The world’s most diverse collection of wild Rocky Mountain mushroom specimens can be found in a decidedly urban location in the heart of Denver, Colorado. It was here at Denver Botanic Gardens fifty years ago in 1967 that a renaissance man, Dr. Duane H. “Sam” Mitchel, developed his dream of understanding and celebrating the fungal diversity of Colorado.

Duane Herbert Mitchel was born on October 10, 1917, and raised on a farm near Winchester, Kansas. The young Duane soon earned the nickname “Sammy” after he portrayed Uncle Sam in a grade school play … and the moniker stuck throughout the rest of his life.

Early years of a future mycologist

Major Sam Mitchel in the Army in 1945. Sam was the son of pioneers. In the late 1800s his parents travelled by covered wagon from Ohio to Kansas, settling on a 640-acre homestead where Sam was born. The youngest of four children, Sam grew up working in the huge farm garden with his mother and helping his father in the fields. He and his siblings had lots of chores to do – milking cows and slopping pigs, pumping and hauling water for the home, and cleaning the outhouse – typical hard work for rural families. The family used horses to work the crops of wheat, potatoes, corn, and hay that were so important to the survival of the family and livestock. In those formative days on the farm, Sam would develop into something of a sharpshooter, a skill that would serve him well later in life.

According to Sam’s son, Kirk Mitchel, he also grew up in a culture of a strict religious sect, Reformed Covenanters, who insisted upon strict adherence to their beliefs. Sam attended the local country grade school during the week, but on Sundays the only focus was church. The children were not allowed to read anything except the Bible, and Kirk recalled that throughout his life Sam was...
able to quote huge passages of Genesis. This early influence of hard work and discipline followed Sam all his life. According to Kirk, this also made Sam something of a “hell-raiser!” He did things his “own way,” but for those who loved and admired him, he stirred things up in the right way! Everyone who knew Sam well agrees that he thought “outside of the box.” He was innovative and creative, extremely well-organized, and always kept his eye on the goal.

The education of a physician-toxicologist-mycologist

Sam graduated from Winchester Rural High School in 1935 and then left home to attend Geneva College in Pennsylvania. The young Sam supported his studies by serving as a handyman in a boarding house and by working nights in a steel mill, shoveling coal into coke ovens in a dark cavernous pit deep underground. Kirk Mitchel retells that one night at the steel mill, Sam and two co-workers were trapped down in the pit because militant strikers had taken over the entire steel mill above. No one could get the three men out safely. Sam and his co-workers were stuck down in that dungeon for three days and three nights with no food. But they did have plenty of dirty water from an underground stream, which was populated by roving rats. Sam found a pistol there in the dark somewhere and the tough sharpshooting farm kid ended up shooting some of those rats for food. They fried the rats in the coke ovens, thus getting along until the labor strike above was over and they could safely come to the surface. Kirk recalls that Sam used this experience to create his own expression: “I’m so hungry I could eat fried rats!”

After graduating from Geneva College in 1939 summa cum laude, Sam was encouraged to go to graduate school and he considered studying either physics or medicine. That decision was evidently made when he was awarded a scholarship to Harvard Medical School. A brilliant student, Sam graduated from Harvard cum laude in 1943 with an M.D. and then finished an internship at Massachusetts General Hospital.

Serving his country

Soon after completing his internship, the young Dr. Mitchel enlisted in the United States Army in 1944, wanting to serve his country during the dark days of World War II. Sam’s other son, Scott Mitchell recalls that Sam earned another title, Major, while serving in the Army Medical Corps as a medic for three years in the Pacific Theater. Most of Sam’s time was spent on the island of New Caledonia, though he also worked in the Philippine Islands. Sam rarely spoke of those days but his work there involved M.A.S.H.-like (Mobile Army Surgical Hospital) intensive surgeries and care for wounded American troops. He recalled learning more in one week about emergency orthopedic surgery than his entire time spent in medical training. Years later, Sam longingly remembered those lush tropical forests he lived in “without an inkling of knowledge about field studies in fungi.” Just think of the new mushroom species this curious diagnostician could have found during those years!

Kirk remembers stories Sam told him about his time in the army, comparing his ability to sharpshoot with trained army snipers. Sam recounted one time during off hours some of his army friends had an impromptu contest, challenging Sam to a bet of $1 for each target each could make. Going toe to toe, this Kansas farm kid turned army medic kept up with the highly-trained Army sniper and in the end only owed the cocky soldier one buck.

