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HISTORY OF SOIL SCIENCE: HANS JENNY

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p0005 Hans Jenny, born 7 February 1899 in Basel, Switzerland, had a career that spanned nearly 70 years, ending only with his death on 9 January 1992. His youth was marked by a rigorous academic training, balanced by outdoor activities and experience on Swiss farms. This background led to his acceptance in the Swiss Federal Institute (ETH) in Zurich, where Jenny received a diploma in agriculture in 1922 and a DSc in colloid chemistry under Georg Wiegner in 1927 for work on ion exchange reactions. A Rockefeller Fellowship to work with Nobel Laureate Selman Waksman at Rutgers University in New Jersey, USA was followed by a position at the University of Missouri. In 1936, Jenny was appointed to a professorial position at Berkeley, which he held (as an emeritus after 1967) until his death. Jenny made significant contributions to the fields of colloid chemistry, ion exchange, and pedology. His most famous achievement is the book *Factors of Soil Formation* (1941), in which the diverse ideas of earlier scholars were combined with the abstract formalism of physical chemistry to produce a quantitative and revolutionary view of soils and ecosystems. He was the author of a biography of Eugene Hilgard, which renewed for many an insight into the significant contributions of Jenny's Berkeley predecessor. In later years, after "retirement" in 1967, Jenny became noted for his mesmerizing lectures on Soil and Landscape Painting and for his efforts, along with his wife Jean, on soil preservation. In 1982, at the age of 83, Jenny trekked Mount Kilamanjaro, collecting soil samples to test his hypothesis on the effect of latitude on soil formation, and subsequently performed the chemical analyses himself. Finally, he remained devoted to the science and preservation of his beloved Pygmy Forest, and the region of ancient, impoverished soils on the Ecological Staircase of Mendocino County, California. Today, Jenny's concepts on soil formation reverberate through the natural sciences. His work on soil organic matter established an observational and modeling framework that is the standard for modern soil carbon-cycling research, and his forward-looking ideas on soil aesthetics and preservation are becoming topics of general research and application in the conservation arena.

p0010 Hans Jenny was born to Johann Jenny, a business accountant, who was himself the son of Johann, the owner of a chimneysweep business. Jenny's mother, Marie T. Althaus, was the daughter of a family of wood-carving factory owners in Meiringen. Jenny's first years in grammar school were in Basel. During his grammar school period, Jenny's entire family moved to Meiringen, to live with Jenny's mother's family, because Jenny's father's business expertise was needed in the factory. Jenny remembered this period fondly. His grandfathers and uncles were artists, and they discussed and created modern art, an experience that early helped forge a lifelong interest in art and aesthetics in the young Jenny. This period also introduced the young Jenny to farm life, and he spent much time on the farm adjacent to his grandparents' home (**Figure 1**).

p0015 Upon the family's return to Basel, his parents decided that he should attend a junior high school that focused on college preparation. As Jenny recollected:

> 'rigorous training began that transformed a näve adolescent into a sophisticated, somewhat smart-alecky young intellectual. . . . (but) throughout this period World War I raged at the Swiss frontiers'.

p0020 Classes began early in the day, and homework kept the young students busy until after midnight. The demands on Jenny through the high school period were traumatic. Great stress was placed on studies, particularly on rote memorization in modern languages, history, science, and mathematics. Jenny later recalled that he had a hard time memorizing words, and that because of broad-ranging extracurricular activities and tension in his parents' relationship he was just an "average student. . . and I know I had my share of feelings of frustration, and of being mediocre, which was considered worse than being a criminal." Jenny's "mediocre" performance in school abruptly changed when he later entered the university.

p0025 In high school, Jenny joined the Boy Scouts, which proved to be an opportunity for him to excel in a different arena of activity and to develop leadership qualities. Jenny's particular troop emphasized an "ascetic" approach to scouting: fasting, no display of merit badges, and no vices. Jenny was good with

f0005 **Figure 1** Hans Jenny, early 1900s.

