The discovery, typification and rediscovery of wild emmer wheat, Triticum turgidum subsp. dicoccoides (Poaceae)

Authors: Lack, Hans Walter, and Van Slageren, Michiel

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This paper is dedicated to the memory of Clara Heyn (1924–1998), professor of botany at the Hebrew University of Jerusalem, who showed natural stands of wild emmer to the first author in Lower Galilee on 28 March 1983, a moment not to be forgotten.

HANS WALTER LACK[1*] & MICHIEL VAN SLAGEREN[2]

The discovery, typification and rediscovery of wild emmer wheat, *Triticum turgidum* subsp. *dicoccoides* (*Poaceae*)

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Abstract: Wild emmer, *Triticum turgidum* subsp. *dicoccoides*, is an annual tetraploid wheat characterized by a brittle spike axis that spontaneously disintegrates at maturity. It occurs widely in the so-called Fertile Crescent of the Near East and is of great importance for understanding wheat evolution and for breeding modern wheat cultivars tolerant of extreme heat and dryness. Wild emmer was first collected by Theodor Kotschy on Mt Hermon in Lebanon in 1855, but was not found again for more than half a century. Friedrich August Körnicke was first to realize that Kotschy's specimen represented an ancestral form of hexaploid bread wheat, *T. aestivum*, but, although he gave it a name, he did not describe it. Paul Ascherson and Paul Graebner were the first to provide a description, basing it on information received in a letter from Körnicke. In doing so, they validated Körnicke's suggested name *T. sativum* var. *dicoccoides* and made Kotschy's specimen the holotype. Five years later, on the basis of information received from Ascherson and Georg Schweinfurth in Berlin, Aaron Aaronsohn rediscovered wild emmer on Mt Hermon and started to send specimens for further study to Europe. Soon afterwards he also discovered it east of the river Jordan, while Theodor Strauss collected the first specimens in Iran. This paper focuses on the as yet widely unappreciated herbarium record, listing and commenting on early specimens collected in the wild as well as those cultivated in botanical gardens up to 1910.

Key words: distribution, Fertile Crescent, *Gramineae*, *Poaceae*, *Triticum*, typification, wheat evolution, wild emmer, wild progenitor

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Introduction

Wild emmer, *Triticum turgidum* subsp. *dicoccoides* (Körn. ex Asch. & Graebn.) Thell., is an annual tetraploid grass of geographically widespread occurrence in the so-called Fertile Crescent of the Near East recorded from western Iran and northern Iraq, but predominantly found in Israel, Jordan, Lebanon, Syria and Turkey (Euro+Med PlantBase, http://ww2.bgbm.org/EuroPlusMed/ accessed 12 Dec 2019; records from Azerbaijan are erroneous). Wild emmer is the ancestor of domesticated emmer, *T. turgidum* subsp. *dicoccum* (Schrank ex Schübl.) Thell., and closely related to the tetraploid durum wheat, *T. turgidum* subsp. *durum* (Desf.) Husn. The latter is probably the donor of the BA genome to hexaploid bread wheat, *T. aestivum* L., characterized by a BAD genome (Dvorak & al. 2012).

1 Botanischer Garten und Botanisches Museum Berlin, Freie Universität Berlin, Königin-Luise-Str. 6–8, 14195 Berlin, Germany; *e-mail: h.w.lack@bgbm.org (author for correspondence).
2 Royal Botanic Gardens, Kew, Richmond, Surrey TW9 3AB, U.K.; e-mail: m.vanslageren@kew.org

Both durum and bread wheat are widely cultivated around the globe, especially bread wheat. For a summary of the genetic relationships see e.g. Dvorak & al. (2012). In the context of this paper it is important to note that the spike rachis is brittle in wild emmer causing its spontaneous disintegration upon maturity, while it is non-brittle in domesticated emmer, durum and bread wheats.

This paper focuses on the discovery, naming, typification and rediscovery of wild emmer. Several aspects of the sequence of events have already been published (e.g. Schiemann 1956; Poyarkova 1988; Katz 2001; Zeller 2008), but these articles do not, or only incompletely, discuss the extant herbarium material. In addition, several early contributions on this topic have appeared in non-botanical journals such as *Altneuland* and *Palästina*, or the daily *Vossische Zeitung* and these have so far been only partly evaluated. By contrast, a major focus of this paper is a discussion of the extant herbarium material prepared shortly after the rediscovery of wild emmer. No attempt is made to review the early genetic studies which started quickly after living material of wild emmer became available for further research (e.g. Tschermak 1913).

