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## Chinese Script and the Invention of Printing

The invention of printing was one of the major technological developments of all time, since it made possible the mass dissemination of both knowledge and debate. However the nature of this invention is still imperfectly understood. It took place in two distinct cultural spheres: Europe, with its gothic and roman alphabets, and East Asia, with its Chinese ideographic script. Although in a significant sense printing was first invented in China and/or Korea, it is still widely believed that it was first invented in Germany by Johannes Gutenberg. This belief is strongly reinforced by the standing exhibition in the otherwise most excellent museum of printing at Mainz, the Gutenberg-Museum, and in associated publications which will be examined below. As will be made clear, the issue is no longer a historical one, a question of proof by documents and artefacts, but an analytical one about the nature of Chinese script and the nature of printing.

Strangely enough, even as the discussion about the invention of printing now centres on the very nature of written or printed language in different cultures, the introduction of computerised printing and word-processing has led to comparable problems of analysis. Computer experts in the western world sometimes say very strange things about the nature of Chinese, Korean and Japanese script. These are only matched by the strange things said about the matter by easterners themselves, especially by Japanese in the forefront of technological advance, who seem to feel a need to match changes in American and European technology step by step. Hence there have been various attempts to reduce Chinese script to something like a western typewriter keyboard for inputting purposes, breaking the characters up into bits and pieces of unnatural shapes and sizes. This will not be pursued here as a technical problem. The point is that at a technological level the difference between Chinese script and alphabetic script does make a significant difference, and the resolution of present problems depends entirely on a correct understanding of the nature and function of Chinese script in the three relevant languages, Chinese, Korean and Japanese.

The history of printing is probably most finely exhibited at the Gutenberg-

Museum in Mainz which has an outstanding collection of printed materials and printing machinery. Although centred on the work of Johannes Gutenberg himself, as a beloved son of the city of Mainz, the museum displays printings etc. from major civilisations and quite deserves the title of 'Weltmuseum der Druckkunst'.

Attention here must centre on the section entitled 'Der ferne Osten' (The Far East), which displays among other things an example of the oldest still existing printed documents in the world, namely the small rolls of paper covered with a Buddhist text (The *Dhāraṇī-Sūtra*) which were distributed to temples all over Japan in 770 AD on the orders of the Empress Shōtoku. These printings, of which one million are said to have been made at the time, and of which a few copies now remain, are referred to in the Museum's 1975 catalogue<sup>1</sup> in the section entitled 'Druck vor Gutenberg' (Printing Before Gutenberg), which concludes with the disarmingly straightforward sentence, 'Sie sind von einer Holztafel abgedruckt, während Gutenberg den Druck mit Einzellettern erfunden hat' (They [the *dhāraṇī-sūtras*] are printed from a wooden block, while Gutenberg invented printing with separate letters)<sup>2</sup>. This statement seems to contradict an earlier statement in the same section which runs: 'Es besteht kein Zweifel darüber, daß in China und in Korea bereits vor Gutenberg mit Einzeltypen gedruckt worden ist' (There is no doubt that there was already printing with separate type in China and Korea long before Gutenberg)<sup>3</sup>. With these statements may also be taken the opening statement of the same section which runs, 'Johannes Gutenberg hat das Drucken mit beweglichen Lettern erfunden. Das Drucken selber ist uralt.' (Johannes Gutenberg invented printing with movable letters. Printing itself is extremely ancient)<sup>4</sup>.

At this point in the Museum's catalogue therefore the reader will be left somewhat confused by the opening and concluding statements of the section 'Druck vor Gutenberg' which stress that Gutenberg invented movable type with separate letters, while it is also asserted that Chinese and Koreans used separable type before him. The second of these statements is itself contained in a longer paragraph which greatly oversimplifies the work of the oriental precursors of Gutenberg and concludes 'Die Buchdruckerkunst, die sich die Welt eroberte, war das Werk von Johannes Gutenberg in Mainz' (The art of printing books which conquered the world was the work of Johannes Gutenberg in Mainz)<sup>5</sup>. Since this is a direct claim to world priority and pre-eminence it needs to be examined very carefully indeed if a distorted view of the history of ideas and the relations between cultures is to be avoided. The only way to do this fairly is to quote and comment on the whole paragraph. The text runs as follows:

'Bereits im Jahre 1409 erschien in Seoul in Korea, wo mit großem Aufwand eine

<sup>1</sup> *Gutenberg-Museum der Stadt Mainz*, Mainz, 1975 Peter-Winkler-Verlag München.

<sup>2</sup> *Ibid.*, p. 29.

<sup>3</sup> *Ibid.*, p. 28.

<sup>4</sup> *Ibid.*, p. 28.