ropes, compasses, etc., skills which he attributed to his previous experiences on the farm. At the same time, the war raged around Switzerland, and Jenny would hear the thunder of canons at night and see planes escaping into Basel pursued by antiaircraft fire. The wounded German and French soldiers in Basel, the families who had lost sons, and the Allied and German war propaganda left a strong impression on Jenny and his friends. Food shortages in Europe became prominent, and Jenny spent summers during his high school years working on a farm in the Emmenthal Valley, eventually being placed in charge of horses, oxen, and plowing.

p0030 When his high-schooling ended in 1918, he was awarded a certificate to enter any Swiss university and chose to study agriculture. However, Jenny first spent a year working on farms in both German and French Switzerland. This period provided him with much practical experience about farming, and he entertained the notion of becoming a livestock manager following his studies at the university. The farming experience also had other effects on Jenny. The acquisition of physical skills, and the additional year of maturity, gave him a more serious perspective as a university student, and Jenny there focused his efforts on the educational opportunities that surrounded him. Many of the faculty at Zurich were internationally famous, and, as a student in agriculture, Jenny eventually took courses from Georg Wiegner in agricultural chemistry, an exposure that shifted his interests toward colloid chemistry and a postgraduate degree. Most notably, Jenny was attracted to Wiegner because he "expounded on principles, concepts, and ideas, rather than practical recipes."

p0035 In 1923, Jenny received his diploma in agriculture, and approached Wiegner about research in soil chemistry. Wiegner responded by insisting that Jenny first acquire a more solid foundation in chemistry. Wiegner was widely famous, and attracted students and postdoctoral scholars from across Europe as well as from overseas. Soon, Jenny became Wiegner's chief assistant in soil and colloid chemistry. In contrast to Wiegner's laboratory interests, Jenny began to spend weekends in the field, collecting and subsequently analyzing soil samples (**Figure 2**). This activity brought him into contact with Josiah Braun-Blanquet, with whom he later collaborated on the relation of soil formation and plant development.

p0040 As a result of Wiegner's preeminence in ion exchange, Jenny was encouraged to study the individual behavior of ions during exchange in relation to their degree of hydration. Jenny found that exchange behavior could not be explained by the activities of the

f0010 **Figure 2** Georg Wiegner (left) and Hans Jenny (right), around 1925.

ions, but instead must involve complex reactions between mineral surfaces and the hydrated forms of ions. Wiegner's and his students moved forward on this problem from several fronts, including conducting the exchange reactions in alcohol, in which the ions were dehydrated. Jenny recalled that the laboratory environment in Wiegner's group was interactive and dynamic, and that "doing research was an exciting cross-fertilization experience." In fact, the field of colloid chemistry at that time held a central position in chemistry and physics, a situation that made research even more exciting for the young scientists in the laboratory. Among the great advancements in that time period was Einstein's Theory of Brownian Movement, which linked molecular theory with the behavior of colloidal particles, revealing a continuity of molecules and atoms and colloidal particles that provided an overall view of the corpuscular system of nature.

p0045 Yet, on a completely different scale, Jenny noted that he had developed a reputation, within a small circle, through his interest in linking laboratory and theoretical colloidal chemistry with soils in nature. Working with Dr. Braun-Blanquet, who was an innovator in the new field of Plant Sociology, they explored the Swiss National Park, linking soil properties with plant distribution. In this report, Jenny drew a speculative curve relating soil organic matter to climate, relying on some of Eugene Hilgard's analyses (whose position Jenny was later to fill at Berkeley). The book, entitled *Vegetation Development and Soil Formation*, was reportedly later called a classic by R. Tüxen in the 1950s, but Jenny jokingly called it a *Jugendsünde* (an illegitimate product of youth).