We use the subspecies combination under *Triticum turgidum*, a name published by Thellung (1918) and a perfect alternative to the species name *T. dicoccoides* (Körn. ex Asch. & Graebn.) Schweinf. that is often used in Flora treatments. The *turgidum* subspecies reflects the BA-genomic constitution of *T. turgidum* L. and all its subspecies, and fits in a genome-defined classification of the wheat genus *Triticum* as presented by, for example, van Slageren (1994) and Hanelt (2001). It will also be promoted in a monographic treatment currently in preparation by the second author. The contrast with the species-level classification, used in many floras (for example by Morrison in Barkworth & al. (2007), is appreciated.

Discussion

Initial discovery of wild emmer

The first specimen of wild emmer that entered a herbarium seems to have been that collected by Theodor Kotschy (1813–1866) in early July 1855. It has a printed label "Th. Kotschy. Iter Syriacum 1855. Crescit alt. die." to which Kotschy had added his collecting number "1054", the locality "ad margines aridos vinetorum pagi Raschaju Antilib.", the altitude "4000 ped." and the date "[die]bus Jul.". Conserved as W 0030713 (herbarium codes following *Index herbariorum*, http://sweetgum.nybg.org/science/ih/), the sheet has three sterile specimens and a few ripe spikelets kept in two attached envelopes (Fig. 1). The name "Raschaju" stands for "Rashaya", a small town situated on the northwestern slope of Mt Hermon (then Ottoman Empire, now Lebanon) at c. 1350 m. Kotschy's expedition to "Syria" is only briefly mentioned in his biography (Kotschy 1868). Fortunately, a proper travelogue (Kotschy 1864) for this tour exists, which also contains the description of a few plants regarded as new to science; wild emmer was not one of these. Indeed, Kotschy refrained from giving a name to his specimen with the consequence that it ended up among the undetermined material, allegedly among the specimens of *Hordeum spontaneum* C. Koch (Aaronsohn 1909a). Although Kotschy often collected an extremely large number of duplicates, e.g. on his travels in Iran (Lack 2020), the specimen in W seems to be a unicate. Nothing indicates that Kotschy ever studied the specimen after collecting it, despite his being from 1847 a staff member of the K. K. Vereinigte Hof Naturalien-Cabinette [Imperial Royal United Court Natural History Cabinets] in Vienna (Fenzl 1867) where it had been deposited.

The first to annotate Kotschy's specimen was Friedrich August Körnicke (1828–1908), a professor at the Königlich Preußische Landwirtschaftliche Akademie [Royal Prussian Agricultural Academy] in Bonn (Abromeit 1909; Ullrich 1970) and at the time a key figure in wheat research (Hammer 2008). He simply wrote "*Triticum* verwandt mit [related to] *dicoccum* Körnicke. 1873." (Fig. 1). Because Körnicke had misplaced his notes referring to Kotschy's specimen (Schweinfurth 1906b), no reference to it appeared in his *magnum opus Die Arten und Varietäten des Getreides* (Körnicke 1885). Four years after the publication of this handbook, Körnicke added to Kotschy's specimen the more precise annotation "*Triticum vulgare* Vill. sensu Körnicke var. *dicoccoides* Köke [his name abbreviated to the first two and last two letters]. Eine wilde Stamform [*sic*] der Saatweizen [A wild original form of bread wheats] exclusii [?] *Tr. monococcum* F Körnicke, 1889". In an oral presentation given at a meeting of the Niederrheinische Gesellschaft für Natur- und Heilkunde zu Bonn [Society for natural history and medicine of the region on the Lower Rhine in Bonn] on 11 March 1889, Körnicke mentioned Kotschy's specimen with the collection dates. The report of the meeting (Körnicke 1889) is extremely brief, but it contains the name *T. vulgare* var. *dicoccoides*; however, there is nothing in the text which can qualify as a description. More important is Körnicke's claim that Kotschy's plant is the "Stammform" [original form] of all other wheats (Körnicke 1889). Here is his wording: "Eine Stammform der zweiten und wichtigeren Art [d.h. aller übrigen Weizen mit Ausnahme von Einkorn] war bisher nicht bekannt. Er [Körnicke] fand sie in einer Pflanze, welche Kotschy … sammelte [An original form of the second and much more important species [i.e. all remaining wheats except einkorn] was not known previously. He [Körnicke] found it in a plant collected … by Kotschy]" (Körnicke 1889). Basically, this is precisely what Körnicke had written on the second label attached to *Kotschy 1054*.

