

seems to be justified that the garrisoning of the stations of the Limes must have ceased some time in the second century A. D.

Considering the short interval left between these chronological limits, the great distance separating the extreme western border of the empire from the centres of its industrial activity, and, last but not least, the conservative ways of Chinese civilization, as illustrated in respect of writing-material by the exclusive use of wood for the Chinese records of the Niya Site down to the latter half of the third century A. D., the discovery of these non-Chinese documents on paper at the watch-station T. XII. a, together with at least one clearly dated record of A. D. 21 and a number of others also belonging to the early years of the first century A. D., was obviously a matter of special interest. This induced me in 1910 to recommend samples of paper taken from these documents to the particular attention of Professor J. von Wiesner, the distinguished plant physiologist. To his long-continued and fruitful researches is due most of any exact knowledge that we possess of the development of paper manufacture in Central Asia and the East generally, and he had previously secured interesting results through the examination of a number of the papers represented among the manuscript finds of my first expedition.<sup>10</sup>

Use of paper  
in docu-  
ments of  
T. XII. a.

Professor von Wiesner's minute and painstaking microscopic analysis of these paper samples from T. XII. a has been rewarded by important discoveries, which have been set forth with great precision and clearness in his paper: *Über die ältesten bis jetzt aufgefundenen Hadernpapiere*.<sup>11</sup> In view of their distinct archaeological interest, it is necessary to summarize here the main points established. The examination of the specimens taken from different documents has definitely proved that the material of their paper was entirely made from textiles which had been reduced to pulp by a rough mechanical process of stamping.<sup>12</sup> The threads, still clearly recognizable by microscopic enlargement and undoubtedly made up of plant fibres, point very distinctly to production from a *Boehmeria*, which can scarcely be any other than the Chinese hemp (*Boehmeria nivea*), cultivated in China since the earliest times.<sup>13</sup> A particularly interesting observation made in the paper sample of T. XII. a. ii. 1. a revealed the presence of a textile fragment, much lacerated but still retaining even for the naked eye a characteristically woven appearance, the threads being laid lengthwise and across.<sup>14</sup> Professor von Wiesner is inclined to attribute this peculiar feature, found in the one sample only, to a more primitive procedure, which at first aimed at transforming thin linen fabrics into writing-material without completely destroying their texture, and shows good reasons for the belief that the paper in question represents a particularly early stage in the evolution of pure rag paper.<sup>15</sup>

Prof. von  
Wiesner's  
paper  
analysis.

In any case, the material of these documents conclusively proves that the manufacture of paper solely from linen rags must have been practised in China immediately after Ts'ai Lun's invention had been made, whereas until the discovery of the T. XII. a documents the use of rags could be traced in ancient papers from sites of Chinese Turkestan merely as a surrogate admixture to vegetable fibres which were obtained from the bark of the paper mulberry and similar trees.<sup>16</sup> The point is of special importance, because it definitely disposes of the previous belief which ascribed the origin of rag paper to an Arab invention first made at Samarkand about the middle of the eighth century A. D. and thence spread through the Near East to Europe.<sup>17</sup> But the fact now

Early use of  
pure rag  
paper.

<sup>10</sup> See v. Wiesner, *Ein neuer Beitrag zur Geschichte des Papiers*, in *Sitzungsberichte der K. Akad. der Wiss.*, Vienna (1904), vol. cxlviii; also *Mikroskopische Untersuchung . . . asiatischer Papiere*, etc., in *Denkschriften der math.-naturw. Klasse der K. Akad. der Wiss.*, Vienna (1902), vol. lxxii.

<sup>11</sup> Published in *Sitzungsberichte der K. Akad. der Wiss., Philos.-Histor. Klasse*, Vienna (1911), vol. clxviii, Abh. 5,

pp. 1-26 (quoted from reprint).

<sup>12</sup> See v. Wiesner, *loc. cit.*, pp. 15 sqq., 22 sq.

<sup>13</sup> See *ibid.*, p. 18.

<sup>14</sup> Cf. *ibid.*, p. 14, with Fig. 1.

<sup>15</sup> See *ibid.*, pp. 16 sqq.

<sup>16</sup> See *ibid.*, p. 9.

<sup>17</sup> For references to this early Arab paper manufacture