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Computer-assisted examination of printing types of early printings

An ever recurring problem of handling early printings is to complete certain missing items of the imprint (place, date of publication, the printer's name). This is not a mere meticulousness on the part of librarians, but — in many cases — the very basis of processing, since a clear statement of these data is of great moment in the bibliographic analysis of publications dating from earlier centuries. Thus the date of publication forms the basis of separating the products of 15th-century printers, incunabula as these printings are called, from other publications. Processing old books by countries and/or towns is another wide-spread practice. It seems sufficient here to refer to the "*Short Title Catalogue*" of the British Museum, a series listing 15th to 16th-century publications by countries so that each volume covers a certain country: Germany, Italy, France, and so forth. There are works which undertake to list the publications of a geographically defined area in chronological order such as *Régi Magyarországi Nyomtatványok 1473—1600* (Early Printings, from Hungary 1473—1600) published recently. In several other cases, efforts are made to compile a bibliography of the products of a certain printer or printing office which makes it indispensable to determine the provenance of publications containing no reference to the printing office.

Furthermore, determining the place and date of publication may cast light upon a number of other connections (commercial or personal relations and the like) which would otherwise remain unrevealed. Thus e.g. the successful determination of the place of publication of a political pamphlet of some importance, in which the place was deliberately left out or falsified, might obviously throw light upon new aspects for the scholar of political history.

Therefore, those engaged in this field of library studies have long been making efforts to make up for the missing data in the imprint, particularly as regards the earliest printings. Some 40 per cent of 15th-century publications do not contain any reference to the place or date of publication.

Until the middle of the last century, attempts at determining these data had been based either on certain facts connected with the work under examination (e.g. where the works of the individual authors were published?) or on formal elements (e.g. the printer's device). Since all this had been mostly based on intuition rather than painstaking investigations, the results proved questionable. It was due to the fact that — even in case of one and the same work — various investigators came to various — and not infrequently widely differing — conclusions.

What a serious progress in this field needed was a systematic investigation instead of highly intuitive process of determination. One of those adopting thi

method was Jan Willem HOLTROP whose description of the earliest printing offices of the Netherlands was accompanied by rich illustrations.[1] The foundations of objective investigations based on formal elements was laid by Henry BRADSHAW who considered the careful comparison of printing types used by the individual printing offices as the only reasonable way of completing data in the imprint.[2] In his train of thoughts, BRADSHAW traces back the history of printing which, for centuries, had consisted in the following operations. Each letter was shaped by the punchcutter in a bar of steel. This was what is called punch or stamp which then was strucked in a piece of some softer metal (copper or bronze) to form the matrix or the negative image of the letter in relief. The matrix was fixed to the bottom of the mould. Then hot lead was poured into the mould from above to fill both the grooves of the matrix and the prismatic space of the mould above the matrix which, after solidifying, formed the type body with the letter face on it. These cast types were then composed into lines, and lines, set under one another, formed what is called type-area or layout of a page. After inking the type faces, a paper sheet was placed and pressed on them which resulted in the appearance of the impression on the paper.

BRADSHAW started out from the fact that each punch was a unique product and thus two punches could never be of exactly the same form. Therefore, he was of the opinion that the identification of 15th-century printings without imprint might only be approached by the method of comparing the characteristic features of printing types.

This approach was further developed by Robert PROCTOR[3] who, though emphasizing the importance of printing types, considered the height of lines as highly significant, too. Since several matrices may be pressed from one punch which are identical in form, at least theoretically. Being easy to transport, matrices were carried to various printing offices where types were cast on the spot. Within a printing office, a certain printing type had to be cast on bodies of identical height to produce even lines. This height was determined by the prismatic body of cast types, which, again, was a function of the height of the mould. This particular height, i.e. height of the lines, or more accurately the measurement of 20 lines, was recognized by PROCTOR as a further objective characteristic facilitating a more reliable identification of publications without imprint with the products of one or the other known printing offices.

The most elaborate method of determining printers by printing types was finally worked out by Konrad HAEBLER. In his famed type-repertory,[4] he systematized all the printing types of 15th-century printing offices that had become known until then. Serving as a basis for this comparison was capital M for the Gothic characters, and capital Q for the Roman types. Since these two letters were to show most of the characteristic variances in form. As to Gothic M, HAEBLER first distinguished 102, then together with sub-types,

[1] Monuments typographiques des Pays-Bas au quinzième siècie. La Haye, 1857—1868. It is worth while noting here that one century later it was the Netherlands again that took the lead in the examination and methodical publication of 15th-century printing types with a work by Wytze and Lotte HELLING: *The Fifteenth Century Types of the Low Countries*. Vol. 1—2. Amsterdam, 1966.

[2] *Collected papers*. Cambridge, 1889, pp. 106—236, 258—280.

[3] *An Index to the Early Printed Books in the British Museum* . . . I. 1. London, 1898.

[4] *Typenrepertorium der Wiegendrucke*. 1—5. Halle a. S. 1905—1924.

not less then 207 types. Within each class of Ms and Qs, the individual types of various printing shops were arranged by the measurement of 20 lines. Since in case of a number of types of wide-spread forms this method had not yet resulted in finding an unambiguous uniqueness, HAEBLER had recourse to examining the peculiarities of the rest of capital letters, then small letters (particularly ligatures and abbreviations), as well as of further symbols (hyphens, numerals, etc.) to distinguish among similar types.

To provide a higher degree of certainty for and to facilitate the process of recognition and identification, the publication of alphabets, including the 15th-century types and the facsimile of characteristic pages composed thereof, was started.[5] This undertaking contained a part of printed sets of initials used in 15th-century printing offices, which were also included in HAEBLER's repertory. Illustrations arranged by the printing offices of German incunabula were also published.[6]

HAEBLER assumed that all printing types of 15th-century printing offices might be distinguished from those of all the other printing offices. Relying on this assumption and by using the above-mentioned repertory, along with other aids, it became possible for almost every 15th-century publication, and even for a one-page fragment of such a publication, to be determined as to where, when and by whom it was produced. All this obviously took an immense amount of work. In this respect it will suffice to consider that some 40,000 incunabula, which are still extant, were produced by some 1,500 printers with approximately 10,000 printing types, each consisting of 150 to 200 characters and symbols. Thus we have reached a figure well over one million. And all this was produced in less than fifty years after printing had been invented.

Some fifty to hundred years ago, the interest of the scholars of old prints was focussed on the 15th-century publications. The *Gesamtkatalog der Wiegendrucke* tended to comprise all the problems encountered in the entire field of incunabula. Even if the publication of this world catalogue of incunabula was temporarily discontinued due to World War II, the whole material collected is readily available in a well-arranged form at the editorial office in Berlin. Thus was it that more and more interest was given to the 16th-century publications which are far more interesting in both content and outlay than the products of the previous century.

Now, let us take a look at how things worked out in this field in the 16th century. To obtain a rough approximation of the number of 16th-century printings printers and printing types, the corresponding figures for the 15th century, as stated above, should be multiplied by ten. The resulting figures are frightfully great by themselves. Thus no wonder that no comprehensive works — and hardly any plan for such works — have been undertaken to provide a systematic survey of 16th-century prints. Some works, concerned with details, tend to cover the early 16th century[7] only, or printing offices of certain countries.[8]

[5] *Veröffentlichungen der Gesellschaft für Typenkunde des XV. Jahrhunderts.* Taf. 1—2460. Leipzig—Halle a. S. 1907—1939.

[6] SCHRAMM, Albert: *Der Bilderschmuck der Frühdrucke.* 1—22. Leipzig, 1922—1940.

[7] E. g. PROCTOR, Robert: *An Index to the Early Printed Books in the British Museum.* Part 2. 1501—1520. Sect. I. London, 1903. ISAAC, Frank: . . . Sect. 2—3. London, 1938.

[8] E. g. ISAAC, Frank: *English and Scottish Printing Types.* 1503—1558. London, 1930—1931 *Polonia typographica saeculi sedecimi.* Fasc. I—VII. Kraków—Warszawa—Wrocław, 1936—1970.

Unfortunately enough, no systematic work on the 16th-century prints is available although a methodical determination of publications with missing imprint is inconceivable without such an aid. Some ten million characters of hundred thousand printing types of ten thousand printers just paralyses any initiative in this field.

Difficulties are increased by the fact that punches were carried from one place to another, furthermore, matrices and cast types were multiplied. Thus Haebler's above-mentioned assumption that two printing types of exactly the same form may not occur at one and the same time, does no longer hold true, without limitation, for the late 15th century, particularly for the more developed areas (e.g. Venice). Ernst CONSENTIUS[9] kept vehemently proving this fact, although he could not suggest any other more reliable method for determining publications without imprint, either. Under the circumstances, for practical purposes, HAEBLER'S theorem is generally accepted for the 15th century.

Tasks connected with the publication of books were separated soon after GUTENBERG. The respective functions of publishers and printers took shape in the following one or two decades. Even in producing types, the work of the punchcutter and the founder was often going on separetely. For reasons stated above, the printing type in itself does not provide a reliable method for determining the anonymous printer who worked in the 16th century, particularly as regards the highly developed West European countries. However, the simultaneous occurrence of various printing types in one and the same publication — especially if due consideration is given to other distinctive features (e.g. language, content) — may generally make it possible, even in case of 16th-century publications, to determine the place and the printing office, and soundly to approximate the date of publication.[10] In the whirling of punches, matrices and letters, that were in increasing numbers carried from one place to another, the common occurrence of printing materials (punches, matrices, letters), coming from different places at a certain time, is still characteristic of one or another printing office.

In vain would someone venture — even with a whole life-work — to compile a tabulation of 16th-century printing types similar to Haebler's type-repertory, it would certainly be inadequate to help a satisfactory determination of printers. To achieve this, it would be necessary to fix the ever moving printing material both in space (by printing office) and in time (almost by years). This work, however, seems to be in every respect far beyond the limits of human performance due to the vast amount of material to be registered.

In the apparently hopeless circumstances, our modern age technology has opened up a new perspective: the computer. Its "knowledge" or rather capacity is increasing at a rapid rate, and there is a corresponding increase in its field of application. It was recently that a practically new branch what is called pattern recognition has begun developing.[11] The highly accurate and mechanical comparison of large masses of data, characteristic of and necessary for the examination and systematization of printing material, lends itself, more

[9] *Die Typen der Inkunabelzeit*. Berlin, 1929.

[10] VERVLIET, Hendrik D. L.: *Sixteenth-Century Printing Types of the Low Countries*. Amsterdam, 1969, p. 13.

[11] It has a separate journal: *Pattern Recognition*, started in 1968.

than anything, to be processed by machine. To determine the missing data in the imprint of 16th century publications, attempts might perhaps be made to meet the related needs, as stated above, by the help of computer technology. A conception of this work may be summed up like this:

Lines of characters and ornaments used in 16th-century publications with full and reliable imprint, which were produced by contemporaneous printing offices, might be scanned optically and converted to discrete dots. The resulting data, along with the related sizes, might then be fed into the computer's memory units. Data obtained by a similar optical scanning of publications to be determined are then matched by the computer with data stored in it, and having finished this operation, the machine establishes the provenance of the publication under examination.

This theoretical suggestion for determining the missing items of the imprint is necessarily very much simplified. Before making even an attempt at its practical application, several problems may be raised. Let us now consider one or two of them which will permit us to discuss the details, too, very briefly though.

The first and most significant question is whether or not the computer will be able to solve all the tasks we expect in the course of this work. In addition to reviewing the special literature on those problems, I have also consulted Mr. Adam MAKAI, research staff member of the Cybernetic Laboratory of the József Attila University (Szeged, Hungary).[12] Thus we may only expect the machine to do what it is actually able to do, that is, the solution of what might be justifiably expected at the present state of computer technology, from a machine specifically developed for this purpose.

The determination of the resolving power of the optical scanner is of great importance. In case of most simple (electric signs etc.) texts, characters and numerals may be composed of not more than 7×5, i. e., 35 illuminating dots, while on TV screen e. g. picture is composed of hundreds of thousands of dots flashing in several hundreds of lines. In practice, then, what is to be determined is the optimum density of dots, which is most feasible for the given work i. e., for recognizing the distinctive features of even the small-size letters without, however, causing any difficulty or confusion in scanning large-size letters by having registered noncharacteristic, minor differences.

Anything, from cast letters to the block of xylographic illustrations, whose impressions are still extant, may be subject to examination through optical way. For different reasons, however, various printings might have been taken from the same letters or blocks, etc. Here I refer e.g. to types cast defectively or faded inking. Obviously this is not characteristic of the printing office, and is confusing rather than helpful in identifying publications. In this case the solution lies in the machine: matching the images of a certain letter occurring many times within one publication, the computer will only store those distinctive features or lines of that letter which are common in the majority of images scanned, ignoring the above-mentioned minor and non-characteristic variances.

The potentialities of the use of computers in investigations concerning printing types is practically unlimited. It is conceivable that — besides determining the printer — the original form of printing materials (punches, blocks, etc.),

[12] Here, too, I wish to express my best thanks for his helpful cooperation.

along with the "migration" of their multiplications (matrices, cast types, stereoplates or clichés) may be traced back. Thus a clear picture may be formed of the characteristic composition of material used by the individual printing offices, and the characteristic changes they underwent in the course of years. The original form of printing materials may also be traced back from reconstituting their subsequent multiplication, in a family-tree manner.

In case of printing types, it is the punch whose unique and original form serves as a basis for investigations, as has been suggested by H. D. L. VERVLIET.[13] