homestead
  The last of the virgin sod,
And a haunting feeling oppressed me
  That we'd marred a work of God.

A fragrance rose from the furrow,
  A fragrance both fresh and old;
It was fresh with the dew of morning,
  Yet aged with time untold.

The creak of leather and clevis,
  The rip of the coulter blade,
And we wreck what God with the labor
  Of a million years had made.

I thought, while laying the last land,
  Of the tropical sun and rains,
Of the jungles, glaciers and oceans
  Which had helped to make these plains.

Of monsters, horrid and fearful,
  Which reigned in the land we plow,
And it seemed to me so presumptuous
  Of man to claim it now.

So when, today on the homestead,
  We finished the virgin sod,
Is it strange I almost regretted
  To have marred that work of God?

Rudolf Ruste
(58-59)

Starr was a coordinator and chief author-editor to compile a regional treatise on "Soils in the Western States" which was published in 1964. His extensive knowledge of the western states area uniquely qualified him to take on this enormous task. The publication stands as a monument to his scholarship and broad knowledge of the soils of the Western States.

"Stereo-photogrammetry" is a word worthy of the soil classifier's vocabulary! It means the art of aerial photo interpretation, employing all the techniques and instruments available. Gilkeson received specialized training in this at Cornell in 1956, and disseminated the training to colleagues and students at W.S.U. in agriculture, forestry, and engineering. The tools of that time seem primitive--almost Stone Age--when contrasted with the further sophistication--after Sputnik--now labelled "remote sensing." Gilkeson and, more recently, Bruce Frazier have sharpened their talents apace of this sophistication to provide effective instruction and leadership in the use of these modern techniques in what started simply as "aerial photo surveys." Frazier's latest application of the aerial photographs has been to identify the soil erosion problem areas of the Palouse and to quantify the soil losses as affected by different cultural practices. Frazier has also begun to use satellite images taken in several spectral wavebands to further explore the changes in the Palouse landscape that result from soil erosion.

The one hundred and fifty soil monoliths prepared and preserved by Dr. H. W. Smith are specimens from the eight soil orders of principal interest in the Pacific Northwest region (76-77). They are unique among such collections. While they are stored in a museum-like room in Johnson Hall and are truly masterpieces, they are extensively used in the teaching of soil genesis, morphology and classification; literally, they bring the

field profile studies into the classroom. Well-known soil scientists, anthropologists, and geologists in the U.S.A. obtained their training in the preservation of soil profiles for future study from the W.S.U. Soils faculty, especially from Dr. Smith. Each profile has been carefully prepared and preserved by Dr. Smith. Digging a pit to establish a vertical plane and full exposure of the profile requires the work equivalent to digging a grave to the depth of the profile. For a deep Palouse soil profile, that depth may be more than ten feet. Dr. Smith took Steve Krashevski and Chairman of the Department, Bertramson, to the hills above Dayton to "dig out" a good, deep Palouse soil profile in the early fifties. The expressed purpose was to obtain one of these fine profiles. The "hidden agenda" was to show Bertramson how handy and convenient a four-inch, undisturbed-core-sampler would be to eliminate all that spade work. Shortly thereafter, Dr. Smith acquired for his project one of these mechanical core samplers. He never again invited the Chairman to accompany him on his profile sampling ventures - and the Chairman never felt badly over the lack of a repeat invitation.

The "Henry W. Smith Monolith Collection" in Johnson Hall was dedicated in 1983. It will forever be a reminder of the tremendous contributions Dr. Smith made to the teaching and study of Washington soils. The Washington soils displayed there cover a range of climates and soil-forming processes almost comparable to those affecting soils across the U.S.A. The climate of the State ranges from six inches of annual rainfall to probably over two hundred inches, from perpetual snow and ice to a frost-free climate, and from sea-level to over fourteen thousand feet in elevation. Relicts of soils from a tropical time can be found in the State. The soils of the State are indeed worthy of these soil scientists dedicated to the study of

soil genesis, morphology, and classification and to the program of soil survey.

The late nineteen-seventies and early eighties have been a time of rapid change in the Department of Agronomy and Soils as a number of the distinguished faculty who came on board in the expansion just after World War II reached retirement and were replaced by a "new crop" of eager young scientists. In soil genesis and survey, Dr. Bruce Frazier was the first and has developed a fine program of teaching and research in the uses of remote sensing in soils, agriculture, forestry, and land use. As Henry Smith, Ray Gilkeson, and Dr. Bob Hausenbuiller retired, they were replaced by Drs. Alan Busacca and John Reganold. Busacca's budding program centers on soil genesis and on the interpretation of recent earth history. He also shares responsibility for ongoing soil survey programs under the SCS and Forest Service. Reganold has the distinct responsibility of teaching the introductory Soils course in the Department and in so doing bringing the newest generation of soil scientists "into the fold" as well as training students from many other professions in the importance of soils to our world. Reganold's research delves into the problems of evaluating soils for their best uses and monitoring changing land uses in the state and U.S. With new faces and new tasks, many aspects of the soil genesis, survey, and classification program have changed in the nineteen-eighties, but the tradition of excellence of this important group in the Department of Agronomy and Soils is being carried on.

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