Biography of Ernst Ule (1854-1915)

by Hermann Harms

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Abstract

This is an edited translation of H. Harms's original biography in German, which was published as an expanded obituary: Harms, H. 1916. Ernst Ule. Nachruf. Mit Bildnis. Verhandlungen des botanischen Vereins der Provinz Brandenburg. LVII Jahrgang. 1915. pp. 150 to 184. Dahlem-Steglitz [7].

1 Translator's Preface

This edited translation of Harms's original German text was prepared by Matthias Schultz (Herbarium Hamburgense, Germany, matthias.schultz@uni-hamburg.de), Simon Mayo (Royal Botanic Gardens Kew, United Kingdom, simonjosephmayo@gmail.com), Ivanilza Moreira de Andrade (Universidade Federal do Piauí, Parnaíba, Brazil, ivanilzaandrade@hotmail.com) and Tiago Arruda Pontes (Universidade Estadual de São Paulo, Rio Claro, Brazil, tiagoarruda@yahoo.com.br).

Scientific names and the names of places have been left in their original forms. The format of literature citations has been brought into line with modern practice in the Reference section. Citations given by Harms in the Publications section are presented unaltered but with English translations of their titles added in square brackets. Within the Biography section, comments in square brackets are explanatory additions by the editors.

2 Biography

Ernst Heinrich Georg Ule was born on 12 March 1854 in Halle an der Saale. His father Otto Ule (born 22 January 1820 in Lossow near Frankfurt an der Oder, died 7 August 1876 in Halle) had made a respected name for himself through several popular natural history books (Das Weltall, 3rd edition, Halle, 1859; Die Wunder der Sternenwelt [1], Leipzig, 1861; Warum und Weil, Berlin; Die Erde und die Erscheinungen ihrer Oberfläche, Berlin, 1873-76, 2nd edition

[1] In the Foreword of the second edition of Otto Ule's Wundern der Sternenwelt (Leipzig, 1877) the editor, Hermann J. Klein, wrote: "With the completion of the printing of the new edition of this work the undersigned learned the shockingly sad news that the original author, Dr Otto Ule, had quite unexpectedly passed away. It was on the 6th August of this year

Figure 1: Ernst Heinrich Georg Ule

by W. Ule 1892); with the famous bryologist Karl Müller, a distant relative of the family, and Roßmäßler as coworkers, he founded the journal "Die Natur"in 1852, to which our Ule also later made some contributions. Ernst Ule very early showed a marked interest in the natural world: already in his childhood observing plants and animals was his greatest pleasure. A gift for the natural sciences was inherited by all the sons of Otto Ule; in addition to the older Ernst, the youngest son Willi Ule, today Professor of Geography at the University of Rostock, also made [scientific] research his life's work.

After Ernst had undertaken several courses at the Gymnasium of his home town, he devoted himself to the horticultural profession and attended the horticultural college at Proskau between 1874 and 1876. A decisive factor in his choice of profession was a long-standing mental illness – possibly the consequence of a bout of scarlet fever – which overtook him at the age of 14 during his school years and hindered his further scholastic career. Paul Sorauer, the noted plant pathologist and long-time member of our Society, was one of his teachers in Proskau and he described Ule as a thoroughly reliable and dutiful student. Since Ule, with his quiet nature, felt little attracted to the company of his fellow students, Sorauer invited him several times to his home and encouraged him to give special attention to plant diseases. Ule was already a very promising collector of fungi during his student days in Proskau, bringing to his teacher some parasitic disease fungi which the latter had not previously found. After graduating at the Proskau college he was employed for a short time as a gardener at the Halle botanic garden and attended at this time the lectures of Professors G. Kraus and J. Kühn, of whom the former taught botany at the University of Würzburg until only a short time ago, and the latter, the renowned leader of the agricultural institute in Halle for many years, died on 14th April 1910. In 1877 Ule moved to Berlin, where he obtained employment in the city parks department and at the same time enthusiastically continued his botanical studies. In the same year he joined our Society of which he remained a member until his death. It was here that his friendship began with our former president P. Magnus, who died on 13 March 1914, and who always retained a genuine goodwill for Ule; and his mycological interests, already awakened in Proskau, found in Magnus an enthusiastic supporter.

In May 1877, on the occasion of the spring collecting excursion of our Society (Oderberg) to the Pehlitzwerder peninsula in the Paarsteiner See, Ule discovered a new species of *Urocystis* on *Poa pratensis* that he later collected again in many localities around Berlin. Magnus named this new species in his honour *Urocystis Ulii* ([12] and Tageblatt d. Naturforscher-Versammlung München

(1876) when the aforementioned author was fatally struck by falling masonry on the occasion of a fire in Halle where he had arrived as commander of the volunteer fire brigade; he died during the following night, at 56 years of age. With his departure from our midst, we lost a man whose wide vision and magnanimous disposition won him numerous admirers throughout Germany. Dr Otto Ule was of a truly noble character who unlike some others, did not keep the abundant treasures of his learning to himself but generously shared them with all those who likewise harboured a thirst for knowledge. And he was a man of genuine goodness, who strove to help others wherever he could, without considering either personal advantage or his own well-being. And thus he left us in the exercise of an unselfish and self-imposed task."

1877, p. 199). Ule subsequently turned his attention especially to the grass-inhabiting smut fungi. The first full communication we have from him concerns some new species and host plants of the Ustilaginaceae, which he reported during the meeting of our Society on 25th January 1878 (he described here two new species of *Sorosporium* that he discovered around Berlin, *S. Aschersonii* Ule on *Helichrysum arenarium*, *S. Magnusii* Ule on *Gnaphalium luteo-album*; [25] and [24]). He would later apply this early awakened interest in the collection of fungi to a much greater degree in the tropics.

In 1879 we find Ule in Koburg. On the advice of K. Müller, he returned to school there in order to obtain a "Reifezeugnis" university entrance qualification that would permit him to take up university studies. However this renewed school attendance turned out badly. During the Christmas period of 1880 he was assailed by a new and more serious attack of his previous mental disorder and this once more prevented him from completing his school career and forced him into a mental institution, where he had to remain for about two years. Eventually he escaped from this place, perhaps sensing the beginning of his recovery. After weeks of wandering under the most wretched conditions he gave himself up to the police, and after a severe fever, brought on by the strain of this experience, he made a full recovery in 1883. Since, as a result of his long illness, he had fallen far behind in his career, he felt the need for new surroundings where he hoped to forget his past sufferings. He came up with the idea of emigrating to Brazil, whither he travelled in 1883. The second part of his life then began, which we may consider as lasting until 1900; it was the period when he lived almost uninterruptedly in Brazil, which became his second home and the botanical exploration of which remained henceforth his life's work. Shortly before his departure he published in Halle a paper dated April 1883 *Beitrag zur Kenntnis der Ustilagineen* [26], the result of his observations around Berlin and Koburg.

He took up residence in the state of Santa Catharina and in the first few years and often in difficult circumstances, he earned his living mainly as a private tutor. He remained in Sta. Catharina until 1891, apart from a stay of several months in Rio de Janeiro during the summer of 1887 (May to October). He settled first in the towns of Joinville and São Francisco (1883-1885) and then in Itajahy (1885-1886), whence he visited the colonies of Blumenau and Brusque, then in Desterro [=Florianópolis] (1886-87), Blumenau (Oct. 1887-88) and in Tubarão (1888-90). At the end of November 1890 he took himself off to Minas [=Lauro Müller] in Sta. Catharina and explored the Serra Geral between December 1890 and April 1891. Everywhere he went, he spent his free time in zealous botanical collecting. Here he first of all continued his cryptogamic investigations; already in 1884 it was reported in our Proceedings [1] that impressive botanical collections by him had arrived in Germany from southern Brazil which contained numerous fungi. Dr G. Winter, the well-known mycologist and founder of the journal Hedwigia, had encouraged him to collect Brazilian fungi. In 1892, O. Pazschke, his long-time friend, published a first list of fungi collected by Ule in 1883-87 [14].

After he moved to Rio de Janeiro he was employed at the city's National

Museum first as "Naturalista viajante" from 1891, and then from 1895-1900 as Subdirector of the Botanical Department. His time in Rio de Janeiro seems to have been one of the most enjoyable periods of his life, because he liked to talk about it later on. During this time he came into closer contact with the resident men of learning, among others the respected pharmacologist Th. Peckolt (died 21 September 1912 at the age of 90), with whom he had much contact. It was here that he had first found a more secure career position in which he could at the same time satisfy his scientific interests. In 1900 he lost his position through political machinations; while he was in Manaus preparing the first of his Amazon expeditions inspired and supported from Germany, someone accused him of working for foreign interests. In 1898-99 he returned to Germany for the first time and worked for a considerable period at the Royal Botanical Museum in Berlin, determining his collections. After 1900 a third phase of his life began; thenceforth he worked as an independent researcher until the end of his life. This was the time of his major research expeditions, interrupted regularly by longer or shorter periods in Germany to work on his collections.

During the years 1883-1891 and later when in Rio de Janeiro, he undertook numerous longer and shorter excursions in the local or more distant surroundings of his places of residence. While in São Francisco he collected on the Pão d'Assucar and the Serra das Laranjeiras and amassed a collection of 200 Phanerogams and numerous mosses and fungi, during the years 1883-1885. [While] based in Desterro [Florianópolis] he travelled to the Serra S. Antonio, Lagoa, Estreito, S. José and the Serra do Mar and [when] based in Tubarão he visited the marsh areas at Congonhas, the campos of Laguna, the lowlands of the Rio Capivary, the montane forests of Pedras Grandes and especially the Serra Geral, a mountain range which he explored from December 1890 to April 1891 from Minas to the source of the Rio Uruguay and the borders of the Province of Rio Grande do Sul. At this time he made an excursion to the Italian colony of Nova Venezia on the Rio Mailusia, about which he made a special report [27]. From Rio de Janeiro he climbed the Serra dos Orgãos several times, and in addition he went repeatedly to the region of Nova Friburgo (Pedra do Conico, Serra Alto de Macahé). At the beginning of 1892 (from the end of January to the middle of April) he travelled in the Province of Minas Gerais based in Ouro Preto, visiting the Serra do Itacolumy, Serra de Caraça, Serra de Itabira do Campo. Among the smaller journeys which he made in the period up to 1900, two especially must be mentioned since he made them the subject of his own publications.