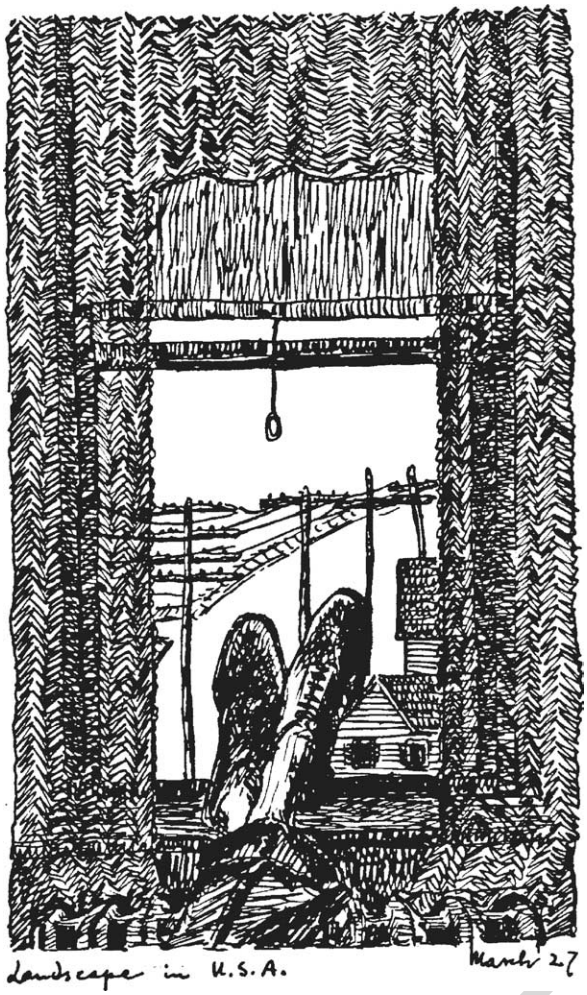
p0050 Near the end of Jenny's doctoral research, Dean Mann from Cornell University, representing the Rockefeller Foundation's International Education Board, visited Weigner's laboratory and asked Jenny if he was interested in spending a year at an American university. This was something Jenny had already considered, and he asked if he could go to Berkeley to work with Dennis Hoagland in plant nutrition. Mann discouraged this idea, suggesting that Jenny select an Atlantic coast institution. Shortly after this, Selman Waksman from Rutgers visited the Weigner laboratory and suggested that Jenny apply to work in his laboratory in New Jersey. Jenny's application, with Waksman's support, was approved and in 1926 Jenny left for America. The voyage itself proved to be memorable for Jenny, for he was paid to travel first class (and was therefore obligated to purchase a tuxedo), but he spent much of the time being seasick rather than enjoying the amenities and improving his English.

p0055 The short year at Rutgers was stimulating for Jenny. Waksman proposed that Jenny conduct litter-decomposition experiments, examine the colloidal character of the humus produced, and characterize the microbes involved. In later years Jenny remarked that the questions and approaches were sound, but the dismal conditions of Waksman's basement laboratory (occupants were forced to wear overboots during rain storms) and the sloppy behavior of the students made Jenny decide to switch his research to the effect of ion type on plant transpiration. This work was conducted with Professor Shive. Jenny remarked that Waksman, who was probably disappointed that Jenny switched laboratories, remained a professional and personal friend until his death, and that, although Jenny never completed his research with Waksman, he was stimulated by the ideas and discussions that Waksman's group engaged in. Jenny ultimately recognized that laboratory conditions were not always indicative of success, for he remarked: "Years later I realized that laboratory life-styles are not crucial, for it was Waksman who got a Nobel prize, not Wiegner."

p0060 The American lifestyle encountered by Jenny proved to confirm some of his European biases and debunk others. Jenny was shocked by the gum-chewing of students, their lack of interest in international affairs, philosophy, and art. He said "What surprised me right away was that everybody put their feet on the table or another thing, so I drew that …. [entitled] A Landscape in the USA!" (**Figure 3**). On the other hand, Jenny was greatly impressed by the experimental ingenuity of American chemists, and by facets of American chemistry which Europeans had ignored or neglected.

p0065 While at Rutgers, Jenny and a Danish colleague, J.H. Blom, were asked to translate submissions to the upcoming First International Congress of Soil Science, organized by Dean Jacob Lippman at Rutgers, which was to be held in Washington, DC. Jenny later remarked that he and Blom were "quite malicious" and "had fun in the translations, giving a certain rhythm as that of a hexameter or a pentameter, making fun of pompous writing." As the Congress approached, Wiegner was able to have Jenny appointed as an official Swiss delegate, which reduced the financial burden and also enabled him to attend the important post-Congress, Transcontinental Soils Excursion.

p0070 The postcongress excursion appears to have been a remarkable trip, bringing forth both cultural and scientific integration. A select group of scientists of differing ages and backgrounds were confined to a private train, with Pullman cars, that traversed North America from the Atlantic to the Pacific. Jenny later



f0015 **Figure 3** Hans Jenny's first sketch in the USA, 1927.

remarked on the tensions and conflicts between the sometimes abrasive youth and the older, established leaders – as well as between scientists of differing backgrounds. Importantly, the trip which passed through enormous ranges of climate, opened Jenny's mind further to the relationships between soil types: "The rolling plains, I fancied, must harbor the secret of mathematical soil functions. At times I could hardly sleep thinking about it." During the Congress, Robert Bradfield, from the University of Missouri, decided to go to Wiegner's laboratory for a sabbatical, and offered his laboratory and teaching position to Jenny for the year, which Jenny "accepted with great pleasure."

In the autumn of 1927, Jenny arrived in Columbia, Missouri. The physically isolated, but vibrant academic setting enabled him to follow through on the ideas which were conceived on the Excursion earlier that summer (**Figure 4**). Professor K.K. Krusekopf informed Jenny of the availability of soil C and N data from various states, and Jenny then began assembling data from across the Plains states, first arranging it by temperature (Canada to Louisiana). Jenny developed equations to describe the trends ("primitive modeling" as he later described it) and showed it to his colleagues, who encouraged him and suggested he present the paper that November at the meetings of the American Soil Survey Association in Chicago. The paper, which was subsequently published, quantitatively explored the climatic effects on soil N, and this effort earned Jenny a research award from the American Society of Agronomy in

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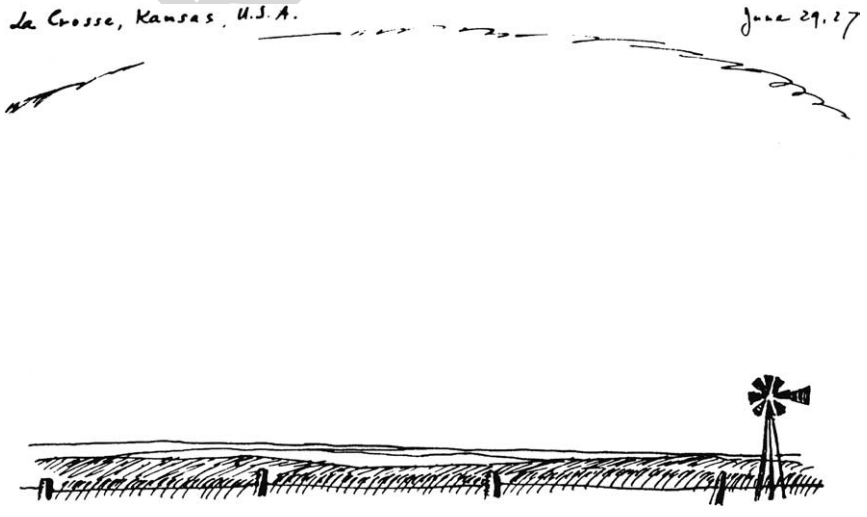


f0020 **Figure 4** Jenny's sketch of Kansas made during the Transcontinental Excursion, 1927.