Validation of the name *Triticum sativum* var. *dicoccoides* and its typification

Körnicke, who had been an assistant at the Königliches Herbarium [Royal Herbarium] in Schöneberg near

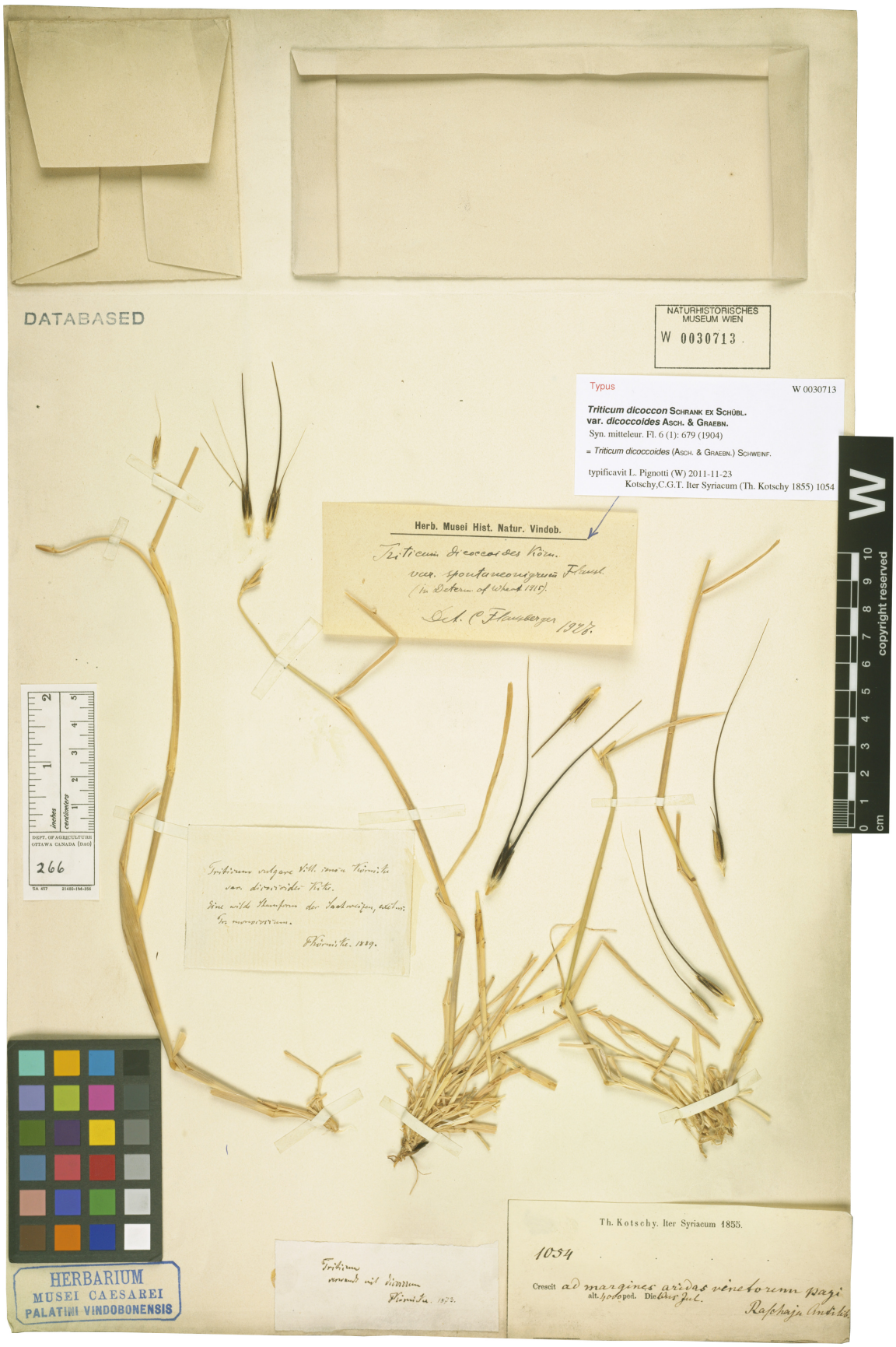

Fig. 1. Holotype (W 0030713) of *Triticum sativum* var. *dicoccoides* Körn. ex Asch. & Graebn. (≡ *T. turgidum* subsp. *dicoccoides* (Körn. ex Asch. & Graebn.) Thell.). – Specimen collected by Theodor Kotschy in July 1855. Annotations by Theodor Kotschy and Friedrich August Körnicke. Contents of the two envelopes laid out. – Vienna, Natural History Museum.

Berlin from 1849 to 1856 (Abromeit 1909), corresponded with its staff members, among them Paul Ascherson (1834–1913) and/or Paul Graebner (1871–1933), even after leaving the institution. Körnicke provided Ascherson and/or Graebner with additional information not included in his report (Körnicke 1889), as is shown by the note "Körnicke br.[ieflich]", i.e. Körnicke *in litteris*, found in the protologue of the name *Triticum sativum* var. *dicoccoides* [Körn. ex] Asch. & Graebn. in Ascherson and Graebner's *Synopsis der mitteleuropäischen Flora* (Ascherson & Graebner 1901: 679, see below). Validating the name of a taxon native to the Near East in a Flora of central Europe is unusual but perfectly acceptable.

