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THE DISAPPEARANCE

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Summary[1]

The role of taxonomists – in the total social structure as well as the academic subculture – is evidenced by their disappearance.

On March 22, 1973, 2:05 a.m. (eastern standard time), an unusual event occurred. In fact, one without precedent. Then and there vanished to the last man and woman all taxonomists, all of their works, and previous work of their ken; likewise the tools of their trade.

It is necessary to qualify in several ways. This fateful visitation extended completely across biology, animal and plant science alike. Herein I recount only some of the tremors within and extending from the plant sciences. The tribulations accruing as a consequence of the parallel zoological amputation were of a similar nature. Again, qualifications. Not all taxonomists were taken; a few (at least as to professional title) remained. These lonely survivors were certain of the numerical and chemotaxonomists plus scattered experimental biosystematists. Apparently these were individuals whose primary professional passions – largely of instrumentation, the elegance of mathematics, or perhaps comparative biochemistry – lay outside of systematic biology. Perhaps one inquires "Was it then the 'traditional', 'classic', 'alpha', 'anachronistic' taxonomists who were thus abruptly and perhaps properly removed from the world?" No, the scythe was much broader. Many taxonomic brethren who were preponderantly cytotaxonomists, chemotaxonomists, and who were otherwise deeply concerned with the most modern idiom, no longer came to their desks. In fact, the mortality was yet more inclusive; there were considerable inroads among other disciplines including conspicuous fatalities in ecology, systematic anatomy, genetics, evolutionary biology, agriculture and from among the enthusiastic amateurs. It seemed as though the hand (Divine – or otherwise) responsible for this event searched the souls of all, programmed for a particular combination of attributes, and performed the removal, regardless of external markings.

The nature of the identifying attributes was analyzed repetitively from all angles. It was evident that the diagnostic key characters included: those who write and (or) use systematic revisionary treatments, botanical floras and popular expositions on the kinds of plants; those who know the names of plants and where they grow, who can render technical identifications

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1 This subjective montage of plant taxonomy obviously owes its idea-for-structure to Philip Wylie's The Disappearance (1951). I affirm this fact by taking up the same title, and gratefully acknowledge such plagiarism as may be evident.

of plants; those whose research tools in part, or entirely, were the herbarium, the field, the library; those concerned with the whole plant and its relationship to its habitat, and its genealogical fellows; those whose emotions concerning these organisms and their environment had usually both aesthetic (often admitted only with qualifications) and intellectual bases.

The event

It is not directly germane to my subject to detail the nature of the disappearance and of public reaction. But a cursory review is desirable as a means of placing subsequent scientific repercussions in context.

The event was apparently world wide and simultaneous in occurrence. It was, of course, immediately emblazoned in incredulous headlines in newspapers in the United States, and the north European countries. In the orient, no formal announcement was made in several countries, but it may be that the number of individuals concerned was so small that the occurrence was attributed to some ingenious and unusual foul play. In the Soviet Union, the only initial information reaching the Western World was of some personnel problems within the Botanical Institute of the Komarov Academy of Sciences. Within a few weeks, however, formal statement was made of the same situation as in the rest of the scientific world.

The above assertion that the event was simultaneous cannot be entirely established. Owing to the early morning time in the United States, many of the disappearances were not recorded until some hours later. But all chance observations apparently coincided. For example, a night watchman in a large eastern University went into the herbarium at 2:00 a.m. for a routine key punch. All was in order when he walked in. When he turned around from manipulation of the key, the herbarium cases had disappeared. He was on sedatives for a week. There was the case of the woman from a midwestern University whose husband disappeared under circumstances in which his absence was immediately obvious. In her agitation, she knocked the clock off the bedside table; it broke and the mechanism remained at 1:05, equivalent, of course, to 2:05 eastern standard. All observations were equally confirmatory.

The social aftermath

The proportion of the nation's population and material goods which were affected was infinitesimal; thus no immediate physical emergency ensued. But the psychological impact resulted almost in national panic. Naturally, the unknown nature of the agency, or powers responsible for this happening and the implied possibility that the same thing (or something more calamitous) could occur again, independent of any known cause and effect, evoked trepidation. The subject was heatedly (even hysterically) discussed on the street, in the churches, the academic towers, and the halls of government. Numerous study committees erupted in universities, industry, and in Washington. Congress established an emergency government commission – with a new hot line to the White House – endowed with broad investigative powers.