A “doctor’s doctor” moves to Denver, Colorado

After the war, Dr. Mitchel returned to Boston and completed residency requirements at Massachusetts General Hospital and later in 1948 at Cushing VA Hospital in Framingham. This highly trained medic then relocated to Denver, Colorado the next year, beginning a 40-year private medical practice in that city. Board certified in internal medicine, Dr. Mitchel also became a well-known teacher serving as Director of Medical Education at General Rose Hospital 1959-1962, Clinical Instructor at the University of Colorado Medical School for 40 years, as well as holding teaching appointments at Mercy and Colorado General Hospitals.

In those early Denver years, Dr. Mitchel lived near the actively-developing city center doing daily house calls as part of his service to his growing medical clientele. Many decades later he could still recite, in proper order, all the streets in the Capital Hill Area, which one could imagine is a useful skill when having to make often-urgent house calls. At one point, Sam was the house doctor of the historic Brown Palace Hotel in downtown Denver, living there as he served residents and guests. Later, Sam set up a summer clinic in the nearby mining town of Central City, to serve as a physician to the opera singers, musicians, and patrons involved with the famous Central City Opera House. It was during the early 1960s in Central City that he met one of his longest-serving mycology volunteers, Rosa-Lee Brace, who was inspired by Sam’s enthusiasm for collecting and studying local native mushrooms.

Mushroom treasures at the ranch

Sam married Lois Goodson in Aspen in 1952. They had two sons, Scott and Kirk, and like their father the boys were curious about everything in nature. Sam and his family had bought a mountain ranch in the high country near New York Mountain near Edwards, Colorado. On the ranch in the summer of 1960 the boys found some mushrooms fruiting where they were playing. Unable to explain to his sons about their mushroom finds, Mitchel sought help locally to identify the colorful Russulas, intricate Mycenas, and huge clusters of Pleurotus they had spotted in those beautiful subalpine sites.

In his quest to better understand these mushrooms Sam visited both state universities as well as the state extension services but found no knowledgeable mycologists in Colorado to help, and leaving his curiosity unrequited. So, characteristically independent and creative, Sam began his own scientifically-based mushroom collection. He gathered what mycological literature was available at the time, thus launching himself into a lifelong quest to know the macro fungi of Colorado; his passion eventually included the native myxomycetes as well.

Pioneering the fungal herbarium and the Colorado Mycological Society

Collecting and identifying the immense diversity of native mushrooms of Colorado was a daunting task. Realizing this, Sam sought out other local mushroom enthusiasts in the Denver
area who were happy to collect and learn with him. In 1963 he visited the Denver Museum of Natural History (currently the Denver Museum of Nature and Science) where he met another physician, Dr. E. H. Brumquist, who shared his passion for studying Colorado's rich diversity. He also encountered Mary Wells, a volunteer in graphic design who joined in Sam's mycological pursuits. Soon Sam and Mary's specimens began to accumulate at the Museum, most of which were newly documented fungi for this region. Sam brought his microscopes and laboratory equipment to the Museum where he and his new colleagues could work.

Others continued to join, including several physicians, lawyers, teachers, pharmacists, geologists, as well as lovers of wild flowers and naturalists, and not least of which were two of the editors of Denver's leading newspapers, Palmer Hoyt of the Denver Post and Jack Foster of the Rocky Mountain News along with his wife Frances Foster. Among this early, prolific group were Robert and Rosa-Lee Brace, Shirley Chapman and George Grimes, all contributing many hundreds of specimens during those early days, with some continuing for many more decades. Today such individuals would be called Citizen Scientists.

Since many of these mushroom enthusiasts were professionals from the Denver area, they would leave their offices early in the afternoon to go collecting in the mountains west of Denver with Sam on his day off from medical duties. Rosa-Lee nostalgically reminisced about watching those avid mushroom collectors happily walking around in the mountain forests and aspen groves still dressed in white shirts, business suits, skirts and dresses, each one carrying big collecting baskets and taking notes. While not the first mushroom collectors in this part of Colorado, this eager group of Sam's friends and colleagues were indeed pioneers!

By 1964 the group was at an impasse, having reached the limits of their mycological knowledge due to the general lack of expertise available in the Rocky Mountain region at that time. So that summer Mary Wells volunteered to attend the University of Michigan's so-called “Bug Camp” to participate in an intensive mycology course taught by University of Michigan Professor Alexander Smith. Her fellow participants at the Bug Camp read like a “Who's Who” in international mycology. Mary came back to Denver with stories of studying with Orson Miller, Ron Petersen, and Roy Watling that summer. Also at the camp were Harry and Elsie Knighton who were organizing the first amateur mushrooms clubs under President Eisenhower’s People to People Program, an endeavor that would eventually morph into the North American Mycological Association (NAMA).