Nothing indicates that Ascherson and Graebner had studied Kotschy's specimen: instead they relied on Körnicke's authority as they explained in the introduction to the treatment of their *Triticum sativum* s.l. "Wir haben … uns, da wir natürlich nichts Besseres bieten konnten, so streng wie es ging an Körnicke gehalten [We have … relied on Körnicke as strictly as possible, since quite naturally we could not offer anything better]" (Ascherson & Graebner 1901: 675). Nevertheless, the diagnostic characters "Aehrenachse an den Kanten und am Grund der Aehrchen zottig behaart" [sides of spike axis and base of the spikelet shaggily hairy] and "Aehrchen oft mit nur einer fruchtbaren Blüthe" [spikelet often only with a single fertile flower], provided by Körnicke and cited in Ascherson and Graebner's *Synopsis*, serve as a validating diagnosis for the varietal name *T. sativum* var. *dicoccoides*. Consequently, the authors of this name should be cited as "Asch. & Graebn."; but, because of their direct reference to Körnicke's *nomen nudum*, one may precede the two names by "Körn. ex". The associated specimen is unequivocally cited as "Am Antilibanon, in 1300 m Meereshöhe, 1855 von Th. Kotschy gesammelt [in the Antilibanon, 1300 m above sea-level, in 1855 collected by Th. Kotschy]".

As a consequence of its detailed citation, *Kotschy 1054* preserved in the Natural History Museum Vienna (and without a duplicate in the Botanical Museum Berlin or anywhere else) has to be regarded as the holotype of the name *Triticum sativum* var. *dicoccoides*. Previously, Kotschy's collection had been indicated as "type" in *Flora of Turkey* (Tan 1985). The status of holotype can be conferred in the sense of Art. 9.1 of the *International Code of Nomenclature for algae, fungi, and plants* (Turland & al. 2018) because the collection W 0030713 has proven to be "the one specimen". The typification suggested in *Flora iranica* (Bor 1970) involving a cultivated specimen from the Trentino region in Italy is incorrect. The material mounted on W 0031713 is regarded as homogenous, belonging to a single gathering and representing one taxon.

The Berlin network and Aaron Aaronsohn

Körnicke's interpretation of Kotschy's specimen in Vienna seems to have spread among the circle of the initiated in Berlin, notably to Otto Warburg (1859–1938) and Georg Schweinfurth (1836–1925). Warburg was a professor at Berlin University with a specialization in economic plants of the tropics, but whose interests after 1898 started to gravitate toward Zionism. In 1903, he had become the head of a "Commission for the exploration of Palestine" (Leimkugel 2005) and the leading botanical Zionist (Suffrin 2019). Schweinfurth, a gentleman of private means with an extremely broad spectrum of knowledge and competence, was loosely associated with the Royal Botanic Garden and Museum in Schöneberg; one of his fields of study was the plant life of the Near East and Egypt.

In 1902 Aaron Aaronsohn (1876–1919), an agronomist and Zionist activist based in Zichron Jacob [Zikhron Ya'akov] (then Ottoman Empire, now Israel), visited Berlin, Bonn and Munich (Leimkugel 2005). Apparently in Berlin Aaronsohn was introduced by Warburg to Ascherson and Schweinfurth and all three suggested he searched for Kotschy's plant (Aaronsohn 1909b; Suffrin & Nickelsen 2014: footnote 24). In retrospect, Aaronsohn (1909b) wrote: "Ich stellte mir das Ziel, den *Tr. vulgare* var. *dicoccoides* wieder aufzufinden, den wir von nun an mit Ascherson und Graebner *Tr. dicoccum* var. *dicoccoides* nennen wollen und von dem ein einziges Exemplar sich in dem Herbarium des Gelehrten Kotschy sozusagen eingeschmuggelt hatte [I set myself the goal of rediscovering *Tr. vulgare* var. *dicoccoides*, which from now on, in accordance with Ascherson und Graebner, we want to call *Tr. dicoccum* var. *dicoccoides*, of which a single specimen has, so to speak, smuggled itself into the herbarium of the learned Kotschy]". One notes the error in Aaronsohn's interpretation of Ascherson and Graebner's concept: they treated all cultivated and all wild annual *Triticum* taxa, except *T. monococcum* L. and *T. polonicum* L., as infraspecific taxa of what they called *T. sativum* Lam. with "B. II. *T. dicoccum*" one of the subspecies (Ascherson & Graebner 1901: 674, 676, 679). This classification within *T. sativum* is stated on p. 676 "Zerfällt in eine Reihe von Unterarten und Formen [subdivides into a series of subspecies and forms]".

Success was not achieved quickly. In June 1904, Aaronsohn searched in vain for wild emmer at the foot of Mt Hermon but refrained from persisting because he presumed that Kotschy's specimen must have been associated with an incorrect locality. Back in Berlin the following year, both Ascherson and Schweinfurth encouraged Aaronsohn to continue his hunt (Aaronsohn 1910), which in the end was successful and led to the rediscovery of wild emmer. The sequence of events was related in detail by the rediscoverer in three languages (Aaronsohn 1909a, 1909b, 1910) and by historians of science (Katz 2001; Leimkugel 2005; Suffrin & Nickelsen 2014; Suffrin 2019), stressing various aspects, such that we present only a brief summary.