The reasons for the selection of this particular professional group was as obscure as the agency of elimination. Taxonomy became a byword to

millions of people who had never heard the term before; taxonomists by their absence achieved a level of notoriety antithetical to their previous role in the scientific community. There was much speculation concerning taxonomists as individuals, as a cultural group, and as a profession with a view towards discerning the reasons for their extirpation. Several church groups, seizing upon the taxonomist's role in the teaching of evolution, envisaged a situation of Divine retribution and warning; their membership increased tenfold within a year.

Withdrawal symptoms in the universities

The readjustment of the scientific community to life without taxonomists initially created only minor problems. After recovery from the initial shock, there was much competition within institutions for positions and physical facilities. There was no attempt to refill taxonomic positions as such for the simple reason that there were no qualified applications. Thus, it was necessary to drop nearly all taxonomically oriented courses from university offerings. There was local pressure to continue certain popular plant identification or spring flora courses, but, by and large, other botanists who were reasonably qualified were loath to attempt endeavours in this apparently dangerous field; there were, in any event, no reference or teaching guides available for such courses, these having gone the route of their authors. The greater problems in some institutions revolved around personnel to teach beginning botany, biology, morphology, and ecology courses since many of these had previously been manned by professors of taxonomic affiliation.

Intra-institutional competition for the physical space vacated by taxonomists developed rapidly: offices, herbarium rooms, laboratories, and the vacant shelves in libraries. The extensive space formerly occupied by some of the larger herbaria proved a major boon to overcrowded departments and institutions. For example, the vacant herbaria in four universities were eventually allotted in the following manner: a dance studio for physical education for women, storage for the physical plant department, a plant physiology laboratory, a file room for the registrar's office.

The plant science disciplines adjusted reasonably well to the withdrawal of their herbarium colleagues and there was some facetious discourse to the effect that while the plant identifiers had been reasonably ornamental frills, they were scarcely essential to the orderly growth of biology and agriculture. Certain disquieting symptoms were, however, quickly evident. Many workers, especially in the applied sciences, found themselves continuously handicapped by the loss of reference texts treating plant classification, distribution and identification. There was minor panic among veterinarians because there were few who knew poisonous plants in the field, and there was but little reference material to which to turn. A massive effort to prepare some kind of an identification manual was soon started, but difficulty was experienced in finding a group with the qualifications to undertake the endeavour.

Among the basic plant sciences, the teaching and research of the ecologists was subject to most obvious handicaps, first, because of a serious inroad in their number, and the need for determination of many wild species. The students in all areas, however, experienced recurrent incidents of uncertainty concerning the identity of the organisms they were working with or

writing about, and the interpretation of literature in relation to current work.

But most of these annoyances and limitations remained just that; or solutions were gradually worked out. Others evolved into situations of institutional and national importance. A few examples:

What is this plant?

The identification of plant specimens soon constituted a public service embarrassment. Starting as an irritant, it rapidly became a major source of exasperation to both the public and to the plant scientists. As soon as six months after the disappearance, *Time* magazine carried a facetious article: "Botanists: the non-plant scientists". A conscientious extension horticulturist with the Agricultural College of a state university offered an interpretation of the furor.

"You see, people who are interested in plants – house plants, weeds, wild flowers, trees – or are concerned with them in business, are constantly submitting flowers, leaves, pieces of stems, seeds for identification. Even before this happened, I answered about 900 identification requests a year – and I get about 2–3 times that many now. I can identify about two-thirds of the things that come in fairly easily, common ornamentals, wild flowers or weeds. Previously I could do a lot better than this – but now I receive a lot of the less common or technical stuff that used to go to the botanist. I don't know these plants, and I no longer have any of my taxonomic books. So I have troubles. Often so-called specimens are fragmentary. Some look as if the guy had carried the sample in his overall pockets for six weeks before putting it in the mail. Some I can name to genus but don't know which species. Used to be I could look some things up, or I'd check with the plant taxonomist for help with the stinkers. He also got lots of this kind of stuff to handle even though it really wasn't part of his job; but he was used to it and he would always help me if he was around. Or if he wasn't in, and I had some time and hunches, I'd go into the herbarium and see if I could match the specimens. Now, I don't have any help, no good books, no nothing. And I get a hell of a lot more of this junk! Why? Well, the university over at Cedar City doesn't have an agricultural college like we do. And no people who know common or economic plants. Their two taxonomists are gone, and the botany department refuses all identification requests. I guess they have to. I don't think most of their people would know the difference between a geranium and poison ivy. So they tell the public to send stuff over here; we get it all. Sure the papers are yelling about how dumb we are. But our Director is saying we're spending too much time on this ancillary activity. There ought to be somebody given a job of taking a census of all the plants in the state, and preparing it in a way so we could make determinations. I wouldn't want it as technical as those botanical manuals we used to have, but I think we need something like the keys that the taxonomists used. Trouble is, we don't have common names for a lot of the wild plants. We'd have to start all over and name everything. It's a hell of a mess!"

This man accepted a departmental headship in another state a year later. Subsequent to his leaving, the horticulture and agronomy departments decided to limit identifications to species of known economic importance. The botany department appointed a retired school teacher who was a wild

flower enthusiast to a part time instructorship to take care of the plant-naming. The institution set up a plant resources committee with the avowed aim of tabulating and identifying by number and computer code all known species in the state. However, there was no formal transfer of a portion of anyone's official duties to this activity. The committee met a few times to discuss the problem and the possibility of hiring someone to do this job; but nothing came of the matter.

Plants need names or social security numbers

Difficulties in assigning the appropriate name to plant and animal species soon resulted in concern and uneasiness in the biological sciences. It was not that biology was without names. Several societies (the Weed Science Society and the Agronomy Society, for example) had previously published check lists of approved scientific and common names; from the few wild-flower books remaining in existence, one could obtain the names of common wild species; and, of course, biological literature was replete with all kinds of technical names. Thus, no acute problems were immediately encountered among members of close knit disciplines which had well-known reference lists; and among whom at least some members knew what names referred to which plant. But difficulties in cross communication were soon encountered; enumerations of names had been prepared at different times and by different people; and numerous inconsistencies were not easily resolved. The scientific literature contained thousands of names which could not be matched in reference lists nor in anyone's knowledge.

Biologists in several countries established nomenclature committees to study the issues and establish consistency of utilization. After a couple of years, an International Commission on plant and animal nomenclature was organized and funded by FAO and the governments of several nations. The delegates were government representatives (e.g., the U.S. delegate was from the state department); advisors included specialists in biology, linguistics, computer science and related fields. Members-at-large and observers represented the lay public and various political groups.

During the few years of its existence, this commission had a frustrating and controversial history. Initially, the goal of establishing a register of all organisms and providing a designation for each was discussed. This was soon abandoned as unrealistic, and the enumeration limited to those "environmentally relevant." Yet, it appeared that the necessary list would include at least a thousand species.

The computer scientists and some biologists advocated a scientific designation of organisms which was a computer code characterizing each in a neo-Linnaean Fortran polynomial. Others insisted that man-to-man as well as man-to-computer communication was essential, and that scientific names would be required. The commission determined to pursue both courses of action.

A couple of months were spent in discussion of the format and language of scientific names. Nine committees were established to investigate specific alternatives. Many of the delegates made several trips home for instructions from government authorities or national committees to whom they were responsible.

It was finally proposed that scientific names be rendered in English — the most widely used scientific language — and that names be short and

euphonious. However, strong objections were registered by many delegates representing non-English speaking nations. Extended and occasionally acrimonious debate finally resulted in a compromise decision to return to a Latin format so that current improper national and political implications might be avoided. Following this decision, it was determined to take up scientific names in general usage at the time of the demise of the taxonomists. Subcommittees were established to prepare lists of such names for Commission approval.

In due course, appropriate enumerations including the names of more than two thousand species of plants were submitted for study and approbation. Some delegates were appalled by the magnitude of the task and a strong minority pressed for reducing the agenda to five hundred names. However, arguments for the greater number prevailed, and in fact, additional names were submitted nearly every day.

The majority of binomials under consideration were of consistent traditional usage. Most of them were accepted without major controversy. Objection was taken to some names because of their length or misleading descriptive nature and alterations were made. It was possible to reach decisions on approximately 80% of the names in this manner. However, in several instances, there were uncertainties as to what plants the names had reference; these situations were referred to subcommittees. Other subcommittees and *ad hoc* technical committees were assigned responsibilities of preparing computer diagnoses.

But determination of appropriate names for perhaps 20% of the taxa was accompanied by severe difficulties. There were found to be several available scientific names for numerous well-known species (for example: the soybean, the douglas fir), no one of which was acceptable to a voting plurality. Some species names were noted to be associated with more than one generic name (e.g., the apple: *Pyrus, Malus*) and some kinds were held to be species by certain biologists and varieties by others. Slow progress was made on the basis of formal ballot. Then a proposal made by a geneticist (USSR) and a flower breeder (US) was studied. Their posture was that the generic position of population aggregates as species or varieties should be affirmed only *pro tem,* final decisions awaiting studies of the relationships of the organisms concerned. Majority opinion, however, held that technical studies of relationship between organisms was unnecessary and irrelevant to nomenclature and the proposal was voted down.

Standing nomenclatural committees were established to thresh out individual binomials remaining in contention and to receive lists of proposals of nameless plants for christening. The ecologists and conservationists desired names for many wild plants. A group of veterinarians assaying the toxic qualities of plants in connection with preparation of a new reference work desired names for numerous species. Much discussion ensued regarding the merit of demands of such special interest groups. The philosophy which ultimately emerged was that there should be no bar to individual disciplines developing supplementary nomenclature as needed, but that such should not properly be the concern of the Commission. Many of the government representatives (not always in concurrence with the biologists) took the position that beyond the limited number of major economic plants, biology should concern itself less with the kinds of plants than with their total effect on the welfare of man. For example, as the energetics of the biosphere involves the productivity of the earth's mantle as a whole, concern with

individual species and their names was held to be of secondary importance. The matter of names for hundreds of minor poisonous plants was regarded as superfluous; appropriate efforts to eradicate these plants should, in any event, render nomenclature for them unnecessary.

These and related discussions rendered the Commission's progress so slow that it reached the end of its initial funded period with much work yet incomplete. At this time, several nations exhibited impatience with both the objectives and progress of the Commission and withdrew support. The final calamity was a series of partisan disputes concerning new names proposed by the Chinese delegation for rice, wheat and corn. A clash between ideological philosophies resulted in major rifts between the Chinese and Russian delegations, and the Russian and Israeli groups. Reaction in the United States Congress to the total objectives of the Commission became so negative that support was withdrawn. The endeavour was abruptly terminated.

The United States Rockefeller-Kennedy Institute for Plant Research

Among numerous incidents involving public welfare, the great loco-hunt and its antecedents perhaps received the most public attention. The orderly accession of plant materials to be tested for anti-cancer action had essentially ceased since the missing taxonomists were those who had primarily been responsible for the collection and determination of species for screening. But assays of collections stockpiled were continued at the National Cancer Institute and among cooperating research centers.[2] During routine bioassays on accessions of foliage and seeds of the leguminous genus *Astragalus* (commonly called locoweed), unprecedented remission of tumors in mice was encountered. Feverish reruns validated the original results Much of the remaining material was crudely purified and used in the treatment of two terminal human cancer patients, and one of them made a rapid, temporal recovery. An inventory of *Astragalus* accessions at the Institute amounted to about 70 collections of foliage and 30 of seeds. Some were identified by binomial designations; the identification of others had gone no further than the botanist's accession number at the time his work was terminated. The fact that some of the material was named, however, was only of limited aid. A species such as *Astragalus bisulcatus* could be found in several reference books and was reasonably known to ranchers and veterinarians. Names such as *Astragalus kentrophyta, paysonii, fucatus* and many others were unavailable in literature and unknown to those called into consultation. Two different leaf samples identified only by number gave the most striking positive results; milder tumor remissive effects were obtained from another collection marked *Astragalus miser* var.? from central Wyoming.

The sample of one of the active species was inadvertently entirely used up as a result of subsequent trials. The foliage of the other consisted of large, pinnately compound leaves with pick-shaped (dolabriform) pubescence; there was no way of determining what it was.

Several collectors worked throughout the western states the coming

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2 Why had not these collections of plant material disappeared as did all herbarium material? The answer is speculative: namely, that the purpose in collecting and preserving was other than taxonomic.

growing season in areas where *Astragalus* was known to possess many species and some 1000 samples were gathered and assayed. Anti-cancer activity was evident in varying degrees from material of some ten collections. The subject material came from diverse areas in Mexico and the western United States, and seemed to represent 2–3 unrelated species groups.

The situation recalled in some quarters that of the search for the high alkaloid species or varieties of *Cinchona* during the second World War, or the exploration among the poorly known genera *Strophanthus* and *Dioscorea* as possible sources of precursers of the cortical steroids. But during those times in the past, taxonomists had been available not only to conduct the physical aspects of the exploration, but, most importantly, to quickly synthesize enough of the fragmentary taxonomic knowledge of the subject genera to render decisions and action possible. And as a consequence, the western hemisphere was back in quinine production, and *Dioscorea* became the major backbone of the multimillion dollar cortical steroid industry (cortisone, "the pill"). Contrariwise, practical consideration relating to *Strophanthus* had proved too complex; it had largely dropped back into popular, if not taxonomic, oblivion.

The current problem was that the American Astragali included several hundreds of species, many of which were extremely local and possibly approaching extinction. There was but limited knowledge of more than a few of them. No one concerned was sure how *Astragalus* was differentiated from related leguminous genera, particularly *Oxytropis,* (also commonly called locoweed), or whether some of the untested species among these related kinds might also posses allied chemical characters.

Due to the emotional trappings of a possible cancer cure and to somewhat exaggerated public press accounting, a public response rapidly developed: we can make an atomic bomb; we can put a man on the moon; let's pull out all of the stops for cancer! Congress reacted by approving an emergency crash program to supply the initial missing link, an undertaking directed towards obtaining a comprehensive descriptive and biological understanding of *Astragalus* and its immediate relatives in the Americas, and the establishment of gardens in which all genetic material could be tested and preserved. The emergency nature of the situation was heightened by the fact that the plants were being sought out by hundreds of amateur collectors; and that several industries were making wholesale collections in the preparation of "*Astragalus* juice" and other formulations as a preventative of, or possible cure for cancer.

An initial operating budget of $ 100,000,000 was approved by Congress but through an oversight, no funds were designated for purchase of a site for the Institute, nor for capital construction. While three states were lobbying for the locale of the research center, the matter was settled by Winston Rockefeller's gift of 500 acres of a mountaintop in Arkansas. The Kennedy family chipped in by providing three million dollars for the first building. Hence, the agency was designated by a grateful country as the United States Rockefeller-Kennedy Institute for Plant Research. The lengthy alphabet designation, USRKIPR, was subsequently vulgarized to USURK.

A distinguished administrative scientist was appointed as director. He immediately established temporary headquarters in a town near the permanent site. A steering committee composed of fifteen scientists was appointed and charged to meet annually at the Institute and advise the

director and staff concerning policy matters. Field exploration and assembly of a staff was initiated while the research building was under construction.

A systematic search of western North America was made over a period of 5 years. Upwards of 50,000 accessions were made of *Astragalus* and *Astragalus*-like plants. Over 20,000 of these were successfully established in 10 test gardens strategically located in different parts of the country. Detailed data were obtained from living and dried specimens of all accessions. These data related to the morphological and physiological nature of the plants, their cytology, and chemical relationships. Genetic investigations were initiated and population structure studied. Geographic and ecological data were tabulated. The data was programmed for computer storage and analyses. Although interpretation of the results and operational sequence was computer oriented, it was supplemented by judgements of research teams of the staff who passed on the validity of each decision or conclusion before passing to the next.

The limits of this accounting do not allow for the parallel story of medical research. Suffice to say, test garden accessions were used as sources of material for the assaying of anti-cancer activity, and that the active agent was found to be produced by only a few of the seleniferous species [3] and then under rather specific environmental conditions. Intensive physiological, genetic and chemical studies of phenotypes were undertaken. The immediate objectives related to identifying and isolating the active anti-cancer agents, and obtaining some understanding of factors affecting their metabolism. The very practical matter of growing the plants under agricultural conditions was investigated by other research teams. The end result of a lengthy and complex story was eventually, and indeed, a reasonably effective emergency deterrent for several kinds of cancer.