<sup>5</sup> *Ibid.*, p. 28.

Staatsdruckerei gegründet worden war, der erste mit Einzeltypen hergestellte Druck. Auch in China soll lange vor Gutenberg und sogar einige Jahrhunderte vor Korea mit Einzeltypen gedruckt worden sein. Diese Einzeltypen waren um die Mitte des 11. Jahrhunderts von dem Schmied Pi Sheng hergestellt worden. Nach einem alten chinesischen Bericht haben diese Typen aus gebranntem Ton bestanden. Von diesen zerbrechlichen Tontypen hat sich aber keine einzige bis heute erhalten. Es besteht kein Zweifel darüber, daß in China und in Korea bereits lange vor Gutenberg mit Einzeltypen gedruckt worden ist. Da aber die fernöstlichen Schriften mehr auf einem Silbensystem als auf einem Buchstabensystem aufgebaut sind, konnte diesen Erfindungen kein bleibender Erfolg beschieden sein. Die Buchdruckerkunst, die sich die Welt eroberte, war das Werk von Johannes Gutenberg in Mainz.'

(The first printing produced with separable type appeared as early as 1409 in Korea, where a state printing house had been established at great expense.<sup>a</sup> In China too, long before Gutenberg and even a few centuries before Korea, it is said that printing with separate type was carried out. This separate type was manufactured by the smith Pi Sheng about the middle of the 11th century. According to an old Chinese account this type consisted of baked clay. However not one of these fragile earthenware types has survived to the present.<sup>b</sup> There is no doubt that there was already printing with separate type in China and Korea long before Gutenberg.<sup>c</sup> However, since the far eastern scripts are built up on the basis of a syllable system rather than on a letter system, these inventions could enjoy no lasting success.<sup>d</sup> The art of printing books which conquered the world was the work of Johannes Gutenberg)<sup>6</sup>.

Comments can now be made on this statement (c.f. the a, b, c, d in the English translation).

a) There is no basis for suggesting that the production of metal type in Korea for Chinese script was intrinsically expensive. The amount of metal needed for oriental printing is about the same per area of printed page as it is for western printing. The requirement of casting a large number of different characters has two aspects. Firstly, though many different ones are needed, less of each are needed on average to print a work of comparable length to a western work. Secondly, the economic cost of the work involved in making them was probably no greater than that of cutting a large number in a wood-block, which was the alternative process of the time.

b) The catalogue text implies that type made of earthenware was somehow different in principle in that it has not survived to the present. Of course the whole value of movable type is that it can be mass produced from moulds and used several or many times. In fact the earthenware type of Pi Sheng was designed for re-use, because the pieces were held in a wax base which was later warmed to release the pieces<sup>7</sup>. Thus in principle the earthenware type was movable and re-usable. Presu-

<sup>6</sup> Ibid., p. 28.

<sup>7</sup> C.f. A. Ruppel, *Haben die Chinesen und Koreaner die Buchdruckerkunst erfunden?* Mainz 1954, Verlag der Gutenberg-Gesellschaft, p. 8.

mably Pi Sheng chose earthenware because it was easily available to him. It should not be forgotten moreover that separable types cut in wood are also documented from China at about 1300 AD and to still exist<sup>8</sup>. Clearly these were less fragile. There seems to be a natural development from earthenware to wood to metal, as it became clear that storage and re-use were advantageous.

c) The fact that there was printing movable type in China and Korea long before Gutenberg's invention of the same is the statement within this paragraph which deserves real prominence. It should not be obscured by being placed in the context of negative comments about far eastern practice and an extremely general discussion of pre-Gutenberg printing in Europe (see the general lay-out of the catalogue). Nor should it be overlooked that the Asian type was not only 'separate' but also 'movable', although the text unfairly refers only to Gutenberg's type as movable (*beweglich*).

d) It is completely misleading to say the the Sino-Korean invention enjoyed no lasting success. For various reasons it existed side by side with wood-block printing in the countries of East Asia, but eventually it did in fact come into general use and is to this day the system upon which all non-computerised modern printing in China, Korea and Japan is based. The assumption that the relative slowness of the system's coming into common use is something to do with the 'syllabic' nature of the script is quite erroneous. The reasons must be sought elsewhere, probably in the extremely highly developed state of the wood-block printing tradition and the lack of overwhelming political need in the power structures of the time for anything different. The printing revolution in Europe was partly fired by a religious zeal for printing the scriptures for all to read, and partly made possible by the existence of an independent bourgeoisie in European towns. Such conditions were later matched in East Asia, particularly in Japan, and it was never necessary to reinvent printing with movable metal type, or to learn it from Europe, when it eventually came into wider use.