The rediscovery on Mt Hermon

Here is Aaronsohn's report: "On June 18 [1906], I was walking with my friend, the agronomist Mr. M. Bermann,

in the vineyard of the Jewish Agricultural Colony at Rosh Pinar [Rosh Pina, now Israel], at foot of Jebel Safed … Suddenly I noticed … an isolated plant which at first sight looked like a stool of barley, but which on closer inspection proved to be wheat, the ripe spikelets of which could be detached from the brittle rachis by the slightest shake. I could hardly believe that it was really the plant for which I was looking. The development of the head and grains was so perfect – so nearly like the forms produced under cultivation at the present day – that I could scarcely believe that this was the wild prototype" (Aaronsohn 1910). This text appeared four years after the original rediscovery, when the importance of the finding had already become clear; Aaronsohn's original diary entries (Oppenheimer & Evenari 1941) lack any excitement and just mention the occurrence of *Triticum* for 18 June 1906. A few days later, Aaronsohn also found wild emmer at the locality given by Kotschy more than half a century earlier, and subsequently at the village of Arny [Aarné/Erneh, Syria] on the eastern slope of Mt Hermon (Aaronsohn 1910).

Back home, probably in Zikhron Ya'akov, Aaronsohn sent a letter, which has since disappeared, reporting his findings to Schweinfurth in Berlin. Very pleased, the latter replied on 20 August 1906 stating "Grâce à vous … cette éternelle question de la patrie du froment serait finalement éclaircie et je me félicite de mes 70 ans et d'avoir vu cela en ma vie [Thanks to you … this eternal question on the geographic origin of wheat will finally be clarified and I am pleased to be 70 years old and to have seen this in my life]" (cited in Leimkugel 2005). Apparently Aaronsohn had included spikelets of wild emmer in his letter, which Schweinfurth forwarded to Körnicke in Bonn for further study and, probably, cultivation in the garden for economic plants founded by the latter in 1867 (Ullrich 1970). Körnicke seems to have replied quickly to Schweinfurth, since the latter reported to Aaronsohn on 28 August 1906: "hourrah; ce sont maintenant 17 années passes que nous attendons la re-découverte. Toutefois nous sommes Körnicke et moi encore un peu en divergence de vue … K. n'admet que pour l'exemplaire de Rosh Pinah l'identité avec son *Tr. dicoccum* var. *dicoccoides* … Enfin votre découverte est bien assurée [Hurrah; seventeen years have now passed while we were waiting for the rediscovery. Nevertheless, Körnicke and I still have somewhat divergent views … K. only admits the identity of the specimen from Rosh Pinah to his *Tr. dicoccum* var. *dicoccoides* … Finally, your discovery is well assured]" (cited in Leimkugel 2005). This may indicate that what Aaronsohn had sent was mixed material and only the Rosh Pina specimen was regarded by Körnicke as wild emmer. Only three dated specimens document Aaronsohn's report: Mt Hermon, Rachaya to Arny, 18 Jun 1906, *A. Aaronsohn s.n.* (BM, K) and Rachaya, 19 Jun 1906, *A. Aaronsohn s.n.* (K). The following two undated specimens also originate from localities mentioned in Aaronsohn's report: Wadi Amud, near Rosh Pinah, *A. Aaronsohn s.n.* (BM) and Rosh Pinah to Jebel Kena'an, *A. Aaronsohn s.n.* (MPU). They could have originated from the collection tour undertaken in 1906. Further material may exist in the private herbarium of Aaron Aaronsohn kept in Beit Aaronsohn in Zikhron Ya'akov. It should be noted in this context that the specimen of wild emmer conserved in this herbarium and published in a key paper (Schiemann 1956: t. 8, right-hand side) was neither collected by Aaron Aaronsohn nor in the year 1906. Specimens of wild emmer collected by Rifka Aaronsohn (1882–1981), Aaron's sister, are from more recent years and not relevant in our context.

So far not mentioned in the literature, spikelets of wild emmer collected by Aaron Aaronsohn on Mt Hermon in 1906 were cultivated in the Grand Ducal Garden at Karlsruhe. Johann Andreas Kneucker (1862–1946), curator of the Grand Ducal Natural History Cabinet in Karlsruhe, collected at least one specimen from the garden and sent it to his colleague Joseph Bornmüller (1862–1948), the curator of the Herbarium Haussknecht in Weimar. It is now kept in B (B 10 0379338).