1931. In this and subsequent papers, data were aligned in graphs and described mathematically, and Jenny remarked:

> 'I enjoyed seeing field data aligned by equations and derived aesthetic pleasure from the shapes of the curves. Several pedologists, however, accused me of trying to be erudite'.

p0080 In addition to his work on the climatic effects on soil N, Professor M.F. Miller suggested to Jenny that he examine the effects of cultivation on soil organic matter. A study between a native pasture soil and an adjacent cultivated field, along with data derived from the literature, produced a seminal paper and report on the loss of C and N during cultivation, and its rate. Jenny later remarked that this study added the factor of "time" to his growing list of what would later become the famous factors of soil formation.

p0085 In addition to Jenny's pedological research at Missouri, he was greatly engaged in renewing and expanding his research on colloids and ion exchange. This interest was partially the result of large conceptual differences held by Robert Bradfield, Jenny's Missouri colleague, and Wiegner. One the major experimental differences in Missouri was that Jenny worked with natural clays, in contrast to artificially made colloidal gels used in Zurich. A result of this work was a statistical model of ion exchange, one derived during late hours at night in his basement office during the hot and humid Missouri summer. About this period, and his parallel work in pedology and colloid chemistry, Jenny asked himself: "Am I doing the right thing... but both avenues proved interesting and beneficial to me, so why should I give up either one? I could have two sweethearts." An important, but not widely known additional area that Jenny also explored at this time was the differential behavior of K and Na during chemical weathering, work in a topic now widely recognized as geochemistry. This work, published in the Missouri Agricultural Experiment Station Bulletin was, as Jenny noted, not widely read. But Jenny sent a copy to V.M. Goldschmidt, who later cited the work in his discourses on geochemistry.

p0090 With the Great Depression still in full force, the University of Missouri was hit with financial difficulties. Young faculty were laid off, though Jenny (then an Assistant Professor) was spared. In 1934, faculty members were forced to take a year's leave of absence without pay, and Jenny's turn was set for 1934–35. With the assistance of his old Zurich friend Max Kleiber (then at the University of California–Davis), Jenny was able to obtain an appointment at the Citrus Research Station at Riverside, California. There, Jenny collaborated with W.P. Kelly, an arid-lands soil chemist and the codiscoverer of the crystalline nature of soil clay minerals. Jenny also, with E.R. Parker, developed a study to examine the role of tillage on water infiltration, and the time required for adverse tillage effects to disappear. While at Riverside, Kelley encouraged Jenny to visit Berkeley, where he delivered one or two lectures in the Department of Plant Nutrition. Soon, Jenny was offered a position of Associate Professor of Soil Chemistry and Morphology, which he accepted.

p0095 Upon his arrival at Berkeley, Jenny became a member of the Plant Nutrition Department, under the leadership of the famous plant nutritionist Dennis Hoagland. The Department contained numerous faculty, including Roy Overstreet. Overstreet, a soil physical chemist, was a colleague with whom Jenny was able to critically discuss his ideas and with whom he conducted joint research. Jenny repeatedly recounted the great scientific and personal pleasure that his discussions with Overstreet produced, and Jenny gives great credit to Overstreet for rigorously challenging his ideas and concepts. At the time of Jenny's arrival, the Department of Soil Technology, headed by Charles Shaw, contained people devoted to more pragmatic soil research agendas. Jenny notes that conflicts between the two groups existed, but that Jenny's interests in pedology led him to interact with Shaw, who told Jenny he (Jenny) "was going to be the new Dukuchaev." Shaw suddenly died, and Jenny and Overstreet, along with other soil researchers (soils people), then moved to a new Department of Soils.

p0100 The breadth and depth of Jenny's scientific accomplishments at Berkeley are truly remarkable. He later described his preceeding years in Missouri as his "*Sturm und Drang*" (storm and stress) period because, while he was rapidly developing ideas (and publishing) in colloidal chemistry and pedology, he was haunted with insecurities ("Sometimes you have nightmares... is what you are doing all wrong?"). Berkeley provided Jenny with colleagues and collaborators who challenged him and questioned him, encouraging him to become more confident in his emerging research.