A further statement about oriental printing is found in a later section of the catalogue entitled 'Der Nahe und der Ferne Osten' (The Near and Far East). Two passages in this section are directly relevant to the present discussion, and they run as follows.

'Im Fernen Osten war lange Zeit die chinesische Schrift vorherrschend. Da es über 6000 chinesische Zeichen gibt, war diese Schrift für den Buchdruck ungeeignet. Der chinesische Schmied Pi Sheng erfand um das Jahr 1000 den Druck mit aus Ton gebrannten Lettern. Seine Erfindung konnte sich aber nicht durchsetzen, da diese Lettern äußerst zerbrechlich waren.'

(In the Far East Chinese script was dominant for a long time.<sup>9</sup> Since there are over 6000 Chinese symbols this script was unsuitable for book-printing.<sup>9</sup> The Chinese smith Pi Sheng invented printing with letters of baked clay round about the year

<sup>8</sup> Ibid., p. 8.

1000. However his invention did not become generally accepted because the letters were extremely fragile.)<sup>c</sup> ...

'In Korea wurden schon hundert Jahre vor Gutenberg Bücher mit Lettern aus Kupfer gedruckt. Dies konnte aber nur mit Hilfe des Königs geschehen, da das Verfahren sehr kostspielig war. Mehr Verbreitung fand das Drucken von Holztafeln, in die der Text eingeschnitten war. Zur Zeit Gutenbergs erfand der koreanische König Se Jong eine neue Schrift, die Buchstabenschrift Hangul. Diese wurde später zur heute noch gültigen koreanischen Nationalschrift.'

(In Korea books were already printed a hundred years before Gutenberg with letters of copper. However this could only be done with the help of the king because the process was so costly.<sup>d</sup> Printing from wood-blocks into which the text was cut was more widespread. At the time of Gutenberg the Korean king Se Jong invented a new script, the alphabetic script Hangul. This later became the national script of Korea which it remains to the present day.<sup>e</sup>)<sup>9</sup>.

These statements also require some comment (cf. the a, b, c, d, e in the English translation).

a) To say that Chinese script 'was' dominant in Asia for a long time betrays serious ignorance of Asia. Although no longer used in Vietnamese, Chinese script still plays a major role in written or printed Korean and Japanese, and of course is used entirely in Chinese itself. It is true to say that Chinese script is still dominant in East Asia and is likely to remain so.

b) Altogether there are about 40,000 historically recorded forms of Chinese characters, but in any one text there are probably considerably less than 6000 different ones used on average, except of course in dictionaries. The number of different characters does not lead to any special problems in book-p r i n t i n g, particularly on the wood-block method. It does lead to the more specific problem of classified storage and selection of characters for type-setting. This problem had long been a head-ache for dictionary work, and today has resurfaced as a problem for the inputting stage of computer work. Gutenberg did not, unfortunately, invent a solution to this particular problem. The relatively cumbersome process of type-selection from storage trays may indeed have made movable type printing for Chinese script seem less of a breakthrough than it seemed in Europe. Nevertheless the method, as invented in Asia, did in fact eventually displace wood-block printing. Thus simply to say that 'the script was unsuitable for book-printing' is a very disingenuous way of putting it. Chinese script is uniquely suitable for printing Chinese books. The same is true for Korean and Japanese books to the extent to which Chinese script has become incorporated into those languages.

c) The renewed reference to Pi Sheng gives a different impression of the date of his invention, which Aloys R u p p e l cites as between 1041 and 1048<sup>10</sup>. Again the fragility of his earthenware type is stressed, but nothing is said positively about the p r i n c i p l e of his invention.

<sup>9</sup> *Gutenberg-Museum der Stadt Mainz*, p. 62.

<sup>10</sup> A. R u p p e l, *op. cit.*, p. 8.

d) The Korean development of printing is again described as being costly, but as already argued above, the basis for this assertion is questionable. The Korean method was not particularly costly in principle. In any case, with inventions it is the principle which counts.

e) The Korean Hangul script came into use on the same principle as the two Japanese phonetic scripts. These are all used at the present time in conjunction with Chinese characters. That is to say, a typical sentence contains both forms of script. The reference to the design of the Hangul script in the catalogue text is not related to the invention of printing. The fact that it was invented 'at the time of Gutenberg' is not relevant to the question of priority in the invention of printing.

The main trend in this account is again to play down the oriental invention of the use of movable type, blaming the fragility of earthenware type, the expensiveness of metal type, and the 'unsuitability' of Chinese script for printing.

