William Taylor Marshall: his contributions to succulent plant study and a full bibliography of his published work

Colin C. Walker*1 & David M. Schultz2

1School of Environment, Earth & Ecosystem Sciences, The Open University, Milton Keynes, MK7 6AA, England. email: c.walker702@btinternet.com
2194 Benham St, Torrington, CT 06790, USA. email: dmschultzcactus@yahoo.com
* Author for correspondence: c.walker702@btinternet.com

Abstract: William Taylor Marshall (1886–1957) was a leading researcher in cactus taxonomy over a 25-year period, notably based on fieldwork in Mexico and the deserts of southwest USA (1933–1957). His publication output is assessed and documented fully for the first time. Notable are the books Cactaceae (1941), co-authored and illustrated by T.M. Bock, and Succulent Plants (1945), co-authored with Rupert Leach and accompanied by a unique set of 3D slides. His journal articles were prolific, published in many C&S titles around the world. A major vehicle for his publications was Saguaroland Bulletin which he established in 1947. He was Cactus & Succulent Society of America President (1938–1941), then President Emeritus until his death, during which time he initiated the biennial CSSA conventions. As it stands today, the Desert Botanical Garden in Phoenix, Arizona, where he was Director (1947–1957), with its living collections, library and herbarium, is a major Marshall legacy.

Keywords: William Taylor Marshall, cactus research, biography, full bibliography, Desert Botanical Garden, CSSA President, Saguaroland Bulletin

INTRODUCTION

Britton and Rose are famous for the publication of the most extensive monograph of cacti, The Cactaceae (1919–1923), which has ever been produced. Its four volumes included 137 colored plates, specially commissioned and principally the work of Mary Emily Eaton, supported at great financial expense by the Carnegie Institute of Washington. At the time of publication this work was controversial because of the inflation or apparent excessive splitting in the number of taxa. They recognized 124 genera, six times the number adopted by Karl Schumann just two decades earlier (1903), to accommodate 1235 species, many of which were newly described. The work of Britton and Rose, however, now a century on, is seen as the foundation of modern cactus taxonomy and is yet to be surpassed in terms of quality of presentation and level of detail. Britton and Rose provided the stimulus and starting point for further research on cacti. In Germany leading players included Alwin Berger, Franz Buxbaum and Curt Backeberg (Rowley 1997).

Here in America, William Taylor Marshall (Fig. 1) initiated research that was to span just over two decades before his untimely death. 1933 saw his first habitat trip in search of cacti to be followed by several more excursions to procure living material and data on which his research was partially based. He became a leading light in the activities of the Cactus & Succulent Society of America (CSSA), becoming President in 1938 until 1941, followed by his status as President Emeritus until his death.

In 1947 Marshall made a major career change when he was appointed Director of the Desert Botanical Garden (DBG) in Phoenix, Arizona. Here he developed the library and herbarium while expanding the living collections, all essential assets to support his research.

In 1933 he began publishing on cacti in particular and succulents more generally. His publication output includes some books, booklets and a very extensive range of articles published especially in the US by the CSSA. In 1947 he founded the Saguaroland Bulletin as the membership publication of the DBG, which
became his major vehicle for the publication of his research. This was later renamed the *Sonoran Quarterly*. Journal articles were also published in a number of journals around the world dedicated to cacti and succulents, sometimes as reprints or translations into non-English languages. His publication output was prodigious and has never been properly assessed until now. One of the major aims of this paper is to catalog Marshall’s publications on succulents. An incentive for this is that Marshall is omitted from Stafleu and Cowan
(1981), which is the vast and invaluable compilation of taxonomic literature. This oversight is regrettable and hopefully here we have compensated by providing a review of Marshall and his input into the taxonomy and literature on cacti. By 1941 the work of Britton and Rose was becoming dated, lacking newly described species and taxonomic revisions. Marshall collaborated with artist T.M. Bock to produce a single volume in a popular style as an update entitled *Cactaceae* (Marshall and Bock 1941). This was followed by other books and a wide range of journal articles included here in what we hope is a full Marshall bibliography with appropriate commentary and background information.

In contrast to the absence of an entry for Marshall in Stafleu and Cowan (1981), his significant number of taxonomic innovations are listed in the *International Plant Names Index* (IPNI).

The Marshall legacy, however, is much wider than his prodigious publication output. He held various posts and received several awards and honors. The DBG as seen today originates from Marshall's outstanding Directorship (1946–1957). Of special note is his leadership of the CSSA during a formative period in its history, notable for example in terms of his initiation of the biennial conventions. He was also Vice President of the American Horticultural Society and the President of the Arizona Cactus & Native Flora Society. All of these organizations benefited significantly from Marshall's sterling leadership. These and other aspects of Marshall's career and interests are discussed below, although the major focus is on his publication record. To set the scene we begin with some biographical background.

**A BRIEF BIOGRAPHY**

William Taylor Marshall was born in 1886 but his interest in succulent plants did not take hold until Easter Sunday, 1930, when his daughter gifted him with a small cactus plant. At that time and for the previous 15 years, he had “followed his calling of grocery salesman in the desert sections of southern California, western Arizona and southern Nevada with all the intensity required to pile up orders in territory so sparsely populated” (Marshall 1944a). It was a small but attractive plant and looked “mighty lonesome there in the garden” (Marshall 1944a). He began bringing home other plants from his trips to add to his desert garden (Cutak 1943). He was proud of his “little section of desert” and showed it to his friends; therein lies the beginning of his obsession. He was embarrassed to not be able to answer his friends' questions of the identity of any of the plants. His curiosity and interest in the plants drove him to search for answers, leading to his discovery of Britton and Rose, *The Cactaceae* (1919–1923). The plant descriptions there were technical, so to understand them, he studied Latin and botany. His “incurable curiosity …not only kept him at botanical studies from 4:30 to midnight daily, but prompted him to join the newly-formed Cactus & Succulent Society” of America (McChesney 1947). He was still working as a grocery salesman and set aside each evening for his studies, although “At this time (c. 1931–1932) my health failed under the strain of my work” (and he quit his job to) “take it easy” (Marshall 1944a).

Starting an interior decorating business allowed him more time for his plants and cactus studies. Over the next several years he was able to break away from his business and spend 3 months in 1933 in Baja, California (Marshall 1933a, c), 4 months (1935) in Sonora and Sinaloa, Mexico (Marshall 1944b) and 6 months (1936) in the West Indies (Marshall 1944b), studying and collecting succulent plant material. He was elected the President of the CSSA from 1938–1941. His participation and influence in the society (CSSA), both during his tenure and after, is very evident in the journal through his Presidential messages, administrative reports and other references to participation on the Nomenclature Committee, Grafting Department, the Q&A columns and Show Chairman duties of the annual show. He also published several books: *Glossary of Succulent Plant Terms* (1938), *Cactaceae* (1941), *Succulent Plants* (1945) as well as numerous articles in journals; all the while, continuing his interior decorating business.

Brassfield (1953), the CSSA President in 1943, wrote in his survey of the highlights of the history of
the CSSA 1929–1943 that Marshall “became president in 1938 and served four years, during which time affiliate societies were formed throughout the United States…His greatest achievement was the first convention which was held at St. Louis in 1941. This convention was well attended and helped to create a national interest in our society…For his many efforts in behalf of the cactus society, he was made President Emeritus”.

Figure 3. Reg Manning cartoon. (From Manning 1947.)
Finally, in Jan., 1947, an announcement appeared in the *National Horticultural Magazine* (Anon. 1947), in which Mrs. Gertrude Webster, the President of the Arizona Cactus and Native Flora Society indicated that Marshall had been offered the position of Director of the Desert Botanical Garden (DBG) of Arizona. It is purported by the DBG that, in Marshall’s reply to Mrs. Webster, she would not only be getting a new director but he would provide his extensive library to the DBG as well. One of the authors (CCW) discovered Marshall’s bookplate (Fig. 2) in his collection and the DBG library contains many books with Marshall’s bookplate from his donation. As an interesting footnote, this bookplate is identical to the artwork by H.E. Trefry on the covers of the Cactus and Succulent Journal from volume 1 through volume 28. Mrs. Webster’s offer prompted him to leave California and take that position, since he “was pretty certain that California had enough interior decorators anyway” (McChesney 1947). He joined the garden in December, 1946, finding that “from 1941 to 1946 the garden had been in the hands of a series of caretakers and much of the planting had been lost due to lack of supervision” (Marshall 1954b). He was now in a position of his dreams, no longer working to pay for his passion of desert plants, but being paid to do the work he wanted among desert plants.

In a reply to Mrs. Webster dated October 7, 1946, Marshall presented his “Ultimate Aims for the Garden” which included a very aggressive list of twelve goals that he believed could be accomplished “by hard work within five years” (Huizingh 2005). High among the goals was to develop the desert garden in a natural setting. It is interesting that, with Mrs. Webster absent due to chronic illness, board member C.A. Dowdell presided over the selection process. Dowdell decided that Marshall’s aims were too ambitious and Marshall was initially hired on a 2-month trial basis (Blanc 2000). Nevertheless, he threw himself into the tasks with an enthusiastic abandon. First, the plantings that still existed had to be evaluated and saved where possible; there was an infestation of rabbits and rats which continued to be a source of destruction of any new plants introduced and these had to be dealt with. The war that he waged on the vermin makes for entertaining reading throughout volume 1 of the *Saguaroland Bulletin*, but between fencing, a pest exterminator and a group of donated cats, the rabbits and rats were finally brought under control.

A second goal put forth in his “Ultimate Aims” was to publish a magazine for distribution to members and other botanical gardens (Huizingh 2005); he was instrumental in establishing and publishing the *Saguaroland Bulletin* with J.T. McChesney as editor and Marshall as assistant editor and major contributor. By the end of 1948, he had, in addition, taken over the editor’s duties on the Bulletin.

Repair of the existing building, planning new buildings, parking, restrooms; all were top priorities included in the development of the desert garden. The Webster Auditorium was the only building when Marshall joined the DBG; with his quarters also in the building, it needed a large amount of attention, and he had to deal with some major issues as evidenced by Reg Manning’s cartoon in the *Saguaroland Bulletin* (Manning, 1947) (Fig. 3).

McChesney (1947) noted in the number 1 edition (June, 1947) of the *Saguaroland Bulletin* that “as Director of the Garden, Marshall had two principal responsibilities: first to conduct a ‘popular’ program in keeping with the Garden’s aim of being of public service; and second, to further the cause of science with a technical program of research and study”. This is an over-simplification of the tasks that were facing Marshall in the early years. The remaining “goals” in his 12 “Ultimate Goals” can be restated in somewhat simpler terms: publicity and recruiting more members, plant acquisition, planting, educational lecture programs, develop a library emphasizing succulent and xerophytic plants, and establish an herbarium for the preservation of desert plants and research. What a daunting list of tasks/goals, yet the *Saguaroland Bulletin* editorial comments and comments by Marshall throughout the first year show only one frustration: getting more members.

Another stated “goal” was to publish articles in appropriate national and international journals, which was accomplished through his literary contributions to the *Cactus and Succulent Journal*, and other cactus and succulent publications in Mexico, Great Britain, France, Japan and New Zealand. It was also suggested in an obituary on Marshall (Anon. 1957b) that he had made contributions to other publications. With regard to the New Zealand publications, we have been able, with the help of the DBG, to add two references from the C&S Journal, New Zealand (Marshall 1954 k, l). However, the authors would appreciate any feedback on possible Marshall contributions in *The New Zealand Gardener* and the Journals of the C&S Society of Japan and Desert Plant Society of Japan. These were also mentioned in the obituary but we were unable to find a source for checking these publications and have not seen them referenced elsewhere.

Although he did not have a published article in *Succulenta*, Marshall had apparently contributed Plate 12 from *Cactaceae* (Marshall and Bock 1945) and the descriptions from that publication were included (Fancier 1955).

Franz Buxbaum (1951, 1953) also referenced Marshall (1947c) and Marshall and Bock (1945) in taxonomic comparisons and discussion. Interestingly, Buxbaum travelled to the USA in 1956 en route to a Fulbright Research Fellowship at the University of CA Berkeley and visited Marshall and the DBG for a discussion on the taxonomic differences between their classification systems. Marshall (1956g) wrote that “we feel that a new and more cordial relationship with European scientists will result from that visit.”