In the summer of 1965 Mary once again returned to Michigan where she worked as a mycological assistant to Robert Shaffer. Sam also took a graduate course “Identification of Higher Fungi” from Alex Smith that summer at the University of Michigan Biological Station. All this newly acquired scientific information enabled Sam and his associates to organize their collections into a nascent herbarium at the Museum. Around the same time, Sam co-founded the Colorado Mycological Society, taking turns with Mary Wells to serve as its president and vice president in those early days. In 1966 they wrote Colorado Mushrooms, a pioneering Museum publication in which local urban and native wild mushrooms were featured. The booklet was revised and republished in 1974.

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Soon the busy amateur mycologists grew out of their space at the Denver Museum of Natural History and in 1967, at the invitation of Denver Botanic Gardens (DBG) board members, Dr. James J. and Ruth Porter Waring, they moved their collection to DBG, first to the historic Waring House and then to the newly built Boettcher Education Building. Sam was appointed Honorary
Curator of Mycology and Shirley Chapman his assistant. Along with a dedicated group of volunteers, they developed a diverse and comprehensive collection of mushroom-forming fungi from Colorado, collecting, documenting, and cataloging 300-500 mushroom specimens per year, many with accompanying photos. Most of these collections had never been documented from Colorado before.

Sam helps to lead expertise in mushroom toxicology

As the general public in the Denver area became more interested in eating and experimenting with wild mushrooms, the local physicians began to get more and more calls about mushroom poisonings. Sam became involved in toxicology early in the 1970s by working with Barry Rumack, M.D., Director of the Rocky Mountain Poison Center in Denver and an active Denver physician. Dr. Rumack remembers Sam as having “an extraordinary medical mind with the longest differential diagnostic list I have ever encountered.” Always thinking ahead and beyond Colorado, Sam developed the original International Mushroom Toxicology System in 1973 in which mushroom toxins were categorized and the diagnosis and treatment were detailed. This detailed toxicology system was later featured in the book, Toxic and Hallucinogenic Mushroom Poisoning written by Gary Lincoff and Sam Mitchel in 1977. In 1974 Dr. Rumack worked with Sam to develop the original Poisindex data system, on color microfiche, as aids for mycotoxin information, identification and treatment procedures. Physicians and hospitals all over the United States used it when dealing with mushroom poisoning in those days before the internet.

Sam’s photo in *Colorado Mushrooms: Boletus edulis*, now named *Boletus rubriceps*.
Dr. Mitchel continued to hone his skills in mushroom identification and blended them with his extensive diagnostic and medical treatment protocols to write the popular *Toxic and Hallucinogenic Mushroom Poisoning: A Handbook for Physicians and Mushroom Hunters*, published in 1977 with Gary Lincoff as a co-author.

Sam was an ardent early member of NAMA, joining in 1966 and serving for many years as a trustee of the Rocky Mountain region. Combining his two great passions, medicine and mushrooms, Sam became the “father” of the NAMA Toxicology Committee, which, under his guidance, evolved into both the Toxicology and Mycophagy Committees. He worked with NAMA on their policy manual, volunteered to help edit *McIlvainea*, and promoted amateur mycology through identification and treatment of mushroom poisoning. All this resulted in his being awarded the NAMA “Award for Contributions to Amateur Mycology” in 1975.

Early in the 1960s Sam joined the Mycological Society of America. There he made contacts with prominent mycologists from many universities and invited them to bring their expertise to Denver Botanic Gardens. In addition to his early acquaintance with Alexander Smith and Robert Shaffer (University of Michigan), Sam also met MSA members Joe Ammirati (University of Washington), Harry Thiers (San Francisco State University), Kent McKnight and Marie L. Farr (USDA in Beltsville), and Orson Miller (Virginia Polytechnic Institute and State University). As a result of collecting in Colorado together for years, Sam and Alex co-authored several articles on Colorado fungi, including studies in the genera *Hygrophorus*, *Armillaria* (*Floccularia*), *Hebeloma*, and *Mycena* (Mitchel and Smith, 1975; 1976; 1978).