Between 19 February and 30 March 1894 he made a longer visit to the Serra do Itatiaia (on the borders of the States of Rio de Janeiro and Minas Geraes) at 2090 metres above sea level. He was there a second time between December 1895 and January 1896, this time reaching the Agulhas Negras up to the summit Itatiaiassu at an altitude of almost 3000 m. He has reported at length on the first visit [33]; on this occasion he discovered the cleistopetalous Melastomataceae which he later described in depth ([33] p. 199). Attention should be drawn especially to the comments in his report on the epiphytes. He disagreed with Schimper's view that the higher [= ?vascular] epiphytes do not reach the higher

mountains of Brazil, since this did not accord with his observations. In the Serra do Itatiaia at least three Bromeliaceae, three Orchidaceae, two Cactaceae, and five vascular cryptogams occur at around 2,000 m elevation as epiphytes and a [species of] *Vriesea* is even a feature of the landscape's characteristic appearance. According to him, epiphytes need air saturated with moisture which they receive in the coastal mountain ranges that are subjected to moist sea winds, but not in the colder climates of higher latitudes. Here the yield in bryophyte collections was great; in 1898 K. Müller, his teacher in bryology, worked up the rich collection in a special paper, in which mosses from other parts of Brazil are also treated [13]. O. Pazschke enumerated the fungi of this journey [15].

In October 1899 Ule stayed in the botanically very interesting region of Cabo Frio, east of Rio de Janeiro; he published an outline of the vegetation of this area, describing in particular the various forms of the restinga, [composed of] heath-like, low-standing thickets [44].

The first large-scale research expedition that Ule undertook during these years took him to the inner highlands of Goyaz (Planalto central do Brazil). In 1892 the Brazilian government organized an expedition to this region to discover a suitable site for a new capital city [28]. Ule participated in this expedition as botanist [2]. The region that was being considered for the foundation of the capital city lies in the State of Goyaz between the towns of Meiaponte and Formosa on the watershed of the Rio Tocantins and the Rio Paranahyba, respectively of the tributaries at often about 1,000 m. above sea level. The point of departure of the expedition was Uberaba in Minas Geraes which Ule left on 29 June 1892 and to where he returned on 7 March 1893 after a journey of more than 8 months. During this journey he collected 450 numbers of Phanerogams and 310 numbers of Cryptogams. The former group were worked up by P. Taubert with the help of other authors [29], [30], [23]; the bryophytes were worked on by V.F.Brotherus [4] and the fungi by P. Hennings [8]. In Taubert's treatment there is also a description of the flora and vegetation by Ule. Ule was only able to work on the rich collection of parasitic Rafflesiaceae during the last months of his life [80].

Apart from his prolonged collecting activity, Ule carried out studies of floral biology in Brazil, to which he was strongly stimulated by the diverse flora. At all events, his acquaintance with Fritz Müller – the "Prince of Observers" as this researcher has been called – in Blumenau was fruitful in this regard, as he was a true friend and scientific counsellor to our Ule during many years. In the great compilation on Fritz Müller's scientific work, now published by Alfred Moeller, Ule collaborated by translating into German those works of the great biologist which had been published in Portuguese (Fritz Müller, Werke, Briefe und Leben; Jena, Gustav Fischer, vol. 1). From Rio de Janeiro he submitted several articles for the Berichte der Deutschen Botanischen Gesellschaft. In 1894

[2] In the years 1894-95 the Brazilian government sent a second expedition to Goyaz, in which A. Glaziou took part as botanist (A. Glaziou, Noticia sobre botanica applicada et Resumo numerico das especies de plantas colhidas, in L. Cruls, Commissão de estudos da nova capital da união, Rio de Janeiro 1896, p. F.3 - F.16; see I. Urban, Fl. brasil. I. 1. [1906] 28).

he discovered *Purpurella cleistopetala* (later named by him *Itatiaia*), a plant of the Melastomataceae with closed flowers [31], on the Serra do Itatiaia [32], [36], and thus provided an excellent example of the occurrence of cleistoflorous, or better, cleistopetalous flowers. The term "cleistopetaly" is ascribed to him; Kirchner (Lebensgesch. der Blütenpflz. Mitteleuropas I, 1, [1908] 46) defined the phenomenon as permanent closure of the perianth, unconnected with cleistogamy, in contrast to chasmopetaly. Ule furthermore found this character in other genera in Brazil, as for example in the Apocynaceous genus *Dipladenia* (*D. pendula* Ule [35]); in particular he studied its occurrence in the Bromeliaceae where he detected it in species of the genera *Nidularium* and *Aechmea* [34]. His understanding of this floral form, once awakened, led him to the discovery of similar cases later in the Bignoniaceous genus *Amphilophium*, in which he observed two cleistopetalous species (*A. mutisii* H.B.K. and *A. aschersonii* Ule; [51]) in Peru. He sought to understand the peculiar biological nature of the Bromeliaceae, [a family] so richly diverse in Brazil, by thorough study; he repeatedly described the habitat conditions of these very interesting plants, their organization and their floral structures. He always had a special liking for this plant group and he enriched it by the large number of new species he discovered and also for the most part described. The stimulus to undertake research on the Bromeliaceae obviously originated from Fritz Müller, who himself published many articles on species of this family, works whose lasting value rests on [the author's] painstaking field observations. Ule was able to publish the posthumous notes of the great biologist on the hybrid Bromeliaceae the latter observed at Blumenau; [Ule] himself discovered a new hybrid *Nidularium cruentum* × *utriculosum* in the restinga of Copacabana. However, when describing this hybrid he expressed strong opposition to the view that new species can arise from hybridization [43]. In addition to the Melastomataceae and Bromeliaceae, he made, during his residence in Rio de Janeiro, a particular study of the Aristolochiaceae of that region, [a family] whose bizarre floral forms were bound to excite such a keen and well-trained eye ever-renewed examination [39], [38]. When he came to Germany in 1898, he compared here the observations he had made of the native species in Brazil with those he was able to make in the Halle Botanic Garden on *Aristolochia clematitis*. In Rio de Janeiro he set up fertilization experiments on these plants; he was thus able to breed a very peculiar hybrid between *A. brasiliensis* Gomez and *A. macroura* Mart. Later on he continued his studies on Aristolochiaceae in systematic works [37], [42], [45], [41] as he came across a large number of new species during his expeditions to Amazonas. The epiphyte-rich forest of the Brazilian coastal mountains induced him to study this life form in its geographical occurrence and ecological conditions – among other examples, he especially investigated the increasing level of epiphytism of various *Utricularia* species adapted to grow in association with Bromeliaceae. He also described the epiphytic species of *Dipladenia* and Begonia [40], [46]. In all cases, he sought to establish the connections between the species growing as epiphytes and those occurring on the ground or as climbers. He added to the knowledge of saprophytes through his description of a new species, *Triuris mycenoides* [46], p.254, which he discovered near Nova

Friburgo. Of the greatest interest, however, were the observations he had already made during these years on the connections between ants and ant plants. As will be later explained, he opposed Schimper's theory and we find the initial stages of his own interpretation intimated already in 1900 [[46], p.258].

In 1899, at the suggestion of Karl Schumann our former long-serving chairman (died 22 March 1904), an expedition was organized with the support of the businessman Nic. Witt in Manáos and Senator Dr. Traun in Hamburg, with the aim of studying the geographical distribution and ecology ["Lebensbedingungen"] of rubber plants as well as the methods of harvesting rubber [practised] in the Amazon region; along with this, however, other botanical questions were envisaged, the biological relations of the flora of the region and its plant formations were to be studied, plant collections were to be made from the regions explored and seeds were to be obtained of the different [kinds of] rubber trees with a view to carrying out field trials in our colonies. The leadership of this undertaking was entrusted to the young botanist Dr Kuhla, at that time Assistant in the Botanical Institut at Marburg; he travelled to Manáos in June 1899 but only one month later he died there of yellow fever. Since Ule was staying in Germany that same year, he was approached as someone who was a long-time resident of Brazil and had travelled the length and breadth of the southern and central parts of the country. He was ready for the task and a contract was signed between himself and the Director's office of the Botanical Museum in Berlin [48], [49], [50], [52], [53].

On 22 June 1900 he left Rio de Janeiro and arrived in Manáos on the 25 July. On the advice of Consul Dusendschön in Manos, who later was always very supportive of him, he first visited the Rio Juruá, a right-bank tributary of the Rio Amazonas. His departure by steamer ensued on 15 August and he arrived in Marary on the Juruá on 31 August. From here on Ule explored the extensive rubber forests of this river basin and apart from Marary he stayed in the settlements of São Romão, Bom Fim, Santa Clara and Itapoana (at the mouth of the Churuan). It was not until 5th December that he travelled back to Manáos in a 6-day steamer journey; there he stayed for a longer period, in order to organize his collections. In the region of the Rio Juruá he had focussed his attention especially on the genera *Hevea*, *Sapium* and *Castilloa*, which there were the most important rubber trees. On 27 March 1901 he undertook a new journey up the Rio Juruá, this time with the purpose of penetrating the upper reaches of the river; after passing the tributaries Rio Taranqua, Rio Gregorio, Rio Moa, Rio Juruá Miry, Rio Minas Geraes, he reached the Rio Tejo, at the mouth of which (Bocca do Tejo) he arrived on the night of the 25th April after many difficulties; this district lies not far from the Peruvian frontier. After a longer stay on the upper reaches of the Juruá, he travelled downriver on 4th May and then visited the river basin of the Juruá Miry (the small Juruá) until 8th October; on this day he returned to the harbour on the Juruá Miry where he remained until 15th October to organize his collections. On 19th October he travelled to the lower Juruá; he stayed in the settlement of Fortaleza until 18th November so that he could then return to Manáos in about 9 days, where again he remained for a longer period. During this journey to the Juruá region he