In addition to the articles in *Cactus (Paris)* that Marshall had submitted, there were more indications
that Marshall contributed further to the French society. The series of articles, apparently written by A. Bertrand (1947 a,b, 1949 a,b, 1950 a,b), on the classification of the Cactus family included reprinted excerpts from Marshall, both plant descriptions and figures drawn by T. M. Bock (Marshall and Bock 1941, Marshall 1946c). One of the Bock drawings, specifically in Bertrand (1950a), was previously unpublished, likely done in preparation for Marshall’s *Cactaceae* revision. His intent to publish a revised edition of *Cactaceae* in 1950 (Marshall 1950a), did not come about, and it is possible that the many projects and responsibilities at DBG and his sometimes-precarious health, likely affected this project. This possibility is explored in more detail in the *Cactaceae* book discussion (Marshall and Bock 1941).

Marshall, in 1947, was the Chairman of the 2nd CSSA Conference (in Cincinnati, OH) and, while there, persuaded the CSSA to plan the 3rd with the DBG as venue. Optimism ran high to have what started out as a very much depleted garden to be the host of the conference in July 1949! Marshall also became President of the Arizona Cactus & Native Flora Society, the non-profit that ran the DBG, in 1947. There were collecting and exploration treks during 1948, as well as many donations, that increased the number of native species in the garden. By July, 1949, when the convention was held there, the garden was in much better shape for the attendees.

Marshall also expressed his love of nature and natural spaces with his deep interest in the U.S. National Monuments as both recreational and educational opportunities. “The Rangers, Naturalists and Archaeologists are picked men of infinite patience and specialized knowledge which they will share with you on request. We feel that all of the National Monuments should have many more visitors than they do, if their value was understood, and we intend to spread the word . . . . by a series of articles on the Monuments of Arizona and New Mexico” (Marshall 1951a, 1951b, 1952). As he and Jim Blakely returned from the Denver CSSA National convention in July, 1951, they stopped in “Santa Fe to arrange for two meetings to be held at [DBG] on October 2–3 and October 9–10 [1951] for the Superintendents and Rangers of the National Monuments concerned with desert plants.” The training sessions “were very successful if one may judge by the enthusiastic comments of the trainees” (Marshall 1951a).

For the remainder of his life, Marshall remained at the DBG as President of the ACNFS, Director of the DBG and editor and major contributor of the *Saguaro-roland Bulletin*, dealing with the myriad issues concerning the building and planting expansions and improvements in the gardens. The lectures at the garden were open to the public for free and attendance at the garden had increased “from essentially nil in 1947 to an estimated 150,000 in April–April (1956–1957)” (Anon. 1958). The garden had become, and continues to be, a

Figure 4. Marshall with Cochemiez halei on Magdalena Island, Baja California, March 3, 1933. Photo: H.E. Gates. (From Marshall 1935a.)
mecca drawing cactus and succulent researchers and enthusiasts as well as tourists. Marshall died on August 25, 1957, aged 71. Cutak (1957), in the Spine Chats column, said that “Although [he] had been in ill health for several years, his sudden death …was a shock to most of us who knew him well.” Other obituary notices were also published (Anon. 1957a, b, Benson 1957, Bravo-Hollis 1957, Byles 1957, Uitewaal 1957), but we could locate no full obituary; a complete bibliography of his published work has not appeared until now.

It is a difficult to overstate the immense effect that Marshall had on our understanding of succulent plants. He was a self-trained taxonomist, lecturer at many local cactus and succulent and garden societies, the DBG and conferences, raising the awareness of the plants and ecology that he so loved, both with the cactus and succulent community and with the general public.

HABITAT VISITS

Mexico, Baja California, 1933. Marshall (1933a) reported that “on January 19th [1933] Mr. Carl Seebach informed me that he would be unable to make the trip to Baja, California…He suggested that I take his place” and on Feb. 15, Marshall joined H.E. Gates on an expedition to this region (Fig. 4). The trip was planned to last about 6 weeks, but the truck had major repair problems resulting in a trip of 13 weeks! Marshall (1933a, c) gave some information on the plant material they encountered in two brief reports, with little hint of the serious issues they had to deal with. He did mention that he developed a mild case of malaria. Gates (1934a) was much more detailed and described the travails in his description of blown tires, muffler blow-out and jerry-rigged repair, steering post break, drive shaft twisted and broken, and holes in the radiator. Nearly all of the repairs were made along what passed for roads. In addition, Gates had to travel, largely on foot, nearly 52 miles to get help with parts and finally had to return to the U.S. to purchase some of the materials needed for the repairs, leaving Marshall with the truck sitting on a stone wall that they had built to support the vehicle so they could climb under it to make the repairs. Marshall was essentially alone with nearly no food or water for a week. One wonders how he survived and in fact went back out again! In Marshall (1944a, b) he described the same journey with more detail than his earlier report; apparently, the trauma had eased in his mind.

Back country of Sonora & Sinaloa, Mexico, 1935. Marshall (1944b) in March, 1935, with the assistance of two younger men and much more suitable transportation than the heavy truck used with Gates, a light sedan and a trailer, Marshall traveled into the west coast mainland of Mexico, visiting the Lower Gulf of California and into the High Sierras, collecting many agaves, *Mammillaria* Haw., *Placocereus* Byles & G.D. Rowley, *Ferocactus* Britton & Rose, *Echinocereus* Engelm. among others. The trip was not marred by difficulties and was successful from a “tourist” and botanist point of view. One of the discoveries was described by Marshall as *Echinocereus bristolii* W.T. Marshall, in honor of one of his associates.

The West Indies, 1936. In November, 1936, Marshall “again started on a trip of exploration, this time to the West Indies, visiting Puerto Rico, Dominican Republic, Haiti and Jamaica.” He spent 6 months in the islands which resulted in “ecological findings of considerable importance” (Marshall 1944b). Specimens were collected to be shipped to public and private cactus gardens in the US, England, Denmark and Australia. Among the more tropical forests in the Dominican Republic were found *Hylocereus* (A. Berger) Britton & Rose, *Rhipalis* Gaertn., *Selenicereus* (A. Berger) Britton & Rose, and *Opuntia* (L.) Mill. In a more mountainous area were several *Pilocereus* Lem. species, including what he considered an unknown species. Several different *Hylocereus*, *Opuntia*, *Harrisia* Britton, *Selenicereus* and *Meloacactus* Link & Otto were also reported. The list of cacti continues in Jamaica and includes many of the same genera with different species. As well as collecting, he spent time visiting botanical gardens and sight-seeing. The travelogue is an interesting insight into the obvious curiosity of Marshall. He had sent back information as the visit progressed (Marshall 1936c, d, e).