The catalogue contains one further section of interest in the present discussion, namely a table showing the chronological spread of printing throughout the world, giving dates with countries and towns. This begins with 1450 (approx.) Germany, Mainz, and then goes on to include most of the countries of Europe by about 1500. Thereafter 'printing' allegedly spread to countries all over the world including Japan (Kazusa) in 1590 and China (Shanghai) in 1644! Although countries as far apart as Chile (1776), Burma (1827) and Kenya (1895) are listed, there is no reference at all to Korea in the list. This amazing omission simply serves to underline that the table, though it does not say so, is referring to the spread of printing for the western alphabet only. Historical reality is more complex. For example when Tokugawa Ieyasu ordered various stocks of type to be made in Japan in the early 1660s this was not a consequence of the arrival of Gutenberg's invention in Japan in 1590, but simply the practical application of an available oriental technique. Various details may be found in A. L. Sadler's *The Maker of Modern Japan*, Chapter XXXVIII, where it will be seen that large quantities of both metal and wooden type were in use<sup>11</sup>. The catalogue table therefore, headed *Ausbreitung der Druckkunst in der Welt*, needs major revision or redefinition, and indeed it would be much better if two tables were presented showing the spread of oriental and occidental printing respectively, oriental first.

The above criticisms may seem unduly extensive for a museum catalogue. However it is a catalogue for a 'world museum of printing', and the main points of the text are prominently summarised in the standing exhibition itself, in the Far East section. A statement there displayed triumphantly concludes that 'The art of printing which has spread to all countries stems from Johannes Gutenberg'. The complete text of the statement, which provides new ingredients for the discussion, runs as follows.

"Korea ist das Land der Erde, in dem mit einzelnen Metalltypen gedruckt worden ist, nachdem bereits bald nach 1040 der chinesische Schmied Pi Sheng Worttypen aus gebranntem Ton zum Drucken verwendet hatte. Ein in Korea im Jahr 1377 mit

<sup>11</sup> London 1937, reprinted Tokyo 1978, Tuttle.

Metalltypen gedrucktes Buch wird in der Nationalbibliothek zu Paris aufbewahrt. Es ist in dieser Ausstellung in einer Nachbildung zu sehen. Im Jahr 1403 ordnete König Thä-tjong an, daß zum Druck von Büchern Einzeltypen aus Kupfer gegossen werden sollten. Allerdings handelte es sich dabei nicht um einzelne Buchstaben, sondern der Eigenart der verwendeten chinesischen Schrift gemäß um Wörter und Silben. Das kostspielige koreanische Verfahren, das unter der Kontrolle des Königs stand, der nur chinesische Texte drucken ließ, konnte nicht die Verbreitung finden, wie die Kunst Gutenbergs. Es fehlte das Handgießinstrument, es fehlte die Presse und es fehlte die Möglichkeit volkstümliche Texte zu drucken. Die Druckkunst, die sich in alle Länder verbreitet hat, stammt von Johannes Gutenberg”.

(Korea is the land on earth where printing was done with separate metal type, after the Chinese smith Pi Sheng has used word-casts of baked earthenware for printing as early as just after 1040. A book printed in Korea with metal type in the year 1377 is preserved in the Bibliothèque Nationale in Paris. A copy is displayed in this exhibition. In the year 1403 King Thä-tjong ordered separate type to be cast in copper for printing books. This did not however consist of separate letters but, in accordance with the nature of Chinese writing, of words and syllables. The expensive Korean process, which was under the control of the king, who only had Chinese texts printed, could not enjoy the widespread acceptance found by Gutenberg's technique. It lacked the hand-held type caster, it lacked the printing press, and it lacked the possibility of printing popular texts. The art of printing which has spread to all countries stems from Johannes Gutenberg)<sup>12</sup>.

It will be noted that this statement contains additional reference to no less than an extant book printed with movable type in Korea and dated at 1377. The defence in favour of Gutenberg here concentrates on two points, firstly the very nature of Chinese script, and secondly the machinery used in the process. These two points occurred centrally in the argument advanced by Aloys Ruppel in his paper *Haben die Chinesen und Koreaner die Buchdruckerkunst erfunden?* (1954) (i.e. Did the Chinese and Koreans invent book-printing?)<sup>13</sup>. This is a significant paper since it represents the way in which the question was viewed by a man who was for many years the director of the museum, and who, in the words of his successor, the present director Helmut P r e s s e r, ‘worked tirelessly to spread the name of Gutenberg in the world’<sup>14</sup>. Naturally the oriental development of printing was a major embarrassment in the attempt to promote Gutenberg's fame. It is presumably for this reason that a tendency arose in the museum's presentations to play down its significance, and, no doubt unconsciously, to distract or confuse the visitor or reader with a small number of half-appropriate comments. R u p p e l's paper gives a much fuller account and deserves attention in its own right as a scientific discussion of the matter.