had plentiful opportunities to explore different stands of rubber and accumulate extensive collections. Now he decided also to become better acquainted with the Rio Madeira. Before this, however, he made a short excursion from Manáos up the Rio Negro to São Joaquim (28 January to 6 February). Then he set out on the longer journey. On 25 February 1902 he travelled from Manáos up the Rio Madeira; on 1st March he arrived in Santa Maria de Marmellos on the lower Madeira, from where he undertook a journey marked by many difficulties and accidents up the Rio Marmellos with detours to the Rio Branco and Rio Macaco. After the return journey to Sta. Maria de Marmellos Ule took a ship to Manáos on 8th May, which he reached two days later. Here he remained for a month. The main objective of the expedition, the exploration of the rubber forests, had essentially been accomplished, as far as it is possible to say so for such a difficult undertaking; in addition to this, the resources available were mostly spent. The explorer wished now to bring his journey to a fine conclusion, and decided to make a detour to the west as far as the slopes of the Andes, at his own expense. On 10 July 1902 he once again left Manáos and travelled by steamer to the Peruvian border at Leticia, where he disembarked. After a 14-day stay there, he continued his journey to Iquitos (9 July). On 2 August he continued his steamer journey to Yurimaguas on the Rio Huallaga, where he remained for 15 days; in these localities he collected and photographed zealously. Then on 27 August he made a 3-day canoe trip with Indians up the Rio Huallaga; a 5-day journey then ensued up the small tributary called the Cainarachi, as far as it was navigable. At the final point (the Pongo de Cainarachi) he made a halt of 15 days in a very interesting area; from here on Ule went with 9 bearers over the mountains (Cerro de Hotanahui, Cerro de Ponasa, Cerro de Escalero) to Tarapoto, where he arrived three days later to begin a several month residence. From Tarapoto he now made numerous excursions in the different plant formations of the very diverse hinterland (e.g. to a mountain of rock salt), so that he was able to amass a very complete collection of this part of the eastern slopes of the Andes. On 3 March 1903 he set out from Tarapoto with his whole collection and took up his abode in S. Antonio on the Cumbaso, a small place inhabited mostly by Indians. He then decided to make the return journey to Germany. On 28 March he crossed the mountains again to the Pongo de Cainarachi and from there he travelled by canoe to Yurimaguas and then by steamer to Iquitos and Manáos. On 15 May he left for Hamburg where the explorer arrived on 23 June 1903.

The expedition was rich in collections and achievements. Ule had got to know a large part of Amazonia: the surroundings of Manáos, the Rio Juruá up to its upper reaches, the lower reaches of the Rio Negro, the Rio Madeira up to the Rio Marmellos, and additionally - a result of great importance to plant geographers - he had become acquainted with the transition zone from the Hylaea to the Andes, and within the Andes region, the very diverse surroundings of Tarapoto. What was now needed was to work on the treasures he had amassed. Ule settled down in Berlin and worked at the Botanical Museum on the scientific utilization of his collections, in association with the botanists of that institute. In accordance with the aims of the expedition, the results obtained on the rubber question had to be published first. This took place after the determination

of the collected specimens of rubber trees, in a monograph entitled "Rubber collection and rubber trade on the Amazon river" [58], [57], [56]. The explorer had discovered several new species of the genera *Hevea*, *Sapium* and *Castilloa*, among others, *Castilloa Ulei* Warb., named after him, which supplies the so-called Caucho. The numerous new species of other families discovered by him were described in various papers; he himself worked on only a small part of these, rather entrusting their treatments to recognized specialists. The collection of Cryptogams was particularly extensive and numerous new species of fungi and mosses were recognized in his collections, the former described mainly by H. Rehm [18] and P. Hennings [9], [11], [10] and the latter by V.F. Brotherus [5]. However, [his collections also] yielded a considerable increase in new and singular taxa of Phanerogams [16], [66], [71]. After working out the taxonomic results of his material, Ule himself was able to give an overview of the plant formations of the Amazon region in 1907-8 in two longer papers [65], [70]. These studies, next to those of Jacques Huber [64] (director of the botanical garden of Pará, died 18 February 1914) are the best foundation for our knowledge of the greatest rainforest region of the world.

In addition to plant geographical problems, he was especially concerned during these productive years with a biological question to which he had earlier devoted his attention in south Brazil, namely the symbiosis between ants and plants. With his keen powers of observation, he was able to discover in the Hylaea [= Amazonia] the so-called ant flower gardens [47], on which he had already reported in March 1901 from Manáos: the ants create suspended gardens on bushes and trees in which they sow, raise and cultivate certain particular flowering plants as protection for their dwelling places. These plants, so far detected only in ant gardens, Ule named ant epiphytes. The observations made during his expeditions led him to a view of the relations between ants and the plants which they inhabit which differs essentially from that which Schimper had first maintained. Ant plants are generally understood to be those which afford habitation and shelter to ants in cavities in the stem and branches or in tube-like spaces within petioles and leaves and which furthermore occasionally offer these animals food by means of special secretions. There is a large number of such ant plants in the Hylaea. Schimper, mainly on the basis of observations of southern Brazilian *Cecropia* species, supposed the existence of a symbiosis between animal and plant in the sense that the former found habitation and nutrition in the plant, and the latter obtained protection through the agency of the animal against leaf-cutter ants; he further presumed that the cavities of ant plants owed their existence to [natural] selection which is caused by the protection from leaf-cutter ants which the plant gains through the presence of the resident ants. Ule on the other hand, based on his own observations in Amazonia, maintained first of all that the protection against leaf-cutter ants that the resident ants could offer to their host plants was frequently unnecessary and often not demonstrable. He was of the opinion that the cavities should be presumed pre-existent, and not to have come about by selection with help from the plant-protecting ants. The impetus for the association comes from the ants, which colonize those plants in which they find suitable cavities. Protection of

the plants by ants against leaf-destroying animals is certainly to be supposed is some cases and may have been an advantage to the plants in the struggle for existence. But the importance of this protection is not so great as to cause the evolution of specialized structures. These remarkable cavities are to be explained by deeper causal factors founded within the structural organization of the plant [54], [60], [55], [61], [62], [63].

The period 1903-1906, during which he worked in Germany on the results of his Amazon expedition, was interrupted only by smaller journeys within central Europe. Thus in August 1904 he was in the Carpathians. In June 1905 he took part in the International Botanical Congress in Vienna and organized an exhibition there of his photographs from Amazonia and of his exsiccatae collections, for which he received a second prize (Verhandl. Internat. Bot. Kongr, Wien [1906] p. 80). In the meantime he began to plan a new research expedition and this time his goal was the northern part of the Amazon region, the "campos" region of the Rio Branco from where he aimed to penetrate the 2,600 m high Roraima mountains on the frontier between Guyana and Venezuela. He succeeded in obtaining a grant for this purpose from the Royal Prussian Academy of Sciences in Berlin, and thus in the spring of 1906 he was eagerly making his preparations. However, for the time being this plan could not be carried out. A Bahian rubber syndicate based in Leipzig proposed that he first travel to Bahia to make an estimate of the rubber yields of estates there. The journey was judged to require four months. Ule accepted the commission and travelled to Bahia on 1 July 1906. It was clear from his visits to the rubber estates that the splendid promises of the syndicate's prospectus were incorrect and that the estates could not produce even a hundredth of the promised rubber yield. Ule's official task was thereby completed and he made ready to travel on to Manáos. However, he received a reply to his telegram to the syndicate requesting him to await further written instructions. He was then delayed by promises [from the syndicate] until finally he was left without further information. He made use of this time to study the rubber districts of the states of Bahia and Piauhy and in zealous plant collecting. He travelled back to Germany in March 1907, and there sued the company. He reached a settlement with them, which they did not honour and finally he succeeded in his demands by appeal. During this sometimes very annoying period, which was clouded by unproductive transactions and time-wasting legal disputes, he nevertheless worked diligently on the evaluation of his results from Bahia that were much more valuable than had been expected. The knowledge that he had gained concerning the rubber-producing *Manihot* (Maniçoba) species of that region and their market value were set down in a separate longer work [72], [74]; he had discovered there several new species of that genus ([67], cf. also [77]), of which *M. dichotoma* supplies the so-called Jequié-rubber, *M. heptaphylla* the major part of the São Francisco rubber and *M. piauhyensis* the Piauhy rubber. Systematics was enhanced by his paper Contributions to the Flora of Bahia [73] and plant geography by his description of the Caatinga and Rock formations of that mainly xerophytic region [68], in which he was able to discern a series of strange new species of Cactaceae [69]. During this trip to Bahia, Ule travelled through the following places. In Au-

gust 1906 he visited the region between Serrinha and Soura [= Soure] in the northeast of the state, to the exploration of which the syndicate had given special emphasis. In September he travelled through Cachoeira and São Felix to Tambury and then to Maracás, which is situated at 1000 m altitude. At the beginning of October he went to the village of Calderão [sic!], 30 km distant. After climbing the Serra do Sincorá, he returned by the same route and arrived back in the city of Bahia [= Salvador] in November. He now wanted to get to know the regions deep in the interior along the Rio São Francisco, where an exceptional species of *Manihot* was thought to occur. On 12 December he set out by train to the villages of Alagoinhas and São Joazeiro on the Rio São Francisco, from where he travelled by steamer to Remanso. With a small expedition mule troop he visited the small town of São Raimundo in the state of Piauhy situated 150 km further on, mainly in order to look for stands of *Manihot* in the Serra Branca. On 20 January 1907 he returned to Remanso and then travelled in a small steamer upstream to Chique-Chique. From there he went to the Serra do São Ignacio 60 km away. After 8 days he returned to Chique-Chique and from there to Bahia [= Salvador].

On 1 August 1908 Ule departed from Hamburg and began his longest research expedition, which would [also] be his last (no. 86). After arriving in Manáos (1 Sept) and some time making preparations, he embarked there on 23 September and travelled up the Rio Negro, then taking its left-hand tributary, the Rio Branco, and thus passing the Santa Maria station and the mouth of the Catrimani until he reached Caracarahy, where the rapids begin. From then on he had to travel in small boats, because the shallow water level of the river meant that the steamer could progress no further. After overcoming the rapids, notorious there for the predominance of malaria, Ule travelled along the high Serra Grande de Carauma with his companions and on 4th October he reached the village of Boa Vista, where he stayed for longer in order to study the vegetation of the Campos. After an excursion of several days on the Serra Grande de Carauma he fell ill with malaria fever. When his condition improved he travelled on 30 November in a boat from Boa Vista to S. Marcos at the mouth of the Uraricuera, a righthand tributary of the Rio Branco; here he also suffered further attacks of fever with accompanying symptoms such as swellings on his legs and a cough. After taking quinine, the attacks decreased and he was able to walk around the environs. Above all he wanted to penetrate further into the highlands of this campo region on the upper Rio Surumu, inhabited by indians. After a brief return journey to Boa Vista in order to obtain wares to exchange with the indians and provisions, he departed on 20 January 1909 with the chieftain Ildefonso and two indian oarsmen from S. Marcos up the broad and beautiful Rio Tacutu and the next day he entered the mouth of the Rio Surumu. On 23 January the difficult journey through the rapids began and after seven days they reached the mouth of the Cutingo [=?Contigo] and the home of chief Ildefonso. After a rest day they went further up the Surumu by canoe to the bleak Serra do Sol. From here on they marched overland to their destination at the Serra de Pracauá. Here, in a wide valley surrounded by mountains, Ule settled down in a hut lent to him by the indians, where he