Collecting Trips to Deserts of the Southwest USA and Mexico

(Editor’s note: some of the taxonomy in quotations directly from trip descriptions is out of date, but left as is to reflect the original publication. Authorities are given for taxa not included in quotations).

Marshall made many expeditions to deserts of the southwest accompanied by his fellow “Cactomaniacs”, a group of collectors of desert plants formed within the membership of the Desert Botanical Garden, to encourage the use of desert plants in landscaping and to boost the hobby of cactus collecting in general for exploration and collection. For a humorous description of this “affliction” see Mieg (1951). Most expeditions were mounted with specific intent to search for and collect plants needed for the botanic garden in Arizona, under permit and in other states following the local guidelines. Generally, there were specific species in the search area that the group was looking for. Some of these friends also made trips to Mexico either on vacation or as a privately financed expedition that primarily benefited the DBG with new acquisitions.

Although no details are given, in 1947, Marshall notes that staff collected “100 specimens of native cactus and yuccas” which were added to the DBG collection (Marshall 1947i).

The first expedition in Jan., 1948 (Archer 1948), to the Congress Junction, AZ. area, was without Marshall, since “virus X held the Director in bed” (Marshall 1948e). Mrs. Claire Proctor led the group and “30 plants of *Theocactus johnsonii* var. *arizonica* and *Mammillaria tetrancistra*, both badly needed in the Garden collection, were collected.”
In May, 1948, during a trip to northern AZ, they collected over 300 plants native to Arizona, including specimens of *Echinocereus*, *Echinocactus* Link & Otto, several *Opuntia* species, *Toumeya pappacantha* (Engelm.) Britton, Rose & M.P. Berg and *Utahia sileri* (Engelm.) Britton & Rose (Marshall 1948e).

In August, a trip was made to northeastern AZ “to again attempt to relocate *Toumeya peeblesiana* and again our expedition failed in its objective”, although they were able to collect “nine specimens of *Mammillaria wrighitii*”, a species newly reported as occurring in Arizona. (Marshall 1948e).

Late Sept., 1948, found Marshall in Tucson, AZ, for a week collecting in southern AZ, where they found specimens of *Echinomastus* Britton & Rose, *Echinocactus*, *Coryphantha* (Engelm.) Lem. and agaves to collect for the DBG (Marshall 1948e).

In July, 1949, the CSSA held its 3rd convention at the garden. The only collecting expedition the DBG was able to undertake that year was after the convention in northern AZ, Navajo country (Marshall 1949d). They were again foiled in their search for the elusive *Toumeya peeblesiana*, although *Utahia sileri*, *Sclerocactus whipplei* (Engelm. & J.M. Bigelow) Britton & Rose, and *Toumeya pappacantha*, were among 70 plants added to the DBG collection.

In May of 1950, an exploration trip was taken in conjunction with the New Mexico College of Mines at Soccoro, to “Indian Country” in northern AZ, southwestern CO, southern UT and northwestern NM. This was a success with the addition of “200 specimens of *Opuntia erinacea* Engelm. & J.M. Bigelow and its varieties and specimens of numerous other cactuses” (Marshall 1950b).

Marshall, accompanied by the DBG junior botanist Jim Blakley, completed a trip of twelve days in southern Arizona for the collection of several hundred plants for the garden, including *Echinomastus* sp. and *Echinocereus rosei* Wooton & Standl. and more than 200 herbarium specimens of late summer flowering plants (Marshall 1950b).

In 1951, W.H. Earle (Chief Horticulturalist) and Jim Blakley collected plants in the remote districts of Mojave County and Hualapai Mountains south of the Grand Canyon and the Arizona Strip. No details were provided but Marshall did report they were successful in returning with new plants and several hundred herbarium sheets for DBG (Marshall 1951a).

In July, 1951, Marshall, accompanied by Jim Blakley, traveled to Denver for the CSSA convention where Marshall gave a series of talks. Collecting plants on the return trip from Denver to El Paso was also successful (Marshall 1951a).

A 1952 southeastern AZ expedition involved Marshall and Blakley (DBG) and scientists, including J. McCleary, from the Arizona State College (Tempe). The stated purpose was to check “a number of species of plants, birds and insects described as indigenous only to the Guadalupe Valley.” The description of the expedition is entertaining in the detail provided by Marshall.
Herbarium and ornithological specimens were collected and preserved. *Agave, Yucca, Mammillaria, Coryphantha*, and *Echinocereus* were among the succulent genera collected for the DBG as well as other desert plants (Marshall 1952c).

In June 1952, Marshall and Blakley traveled to west Texas to visit Big Bend National Park, stopping at numerous points along the way to collect plants. Their visit to the park and the cactus they observed during their various hikes were well-documented (Marshall, 1952f). The plant material they collected along the 2,500-mile round trip drive from DBG to Big Bend included many species of *Mammillaria* (e.g., the newly described *Mammillaria tobuschii* W.T. Marshall, later recognized as a species in *Ancistrocactus* Britton & Rose), *Coryphantha, Opuntia, Echinocereus, Echinocactus, Hamatocactus* Britton & Rose, *Epithelantha* F.A.C. Weber ex Britton & Rose, and *Escobaria* Britton & Rose (Marshall 1952h).

In 1953, Marshall reported in his editorial that the DBG’s summer plans included a trip to Utah and Nevada, to “trace the exact identity of *Opuntia pulchella* and a group of three species which have been described as a new genus, *Micropuntia*” (Marshall 1953f). Marshall and P. Hutchinson of the Botanical Garden of California (Berkeley) made the trip and Marshall was forced to cut his participation short because of a “severe asthma attack due to high altitude and damp air” (Marshall 1953f). Hutchinson brought back to DBG nine rarities from this expedition.

In March, 1953, Marshall ventured to southwestern AZ, nearly to the Mexican border (Marshall 1953h). His narrative of the several days visit to the region is fascinating but *Opuntia stanlyi var. wrightiana* (E. M. Baxter) L.D. Benson, and *Echinocactus polycephalus* Engelm. & J.M. Bigelow were the only succulents mentioned.

In 1953, C. Mieg, the chief “Cactomaniac,” reported that “After several years of failure I finally found this much sought for cactus [*Coloradoa mesae-verdae*] on our vacation last August”. He extended the known range from Colorado into New Mexico and brought four specimens back to the DBG, including a crested plant. (Mieg 1953a). Then, on a three-day trip to the Four Corners region made late in September, 1953, Mieg, Blakley, Alan Blackburn of the Tucson Trailside Museum, and John Hales primarily wanted to determine if the range of these plants extends into Arizona. They were not successful at finding any in AZ but extended the known range in NM slightly further (Mieg 1953b).