<sup>12</sup> This statement was on display in 1978, and it was either written by Aloys Ruppel or based on his work referred to above, and again below.

<sup>13</sup> See note 7 above.

<sup>14</sup> *Gutenberg-Museum der Stadt Mainz*, p. 10.

Ruppel presented the problem straightforwardly as a problem of priority. As he wrote, it is generally agreed that other European claimants to the honour of inventing printing cannot really compete with Gutenberg, much to the disappointment of Dutch, Italians, Czechs, French, Belgians, etc. The main facts about the Chinese and the Korean inventions are then adduced (as given above), and the rest of the argument is devoted to rendering them harmless. Ruppel provides *en route* a convenient summary of the historical data (with illustrations), based on relevant literature and divided into three sections headed Paper, Woodblock Printing and Typography. None of the historical information presented is here in dispute.

By means of the materials presented Ruppel was taking issue with an argument published in January 1953 by André Blum of the Musée du Louvre under the provocative title '*Gutenberg est-il le premier Inventeur de l'Imprimerie?*'<sup>15</sup> which had already been countered once by Georges Dangon, from a Swiss standpoint, in a piece entitled '*Gutenberg est bien le premier Inventeur de l'Imprimerie*'<sup>16</sup>. On the 11th May in the same year Ruppel gave his answer at a lecture in Copenhagen which then formed the text of the paper now under consideration. It was indeed a long-standing issue, having already been stated provocatively by the famous orientalist Stanislas Julien in an article entitled '*Sur l'Art d'imprimer à l'aide de Planches en bois, de Planches en pierre et de Types mobiles, inventée en Chine bien longtemps avant que l'Europe en fit usage; Extraits de Livres Chinois*' (1847)<sup>17</sup>. With this theme being revived by a Frenchman, a definitive statement from Gutenberg's home town no doubt seemed essential, though Ruppel interestingly enough described Gutenberg as a European as well as a German and a citizen of Mainz in his resounding conclusion:

"Der Erfinder der Druckkunst, die sich die Welt eroberte, war kein Chinese und kein Koreaner, sondern der Europäer, der Deutsche, der Mainzer Johannes Gutenberg."

(The inventor of the art of printing which conquered the world was not a Chinese and not a Korean, but the European, the German, the citizen of Mainz, Johannes Gutenberg)<sup>18</sup>.

There was a most unfortunate feature to the 1953 debate, and this was that both sides tried to prove too much. Blum tried to show that Gutenberg not only was preceded by Koreans and Chinese, but that his work was influenced by them. Not only had the Europeans learned about paper from the Orient, via the Turkestan Silk Road, but they had later learned from the Orient what to do with it, this time not via the Mediterranean but via the Caucasus, Novgorod, Warsaw and Prague, and only then in Germany. Ruppel's counter-arguments here seem quite convincing. Firstly there is insufficient evidence for this transfer of technology, and secondly the time-span to which dates can be precisely assigned for a possible move-

<sup>15</sup> In "La Chronique Graphique", January 1953, pp. 4-13.

<sup>16</sup> In "Schweizerisches Gutenbergmuseum", March 1953, pp. 17-24.

<sup>17</sup> In "Journal Asiatique", 1847.

<sup>18</sup> A. Ruppel, *op. cit.*, p. 11.



ment of the idea of metal type (1409–1436) is much too short to be plausible. Not that the question is unworthy of consideration. Ruppel himself reproduces, without any comment, an illustration of printings from the early 14th century from separate pieces of wooden type in the language of the Central Asian Uigurs (a long way from Korea)<sup>19</sup>. This would seem to indicate a transfer of the principle of movable type to a phonetic script which on some interpretations would be a significant cultural jump. R u p p e l also reproduces without any comment an illustration of a Chinese revolving box for keeping movable type which had already been so described as early as 1314<sup>20</sup>. This would seem to allow a much longer period for the general idea of movable type to wander from China, westwards as well as eastwards. Nevertheless, although diffusionist speculation is always tempting, it may be admitted that R u p p e l was right to say that it remains unproven in this instance. In any case it does not form part of the present argument.

However, if B l u m overreached himself by arguing for historical influence instead of mere priority, Ruppel himself was not satisfied with rejecting the possibility of historical influence but sought to state Gutenberg's uniqueness in the strongest possible way. This is where his problems began. He opened the final section of his argument drastically :

“Viel wichtiger aber als das ungelöste Wegeproblem ist die Tatsache, daß der koreanische Typendruck etwas ganz anderes ist als die europäische Erfindung Gutenbergs”.