made himself at home for a longer period in order to undertake shorter and longer excursions in the mountains. He twice climbed the 1,100 m high Serra de Mairary. New attacks of malaria and severe leg wounds finally forced him to consider the return journey to Manáos and so he arrived again in São Marcos on 9th April; from there he travelled on 14 April in eleven days to Manáos, in order to get medical treatment. After four weeks his leg wounds had healed and he prepared himself for a second journey to the region of the Rio Surumu, so that if possible he could climb the higher mountains. On 1st June he departed from Manáos by steamer. This time his destination was the Serra do Mel (some 30 km west of the Serra de Pracauá). After overcoming many hardships during the journey up the Surumu and the trek overland, Ule arrived in July in a small settlement of indians of the Macushi tribe in the Serra do Mel, where again he stayed for a longer time as a base from which to make excursions; the Serra do Mairary was visited again and the plains between these mountains and the Serra do Mel, which are a long way from the Surumu and are watered by its tributary streams Mniam and Yalbury. His stay in this region lasted until September. Ule then decided to climb the Roraima mountains. In October he went first to São Marcos in order to bring his collections there and to obtain supplies. After returning to the Serra do Mel he first undertook a five-day excursion into the Serra do Paracaima and then he made preparations for the journey to Roraima, which on 27 November was begun with the chieftain Ildefonso as leader and 12 Arecuna indians as bearers. At first he went along the valley of the Mniam in the direction of the Serra do Mairary. Then the region of sandstone mountains on the frontier with Venezuela was reached and they came nearer to Roraima, now visible in the distance. After crossing the Cuquenan, a tributary of the Orinoco, the trek continued in the vicinity of the river as far as an indian village which lay at about 1,200 m elevation and three hours from Roraima. In order to be able to collect most conveniently on Roraima, Ule installed himself in a forest hut situated at about 1,900 m on the slope of the mountain where the real ascent begins. He stayed there for seven weeks and climbed to the high plateau four times. In February 1910 he set out on the return journey to Manáos, which he reached on 5th April after repeated stops at the intervening localities (Serra do Mel, S. Marcos). He stayed in Manáos again for a while in order to organize his collections and prepare for a new journey.

The Commercial Association of the Amazon in Manáos proposed that he undertake a journey in the region of the Rio Acre to investigate the rubber forests of that region. This expedition was to be carried out only in November or December since travel along the Rio Acre was not possible before this. In the intervening period Ule undertook some smaller journeys. He established himself at Cachoeira Grande near Manáos and again explored the rich flora of this district, almost inexhaustible in novelties [= new species]. He also intended to make an expedition to the high mountains of the Rio Catrimani. However, when he reached the mouth of this river, he had to return to Manáos, since he became ill and did not want to abandon the Acre expedition. He arrived again in Manáos on 11th August. The doctor found his health so weakened that he urged him to take a health cure in the State of Ceará, which Ule acted on. A

three-week stay in the Serra de Baturité of the State of Ceará, during which he avidly collected in this mountain range, allowed him to regain his strength. He returned to Manáos on 25 November and on 23 December he travelled up the Rio Purus, a right bank tributary of the Amazonas, into the region of the Rio Acre, reaching its mouth on 7th January 1911. The region of the Rio Acre previously belonged to Bolivia, but later a large part of it was given over to Brazil. The journey upriver from Manáos to the terminal station at Paraguassu lasted 59 days, on account of longer or shorter stops at intermediate stations, often made necessary by the temporarily low river level. The most important stations visited were Porto do Acre, Empresa, Xapury, Cobija on the Bolivian frontier (from there the right bank of the Acre belongs to Bolivia), Buenos Aires, Volta Alegre, Nova York, and finally Seringal Paraguassu (11 Febr.). The Bolivian border station with Peru, Tacna, lies diagonally opposite on the other bank of the river a little further upriver and serves in general as the terminus of the steamer voyages. From there on Peru begin on the right while Brazil continues on the left bank. On 3rd March Ule moved to the house of Messrs. Berta and Stegelmann, which was situated about 3 hours boat-journey up the Paraguassu on the right, Peruvian side of the river. Ule remained in this advanced post until October and employed his time in making many excursions into the forests. On 6th November he began the return journey but reached Manáos only on 21 February 1912, because once again in various places long delays to the journey were unavoidable due either to insufficient water levels or to mechanical problems. On 17 March 1912 Ule departed from Manáos; on 10 April he arrived in Berlin. This last journey had in all lasted three years and $8\frac{1}{2}$ months.

He was now fully occupied with the organization and working up of his extensive collections. A very large part has already been determined, as shown by the contributions so far published and edited by R. Pilger [17]; however, a not insignificant remainder still await attention. Ule himself participated much more than previously in the determination of the plants, since he planned to write in the forseeable future phytogeographical descriptions of the regions through which he had travelled. Unfortunately he was not carry out this plan; he [was able to give] only a short outline of the vegetation of Roraima which he [had] hoped to develop into a full overview of the flora of this very interesting region (no. 89). Since he had once again become acquainted with new parts of the Hylaea, he was urged to bring together his observations of Amazonia into a synoptical description. His last two larger works, which together are his most accomplished, are concerned with this region which for him was the centre of his scientific interests; the one seeks to capture the floristic essentials of the Hylaea, and the other summarizes once more all his biological observations in these primary forests, to the exploration of which no-one since Spruce has contributed more than he [79], [78].

In his last years Ule lived in Steglitz and here he led a secluded life that was wholly given up to the work on his collections. Almost every day he came into the Botanical Museum in order to work assiduously for several hours; he complained jokingly about "forced holidays" when the Museum remained closed

because of a public holiday. Only seldom did he miss the meetings of our Society and those of the Deutsche Botanische Gesellschaft; as previously, he often gave lectures at these meetings in more recent times. He enjoyed taking part in excursions; because of his years in the open air, he needed relief when he had spent much time in closed rooms for the sake of his work. He was for many years a member of the "Gymnastics Group for older members of the Berlin Gymnastics Club", in whose exercises he actively participated; his father had also been a keen gymnast. He followed the political development of our Fatherland with the liveliest concern; in his conversations he always expressed his inclination towards liberalism. He ardently hoped for the victory of German arms, from which he also anticipated an improvement in some defects of domestic politics. He was a man of strict principles and sincere and upright character.

After his emigration to Brazil Ule enjoyed excellent health; his tough body overcame rather easily the hardships of many journeys. Whoever made the acquaintance of the quiet man with his shy character would hardly believe him capable of carrying out such research expeditions; but with perseverance and an ability to wait calmly for the right opportunity, Ule reached his goal perhaps more successfully than some others. Occasionally he talked of going once more to Brazil once he had completed his work on the previous expedition, with the aim of roaming through the more healthy regions of the south, where he had begun. The last expedition, however, during which he had suffered often from malaria and leg wounds, had somewhat exhausted him so that in the summer of 1912 he went to Kissingen to recover from a liver ailment. His health then improved quickly and in the summer of 1914 he undertook prolonged climbing expeditions in the Alps, which were only called off with the outbreak of the [First World] War. Only a few weeks before his death he began to complain of weakness, which he himself put down to a mild influenza. Finally however, a change became evident in his demeanour and facial expression which were puzzling to his colleagues, such that he was urgently advised to consult a doctor, although he himself was making ready for a holiday in the Alps to recuperate. Then quite suddenly serious symptoms of paralysis appeared which made it at first difficult and then impossible for him to speak or take food. On 9 July he had to be taken to the Lichterfeld District Hospital, where he died on 15 July 1915, without having fully returned to consciousness.

When we survey the life work of our researcher, we must first of all remember the extensive collections, which are among the most valuable which we possess from Brazil. The number of plants collected by him runs to about 17,000 numbers or somewhat more. Of these, somewhat more than 10,000 are allotted to the separately numbered Phanerogams (including the Pteridophytes); the remainder consist of Cryptogams, which are again numbered by group (2500 mosses, 666 liverworts, 3527 fungi, 366 lichens, 46 algae). The large number of Cryptogams is remarkable, especially of Bryophytes and fungi, both groups in which he had shown a special interest at the beginning of his career. He had distributed collections of exsiccatae of Bryophytes and fungi more than once [2], [3], [59]. Just because of his preference for Cryptogams, he accomplished very much in [increasing] our knowledge of the richness of these plants in South

America. The very painstaking treatment [?preparation] of all the specimens is especially to be praised. The Berlin Herbarium has the greater part of his collections; the remaining specimens of his last collection found in the materials he left, as well as some earlier and smaller collections (European and Brazilian plants; Cryptogams from various regions) as well as his botanical library have been entrusted in gratitude to the Berlin Botanical Museum by his brother, Prof. Dr. W. Ule. Ule had earlier sold the first part of his Phanerogam collection up to the year 1900 to the Botanical Museum in Hamburg, which in addition also possesses the largest part of the later collections. The Berlin Herbarium has obtained a part of the Phanerogams of the Santa Catharina collections through the Herbarium Hieronymus; the whole of the collections from the year 1900 onwards are at Berlin.

Ule also collected 1,274 galls, the first series of which he deposited at the Zoological Museum in Berlin; they were worked up by Ew. H. Rübsaamen [19], [20], [21]. In several cases he himself reared flies from the galls; this enabled him to discover a large number of new genera and species. He furthermore collected on his Amazon expeditions a number of ants which Forel [6] and Stitz [22] have described (14 new species of which four were named after Ule, and several new varieties). He deposited at the Berlin Zoological Museum a number of exquisitely prepared ant gardens; our Botanical Museum also possesses some examples of this biological phenomenon. On his last expedition he also collected ethnographic objects (about 400 numbers), of which the Berlin Ethnology Museum received the first series and the Ethnology Museum of St Petersburg received the second.