In 1954, Marshall (1954e) noted that there were several expeditions planned in Utah and New Mexico, with the goal to collect more plants of *Pediocactus hermannii* W.T. Marshall, a new species described in the same issue of *SaguaroLand Bulletin* (Marshall 1954f). Earle and Mr & Mrs Hermann, while on vacation, were successful in collecting more specimens of this species in Utah as well as *Opuntia, Utahia, Sclerocactus* and yuccas in AZ.
Also in 1954, the Hermanns, while on vacation and acting for the DBG, in the Four Corners area, found two locations where *Tooumeya papyracantha* were plentiful as well as the first examples of *Opuntia fragilis* (Nutt.) Haw. found in AZ (Marshall 1954e).

Mr and Mrs Mieg, in 1954, vacationed in Mexico, traveling nearly 4,500 miles through a number of “climatic zones ranging from the lower Sonoran to high plateau country, the alpine zone as well as the tropical jungle of both east and west coast” (Mieg 1954). They collected species of *Mammillaria*, *Neolloydia* Britton & Rose, *Pilocereus* and others and upon return to the DBG, when “I asked the director if he wanted the loot that I brought, William Taylor began to drool” (Mieg 1954).

In June, 1955, on a vacation trip, C. & L. Mieg and G. & S. Hermann and their families travelled to Mexico with some specific DBG “wants” from Marshall (Marshall 1955h), which resulted in the donation of over 275 cactus plants to DBG. Charlie Mieg is listed as a Board Member of the DBG and Gus & Sylvia Hermann as Research Associates (Marshall 1955c).

Also, in 1955, in his report of Accessions, Marshall noted that “We have received 60 plants needed for research from Mr. and Mrs. Gus Hermann who made a special trip to northern Arizona to collect them for their own expense. Dr. James McCleary, while on vacation with his family made extensive collections of needed material from Utah” (Marshall 1955h). No details of the plants were given.

On May 25, 1956, on an expedition “to secure a number of species of plants from Mexico which are not in our collection now” (Marshall 1956e), Dr. J. McCleary, accompanied by C. Mieg (who financed the expedition) spent about 18 days on the trip. There was not a detailed report of the results, but they did return with an *Opuntia* which appeared to be a new species (Marshall 1956n).

**PUBLICATIONS: BOOKS & BOOKLETS**

**Glossary of Succulent Plant Terms**

Marshall’s first foray into publishing books on succulents was a glossary of terms relating to these plants (Marshall and Woods 1938). Its full title succinctly summarizes the coverage: **Glossary of succulent plant terms: A glossary of botanical terms and pronouncing vocabulary of generic and specific names used in connection with xerophytic plants.** As far as we are aware, this is the first time that a glossary had been published specifically related to succulents and hence was groundbreaking. It aimed to explain the etymology of generic and specific names as well as providing definitions of selected botanical terms often appearing in plant descriptions.
Figure 10. Plate of Coryphantanées [Coryphanthanae] by T.M. Bock from Bertrand (1950a).

was well illustrated with a range of half tone photos and line drawings (Fig. 5). The book was a collaboration with R.S. Woods and set the trend of co-authorship seen in most of Marshall’s later books. The glossary was initially published in serialized form in the *Cactus and Succulent Journal* and then published as a softbound book with a second printing in 1945 (Marshall and Woods 1945).

**A Contribution for a Better Understanding of Xerophytic Plants**

This 15-page booklet was published by the CSSA (Marshall 1940) with the following aim, as indicated in the foreword: “This study course is a series of lessons intended as an outline to assist cactus clubs and individuals who wish to become better acquainted with succulent plants. These lessons will suggest lines of study along which the student may conduct his research”. It is divided as follows: Chapter I [Introduction], Chapter II Morphology, Chapter III Plant physiology, Chapter IV Plant organography, Chapter V Systematic botany, Chapter VI Ecology, Chapter VII Nomenclature, Chapter VIII Paleobotany and genealogy. The booklet ends with a request: “I will appreciate suggestions whereby the value of this contribution will be increased to students of xerophytic plants”. Chapter 4 was reprinted by the Henry Shaw Cactus Society in the *Cactus Digest* (Marshall 1943f). Apart from this we found no indication that the pamphlet had much impact.

**Cactaceae**

Britton and Rose (1919–1923) published the most comprehensive and extensively illustrated monograph of the cactus family: *The Cactaceae*. However, with continued exploration and publication of new material, notably by the German Curt Backeberg, this work was starting to be outdated as early as the late 1930s. So was born Marshall’s most comprehensive work in book form: *Cactaceae* (Marshall and Bock 1941) (Fig. 6). In the foreword, Scott Haselton, publisher, said that “The ‘Cactaceae’ with its illustrated genera, its recent species since Britton and Rose’s monograph, its new species described herein for the first time, the understandable comparisons of genera, and the check list of all species, is sure to be of inestimable value to collector, grower and student.” Again, Marshall had a collaborator, this time the talented botanical artist Thor Methven Bock. Cacti with their complex symmetry and intricate spination are difficult subjects to capture accurately in line drawings, but Bock succeeded admirably. At the start of the book, 25 of his plates illustrate examples of the genera (Fig. 7) to accompany Marshall’s keys: in total 146 genera are illustrated in the line drawings. The bulk of the book surveys the tribes and genera of cacti, updating Britton and Rose’s treatment, and is illustrated with 165 half tone photos. Appendix I includes six more plates by Bock illustrating morphological and anatomical features of cacti. Overall, Bock spent a year preparing his superb plates. The book concludes with four more appendices: Appendix II Cultural Notes, Appendix III Errata, Appendix IV Bibliography, and Appendix V Abbreviations of Botanists.