(Much more important than the unsolved route problem however is the fact that Korean printing with type is something quite different from Gutenberg's European invention)<sup>21</sup>.

His argument then had two parts, which clearly became the basis for the statement exhibited to this day in the Gutenberg-Museum in Mainz. One part refers to the range of machinery used in the process, and the other part refers to the very nature of the scripts printed. In order to achieve a balanced judgement about the historical development of printing, these two distinct matters both require to be correctly understood.

As to the machinery used in the total process of printing, it is probably here that the main strength of Ruppel's argument for Gutenberg's fame lies, though the reasoning is not without flaws. R u p p e l makes a distinction between the Korean and German methods of making the type itself. The Koreans first cut their 'virtually innumerable characters' (*schier zahllose Schriftzeichen*, an exaggeration this, based on European superstition) out of wood, then pressed these in sand and cast metal type in the sand matrices. Gutenberg by contrast first made his letters

<sup>19</sup> Ibid., p. 8.

<sup>20</sup> Ibid., p. 8. The drawing shows eight central sections for characters written with from one to eight strokes and sixteen outer sections for characters with from nine to twenty-four strokes respectively, which graphically illustrates acquaintance with the practical need for sorting and finding different pieces of type.

<sup>21</sup> Ibid., p. 10.

in steel, then produced a permanent copper matrix and used this again and again for making lead type. There is some over-emphasis on Ruppel's part when he stresses the permanence of the German materials as opposed to the transience of the Korean. Of course, only one type, or set of type, would be made from one casting in a sand matrix, but then the sand matrices could themselves be almost immediately reformed from the wood block for further castings. Another aspect of this is that with a greater variety of characters less of each are required to print a comparable text. One might say that by contrast with the classical Chinese script it was the European alphabet which required 'virtually innumerable' exemplars of the same thing to print even a dozen pages or so. This is purposely stated so, in reverse, to illustrate the importance of nuance in setting out the factual situation. The ability to produce very, very many types of one same letter was a much more important requirement in the European case than in the Oriental case, and it is inappropriate to cast a negative light on the Oriental development for not treating this matter so urgently. In the early development of printing the wood-sand-metal procedure was not inappropriate for Chinese script. Wood was fine for carving the shapes with existing craftsmanship, sand cost nothing, and the expensive metal was used only for the type itself.

Ruppel goes on to emphasise, in this connection, the importance of the hand-held type-caster (*Handgießinstrument*), the tool used by the printer to make further type as required. Again, this is probably over-emphasised as a function of the contrast between European and Oriental printing. After all, the whole advantage of movable and reusable type was that once one piece of printing was done the type would be reordered for a different text. Ruppel himself speaks of several hundreds of thousands of characters being cast on the orders of the Korean king T'ai Tsung. If we placed the figure, for the sake of an estimate, at 500,000, giving an average of 50 types for a set of as many as 10,000 different characters, this would be enough to print a book of 3,000 pages of the format shown in Ruppel's own final illustration, leaving a few hundred characters to spare. Thus when Ruppel says, 'Gerade dieses Gießinstrument gilt als der wesentlichste Teil der europäischen Erfindung' (Precisely this casting machine is reckoned to be the most essential part of the European invention)<sup>22</sup>, problems abound. For long one had been led to believe that the invention of movable, re-usable type was the central feature of the printing revolution, but now the ground seems to have been shifted to the tool for the convenient quantity production of type for the European alphabets. As Ruppel says, 'Und dieses hatte in Ostasien keinerlei Vorbild' (And this had no kind of model in East Asia)<sup>23</sup>. But they printed just the same.

The other main piece of machinery related to the use of the type after being set as a text, the printing press used in the process of printing on to a page. This machine the Orientals did not have, as Ruppel hastens to point out. They did their printing the same way as they had always done it from wood-blocks, by pressing the paper

<sup>22</sup> Ibid., p. 10.

<sup>23</sup> Ibid., p. 10.

on the inked texts and rubbing it on the back. This did not leave the possibility of printing on both sides of the sheet of paper, which might be admitted to be a disadvantage. However this can also be overemphasised. The standard way of binding in East Asia was with folds at the turning edges of the pages, giving a pleasant feel to the book, and with this method of binding there was no call for printing on the backs of sheets of paper. Indeed this method of binding meant that several pages could be printed together on a large rectangular piece of paper which needed no further cutting, unlike in the European case where page-cutting has usually been necessary for books in small format. As a matter of fact it seems never to have been usual even to write on both sides of a paper in the Chinese sphere of influence, so it is not really appropriate to see this as a problem in the Oriental development of printing. It is even possible that the Koreans were not far behind the Germans in the speed of printing off their sheets of paper, for the first printing presses in Europe were themselves manually operated. Printing off sheets from wood-blocks was already established practice, and there is a sense in which a highly drilled craftsman is close to being a machine. The premium qualities of pre-industrial craft are exactness, repetitive reliability and fairly high speed, as can still be seen in the observation of some traditional crafts in Japan today. Such craft should by no means be confused with post-industrial craft, which is more individualistic and more akin to art. It is questionable therefore whether the lack of the printing press as a machine for the final part of the printing process should be considered a crucial feature in a comparison of the Oriental and European developments.