Schweinfurth arranged for the publication of Aaronsohn's findings in two journals published in Berlin, *Altneuland*, a professional Zionist journal co-edited by Warburg, and in the daily *Königlich privilegierte Berlinische Zeitung von Staats- und Gelehrten Sachsen*, better known as *Vossische Zeitung*. The first contribution must have appeared in September 1906 at the earliest (judging from internal evidence in the July/August issue of *Altneuland*) and consists of two parts: a text by the rediscoverer (Aaronsohn 1906) followed by a commentary (Schweinfurth 1906a). The second text (Schweinfurth 1906b), which appeared on 21 September 1906, is more general (for a reprint in a journal on the study of Egyptian antiquities see Schweinfurth 1906c) and based on the commentary. All three texts are in German. Judging from a later note (Schweinfurth 1908a), Aaronsohn's text in *Altneuland* had been translated from French, possibly by Schweinfurth.

In 1907, Aaronsohn continued his hunt for wild emmer and sent a report, dated 12 October 1907, to Schweinfurth (Schweinfurth 1908a; translated from French to German); apparently Aaronsohn also included specimens. On 31 December 1907, Körnicke wrote to Schweinfurth that Aaronsohn's specimens of *Triticum dicoccoides* had been correctly determined, proved surprisingly variable and that later cultivation would show how they behave (cited in Schweinfurth 1908a). The results remained unknown to Körnicke, because he died on 16 January 1908 (Hammer 2008). A specimen collected in the wild by Aaronsohn in 1907 exists (see below), and three specimens (B 10 0379336 [Fig. 2], B 10 0379339 and B 10 037940) raised from material collected by Aaronsohn in that year and cultivated in the botanical garden for economic plants in Bonn-Poppelsdorf survived. They were collected in 1908 by Max Koernicke (sic; 1874–1955), the son of Friedrich August Körnicke and the latter's second successor in the job at the Royal