*Cactaceae*, however, did not receive a favorable review from Croizat (1942). Indeed, the book did not match the exacting standards set by Britton & Rose, who provided full descriptions and synonyms for
all the species they accepted, which were also as well illustrated as possible with the plant material available. By comparison Marshall and Bock provided summaries of the changes in the intervening years as opposed to the earlier, thorough monographic treatment. Croizat did however acknowledge that the book was “beautifully illustrated” and that “As a work for the amateur, the ‘Cactaceae’ has merits, and it may not be doubted that it serves the purpose of fostering the knowledge of cacti among those who love these plants and find in them relaxation and pleasure.” In summary, Croizat said that “the ‘fifth’ volume of Britton and Rose is still to be written, and no ‘supplement’ to the monumental work of those two botanists may be said to have been published.” Marshall and Bock (1945) is Supplement No.1 to this book. Marshall also published three more articles on revisions (Marshall 1947h), although an updated edition of the Cactaceae incorporating the supplement and revisions was not published. However, the Schilling Library Archive at the DBG has an unpublished annotated copy of Marshall and Bock (1941) which was planned as the basis for a second revised edition. According to DBG Head Librarian, Beth Brand: “What I can help with is Marshall’s unfinished revision of Cactaceae. Some years ago, his granddaughter visited the Garden and afterward sent me a marked-up copy of his book for the library. I am including a photo of the title page where it appears he hoped to publish a second edition in 1949. On other pages he inserted that the second edition is issued as Botanical paper #2 of The Desert Botanical Garden of Arizona’. He also noted that it was to be ‘respectfully dedicated to Mrs. Lou Ella Archer of Phoenix in appreciation of her interest in and aid to The Desert Botanical Garden of Arizona.’ I think you may be correct about the revision taking a back burner to the many needs of the Garden at that time and also that he may have used the Saguaroand Bulletin to publish botanical updates” (Figs. 8 and 9).

A final ‘revision’ appears in Bertrand (1950a) where a plate (Fig. 10) is credited to T.M. Bock. This does not appear in Marshall and Bock (1941) in this form where instead the 9 images are spread across three plates of this earlier book. In contrast Bertrand reproduces other Bock plates faithfully.

**Succulent Plants**

The book Succulent Plants is probably Marshall’s most innovative publication. It was co-published by Sawyer’s of Portland, Oregon and Abbey Garden Press of Pasadena, California. The Preface to the book sets the scene: “The publication of this book marks a unique and important forward step in the technique of book illustration. Here for the first time the reader may see full-color, photographic, Kodachrome illustrations of text material in the true-to-life realism of third
dimension. Natural history students, horticulturists, flower and plant lovers, as well as the general reader will, we hope, find in this volume and the stereoscopic illustrations which accompany it, a new appreciation of the beauty of form and color of the cactus and other succulent plants as well as an accurate knowledge of the terrain to which these plants are native” (Sawyer’s in Marshall and Leach 1945).

The book was first published in 1945 and reprinted in 1947 with text by Marshall and photography by Rupert Leach (Marshall and Leach 1945). Its Introduction covers: Succulence in Plants, Parallelism, Fasciation, General culture and Succulent Plant Names. The bulk of the book deals with the families of Cacti and Other Succulents: Fig Marigold Family (Aizoaceae), Century Plants (Amaryllidaceae), Desert Milkweeds (Asclepiadaceae), Pineapple Family (Bromeliaceae), Cactus Family (Cactaceae), Daisy Family (Compositae), Opium Family (Crassulaceae), Spurge Family (Euphorbiaceae), Candlewood Family (Fouquieriaceae) and Lily Family (Liliaceae).

There is, therefore, a good balance of coverage across succulent plant families, albeit Cactaceae feature most prominently. The book ends with an extensive, but often incomplete, Bibliography including about 300 entries and an Index.

However, it is the illustrations that mark this book out as being unique, as already noted by Rowley (1997) who commented that this was “The first and only work on succulents with 3D illustrations.” The book itself includes just two printed illustrations: “The parts of a stapedliad” (p.31) and “Typical Opuntia growth” (p.39), both reprinted from elsewhere with acknowledgments. The book is accompanied by 140 3-D color slides in 20 reels (C1–C20) with an accompanying View-Master (Fig. 11). The View-Master used disk-shaped reels, each of which is a thin cardboard disk containing seven stereoscopic 3-D pairs of small color photos on film. The reels for Succulent Plants are as follows: C1–C3 Morphology, C4 Parallelism, C5 Ornamental, C6 Methods, C7–C14 Cactaceae, C15 Asclepiadaceae, C16–C17 Crassulaceae, C18 Euphorbiaceae, C19 Amaryllidaceae, and C20 Aizoaceae. The order of the photos in the reels does not, therefore, follow the order of material in the book. So, for example, when reading the commentary in the book on Euphorbiaceae, reels 3, 4, 5 and 18 need to be examined. This aside, the book and its 3-D images make for an interestingly produced and informative work. For one of us (CCW), the most evocative 3-D imagery is shown by the close-up views of cactus spines and flowers. In contrast, the wider habitat and garden shots are less impressive in their three dimensionality. [Interestingly, the set belonging to one of us (CCW), has an additional reel 289 “Desert cactus in bloom” which is not part of Succulent Plants.]

The photos for the reels were taken in several different US collections and gardens as included in the Acknowledgments. Sawyer’s (in Marshall and Leach 1945) notes that “Almost four years were spent in making the hundreds of three-dimension, full-color photographs from which one hundred and forty were selected to illustrate this text”.

This book is now considered to be a collector’s item and only rarely appears in the second-hand book market. There are two features that most likely account for this, firstly the price. In what appears to be the first advert for the book ((Haelson 1945) it is priced at “$11.50 with View-Master”; in 1945 this was an expensive book [equivalent to c. $178 in 2022]. Secondly, the book with accompanying reels and View-Master would be tricky to store as a single entity and pass on as a complete package, so sets could readily become separated. Hence one of us (CCW) has waited over 30 years to acquire a complete set in near fine condition and the other (DMS) is still looking!

Arizona’s Cactuses

This booklet was published by the Arizona Cactus and Native Flora Society for the Desert Botanical Garden of Arizona, where Marshall was Director, as Science Bulletin No. 1. The first 20 species were first published in the Saguaro Land Bulletin in serial form but the series was not completed when the book was published in December, 1950 (Marshall 1950c). There were two editions, the first in 1950 and a second revised and slightly expanded edition in 1953 (Marshall 1950, 1953). The first edition was available in both paper bound and cloth bound versions and was dedicated to Mrs. Lou Ella Archer “who has aided the garden in many ways and at all times”, whilst the second edition was dedicated to Reg Manning, “Chairman of the Board for five years during which the garden made great progress.” The first edition of 111 pages has 64 half tone illustrations: 47 are photos of plants in habitat or cultivation plus 9 reprinted and credited to the works of Engellmann, together with 8 line drawings of opuntias, reprinted with acknowledgment from Britton and Rose (1919). The second edition, 116 pages, includes 75 illustrations: 60 are photos of plants in habitat or cultivation plus 2 fewer of the credited reprints and the same 8 line drawings. This is a standard cactus flora with keys and descriptions. There are some new descriptions and combinations by both Marshall and Lyman Benson, but some or all of these were validly published elsewhere. Overall, this is the least original of Marshall’s books or booklets. It was preceded by Stockwell & Breazeale (1933) Arizona Cacti, Benson et al. (1940) and Benson (1950, 1953) with The Cacti of Arizona [later expanded to be an even more complete state cactus flora in its third edition (Benson 1969)].