p0105 Upon his arrival, Jenny continued to pursue his twin "sweethearts" of colloid chemistry and pedology. It is instructive to remember that his hiring was based on his expertise in colloids, and he immediately began teaching a rigorous and widely attended course on the topic – one attended by students from across the campus. In turn, in preparation for his courses and research, Jenny himself also audited classes on optical mineralogy, geography, and mathematics. In terms of research in colloidal chemistry/

ion exchange, some of Jenny's achievements are remarkable.

p0110 First, Jenny's ion exchange expertise was applied to a problem, brought to him by Hoagland, regarding the use of ammonia gas for fertilization. Jenny demonstrated that ammonia could be applied directly to soil and that, through ion exchange, the ammonia would be held on exchange complexes until is was nitrified or bioaccumulated. Jenny wrote a memorandum to Hoagland illustrating the manner in which the gas could be injected into the soil, and the adsorption mechanisms involved. Jenny shared the memorandum with a representative of Shell Oil, who himself then patented the idea shortly thereafter. Though Jenny recognized the missed financial opportunities and prestige for the University and himself, he was pleased to see that basic scientific research in ion exchange could yield such widespread and useful applications to agriculture.

p0115 Second, following his earlier work at Missouri and before, and stimulated by his new colleagues (particularly Hoagland), Jenny and Overstreet set out to conceptually and experimentally explore the concept of "contact exchange," or the direct ion exchange between roots and soil colloids, in ion uptake by plants. Their work involved refined concepts of the concept of soil water (or the differing character of soil water adjacent to colloids and roots) and clever experiments with roots and gels to illustrate exchange reactions.

p0120 Additionally, in relation to contact exchange, Jenny and Overstreet (with the help of other colleagues), quickly recognized the utility of radioisotopes, then being produced by Berkeley's new Radiation Laboratory under the direction of Ernest Lawrence, in their research. Jenny recalled the intellectual excitement and potential that the Radiation Lab caused on the campus at the time:

> 'I remember a lecture given by J. Robert Oppenheimer where he actually drank a glass of water with radioactive sodium chloride in it, and then showed two or three minutes later that his fingers were radioactive. I guess he wouldn't do that anymore. . .'

p0125 Jenny and Overstreet received solutions of radioactive potassium (treated by Lawrence's cyclotron) on a preferred basis, partly because both knew and talked to Lawrence, but also because the graduate student (Niels Edlefsen) who helped Lawrence build his first cyclotron (which resulted in Lawrence's Nobel Prize) later became a soil physicist, and "soils (were) known at the time to be very progressive."

p0130 While Chair of both his Department at Berkeley, and the smaller one at Davis, Jenny traveled weekly to meet his Davis colleagues. There, he discussed his model of monovalent ion exchange with Professor Lannes Davis. Jenny encouraged Davis and Overstreet to further investigate the problem, and they began to develop a thermodynamic based model of ion exchange. Jenny encouraged and supported this research, but did not participate, because he felt the thermodynamic approach did not reveal the colloid chemical phenomena he wished to illuminate, and Jenny's own skills in mathematics and statistical mechanics were insufficient for him to effectively push his own approach further.

p0135 Jenny and his colleagues, inspired by exchange and ion uptake, focused on the nature and meaning of pH measurements in colloidal suspensions and mineral surfaces. Also, to better examine the mechanisms by which roots might interact with soil particles, electron microscopy of the "mucigel" surrounding the root, and its reactivity, was undertaken. These and other studies too numerous to mention in this brief summary continued until Jenny's retirement.

p0140 It is probably fair to conclude, at least from his reputation today, that Jenny's greatest scientific achievement is his classic book *Factors of Soil Formation. A System of Quantitative Pedology.* It is also probably his most misunderstood achievement, a fact reflected in that few people ever cite the full name of the publication (and the second sentence is an essential component of the book), and that many recent pedological texts continue to incorrectly state the premise of the book, and its famous equation:

$$s = f(cl, o, r, p, t, \ldots)$$

where $s =$ is soil properties and cl, o, r, p, t are regional climate, potential biota, topography, parent material, and time, respectively. As Jenny once remarked, "It looks easy, but it's not."