With these points in mind we are now in a better position to consider whether the Korean printing method really was 'quite different' from the European. The answer must be complex. A straightforward 'yes' would involve forgetting altogether the conceptual breakthrough with respect to the use of movable type, in favour of emphasising the method of making the type and the method of taking off the printed sheets at the end of the process. In fact there are three distinguishable aspects to the printing process (until very recently) namely:

- A) the manufacture of type
- B) the setting of re-usable type
- C) print-off.

The cultural developments can therefore be analysed as follows:

|                    | manufacture<br>of type | setting of re-<br>usable type | print-off         |
|--------------------|------------------------|-------------------------------|-------------------|
| Chinese/<br>Korean | independent<br>prior   | independent<br>prior          | traditional       |
| German             | independent            | independent                   | independent prior |

The concept of the print-off is traditional, since it includes woodblock printing and other precursors of modern printing such as the use of seals. Recently the photo-

copier has demonstrated once again the independence of this concept from type-setting. The manufacture of permanent re-usable type however is conceptually dependent on its intended use in the printing process. One therefore is drawn to the rather conventional view that the central, new, conceptual component of the invention of modern printing is the concept of arranging permanent, re-usable, separate pieces of type into a desired text for a print-off. This concept certainly arose first of all in the minds of Orientals, notably Pi Sheng, whose monument, although he perhaps could not afford metal and so just tried out the idea in fragile earthenware, ought to be considered *aere perennium*. However this same concept also took form in the mind of Johannes Gutenberg, we may gladly believe. Since historical influence does not seem to be demonstrable we may grant the independence of his invention in this respect, although we must grant the priority of the Chinese/Korean development (see table above). The Koreans are included in the discussion and in the table at this point because they left hard evidence of having carried the invention through, in the form of actual pieces of metal type and a printed book. Indeed they opened fully the path which others followed in East Asia, particularly the Japanese.

As to the question of priority in aspects A and C, this may be assigned in the one case to Asia and in the other to Europe. Each civilisation developed the manufacture of type in its own way, in both cases with an eye to economy and convenience which varied practically in accordance with the completely different scripts in use. In respect of the manufacture of type Gutenberg had an opportunity for the exercise of mechanical ingenuity, which he took. If he seems to gain some additional credit here it should be remembered on the other hand that the Orientals did not have quite the same task to perform in that they did not require so many examples of such a small number of different letters. Moreover Gutenberg's credit at this point should not be transferred carelessly to the second column in the table shown above, for the variety of methods by which the type was made is essentially secondary in importance compared with the central idea of using it to compose a printing block. As to the print-off stage, the Orientals relied on traditional methods which seemed very good to them. Priority can be claimed for Gutenberg in mechanising this stage. However this represents a priority with respect to a function which is not exclusive to modern printing based on movable type and therefore not inherently connected with the most central feature of the development of modern printing.

Thus in terms of the analysis given in the table above, the result of the game might be declared to work out approximately at a draw.

It remains to consider the second part of Ruppel's argument, about the very nature of Oriental and European script, and in so doing to lay to rest some erroneous superstitions which provide unnecessary mystification for the unwary reader or museum visitor. Ruppel was above all trying to detract from the Oriental achievement. He had to admit the historical certainty that typographical printing with metal type was carried out in Korea at the latest in 1409 when Gutenberg was little more

than ten years old<sup>24</sup>. We have seen that his first move therefore was to shift the emphasis on to the machinery related to the central idea of setting movable type. His second move was to argue, in effect, that because the writing systems of the two cultures were different the two inventions were themselves different, and that moreover the European invention was better and more important. The difference between the scripts used was then described (with some illogicality, after the previous singling out of the *Handgießinstrument*) as 'the most essential difference between the European and the Korean invention' (der wesentlichste Unterschied zwischen der europäischen und der koreanischen Erfindung)<sup>25</sup>.