In 1975, Sam, Barry Rumack, and Dr. Manny Salzman, a Denver physician, recognized the paucity of information about mushroom identification and toxicology available to the medical world. Inspired by the Rocky Mountain Poison Center’s experiences, they founded the academically-oriented Aspen Mushroom Conference. The week-long conference was held annually in Aspen and Snowmass, Colorado and was co-sponsored by Beth Israel Hospital in Denver. Alexander Smith served as Senior Faculty Member, teaching mushroom identification classes to dozens of medical students and physicians. Conference participants were guided into Pitkin County’s spectacular and diverse habitats to collect the unique fungi of the region, many of which had never been examined by specialists. Throughout the 6 years that the Aspen Mushroom Conference was held, many faculty in mycology (including Harry Thiers, Joe Ammirati, and Daniel Stuntz), medicinal and toxicology experts including Scott Chilton, as well as local mycologists (Marilyn Shaw, Linnea Gillman and George Grimes) participated in the meetings. In addition, some widely recognized personalities such as international mycologist Dr. Rolf Singer and ethnomycolologist R. Gordon Wasson gave presentations.

During his active collecting years, Sam became particularly fascinated with *Floccularia fusca* (Mitchel and A. H. Smith) Bon.
Honored these fascinating organisms by writing a delightful article in McIlvainea in 1983 entitled “To Know Slime Molds is to Love Them.”

Known for his acute analytical skills in both mycology and medicine, his passion for the fungi, his broad understanding of the “web of life,” Sam epitomized the synergism of the amateur and the professional. In a 1974 National Health Journal article, Sam summed up his passion for mycology by stating, “I practice medicine to make a living and study mushrooms to make living worthwhile.” Often called a renaissance man by those who knew him well, Sam was a remarkable person and will be forever known as a founder of Colorado mycology.

**The Sam Mitchel Herbarium of Fungi**

On October 15, 2009 lovers of Colorado fungi gathered at Denver

Hebeloma insigne Smith, Evenson, and Mitchel.

Mycena haematopus var. cuspidata Mitchel and A. H. Smith.

with myxomycetes. The unusual lifestyles, colors, and relatively unknown, ubiquitous occurrences of myxos in this Rocky Mountain region all were great stimuli for this ever-curious, always probing mycologist. Sam and his assistant, Shirley Chapman, together collected over 9,000 carefully documented Colorado specimens of these fascinating “slime molds,” including unusual cryophilic species. Many of these valuable collections were donated to the United States National Fungus collection (BPI) when Sam retired in 1991. Together with M. L. Farr and Shirley Chapman, Sam published a new species Physarum alpestre (Mitchel et al., 1986). In characteristic fashion, Sam
Physarum bethelii T. Machbr. ex G. Lister, a myxomycete collected by Sam Mitchel, the name honoring a prolific early Colorado collector, Ellsworth Bethel (1863–1925).

Botanic Gardens to celebrate the dedication of the herbarium that Dr. Sam Mitchel worked so hard to build. The Sam Mitchel Herbarium of Fungi owes its existence to the generous donations of money and time from its volunteers and supporters. The dedication held to honor Sam’s legacy to the herbarium also celebrated the $80,000 endowment that was raised through donations to ensure the future of the herbarium. The endowment is meant to fund research in Colorado fungi, which would include hosting mycologists, both professional and amateur, who wish to visit the herbarium and study the fungi held there.

The Sam Mitchel Herbarium of Fungi is the world’s largest collection of macrofungi from Colorado and the southern Rockies. The collection itself holds over 18,000 specimens of fungi and myxomycetes, of which at least 80% are specifically from Colorado.

The majority of the collections have been made by Sam and the retinue of volunteers he mentored and inspired: Vera Evenson, Shirley Chapman, Bob and Rosa-Lee Brace, George Grimes, Linnea Gillman, Ellen Jacobson, and Ed and Ikuko Lubow. Additionally, there are collections donated by Nelson Jarmie and Fran Rodgers as well as Alexander Smith, Orson Miller, Harry Thiers, and so many others who contributed to Sam’s knowledge and to a greater understanding of Colorado fungi.

The herbarium has been an important focal point for mycology of the Rockies. The Sam Mitchel Herbarium was one of the first contributors of herbarium data to MyCoPortal, the digital repository for data from the NSF funded Advancing Digitization of Biological Collections program. On the MyCoPortal website (http://mycoportal.org) one is able to search all of the DBG’s collections, view available images, and even peruse the macro and micromorphological descriptions of those collections. The diverse mycota of the Rocky Mountain region is also well represented in MyCoPortal, though numerous mushroom species await discovery in Colorado alone (perhaps tens of thousands). Taking Colorado into consideration, for example, we find that over 70,000 fungal specimens have been collected in the state, with approximately half of these representing collections of macrofungi (ca. 3,000 species). Yet another half of these again are specimens housed at DBG, with Sam having personally collected about a sixth of these. Additionally, there are 55 type specimens (the physical basis of fungal scientific names) housed at DBG, with five of these also being collected by Sam.