Ule is in the first rank of researchers who have furthered most our knowledge of the very rich flora of Brazil. We Germans can pride ourselves with justification to have been outstanding and perhaps the most important participants in the floristic exploration of this country, from Martius's expedition and his foundation of the Flora Brasiliensis, to the completion of this monumental work in our own days by I. Urban. However, no botanist who travelled in Brazil, including Martius, became acquainted with so many regions of the country as Ule. To be sure, he did not travel in the great region of Mato Grosso, nor in the extreme south (Rio Grande do Sul), and he was in the estuarine region of the Amazon river only in passing, without having collected there. Otherwise he visited almost all other larger states and got to know all five phytogeographical provinces of the country, first the Dryades province in the forested coastal mountain ranges of southern and mid-Brazil, and also in part the cooler Napaean Zone with its Araucaria forests, later the Province of Oreades in the states of Minas Geraes and Goyaz consisting of the steppes of the interior, and the Province of the Hamadryas in the interior of the state of Bahia, the dry Northeast, and above all and to a greater extent, the primary forests of the Amazonas, the Province of the Najades. In his paper on the vegetation of Bahia [68] he proposed that only three phytogeographical provinces should be recognized instead of the aforementioned five distinguished by Martius: 1. the cooler mountainous south, the Provinces of the Dryades and Napaea; 2. the dry steppe-rich interior of the Northeast, the Provinces of the Oreades and Hamadrayas; 3. the great forest

region of the Amazon river together with Guyana, the Province of Najades, or the Hylaea. He was able even to go beyond the frontiers of Brazil and to see not only the eastern slopes of the Andes and to study, during a stay of several months, the surroundings of Tarapoto so rich in vegetation types, but also to penetrate to the far-off Roraima mountain range on the frontier with Guyana. And so impressions of the most diverse vegetation types were engraved on his memory, which he later reproduced in his descriptions of the regions through which he travelled. Unfortunately his capacity for graphic representation of the vegetation was limited and he also lacked the ability to recognize and clearly make evident the essential features from the wealth of individual phenomena, a shortcoming which manifested itself in his other works and is linked to a lack of skill in linguistic expression. Thus his phytogeographical works cannot compete with the classic portrayals of a Martius or a Schimper; their value lies in the authenticity of the observations. We have his phytogeographical works above all on the Amazon region, then on Bahia and some parts of southern and central Brazil, and finally a floristic sketch of Roraima. He considered the taxonomic works as only an essential preliminary stage for his floristic ones; with the help of his colleagues he familiarized himself with the methods of taxonomic research, in the course of which his inexperience in the study of the literature often caused him difficulties. Nevertheless, he determined a not inconsiderable part of the collections himself and described a large number of new genera and species from various families.

His strength lay in observation of individual phenomena of plant life. His acute eye for the discovery of numerous leaf fungi, bryophytes and galls is clearly connected with this ability. Above all, he was able to uncover some biological facts which previously had been little- or unknown. Cleistopetaly was first described precisely by him. His name will always be connected with the discovery of ant gardens, and his study of the connections between ants and plants led him to his own original interpretation of this relationship.

The lively interest of contemporary industry in the exploitation of the tropical rubber resources was the motive for Ule's first Amazon expedition and also for his journey to Bahia and to the Acre region. With this opportunity he also took on the task of studying the extraction of rubber in the regions he travelled through and to follow the forms of trade in this important product of the tropics. To these efforts we owe two works of commercial content, results of his journeys to Amazonia and to Bahia. These studies are also important because they stimulated experimental cultivation, especially of the species of *Manihot* from Bahia, in other regions of the tropics, especially in our East African colony (cf. Verhdlg. Bot. Ver. Provinz Brandenburg 50, 1908 [1909], Pp. LI and LXIX). Unfortunately the hopes invested in the cultivation of these Bahian species have not been realized, because of greater disadvantages in comparison to the merits of the Ceara rubber of *Manihot Glaziovii* (cf. Tropenpflanzer XVIII, Oct. 1915, p. 493; with a thorough evaluation of Ule's services to tropical agriculture). Ule intended to write a similar third paper on the Acre region; however, whether the notes he left behind are sufficient for publication still remains in doubt. He collected in this region some of the soil samples investigated by F. Wohltmann

[81].

During his last expedition he had come into contact with various indian tribes still living in their original conditions in the region of the Rio Surumu, among whom he lived for an appreciable time. He described their habits and customs in a lecture which he gave to the Berlin Anthropological Society [76].

Ule more often lectured on his researches. To be sure, he had no talent for lecturing, but in spite of this many people liked his unpretentious discourse. He enlivened his lectures with quite outstanding photographic lantern slides which were produced from photographs he took during his travels. He was a master in photography; hardly any other tropical traveller has taken such beautifully sharp photographs of vegetation as he did. Most of the images have been published; he sold commercially a series called Images of the Amazon River (cf. L. Diels in Engler's Bot. Jahrb. XXXIV, Literature Report [1904], p. 39; cf. [75]).

Our Society ["Botanischer Verein der Provinz Brandenburg"; today "Botanischer Verein von Berlin und Brandeburg"], in which this shy and modest scientist had many friends, will honour his memory.

3 Acknowledgements

As a basis for this obituary, I depended mainly on I. Urban's information in the Flora brasiliensis I, 1 (1906) 123, and in addition my personal recollections and Ule's own writings. In addition, his brother, Prof. Dr. W. Ule (Rostock) kindly assisted me and I owe to him much information on Ule's early life up to 1900; I also express here my sincere thanks to him and to all other gentlemen who have helped me (as for example Privy Councillor Prof. Dr. A. Brauer, Director of the Zoological Museum in Berlin; Privy Councillor Prof. Dr. P. Sorauer; Prof. Ew. H. Rübsaamen, Coblenz) for their kind support. Besides Ule's own publications I have also enumerated below those which in some way are concerned with his collections; at the same time, monographs in which only occasionally a species from Ule's collection is described had to be disregarded.

4 Genera named by and for E. Ule

4.1 Genera proposed and described by E. Ule

Cipuropsis Ule in Verh. Bot. Ver. Prov. Brandenburg XLVIII (1907) 148. (Bromeliaceae).
Psathyranthus Ule, l.c. 156. (Loranthaceae).
Gonypetalum Ule, l.c. 174, and in Notizbl.Bot.Gart. Berlin-Dahlem VI (1915) 312. (Dichapetalaceae).
Chamaeanthus Ule in Verh.Bot.Ver.Prov. Brandenburg L (1907) 71. (Commelinaceae).

Sincoraea Ule in Engler's Bot. Jahrb. XLII (1909) 191. (Bromeliaceae).
Cryptanthopsis Ule, l.c. 193. (Bromeliaceae).
Haptocarpum Ule, l.c. 201. (Capparidaceae).
Itatiaia Ule, l.c. 234 (Melastomaceae).
Geogenanthus Ule in Fedde, Repert. XI (1913) 524. (renaming of *Chamaeanthus*; cf. loc.cit. XII [1913] 279).
Poecilandra subgen.nov. *Roraimia* Ule in Notizbl. Bot. Gart. Berlin-Dahlem VI (1915) 340. (Ochnaceae).

4.2 Genera named after E. Ule

1. Plant genera

a. Cryptogams

Uleiella Schröter in Hedwigia XXXIII (1894) p. (65) (genus of uncertain position, adjacent to the Ustilaginaceae; Nat. Pflanzenf. I, 1**, 23).
Uleomyces P. Hennings in Hedwigia XXXIV (1895) 107 (Hypocreaceae; Nat. Pflanzenf. I, 1, 366).
Uleopeltis P. Hennings in Hedwigia XLIII (1904) 267 (Microthyriaceae).
Ulea C. Müll. in Hedwigia XXXVI (1897) 102 (Pottiaceae; Nat. Pflanzenf. I, 3, 421).
Uleobryum Broth. in Hedwigia XLV (1906) 271 (Pottiaceae; Nat. Pflanzenf. I, 3, 1189).

b. Phanerogams

Ulearum Engl. in Bot.Jahrb. XXXVII (1905) 95. (Araceae).
Uleanthus Harms in Verh. Bot. Ver. Prov. Brandenburg XLVII (1905) 150 and in R. Pilger, Nat. Pflanzenf. Nachträge III (1906) 158. (Leguminosae).
Uleophytum Hieron. in Verh.Bot.Ver.Prov. Brandenburg XLVIII (1907) 198. (Compositae).

Animal genera

Uleia Ew. H. Rübsaamen in Marcellia IV (1905) 85. (one of the flies reared by Ule; galls on *Clusia*).
Uleella Ew. H. Rübsaamen in Marcellia VI (1907) 121 (gall on *Dalbergia*).

5 Publications

5.1 Publications by E. Ule

1. Zeigt unvollkommene Pelorien von *Linaria vulgaris* Mill. [Incomplete peloria of *Linaria vulgaris* Mill.] Verh. Bot. Ver. Prov. Brandenburg XIX, p. 146 (meeting in 28 Sept. 1877), 1878.

2. Ueber einige neue Species und Nährpflanzen der Ustilagineen. [On some new species and host plants of the Ustilaginaceae] Verh. Bot. Ver. Prov. Brandenburg XX, pp. 1-4 (meeting in 25 Jan. 1878), 1878.

3. Mycologisches [Mycological Notes]. Hedwigia XVII (1878) 18-21.

4. Legt eine Frucht von *Nephelium Litchi* (Juss.) Camb. vor [A fruit of *Nephelium Litchi* (Juss.) Camb.]. Verh. Bot. Ver. Prov. Brandenburg XX, p. 56.

Legt Pflanzen aus der Berliner Flora vor. [Plants of the Berlin Flora]. Verh. Bot. Ver. Prov. Brandenburg XX, p. 63.

Legt vor *Verbascum Thapsus* L. von Treptow [*Verbascum Thapsus* L. from Treptow]. Verh. Bot. Ver. Prov. Brandenburg XX, p. 84.

5. Beitrag zur Kenntnis der Ustilagineen. [Contribution to knowledge of the Ustilaginaceae] Verh. Bot. Ver. Prov. Brandenburg XXV,1883, pp. 212-217 (dated Halle April 1883; published 1884).

6. Nova Venezia. Besuch einer italienischen Kolonie in Süd-Brasilien. [Nova Venezia. A visit to an Italian colony in southern Brazil] Aus allen Weltteilen XXIII, Part 5, pp. 136-137, May 1892.

6a. Noticia botanica. [Botanical notes]. In L. Cruls, Relatorio parcial Commiss. expl. Planalto central do Brazil. 1893, pp. 133-138.

7. Zur Gründung der neuen Hauptstadt Brasiliens. Aus Briefen von E. U. [On the founding of the new capital of Brazil. From letters of E. Ule]. Petermann's Mitt. 1893, part 4.

8. Relatorio do Dr. Ernesto Ule. Botanico da Commissão. [Report by Dr Ernst Ule. Botanist of the Commission] In L. Cruls, Commissão exploradora do Planalto central do Brazil, Rio de Janeiro 1894, p. 339-365, Annexo VI. (in Portuguese and French).