Returning to USURK. A major achievement was announced in the seventh annual report, the completion of a "Descriptive, ecological and evolutionary treatment of *Astragalus* in North America". The work with much supporting data was published in a multi-volume journal-like series; a two volume synopsis was prepared as a convenient reference for those concerned with applied *Astragalus* research.

A symposium was held to celebrate the appearance of this monumental effort of the new taxonomy, and as a kick-off for support for capital funds for three new buildings and funding for expansion into a program to inventory the remaining fragments of the North America Flora.

A plant physiologist from the New York Botanical Garden held one of the volumes on *Astragalus* in his hand and mused to a colleague of his who was present as a symposium speaker.

"Y'know, funny world. Not many people remember Rupert Barneby. He was one of those who disappeared. And not many knew him when he was around. Retirin' sort of chap with an independent income. At least he successfully resisted all formal efforts at employment. He was around the Garden (the New York Botanical Garden) quite a bit back then, and

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3 A reader familiar with *Astragalus* may recall that one of the original accessions producing tumor recession was marked as *A. miser*, and that this inconspicuous but widespread species is not a selenophyte. Correct. Certainly the accession was misnamed as to its pre-event binomial. Its position in the new classification was soon evident, but its determination in the pre-event taxonomy of *Astragalus* could not be reconstructed.

I knew him pretty well. A different fellow. He did *Astragalus*, you know. Two volumes like this (Barneby, 1964). He gave me a set, and they were on my shelves until the event. But I had fingered through them quite a bit. I spent a couple of hours this morning looking through this new set. Of course it's structured quite differently, and they use code numbers instead of the Latin names. But the organization of the genus, the conclusions concerning the species, the final taxonomy, if you wish, really seems not too different. It took Barneby twenty years of wandering around the west and pawing through carloads of herbarium hay. A lot longer than this gang here that busted clear through from scratch in seven years and half a billion dollars. And Barneby was able to draw on a lot of previous literature of Rydberg, Marcus Jones, and Asa Gray which we no longer have. But he put it together all himself . . . just because he wanted to."

Typification and epilogue

A fire gong clamored, the floor wavered, and the ceiling fell in. The man groaned, twisted upright, and slammed the alarm off. He fell back to a horizontal position and lay motionless. Then he shook slightly, and sat up again running his fingers through his ample, rumpled grey hair.

"Lord and Linnaeus! What a dream," he muttered. He swung around, planting his large bare feet on the gritty floor of the economy style motel room. The morning desert sun was coming through the windows. The room was in some disarray. A large field press lay in one corner, surrounded by a confetti of leaves, scraps of paper, broken stems, and a generous sprinkling of reddish sand. On a small, slightly slanting table were a couple of generously written field notebooks, several pencils, two empty beer cans, and a pocket altimeter. A camera hung over the back of the upright chair. Field boots lay akimbo under the table.

The botanist pushed himself erect and turned on a bedside radio. He proceeded slowly into the bathroom from whence soon came the sound of running water. In a minute he was visible, performing the rite of shaving. The morning news buzzed along. Several people had been killed by an unknown assailant in Los Angeles. Increased funding for the Mariner Mars Orbiters was stated by NASA to be essential if delay of 1–2 years was to be avoided. An investigation of programs supported by the National Science Foundation was underway. The chairmen of the Congressional subcommittee concerned had obtained a list of individual research grants and read a series of them during the hearing. Several congressmen questioned the Foundation's wisdom in using the money for certain of the more kooky research endeavours. Specifically mentioned was a grant for $ 17,500 for two zoologists who were studying the mating habits of a certain group of gulls in Africa; a grant to a botanist in the amount of $ 12,280 who was investigating chromosomes of mosses in Alaska was similarly subject to criticism. A female representative wondered why NSF couldn't develop some panty hose which wouldn't run.

The listener abruptly interrupted his shaving, strode in and snapped the radio off. Surrounded by silence, he picked up the razor again.

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