Where will all the new collections of Colorado fungi, potentially thousands, be housed? At the moment, the current herbarium has space for maybe 15–20 years of collections, assuming collection rates don’t change. But with new staff, students, and research projects, this space could shrink rapidly. The answer to this problem is the creation of the Freyer-Newman Center for Science Art and Education to be built at Denver Botanic Gardens. Here a new fungal herbarium will be housed that allows for up to 50 years of growth. This will be a great way to further establish The Sam Mitchel Herbarium of Fungi as THE regional center for fungal biodiversity.

The next 50 years of the Sam Mitchel Herbarium of Fungi

A lot in the world of fungi diversity has changed since Sam’s early years of collecting and the creation of the herbarium at Denver Botanic Gardens. Mycology has since entered the DNA age where we can use a fungal species’ own genetic code to facilitate identification. While there will always be a use for morphological determination of species, we no longer have to leave this to personal interpretation; we can allow molecules to help point us in the right direction.

To help understand fungal biodiversity, the Sam Mitchel Herbarium of Fungi can be a regional contributor to the North American Mycoflora Project. This project has been mentioned a number of times in the pages of FUNGI Magazine. (Bunyard, 2012; Sheehan,
It is exciting because it represents a collaborative effort between professional and amateur mycologists to better understand, document, and disseminate knowledge of macrofungal diversity in North America.

The Sam Mitchel Herbarium of Fungi intends to contribute to this project by sampling fungi from the far corners of the state with the help of volunteer citizen scientists from the Colorado Mycological Society (CMS) and Pikes Peak Mycological Society. There are even numerous festivals of fungi in Colorado, including the CMS fair and the Telluride Mushroom Festival, where vouchering programs can facilitate sampling fungal diversity in the Southern Rockies. One task toward a better understanding of the diversity of Colorado mushrooms will be generating DNA barcode sequence data for known species whose collections reside in the herbarium; the likely best place to start will be the vouchers of the 220 species found in Vera Evenson’s *Mushrooms of the Rocky Mountain Region*.

The creation of a database of DNA barcodes for Rocky Mountain fungi will enable us to more effectively explore questions about fungal diversity in Colorado’s many ecosystems; from the prairie steppe regions all the way up to the subalpine forests and alpine habitats of the Southern Rockies. In addition, using molecular techniques to describe fungal soil communities will be helpful in developing better practices for managing our Rocky Mountain forests. An example is the herbarium’s current collaboration with Jeff Ravage of the Coalition for the Upper South Platte in Colorado. Jeff and his colleague Marc Donsky are testing the ability of native wood-decay fungi to facilitate the breakdown of woodchip piles and to quickly rejuvenate soils. Through an established DNA database of Colorado, native fungi we will be able to identify the fungi that participate in the succession of these soil communities and determine the effectiveness of new methods in soil restoration.

The Sam Mitchel Herbarium of Fungi
has a significant role to play in better understanding the contributions of fungi to the wild and beautiful forests of the Southern Rockies as well as that of North America. One has to wonder what Sam would think of all this today. Did he have any inkling of the legacy he would be producing when he moved the collection to Denver Botanic Gardens 50 years ago? Probably not, but those who knew him well are proud of what he was instrumental in creating, and are certain that Sam would feel the same.

Acknowledgements

We would like to acknowledge Dr. Barry Rumack for taking the time to share his memories of Sam with us. We also would like to thank Allein Stanley for joining us for Sam’s birthday and the Herbarium’s anniversary. Special thanks to Robert Lentz and Robert Avis for letting us visit and collect on their property – the land that was once owned by Sam – to help celebrate 50 years of the Sam Mitchel Herbarium of Fungi. And we wish to extend a very special thanks to Kirk and Scott Mitchel for sharing their earliest memories of their father and his upbringing.

Resources to be archived at Denver Botanic Gardens


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The Mushroom Hunter

for Sy

At first, I remembered it as a rite of passage from the marriage. And though by then we shared a house, a bed, and a table, it was before the marriage. And it was a rite of passage— even after you took the mycology class with your friend at the natural history museum. Even though you only hunted in the neighborhood and used the buddy system and two field guides, would I trust you enough to eat mushrooms you’d picked and sautéed in butter and cloaked in garlic and offered to me one at a time by hand?

Kathleen Cain
Arvada, Colorado