What does this difference amount to? The Chinese script is described by Ruppel as a set of 'ideograms for whole words', though this is half-correctly modified in the current museum display to 'words and syllables'. In fact, one character in Chinese may represent a single idea, thus being the equivalent of a word, or it may be part of a more complex idea written with two or more characters which would equally be, together, the equivalent of a word. 40,000 such characters are said to be necessary; but this is a gross exaggeration, since this is the approximate number of all known historical forms and variants. At any one time, or in any one type of literature, a much smaller number has regularly been employed. Europeans are said to manage with a mere 24 letters; but this is a gross exaggeration in the opposite direction, as any linguist or internationally minded typist must know. Gutenberg himself had 290 different signs in his box, including abbreviations taken over from mediaeval scribes. He used some of his variations to get his lines to be the same length (justification). This incidentally was a major technical problem for European printing with movable type and is still a factor in the price; but it is a problem which has never arisen for Chinese script, nor for later Korean and Japanese indigenous script with Chinese admixture. Of course there really is a significant difference between the Chinese and European scripts, although the figures are often grossly exaggerated. Ruppel even argued that the simple alphabetic script was a better vehicle for the communication of logical thought. However these matters do not affect the identification of the use of movable type as the central feature of the invention of modern printing. Nor, incidentally, can Gutenberg be given credit for the invention of a western alphabet.

During Ruppel's discussion of these matters, the basis of his argument seems to shift again. The great impact of the European invention, he argues, lay in that it could "produce large quantities of a small number of simple letters, put them together into words, sentences and pages and then, after printing, dismantle them and reassemble them in other words, sentences and pages"<sup>26</sup>. Thus we are back with the use of movable type as the central element in the modern printing process, a welcome return indeed; but now the significance of movable type is qualified by adducing the nature of the alphabet. This is a singular confusion, and one which

<sup>24</sup> Ibid., p. 9.

<sup>25</sup> Ibid., p. 10.

<sup>26</sup> Ibid., pp. 10-11.

is nowadays no longer excusable. With Chinese script the principle of using movable type for the smallest independently viable units of script, that is, the characters taken one by one, is exactly the same as the principle of using movable type for letters of an alphabet. Of course, smaller quantities are needed for a larger number of different characters. The scripts are different, and indeed they are so different that they have different advantages and disadvantages. However such differences do not affect the central principle of the printing process.

Finally we read in R u p p e l's analysis that the East Asian invention of printing did not spread widely, and that for two reasons. One reason was, allegedly, that cutting wood-blocks seemed more practical and rational than preparing tens of thousands of different characters as type. This astonishing argument overlooks the fact that the carver of a wood-block has to work just as hard as the carver of a mold for making type, and in the long run harder. This point, though intrinsically evident, may also be deemed historically proven in that books and newspapers in China, Korea and Japan are not nowadays carved individually in wood. The other method has won the day. That the changeover was a slower process than in Europe may have various reasons, perhaps including the highly developed and entrenched state of wood-block printing in East Asia. However the difference in the speed of take-up was not related intrinsically to the nature of the invention, and only secondarily if at all to the nature of the script. One problem which may have been a disincentive is the problem of storing and retrieving a great variety of characters as movable type. In this respect the wood-block carver had an advantage in that he could keep them in his head. On the other hand R u p p e l was able to reproduce an illustration of an early compartmentalised storage box for this purpose, as already mentioned above, so perhaps too much should not be made of this aspect.

The second reason which R u p p e l gives for the failure of the Sino-Korean invention to spread is that it was only suitable for printing Chinese script. This is stated most tendentiously, for after all, one might just as well say that the European invention was limited to the countries with alphabets and could not be used in China, Korea or Japan, where a significant proportion of the world's population lived, then as now. The argument also quietly obscures the fact that the principle of printing as invented in the two cultural areas was the same. It simply took different forms in some secondary respects because of the differences between the scripts and the differences in the traditions of craftsmanship.

In conclusion it is appropriate to say something in praise of Gutenberg's work. A characteristic which does not come out clearly in R u p p e l's account (because he was trying to fasten on to something "essential" which the Orientals had failed to produce) is that Gutenberg made progress in all three stages of the process as analysed in the table above. He had an organic view of the whole production process. The oriental work by contrast was a mixture of brilliant innovation, more or less makeshift preparatory work, and reliance on traditional craft for finishing. Gutenberg's interrelated mechanical approach provided a basis for ever improving machines and ever more sophisticated printing down to the computerised work of today.

Indeed the stages of the printing process which Gutenberg's work made clear once and for all have a direct analogue in the pattern of computer usage : 1) input via hardware (c.f. physical manufacture of movable type), 2) use of software (c.f. conceptual work of arranging type in a meaningful way), 3) output via hardware (c.f. print-off via printing press).

With our present hindsight informed by the industrial revolution and the computer revolution, it ought to be possible to appreciate the elegance of Gutenberg's work, while happily granting the priority in the invention of printing *per se* to the Orient.