9. Botanischer Bericht über einer in Goyaz zur Erforschung der Hochebene von Centralbrasilien unternommene Reise; in P. Taubert: Beiträge zur Kenntnis der Flora des centralbrasilianischen Staates Goyaz. [Botanical report on a journey in Goyaz undertaken for the exploration of the high plains of central Brazil;

in P. Taubert: Contributions to knowledge of the flora of the central Brazilian state of Goyaz]. Engler's Bot. Jahrb. XXI (1895) pp. 404-421.

10. Ueber die Blüteneinrichtungen von *Purpurella cleistoflora*, einer neuen Melastomacee [On the floral contrivances of *Purpurella cleistoflora*, a new Melastomataceae]. Bericht. Deutsch. Bot. Gesellsch. XIII (1895), pp. 415-420 with Plate XXXII.

11. Relatorio de uma excursão botanica na Serra do Itatiaia [Report of a botanical excursion to the Serra do Itatiaia]. Revista do Museu Nacional Rio de Janeiro I (1896), pp. 185-223.

12. Berichtigung (Umänderung des Namens *Purpurella cleistoflora* in *P. cleistopetala*) [Correction (Alteration of the name *Purpurella cleistoflora* to *P. cleistopetala*)]. Bericht. Deutsch. Bot. Gesellsch. XIV (1896), p. 163.

13. Weiteres zur Blüteneinrichtung von *Purpurella cleistoflora* und Verwandten [Additional notes on the floral contrivances of *Purpurella cleistoflora* and related taxa]. Bericht. Deutsch. Bot. Gesellsch. XIV (1896), pp. 169-178 with Plate XIII.

14. Ueber die Blüteneinrichtung von *Dipladenia* [On the floral contrivances of *Dipladenia*]. Bericht. Deutsch. Bot. Gesellsch. XIV (1896), pp. 178-179; addendum pp. 233-234.

15. Ueber Verlängerung der Achsengebilde des Blütenstandes zur Verbreitung der Samen [On the elongation of axial structures of the inflorescence in connection with seed dispersal]. Bericht. Deutsch. Bot. Gesellsch. XIV (1896), pp. 255-260.

16. Ueber Blütenverschluß bei Bromeliaceen mit Berücksichtigung der ganzen Familie [On floral closure in Bromeliaceae with regard to the whole family]. Bericht. Deutsch. Bot. Gesellsch. XIV (1896), pp. 407-422.

17. Symbiose zwischen *Asclepias curassavica* und einem Schmetterling, nebst Beitrag zu derjenigen zwischen Ameisen und *Cecropia* [Symbiosis between *Asclepias curassavica* and a butterfly, together with a contribution on the same phenomenon between ants and *Cecropia*. Bericht. Deutsch. Bot. Gesellsch. XV (1897), pp. 385-387.

18. *Dipladenia atroviolacea* Muell.Arg. und Begonien als Epiphyten [emphDipladenia atroviolacea Muell.Arg. and begonias as epiphytes]. Bericht. Deutsch. Bot. Gesellsch. XV (1897), pp. (79)-(86), and Plate XX; addendum: emph-Nephrolepis cordifolia Presl var. emphtuberosa Bak., Bericht. Deutsch. Bot. Gesellsch. XV (1897), pp. (85)-(86).

19. Ueber Blüteneinrichtungen einiger Aristolochien in Brasilien [On floral contrivances of some aristolochias in Brazil]. Bericht. Deutsch. Bot. Gesellsch. XVI (1898), pp. 74-91 with Plate III.

20. Beitrag zu den Blüteneinrichtungen von emphAristolochia Clematitis L. [Contribution to knowledge of the floral contrivances of emphAristolochia Clematitis L.]. Bericht. Deutsch. Bot. Gesellsch. XVI (1898), pp. 236-239.

21. Ueber Standortsanpassungen einger Utricularien in Brasilien [On habitat adaptations of some utricularias in Brazil]. Bericht. Deutsch. Bot. Gesellsch. XVI (1898), pp. 308-314, with Plate XIX.

22. Weiteres über Bromeliaceen mit Blütenverschluß und Blüteneinrichtungen dieser Familie [Further notes on Bromeliaceae with closed flowers and floral structures of this family]. Bericht. Deutsch. Bot. Gesellsch. XVI (1898), pp. 346-362, with Plate XXII.

23. Brasilianische Aristolochiaceen und ihre Bestäubung [Brazilian Aristolochiaceae and their pollination]. Die Natur 1898, pp. 207-210 (with plate).

Das Leben in den Wasserbecken der Bromeliaceae [The living world in the water reservoirs of Bromeliaceae]. Die Natur 1898, pp. 158-160.

Die Vegetationsschanzen an der brasilianischen Küste des Atlantischen Oceans [Vegetational patterns in the Atlantic coastal region of Brazil]. Die Natur 1898, pp. 361-362.

Noch einmal das Stinktier [More on the skunk]. Die Natur 1898, p. 392.

24. Ueber einige neue und interessante Bromeliaceen [On some new and interesting Bromeliaceae]. Bericht. Deutsch. Bot. Gesellsch. XVII (1899), pp. 1-6.

25. Ueber einen experimentell erzeugten Aristolochienbastard [On an experimentally created aristolochia hybrid]. Bericht. Deutsch. Bot. Gesellsch. XVII (1899), pp. 35-40, with Plate III.

26. Vorlage einiger Bromeliaceen [Presentation on some Bromeliaceae in Rio de Janeiro]. Bericht. Deutsch. Bot. Gesellsch. XVII (1899), pp. 43-45.

27. Ueber spontan entstandene Bastarde von Bromeliaceen [On spontaneously occurring hybrids of Bromeliaceae]. Bericht. Deutsch. Bot. Gesellsch. XVII (1899), pp. 51-64 with Plate IV.

28. Ein interessanter *Aristolochia*-Bastard [An interesting hybrid of *Aristolochia*]. Allg. Bot. Zeitschr. (1899) pp. 49-50.

29. Ein interessanter Aristolochia-Bastard [An interesting hybrid of emphAristolochia]. Die Natur 1899, pp. 471-472 (with figure).

30. Die Verbreitung der Torfmoose und Moore in Brasilien [On the distribution of sphagnum and bogs in Brazil]. Engler's Bot. Jahrb. XXVII (1899) pp. 238-258.

31. emphBryotheca brasiliensis, herausgegeben von Dr. C.H. Brotherus in Helsingfors, bestimmt von Carl Mller, C.H. Brotherus und C. Warnstorf [emphBryotheca brasiliensis, published by Dr. C.H. Brotherus in Helsingfors, determined by Carl Mller, C.H. Brotherus and C. Warnstorf]. Hedwigia XXXVIII (1889) pp. (57)-(59). Continuation Hedwigia XLIV (1905) pp. (90)-(91).

32. Verschiedenes ber den Einfluss der Tiere auf das Pflanzenleben [Various considerations on the influence of animals on plant life]. Bericht. Deutsch. Bot. Gesellsch. XVIII (1900), pp. 122-130.

33. Verschiedene Beobachtungen vom Gebiet der baumwohnenden emphUtricularia [Observations on the domain of tree-dwelling emphUtricularia]. Bericht. Deutsch. Bot. Gesellsch. XVIII (1900), pp. 249-260, with text figure.

34. Ueber weitere neue und interessante Bromeliaceen [On additional new and interesting Bromeliaceae]. Bericht. Deutsch. Bot. Gesellsch. XVIII (1900), pp. 318-327, with Plate X.

35. emphCardamine africana L. in Brasilien [emphCardamine africana L. in Brazil]. Engler's Bot. Jahrb. XXVIII (1900) pp. 216-217.

36. Die Cactaceen im südlicheren Brasilien [The Cactaceae in southern Brazil]. Monatsschr. für Kakteenkunde X (1900) pp. 115-118, 131-133.

37. Die Entwickelung der Natur im Kreislauf des Jahres in den Tropen des südlichen Brasilien [Nature's development in the course of the year in the tropics of southern Brazil]. Die Natur 1900, pp.97-99, 114-116.

Ein bodenblütiger Baum Brasiliens [A thalamifloral Brazilian tree]. Die Natur 1900, p. 270, with figure.

Verlassen in der Wildnis Centralbrasiliens [Abandoned in the wilderness of central Brazil]. Die Natur 1900, pp. 61-63.

37a. Plantas uteis [Useful plants]. A Lavoura, Bol. Soc. nac. Agric. Brazil (1900) pp. 70-71.

38. Die Vegetation von Cabo Frio an der Küste von Brasilien [The vegetation of Cabo Frio on the coast of Brazil]. Engler's Bot. Jahrb. XXVIII (1901) pp.

511-528.

39. Ule's Expedition nach den Kautschukgebieten des Amazonenstroms. Erster Bericht über den Verlauf der Kautschuk-Expedition bis zum Beginn des Jahres 1901 [Ule's expedition to the rubber regions of the Amazon. First report on the course of the Rubber Expedition up to the beginning of 1901]. Notizbl. Bot. Gart. und Mus. Berlin III Nr. 26 (1901) pp. 111-118.

40. Ule's Expedition nach den Kautschukgebieten des Amazonenstroms. Zweiter Bericht vom 1 Januar bis zum Mai des Jahres 1901 [Ule's expedition to the rubber regions of the River Amazon. Second report from 1 January to May 1901]. Notizbl. Bot. Gart. und Mus. Berlin III Nr. 27 (1901) pp. 129-134.

41. Ameisengärten im Amazonasgebiet [Ant gardens in Amazonia]. Engler's Bot. Jahrb. XXX. Beibl. Nr. 68 (1901) pp. 45-52, with plate.

42. Dritter Bericht über den Verlauf der Kautschuk-Expedition vom Mai bis zum November des Jahres 1901 [Third report on the progress of the Rubber Expedition from May to November 1901]. Notizbl. Bot. Gart. und Mus. Berlin III Nr. 30 (1902) pp. 224-237.

43. Vierter Bericht über den Verlauf der Kautschuk-Expedition vom November 1901 bis zum März 1902 [Fourth report on the progress of the Rubber Expedition from November 1901 up to March 1902]. Notizbl. Bot. Gart. und Mus. Berlin IV Nr. 32 (1902) pp. 92-98.