p0145 The origins of the book appear to have begun back in Jenny's Swiss education and research, but he notes that the key to rigorously expanding the ideas, and putting them in a book, were driven by his assignment to teach Pedology at Berkeley. Unlike his colloid chemistry course, in which he was an expert and part of the scientific mainstream, he entered pedology as an outsider, with somewhat novel views. He strove to develop a logical and integrative means to explaining soil geographical distributions. As many (including Jenny) have noted, his factors included those first discussed by Dokuchaev. But what most do not appreciate is the conceptual gulf between those earlier formulations and Jenny's – a fact that Jenny made clear in the very first sentence of his book: "As a science grows, its underlying concepts change, although the words remain the same." Jenny conceived of soils as a physical system and defined state factors as independent variables that define the properties of

the system, bringing to pedology the formalisms of physical chemistry. The completed manuscript, submitted to McGraw-Hill, was at first rejected. But intervention by Robert Bradfield, Jenny's long-time associate from his Missouri days, succeeded in achieving its publication in 1941.

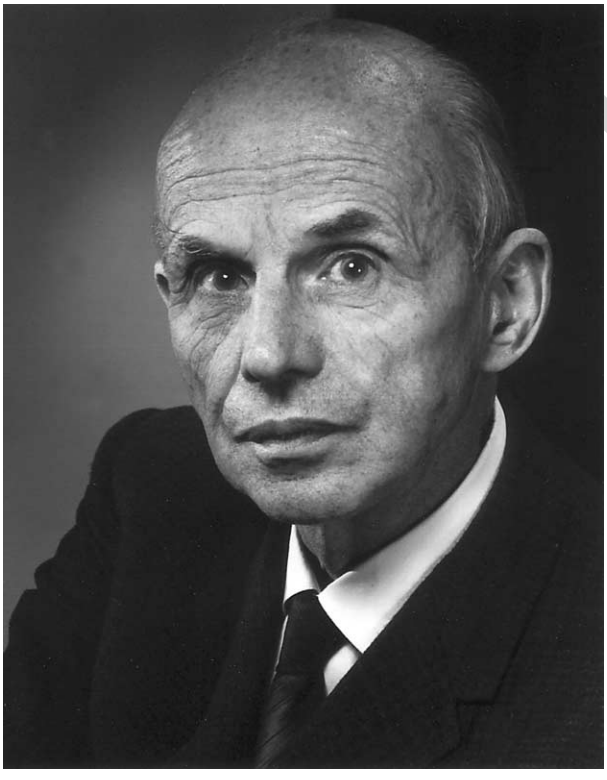
p0150 Today, *Factors* remains a vibrant and hotly debated work, because it is, from cover to cover, a presentation and illumination of a theory, in the same vein as other books of its type such as Darwin's *Origin of Species*. As with Darwin, subsequent reaction was both negative and positive. Yet, as with *Origin of Species*, the ultimate benchmark for its success is gauged in its ability to explain and understand nature. The book *Factors* allows pedologists and other natural scientists to view the world as a natural outdoor experiment, providing them with the intellectual tools to unravel its history and its processes. Scores of papers and books have now been published based on the "factorial" concepts, and this research, which now spans pedology, ecology, and geology, shows no sign of abatement. It is one of the crowning achievements of twentieth century soil science.

p0155 Jenny retired in 1967 (**Figure 5**) though his creative activity might be viewed as having merely shifted, not abated. First, Jenny (with the help of his wife Jean) must be credited with the first rigorous analysis of the role of soils in landscape painting. He lectured widely on this for decades, and, for those fortunate enough to have attended these seminars, the emotional impact will never be forgotten. This lecture was recorded, in published form, as part of a Pontifical Academy of Sciences volume, conference proceedings which mainly focused on soil fertility, and ultimately its role in the sustainability of human populations. To briefly summarize Jenny's views on the aesthetic value of soils, he wrote:

> 'Soil appeals to my senses. I like to dig in it and work it with my hands. I enjoy doing the soil-texture feel test with my fingers or kneading a clay soil, which is a short step from ceramics or sculpture. Soil has a pleasant smell. I like to sit on bare, sun-drenched ground and take in the fragrance of soil. As yet, neither touch nor smell sensations have been accorded aesthetic recognition, but colors delight painters, photographers, and writers, as well as you and me. In loess country, plowed fields on slopes show wide bands of attractive color gradations from dark browns to light yellows, caused by erosion of the surface soil. Warm brownish colors characterize fields and roofs in Cezanne's landscape paintings of southern France, and radiant red soils of the tropics dominate canvasses of Gauguin and Portinari. Soil profiles viewed in pits may reveal vivid color and structure patterns of layers or horizons. I have seen so many delicate shapes, forms, and colors in soil profiles that, to me, soils are beautiful.'

p0160 For decades, Jenny had thought about and discussed additional factors of soil and ecosystem formation. Since his work in the tropics in the late 1940s, he had considered latitude to be a candidate as an additional soil-forming factor. To test the theory required the selection of sites (all with the same mean climates, parent materials, etc.), but at different latitudes. To accomplish this experimental design meant that sites at low latitudes must be found at high elevations in order to be comparable with higher-latitude sites. Mount Kilamanjaro, in Tanzania, offered an opportunity. So, in 1982, at the age of 83, Jenny and Dr. Jennifer Harden, of the USGS, traveled to Tanzania and hiked and sampled soils to an elevation of more than 13 000 feet. Jenny measured the C and N content of the soils himself, upon their return. Though not published alone, the samples and data later formed a central part of an MS thesis by, fittingly, a visiting student (Annelies Uebersax) from the ETH in Zurich.

p0165 For those who knew Jenny during the last decades of his life, it was apparent that his intellectual passion was fueled by a somewhat intertwined attachment to the nutrient-impoverished soils of the marine terraces of the Mendocino coast (the Ecological Staircase), and an effort to preserve them, and other rare soilscapes, for future generations. The Jenny family



f0025 **Figure 5** Hans Jenny, 1967, the year of his retirement.

maintained a farm home, in nearby Comptche, which served as an overnight lodging and rustic "think tank" for a generation of students and visitors of all types. The length of time encompassed by the terraces and the revealing trends in soil chemistry enriched Jenny's views of the effect of time on soil formation, and the fate of soils on the earth's surface. The rarity of these ecosystems, and the low regard in which they were held, led Jenny and his wife on a long journey into the workings of the politics of land preservation. Yet, despite the novel view of "preserving soil," they succeeded, and Jug Handle State Reserve, near Caspar, California, was created as a state-owned park devoted to leading the park visitor on a guided walk through time. The visitor center prominently displays the trends of soils and ecology on the sequence of terraces. It is a living memorial to Jenny's insights and efforts on "soil diversity," many of which are being openly discussed and analyzed in the scientific literature only now. In an interview late in life, Jenny was asked:

> 'Does soil have a right to be protected for any reason other than that based on what is best for humans?'

p0170 Jenny replied:

> 'Today, the idea of stewardship of land is pitted against the belief in soil exploitation for personal gain and that soil is merely an economic commodity in the marketplace... I place soils and ecosystems, the nature museums, on par with art museums... colleges and temples... Society grants human beings the right to exist, regardless of whether we are useful or not... and the same privilege has been extended to a few endangered plant and animal species. I wish society would extend the same right to soil.'

p0175 The remarkable life and genius of Hans Jenny has left an indelible stamp on soil science, forever changing the way in which soils are thought of and studied, and his ideas have diffused so widely that they are now part of the high school curriculum. Jenny often remarked that he was honored and humbled to fill the chair of Eugene Hilgard, his predecessor at Berkeley. (*See* **History of Soil Science: Hilgard** (00540)). Those feelings are now appreciated by those who must follow Jenny.

See also: **History of Soil Science: Hilgard** (00540)

Further Reading

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