Introduction to Desert Plants

This booklet (Fig. 12) was also published by the DBG as Science Bulletin No.3, and sponsored by the Arizona Cactus and Native Flora Society, a non-profit, educational corporation (Marshall 1956). (This Science Bulletin series was concluded with No.4 by Earle (1963) with Cacti of the Southwest). The title sets the scene for the seven chapters: The Desert, Desert Plants,
Succulent Plants, Xerophytes, Mesophytes, Desert Annuals, and Culture. It is illustrated with 27 halftone photos and 10 plates of well executed line drawings by Arthur Douglas, one of which is a map of SW US deserts, another illustrates plant associations at different altitudes, while the remaining 8 plates show a range of desert trees, shrubs and annuals, none of which are succulent. This booklet was also summarised as a 6-part series of articles in *Saguaroland Bulletin* from 1955 to 1956, covering 7 chapters (Marshall 1955m).

As an aside, but of bibliographic interest the bookplates on the inside front cover of this booklet belonging to one of us (CCW) show the provenance of this copy, indicating that it formerly belonged to R.A. [Bob] Foster of Abbey Garden Press (Fig. 13).

### Saguaroland Bulletin

W.T. Marshall considered the *Saguaroland Bulletin* (Fig. 14) to be one of his publications: “I have written five books of full book size of which 18,500 copies have been sold, one 16-page booklet of which 35,000 have been sold and an edition of 12,000 is now on the press and 42,000 copies of our 12-page *Saguaroland Bulletin* in which all of the writing was mine” (Marshall 1955c). He obviously was proud of the continuing Bulletin and considered it equally with his other books. In the first year of the Bulletin, J.T. McChesney was editor with Marshall as assistant editor, with Marshall adding much of the material himself.

As described by McChesney, “The policy of this bulletin, of which this is the first volume and number, is to inform members of activities at The Desert Botanical Garden of Arizona and to promote a greater interest in desert plant life. The bulletin will be issued at the beginning of each month, and will contain certain continued features as well as miscellaneous articles and news items. The size and scope have not been definitely determined, and will depend upon your response and further financial support which would be negligible to the individual member.” During the second year, Marshall stood in for McChesney as the latter was overwhelmed by his private business and interests in the Garden. By mid-1948, Marshall was doing all of the editorial duties and was listed as editor from 1949 to his death.

The featured columns for the first several issues included: (A) *Plant of the Month* in which Marshall gave a description of some plant which for a particular reason was outstanding during the month preceding issue. This plant was sketched on the cover page, and provided a test to members trying to identify it. (B) *Desert Plants* wherein Marshall gave “A fundamental treatment of desert botany from the beginning”. (C) The month *In the garden*, a feature that gave Marshall a place to describe some of the improvements, new acquisitions, various issues and problems, events, as well as what is blooming each month. (D) *Biographical Notes* detailed the important persons associated in the development of the garden and their contributions. The *Editorials* and...
sundry Garden business aspects, including the annual show, were also given voice in Marshall’s input throughout the bulletin, as needed. (E) Contributors’ articles were added when available. Many of these features were continued throughout the 10 years that Marshall was associated with the Bulletin. It became a means for Marshall to publish many articles and even new species descriptions (Figure 15). He was easily the major contributor for nearly all of the Bulletin issues over the 10 plus years that he was Director. The Saguaroland Bulletin continued until 1990, when its name was changed to The Sonoran Quarterly.

**HIS TAXONOMY**

The extent of Marshall’s cactus taxonomy can be seen from the IPNI (International Plant Names Index). There, 123 names attributable to Marshall are listed. However, four of these are duplicated because of corrections, so his overall total is 119 new names at the level of genus, species, variety or new combinations. The standard form of his name is given as W.T. Marshall.


In his article prepared for the 1953 I.O.S. and presented at the conference by R.S. Byles, “The importance of ecology to the cactus taxonomist”, Marshall (1953a) wrote that “*E. [Echinocereus] bristoli* was my first description and from it I learned the necessity of studying the conditions that may influence a change in morphology and now describe as new only plants that can be demonstrated to continue the characteristics that would justify publication after years of cultivation and after growing seedlings from them, to maturity.” Further, Marshall published *Arizona’s Cacti* in 1950, and Benson’s 2nd edition of *Cacti of Arizona* was published later the same year. Marshall (1953a) reported that “both books based on individual ecologcal studies made independently and without consultation by Dr. Benson and myself were in almost complete accord and both of them differed sharply from all published work in that we had both united a number of earlier published species into one species”. Yet in (1956) he reduced his new species to a variety of *E. pectinatus*. This revision is not currently adopted and as noted above, *E. bristoli* is recognized by many current authorities as a good species.

His interest in taxonomy is shown by a series of contributions which we have not individually itemized in the list of Marshall’s publications below, since many are quite short. The prestigious work entitled *Blühende Kakteen* was originally written by Schumann et al. (1900–1921) as an iconography or illustrations of cacti in large format consisting of 180 colored plates with accompanying text, issued in 45 parts. In the *Cactus and Succulent Journal* 18:(8) 1946 to 25:(1) 1953 the first 32 plates were reproduced in half tone reduced in size with the German text translated into English by Myron Kimnach. To accompany this there were *Classification Notes* by Marshall providing current taxonomy for the species illustrated. Sometimes he provided commentary or simply the modern name was provided.

Finally, to his credit, Marshall generally considered cacti as a subset of succulents, so he bucked the trend of the clumsy terminology such as ‘cacti and succulents’ or ‘cacti and other succulents’. Witness his book *Succulent Plants* (Marshall and Leach 1945) which, although prominently featuring cacti, the word “cacti” did not appear in the title. On the other hand, the initial title of his column in *National Horticultural Magazine* was *Cactus & other Succulents* in 1940 and in later years changed to *Cacti & Succulents*, which shows the progression of his thinking.