44. Das Uebergangsgebiet der Hylaea zu den Anden [The transition zone from the Hylaea to the Andes]. Engler's Bot. Jahrb. XXXIII. Beibl. Nr. 73 (1903) pp. 74-78.

45. Fünfter Bericht ber den Verlauf der Kautschuk-Expedition vom 8 März bis zum 21 Juni 1902 [Fifth report on the progress of the Rubber Expedition from 8 March to 21 June 1902]. Notizbl. Bot. Gart. und Mus. Berlin Nr. 33 (1904) pp. 107-114.

46. Ules Expedition in das peruanische Gebiet des Amazonenstroms. Sechster Bericht über den Verlauf der Kautschuk-Expedition vom 21 Juni 1902 bis 23 Juni 1903 [Ule's Expedition to the Peruvian Amazon. Sixth report on the progress of the Rubber Expedition from 21 June 1902 to 23 June 1903]. Notizbl. Bot. Gart. und Mus. Berlin IV. Nr. 33 (1904) pp. 114-123.

47. Epiphyten des Amazonasgebietes [Epiphytes of Amazonia]. Vegetationsbilder, herausgegeb. von G. Karsten u. H. Schenck, 2. Reihe, Heft 1: 1904.

48. Blüteneinrichtungen von Amphilophium, einer Bignoniacee aus Südamerika [Floral structures in Amphilophium, a Bignoniaceae from South America]. J.

Urban, Ascherson-Festschrift (1904) p. 547-551.

49. Verzeichnis von Photographien botanischer Typenbilder vom Amazonenstrom [Index of photographs of botanical images from the Amazon region]. 150 numbers at 135 Marks; single numbers ar 1.50 Marks. See L. Diels in Engler's Bot. Jahrb. XXXIV. Litt. Ber. (1904) p.39.

50. emphMycotheca brasiliensis, herausgegeb. von E.U. und bestimmt von P. Hennings [emphMycotheca brasiliensis, published by E. Ule and determined by P. Hennings]. Hedwigia XLIV (1905) p. (88)-(89).

51. Blumengärten der Ameisen am Amazonenstrome [Ant gardens in Amazonia]. Vegetationsbilder, herausg. von G. Karsten u. H. Schenck, 3. Reihe, Heft 1: 1905. See also Verhandl. Gesellsch. Deutsch. Naturforsch. u. Aerzte, 76. Versammlung, Breslau 1904. II. 1. (1905) pp. 245-249.

52. Wechselbeziehungen zwischen Ameisen und Pflanzen [Interrelations between ants and plants]. Flora XCIV (1905) pp. 491-497.

53. Die Blumengärten der Ameisen am Amazonenstrom [Ant gardens in Amazonia]. Himmel und Erde XVII. 7 (1905) pp. 289-303, with 5 text figures and 1 plate.

54. Bananen als Volksnahrung in Ostperu [Bananas as popular food in eastern Peru]. Tropenpflanzer IX. No. 12 (1905) pp. 709-712.

55. Die Kautschukpflanzen der Amazonas-Expedition und ihre Bedeutung für die Pflanzengeographie [The rubber plants of the Amazonas Expedition and their importance for plant geography]. Engler's Bot. Jahrb. XXXV (1905) pp. 663-678.

56. Biologische Eigentümlichkeiten der Früchte in der Hylaea [Biological peculiarities of fruits in the Hylaea]. Engler's Bot. Jahrb. XXXVI. Beibl. No. 81 (1905) pp. 91-98.

57. Kautschukgewinnung und Kautschukhandel am Amazonenstrome [Rubber extraction and rubber trade in Amazonia]. Beihefte zum Tropenpflanzer VI. No. 1, Jan. 1905, 71 p., 11 text figures, 1 distribution map.

58. Kautschukgewinnung am Amazonenstrome [Rubber extraction in Amazonia]. With 8 original photographs by G. Huebner and Amaral (Manáos).

59. Die Kautschukgewinnung in Brasilien [Rubber extraction in Brazil]. Himmel und Erde XVII (1905) pp. 542-557; 6 text figures.

60. Beiträge zur Flora der Hylaea nach den Sammlungen von E. Ule; herausgegeben von R. Pilger [Contributions to the Flora of the Hylaea from the collections of E. Ule; published by R. Pilger]. Verh. Bot. Ver. Prov. Brandenburg XLVII. 1905 (1905) pp. 100-190, with 3 plates. E. Ule authored : Aristolochiaceae, pp. 118-125 (plus supplement); Violaceae, pp. 156-159.

61. Ameisenpflanzen [Ant plants]. Engler's Bot. Jahrb. XXXVII (1906) pp. 335-352, with Plates VI and VII.

62. Ameisenpflanzen des Amazonasgebietes [Ant plants of the Amazon region]. Vegetationsbilder. herausg. von G. Karsten u. H. Schenck, 4. Reihe, Heft 1: 1906.

63. Eigentümliche mit Pflanzen durchwachsene Ameisennester am Amazonenstrom [Strange Amazonian ant nests with plants growing through them]. Naturwiss. Wochenschr. XXI. No. 10 (1906). Pp. 145-150,. with 2 text figures and 1 plate.

64. Die Verwendung von Palmenfrüchten am Amazonenstrom zu erfrischenden Getränken [The utilization of palm fruits in Amazonia for refreshing drinks]. Tropenpflanzer X. No. 4 (1906) pp. 219-221.

65. II. Beiträge zur Flora der Hylaea nach den Sammlungen von Ule's Amazonas-Expedition II. Contributions to the flora of the Hylaea based on the collections of Ule's Amazonian Expedition]. Verh. Bot. Ver. Prov. Brandenburg XLVIII. 1906 (published 1907), pp. 117-208, with 2 plates. E. Ule authored: Bromeliaceae, pp. 130-150; Loranthaceae, pp. 152-158; Dichapetalaceae, pp. 174-175; Quiinaceae, pp. 183-184; Bignoniaceae, pp. 194-195.

66. Referate über verschiedene Arbeiten von J. Huber [Papers on various works by J. Huber]. Engler's Bot. Jahrb. XXXVII. Litt. Ber. (1906) pp. 13-19.

67. Die Pflanzenformationen des Amazonas-Gebietes [The plant formations of the Amazon region]. Engler's Bot. Jahrb. XL. Heft 2 (1907) pp. 114-172, 5 plates.

68. Vorläufige Mitteilung über drei noch unbeschriebene Kautschukliefernde emphManihot-Arten in Bahia [Preliminary note on three still undescribed rubber-producing species of emphManihot in Bahia]. Notizbl. Bot. Gart. und Mus. Berlin No. 41 (1907) pp. 1-4.

68a. emphHevea discolor Müll. Arg. als Lieferant des Kautschuks vom Rio Negro [emphHevea discolor Müll. Arg. as a rubber-yielding plant from the Rio Negro.]. Tropenpflanzer XI (1907) pp. 788-790.

69. Die Pflanzenformationen des Amazonas-Gebietes II [The plant formations

of the Amazon region. II]. Engler's Bot. Jahrb. XL. Heft 3 (1908) pp. 398-443, 3 plates.

70. Das Innere von Nordost-Brasilien [The interior of Northeast Brazil]. Vegetationsbilder, herausg. von G. Karsten u. H. Schenck, 6 Reihe, Heft 3; 1908.

71. Über eine neue Gattung der Capparidaceen mit Klettervorrichtungen [On a new genus of Capparidaceae with climbing structures]. Bericht. Deutsch. Bot. Gesellsch. XXVI. a (1908) pp. 220-224.

72. Catinga- und Felsenformationen in Bahia [Vegetation of the Caatinga and rock outcrops in Bahia]. Engler's Bot. Jahrb. XL. Beibl. No. 93 (1908) pp. 39-48, 6 plates.

73. Die Kakteen im brasilianischen Staate Bahia [The Cactaceae of the Brazilian State of Bahia]. Monatsschr. für Kakteenkunde XVIII. Heft 2 (1908) pp. 17-24.

74. Eine botanische Forschungsreise in Nordost-Peru [A botanical research expedition in Northeast Peru]. Süd- und Mittel-Amerika (1908) Heft 15, pp. 348-352; Heft 17, pp. 393-396 (Halbmonatsschr. für das Deutschum u. die deutsch. Interess. in Süd- u. Mittel-Amerika u. Mexico, herausg. von Dr. P. Traeger-Berlin.

75. III. Beiträge zur Flora der Hylaea nach den Sammlungen von Ule's Amazonas-Expedition [Contributions to the flora of the Hylaea based in the collections of Ule's Amazonas Expedition. III]. Verh. Bot. Ver. Prov. Brandenburg L (1908) pp. 69-85. E. Ule authored: Commelinaceae. Pp. 69-72; Euphorbiaceae, pp. 74-85.

76. Kautschukgewinnung und Kautschukhandel in Bahia [Rubber extraction and rubber trade in Bahia]. Notizbl. Bot. Gart. und Mus. Berlin-Dahlem V. No. 41a. 1908. 52 p., 2 text figures, 3 plates, 1 map. Price 3 Mark. Eine vom Verf. nicht genehmigte vorläufige Mitteilung (Neue emphManihot-Arten und ihre Bedeutung) erschien [A preliminary communication not approved by the author (New emphManihot species and their importance) appeared] in Tropenpflanzer XI (1907) 861-869; cf. Tropenpflanzer XII (1912) 54.

77. Communications on the rubber-producing species of Manihot from Bahia and Piauhy. Gummizeitg. XXII. No. 29 (April 1908) p. 765. cf C.C. Hosseus, Gummizeitg. XXII. No. 28, p. 737.

78. Extracção e Commercio da Borracha da Bahia; traducção de Carlos Moreira. Servio geologico e mineralogico do Brazil. Rio de Janeiro 1909. (Translation of Publication no. 76).

79. Beiträge zur Flora von Bahia; unter Mitwirkung einiger Autoren herausgegeben von E. Ule [Contributions to the flora of Bahia; published by E. Ule with the collaboration of some other authors]. Engler's Bot. Jahrb. XLII (1909) pp. 191-238, 1 plate, 1 text figure. E. Ule authored: Bromeliaceae, pp. 191-199; Loranthaceae, pp. 199-201; Capparidaceae, pp. 201-202; Euphorbiaceae, pp. 217-225; Violaceae, pp. 230-231; Melastomataceae, pp. 232-236.

80. Vom Amazonenstrom zum Roraima [From the River Amazon to Roraima]. Süd- u. Mittel-Amerika, Vol. 4, No. 6 (1911) pp. 103-106.