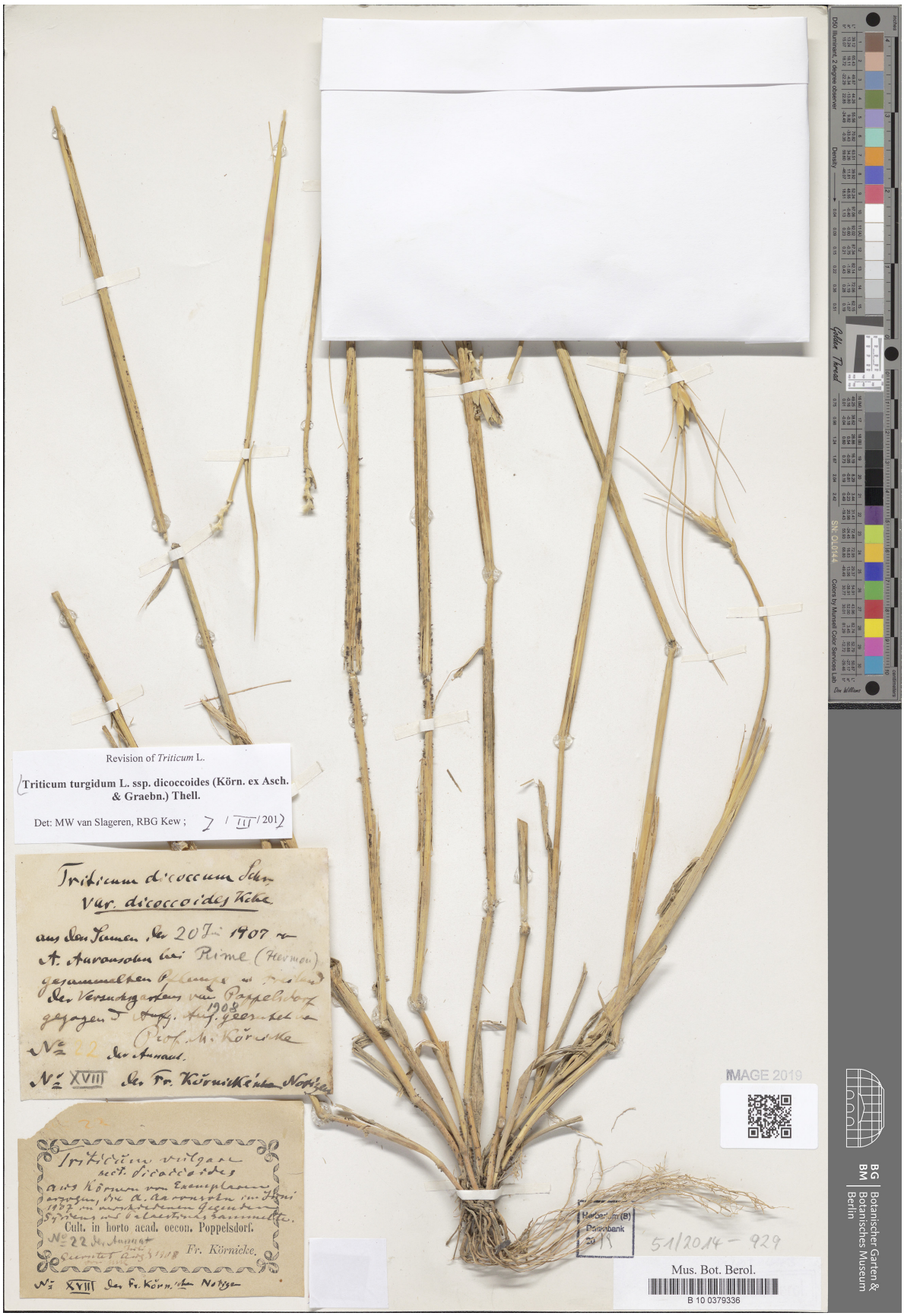

Fig. 2. Specimen (B 10 0379336) of *Triticum turgidum* subsp. *dicoccoides* (Körn. ex Asch. & Graebn.) Thell. – Progeny of a specimen collected by Aaron Aaronsohn in the wild in 1907 and cultivated in 1908 in the garden for economic plants in Bonn. Annotation by Georg Schweinfurth. – Berlin, Botanical Museum.

Prussian Agricultural Academy in Bonn (Schweinfurth 1908b; Kausch 1965). The three specimens are not annotated by him, but by Schweinfurth, only one of the specimens, i.e. B 10 0379336 carries an additional, printed label "ex horto acad. Oecon. Poppelsdorf Fr. Körnicke". A fourth specimen with an almost identical label, also in Schweinfurth's hand, is known only from a photograph published subsequently (Aaronsohn 1910: t. 2) without reference to the herbarium where it was deposited. Aaronsohn had collected the material from which the four specimens were raised between 12 and 20 June 1907, at Rosch-Pinah [Rosh Pina], Rime [Rima, Syria] and between the latter locality and Kabet el-Farras [Kafr Hawar?, Syria]. Considering the sequence of these events, it is no surprise that Körnicke's posthumously published account on new varieties of *Triticum* species (Körnicke 1908) contains no comment on Aaronsohn's new collections, which were still being tested in the garden for economic plants in Bonn, but only on Kotschy's specimen. However, the pertinent note "entschieden wild!!, kein Ackerflüchtling oder verwildert!! [definitely wild!! No refugee from cultivation or naturalized!!]" is crystal clear and may well echo what Körnicke had told his colleagues in Berlin about *Kotschy 1054* before 1901 (see above).

The only specimen of *Triticum turgidum* subsp. *dicoccoides* kept in B and apparently collected in the wild by Aaronsohn has also been annotated by Schweinfurth noting "bei Rahle am nördlichen Fuß vom Hermon [near Rahle at the northern foot of Mt Hermon], 20. VI. 1908" (B 10 039341). Judging from the reference to p. 320 of a paper published that year (Schweinfurth 1908a) on the label accompanying the specimen, it is clear that "1908" was a mistake for "1907". Aaronsohn had described in detail the rich occurrence of wild emmer near Rahle, a locality east of Aaiha [now Lebanon], when on his way to Damascus on 20 June 1907 (Schweinfurth 1908a). The collection B 10 039341 stands out: the specimen is mounted on rather old herbarium paper of a slightly larger size, carries the impression of the "Mus. Bot. Berol." stamp in blue ink and is labelled in Schweinfurth's calligraphy. This seems to suggest that the specimen had been originally put on show in the galleries of the Royal Botanical Museum in Berlin-Dahlem, possibly in the part dedicated to economic plants, for which, however, no descriptive catalogue has ever been published.

In short, the material evidence for the rediscovery kept in public collections seems to be rather meagre, particularly when compared to the extensive literature on Aaronsohn's findings and the expectations they nurtured in the community of wheat-breeders.

Discovery east of the river Jordan and in Iran

Unsurprisingly, Aaronsohn continued to look out for Kotschy's plant in 1908 when taking part in an expedition under the order of Abdul Hamid II, the 34th sultan of the Ottoman Empire (Aaronsohn 1909a). He found it many kilometres further south "while going from Tell Nimrin [Nimrin, Beth-Nimrah, Jordan] … to Ain Hummar [near Wadi Es-Sir, west of Amman towards Al-Salt, Jordan], on the plateau of Es-Salt [Al-Salt, Jordan]" on 17 April 1908 (Aaronsohn 1910); a map showing his itineraries was published posthumously (Aaronsohn 1931). Since then many locations of wild emmer have been identified in northern Jordan all east of the River Jordan. Their genetic variation and introgression from durum wheat has also been studied (Syouf & al. 2006).

In the same way in which Aaronsohn had been encouraged to search for the wild emmer, Theodor Strauss (1850–1911), a businessman and the British Vice Consul in Sultanabad [Arak, Iran] (Frotscher 1998; Lack 2006), had been asked by Bornmüller to look out for this plant (Schulz 1913a). Strauss, like Aaronsohn, was successful in finding *Triticum turgidum* subsp. *dicoccoides* in Mt "Noa-Kuh" [not localized] near "Kerind" [Kerend-e Gharb, Iran] on 14 May 1910. The specimens were sent to Bornmüller who passed at least one of them to August Schulz (1862–1922), a professor of Halle University. The latter described and named the specimen as a form new to science (Schulz 1913a) and in the same year mentioned it in his *Geschichte der kultivierten Getreide* (Schulz 1913b). This view was corroborated by Bornmüller (Bornmüller 1915), whereas today this form is regarded as lying within the range of variation of wild emmer. At least six specimens of this collection survive in four herbaria (see below).

Judging from a recently published distribution map (Zohary & al. 2012), Aaronsohn had collected *Triticum turgidum* subsp. *dicoccoides* near its southernmost locality, Strauss at its easternmost locality. In the following decades many more specimens were collected much further north, in southern Turkey and Iran. They all prove that the distribution of wild emmer is that of a typical Fertile Crescent plant, although with emphasis on the western half of the "arc".

Nomenclatural summary

Triticum turgidum subsp. ***dicoccoides*** (Körn. ex Asch. & Graebn.) Thell. in Naturwiss. Wochenschr., n.s., 17: 470. 1918 ≡ *Triticum sativum* [subsp. *dicoccum*] var. *dicoccoides* Körn. ex Asch. & Graebn., Syn. Mitteleur. Fl. 2(1): 679. 1901 ≡ *Triticum dicoccoides* (Körn. ex Asch. & Graebn.) Schweinf. in Ber. Deutsch. Bot. Ges. 26a: 309. 1908. – Holotype: [Lebanon], Crescit ad margines aridas vinetorum pagi Raschaju [Rachaya] Antilib. [Antilibanon], alt. 4000 ped., Jul 1855, *Kotschy 1054* [Iter syriacum 1855] (W 0030713 [Fig. 1]).

= *Triticum dicoccoides* f. *straussianum* A. A. H. Schulz in Ber. Deutsch. Bot. Ges. 31: 226, 229. 1913 ['*straussiana*'] ≡ *Triticum dicoccum* var. *straussianum* (A. A. H. Schulz) Flaks. in Trudy Byuro Prikl.

Bot. 7: 765. 1914 ≡ *Triticum dicoccoides* var. *straussianum* (A. A. H. Schulz) Flaks. in Repert. Spec. Nov. Regni Veg. Beih. 56: 107. 1929. – Holotype: [Iran], Mt Noa-Kuh, dit. Kerind, 14 May 1910, *Strauss s.n.* (B 10 0264859; isotypes: BP, JE 00006376, JE 00006377, JE 00006378, W-Hack 1916-0001081).

– *Triticum vulgare* var. *dicoccoides* Körn. in Verh. Naturhist. Vereines Preuss. Rheinl. Westfalens Reg.-Bez. Osnabrück 46: 21. 1889, nom. nud.

Epilogue

No attempt is made here to summarize the immense impact of the rediscovery of wild emmer on understanding wheat evolution and domestication, because this topic has been dealt with at a conference in Zikhron Ya'akov in 1999 in an exemplary manner (e.g. Feldman & Millet 2001). The same applies to the role of wild emmer, often referred to as "Urweizen", a term coined by Schweinfurth (Schweinfurth 1907b), for Zionism in general. This topic was recently covered by historians of science (e.g. Leimkugel 2005; Suffrin & Nickelsen 2014; Suffrin 2019). The rediscovery has also had a major impact on our understanding of the nutrition, lifestyle and early artefacts of the Natufians, who lived in the western part of the Fertile Crescent c. 20 000 years ago. It has, for example, been shown that wild emmer is a significant component of the biological remains traceable in Ohalo II, a submerged late Epipalaeolithic site near the Lake of Galilee situated south of Mt Hermon (e.g. Kislev & al. 1992). In short, what Kotschy discovered and Aaronsohn rediscovered gradually changed in a fundamental manner our understanding of the late Epipalaeolithic in the region of the Fertile Crescent, in particular our views on the beginning of a sedentary lifestyle and the domestication of crop plants.

Looking forward, one can see desirable characters from *Triticum turgidum* subsp. *dicoccoides* that are now successfully transferred to newly developed cultivars for the very dry areas: in 2017 Morocco released the durum wheat cultivar 'Nachit' and Mauritania and Senegal the durum wheat cultivar 'Haby'. Both were selected for their good spike fertility under constant heat stress during the growing season, a trait considered to be most likely derived via introgression from the wild relative (Tidiane Sall & al. 2019).

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