**HONORS, AWARDS AND POSITIONS**

CSSA President 1938–1941.
Awarded a Fellowship of the CSSA in 1941 and Permanent Fellowship in 1946.
In January 1942 he was unanimously elected as President Emeritus of CSSA and remained as such throughout his life.
Member IOS (International Organisation for Succulent Plant Research).
Honorary Vice President of the American Horticultural Society and an editor of the *National Horticultural Magazine* 1938–1953.
Director of the DBG, 1947–1957.
He was elected a Fellow of the American Association for the Advancement of Science in recognition of his standing as a scientist and as a spur to greater efforts in the future (Marshall 1955e).
Membership of: Honor of L’Association Francaise des Amateurs de Cactées et Plantes Grasses; the National Cactus and Succulent Society, England; the American Society of Plant Taxonomists; the Cactus and Succulent Society of Great Britain (Anon. 1947).

**EPONYMOUS SUCCULENTS**

Marshall was commemorated in the names of just two cacti. The first of these was *Neomammillaria mar-
shalliana Gates (1934) where the commemoration says that “The specific name is in honor of William Taylor Marshall of Los Angeles, Calif., who underwent great hardships on the discovery trip.” Note that when Gates published this species, Neomammillaria baxteriana Gates was described at the same time. Neomammillaria shalliana became Mammillaria marshalliana (Gates) Boed. ex Backeb. & F.M. Knuth (Backeberg & Knuth, [1936]). Hunt et al. (2006) later considered Marshall’s Mammillaria to be merely a synonym of Mammillaria petrophila subsp. baxteriana (Gates) Hunt.

Backeberg (1950) did not explain the etymology of his new genus Marshallocereus Backeb. However, later Backeberg (1953) published an article including a photo with the caption, in translation: “An idyll in the desert: Schwarz next to a huge Marshallocereus thurberi, representative of a genus I have named in honor of an eminent cactuist.” The genus Marshallocereus is now considered as a synonym of Stenocereus (Bgr.) Ricc. (Hunt et al. 2006).

MARSHALL’S LEGACY

Marshall left a substantial legacy in the world of succulents. Here are some of the highlights:

The Desert Botanical Garden in Phoenix, AZ is now a significant visitor attraction showcasing succulents (Figure 16). It houses 4,482 species in the living collection with 373,547 annual attendees (Desert Botanical Garden 2022).

The Sonoran Quarterly (1990 to 2020), the successor to Saguaroland Bulletin which he initiated in 1947, is a lasting memorial to him.

He developed a library at DBG emphasizing succulent and xerophytic plants.

Marshall established an herbarium at DBG for the preservation of desert plants and research.

The now biennial CSSA conventions were first inaugurated by Marshall in 1941.

His publication output was mammoth, of which his books are the most substantial; of these, Succulent Plants with its 3-D slides is truly unique.

Although much of his taxonomy is dated, some of his species and new combinations are still recognized.

He had a strong interest in the national parks and monuments and was dedicated to educating the NPS rangers and superintendents of desert parks in the habitats they were protecting.

Figure 16, opposite page. Iconic cardon cacti at DBG collected by George Lindsay, the first Director. They are located in front of Webster Auditorium in a grouping of plants he brought from Baja with permission, some of the Garden’s first plantings. A. Note the young cardons in the center and the center-left, as single stems about 4 to 5 feet tall. Image is dated 1946; this predates Marshall by just one year so we can presume it looked about like this when he arrived. (Photo: George Lindsay. Courtesy of the Schilling Library Archive, DBG.) B. Photo taken in 2022 but not at exactly the same angle as (A) because dense foliage currently blocks the view. So, Lindsay’s young cardons (A) became these giant cardons (B) according to the DBG living collections team. (Photo: Beth Brand.)

ACKNOWLEDGEMENTS

We are deeply indebted to the Desert Botanical Garden and especially to Beth Brand, Head Librarian, Schilling Library, for her invaluable assistance from which this publication has benefited significantly on many fronts including retrieving the Manning cartoon, patiently answering numerous inquiries, and providing research on the New Zealand CSSA Journal articles. Beth also read and commented on an earlier draft of this paper. We are especially grateful to The Schilling Library of the DBG for permission to reproduce Figures 8 and 9 and the manuscript pages for the proposed 2nd edition of Cactaceae, held in their archive. Beth also provided Figure 16B. Peter H. Raven Library, Missouri Botanical Garden for help with locating a relevant issue of The Cactus Digest and access to the Saguaroland Bulletin. The Iowa State University Library for research of The New Zealand Gardener back issues from volumes 9–15, resulting in the knowledge that there were no Marshall references in those issues. Sometimes negative results are important too! The Customer Care Team at The New Zealand Gardener for the research into their incomplete archives, again with negative results. Paul Foster (UK) is thanked for providing one of us (CCW) with a near pristine copy of Succulent Plants. The Biodiversity Heritage Library and the CactusPro websites were instrumental in providing access to a number of journals from Europe that would otherwise not have been readily available for research. One of our wives, Barbara Schultze, is thanked for careful reading and insightful comments on an earlier version of this publication.

Author contributions: CCW and DMS: investigation; writing – original draft, review & editing.

REFERENCES

Books and booklets by W.T. Marshall

Marshall, W.T. 1940. A contribution for a better understanding of xerophytic plants. Cactus and Succulent Society of America. 15pp., soft covers. [Unillustrated. Split into Chapters I–VIII. Chapter 4 was reprinted by the Henry Shaw Cactus Society in Cactus Digest 2 (12): 93–94, 1943.]


**JOURNAL ARTICLES BY W.T. MARSHALL**


Cactus and Succulent Journal 7: 156–158.


Marshall, W.T. 1942g. Correspondence between Marshall and...


Marshall, W.T. 1946e. Nous vous offrons notre collaboration. _Cactus (Paris)_ (1): 4. [As President of the CSSA he wrote that “We offer you our collaboration” to the Association Française des Amateurs de Cactées et des Plantes Grasses, in the first issue of their new journal.]


**OTHER LITERATURE CITED**


Desert Botanical Garden. 2022. dbg.org [accessed 10.2.23].


IPNI. International Plant Names Index, [accessed 10.2.23.]