81. Die Maniçoba von Ceará und deren Beulenkrankheit [The maniçoba of Ceará and its pustule disease]. Tropenpflanzer XVI. No. 2 (1912), pp. 91-95.

82. Epiphyten von Südamerika: Ameisengärten des Amazonasgebietes; Ameisenpflanzen des A. [Epiphytes of South America: Ant gardens of the Amazon region; Ant plants of Amazonia]. Fedde Repert. XII (1913) pp. 558-562 (Lichtbilder zur Pflanzengeographie und Biologie 14-16. Reihe, No. 66-80).

83. Unter den Indianern am Rio Branco in Nordbrasilien [Among the indians of the Rio Branco in northern Brazil]. Zeitschr. für Ethnologie (1913) Heft 2. pp. 278-298; see correction in Heft 3.

84. *Geogenanthus* Ule. Fedde's Repertorium XI (1913) 524.

85. Die Kautschukpflanzen Südamerikas (The rubber plants of South America]. Vegetationsbilder, herausg. von G. Karsten u. H. Schenck, 12. Reihe, Heft 6. 1914.

86. Bericht über den Verlauf der zweiten Expedition in das Gebiet des Amazonenstromes in den Jahren 1908-1912 [Report on the progress of the second expedition in the region of the Amazon river in the years 1908-1912]. Notizbl. Bot. Gart. u. Mus. Berlin-Dahlem VI. No. 53 (1914) pp. 78-108. Refer also to H. Harms: Vorläufiger Bericht über die Reise von E. Ule [Preliminary report on the journey of E. Ule] (Engler's Bot. Jahrb. XLVI. Beibl. No. 106 (1912) pp. 102-104).

87. Beiträge zur Kenntnis der brasilianischen *Manihot*-Arten, nach dem von L. Zehntner in Bahia gesammelten Material [Contributions to knowledge of Brazilian *Manihot* species, based on collections made by L. Zehntner in Bahia]. Engler's Bot. Jahrb. L. Heft 5. Beibl. No. 144 (1914) pp. 1-12.

88. *Hevea brasiliensis* Müll. Arg. im überschwemmungsfreien Gebiet des Amazonenstroms [*Hevea brasiliensis* Müll. Arg. in the flood-free region of Amazonia]. Engler's Bot. Jahrb. L. Heft 5. Beibl. No. 144 (1914) pp. 13-18.

89. Die Vegetation des Roraima [The vegetation of Mount Roraima]. Engler's

Bot. Jahrb. LII. Beibl. No. 115 (1914) pp. 42-53.

90. R. Pilger, Plantae Uleanae novae vel minus cognitae [New and little-known plants collected by E. Ule]. Notizbl. Bot. Gart. u. Mus. Berlin-Dahlem VI. No. 54 (20 March 1914) pp. 109-142; No. 55 (4 April 1914) pp. 143-179; No. 56 (15 May 1915) pp. 181-212; No. 59 (30 June 1915) pp. 261-310; No. 60 (20 September 1915) pp. 311-382. E. Ule authored: Thurniaceae, p. 268; Loranthaceae pp. 288-292; Rafflesiaceae pp. 292-293; Nymphaeaceae pp. 293-295; Vochysiaceae pp. 311-312; Dichapetalaceae pp. 312-313; Ochnaceae pp. 335-346; Melastomataceae pp. 348-368.

91. Ueber einige eigentümliche Zweigbildungen der Bume des Amazonasgebietes [On some peculiar forms of branching in Amazonian trees]. Bericht. Deutsch. Bot. Gesellsch. XXXIII (1915) pp. 128-132, with plate V.

92. Die Vegetation des Amazonasgebietes [The vegetation of the Amazon region]. Ver. Bot. Ver. Prov. Brandenburg LVII. Heft 1 (1915) pp. 56-75.

93. Biologische Beobachtungen im Amazonasgebiet. Vorträge aus dem Gesamtgebiet der Botanik [Biological observations in Amazonia. Lectures on Botanical Science], herausgeg. von der Deutsch. Bot. Gesellschaft. Heft. 3. 1915. 19 p., 4 plates.

94. Literature review of: Ludwig Koegel, Das Urwaldphänomen Amazoniens . Eine geographische Studie. [The phenomenon of the primaeval Amazon forest. A geographical study] Engler's Bot. Jahrb. LII. Litt. Ber. (1915) pp. 65-68.

95. Ulmaceae, Simarubaceae, Clethraceae, Ericaceae; in Th. Loesener, Mexic. um Zentralamerik. Novitäten V. Fedde, Repert. XIV (1915) pp. 105, 107, 109.

95a. Ueber brasiliansiche Rafflesiaceen [On Brazilian Rafflesiaceae]. Bericht. Deutsch. Bot. Gesellsch. XXXIII (1915) pp. 468-478.

5.2 Publications related to E. Ule's collections

1. Fungi.

96. Dietel, P. Uredinae brasilienses a cl. E. Ule lectae I. u. II. [Brazilian Uredinae collected by E. Ule, I. and II.]. Hedwigia XXXVI (1897) pp. 26-37, XXXVIII (1899) pp. 248-259.

97. Hennings, P. Fungi goyazenses [Fungi of Goiás]. Hedwigia XXXIV. (1895) pp. 88-116; supplements, pp. 319-324.

98. Hennings, P. Myxomycetes, Phycomycetes, Ustilagineae et Uredineae. Hedwigia XXXV (1896) pp. 207-262 (Beiträge zur Pilzfl. v. Südamerika I. [Contributions to the fungal flora of South America I.).

99. Hennings, P. Beiträge zur Pilzflora Südamerikas II [Contributions to the fungal flora of South America II]. Hedwigia XXXVI (1897) pp. 190-246.

100. Hennings, P. Die Gattung emphDiplotheca Starb., sowie einige interessante u. neue, von E. Ule gesammelte Pilze aus Brasilien [The genus emphDiplotheca Starb., as well as some new and interesting fungi from Brazil]. Hedwigia XXXVII (1898) pp. (205)-(206).

101. Hennings, P. Neue von E. Ule in Brasilien gesammelte Ustilagineen und Uredineen [New Ustilaginae and Uredinae collected by E. Ule in Brazil]. Hedwigia XXXVIII (1899) pp. (65)-(71).

102. Hennings, P. *Xylariodiscus* nov. gen. und einige neue brasilianische Ascomyceten des E. Ule'schen Herbars [*Xylariodiscus* nov. gen. and some new Brazilian Ascomycetes from E. Ule's herbarium]. Hedwigia XXXVIII (1899) pp. (65)-(73).

103. Hennings, P. Uredineae aliquot brasilienses novae a cl. E. Ule lectae [Some new Brazilian Uredinae collected by E. Ule]. Hedwigia XXXVIII (1899) pp. (129)-(130).

104. Hennings, P. Fungi fluminenses a cl. E. Ule collecti [Fungi from Rio de Janeiro collected by E. Ule]. Hedwigia XLIII (1904) pp. 78-95.

105. Hennings, P. Fungi americani I-IV, a cl. Ernesto Ule collecti [American fungi collected by Ernst Ule, I-IV]. Hedwigia XLIII (1904) pp. 154-186, pp. 242-273, pp. 351-400; XLIV (1905) pp. 57-71.

106. Hennings, P. Ueber die auf emphHevea-Arten bisher beobachteten parasitischen Pilze [On the parasitic fungi so far observed on species of *Hevea*]. Notizbl. Bot. Gart. Berlin IV (1904) pp. 134-138.

107. Hennings, P. Fungi bahienses a cl. Ule collecti [Bahian fungi collected by E. Ule]. Hedwigia XLVII (1908) pp. 266-270.

108. Jahn, E. Myxomycetes aus Amazonas, gesammelt von E. Ule [Myxomycetes from Amazonia collected by E. Ule]. Hedwigia XLIII (1904) pp. 300-305.

109. Müller, J. Lichenes Catharinenses a cl. Ule in Brasiliae prov. Santa Catharina lecti [Lichens from Santa Catarina, collected by Ule in the Brazilian

province of Santa Catarina]. Hedwigia XXX (1891) pp. 235-243.

110. Müller, J. Lichenes Exotici III [Exotic lichens III]. Hedwigia XXXIV (1895) pp. 27-38.

111. Müller, J. Lichenes Uleani in Brasilia lecti [Lichens collected by Ule in Brazil]. Hedwigia XXXIV (1895) pp, 39-42.

112. Pazschke, O. Erstes Verzeichnis der von E. Ule in den Jahren 1883-87 in Brasilien gesammelten Pilze [First list of fungi collected by E. Ule in Brazil in the years 1883-87]. Hedwigia XXXI (1892) pp. 93-114.

113. Pazschke, O. II. Verzeichnis brasilianischer von E. Ule gesammelter Pilze [Second list of Brazilian fungi collected by E. Ule]. Hedwigia XXXV (1896) pp. 50-55. Relates to the fungi from the Serra do Itatiaia.

114. Rehm, H. Beiträge zur Pilzflora von Südamerika, III. Dothideaceae, gesammelt von Herrn E. Ule in Brasilien [Contributions to the fungal flora of South America, III. Dothideaceae, collected by Mr E. Ule in Brazil]. Hedwigia XXXVI (1897) pp. 366-380.

115. Rehm, H. Beitrge zur Pilzflora von Südamerika, IV. Hypocreaceae, ges. von Herrn E. Ule in Brasilien [Contributions to the fungal flora of South America, IV. Hypocreaceae, collected by Mr E. Ule in Brazil]. Hedwigia XXXVII (1898) pp. 189-201.

116. Rehm, H. Beiträge zur Pilzflora von Südamerika, V. Hysteriaceae, ges. von Herrn E. Ule in Brasilien [Contributions to the fungal flora of South America, V. Hysteriaceae, collected by Mr E. Ule in Brazil]. Hedwigia XXXVII (1898) pp. 296-302.

117. Rehm, H. Beiträge zur Pilzflora von Südamerika, VI. Microthyriaceae, ges. von Herrn E. Ule in Brasilien [Contributions to the fungal flora of South America, VI. Microthyriaceae, collected by Mr E. Ule in Brazil]. Hedwigia XXXVII (1898) pp. 311-326.

118. Rehm, H. Beiträge zur Pilzflora von Südamerika, VIII. Discomycetes, ges. von Herrn E. Ule in Brasilien [Contributions to the fungal flora of South America, VIII. Discomycetes, collected by Mr E. Ule in Brazil]. Hedwigia XXXIX (1900) pp. 80-99. Supplement pp. 209-234.

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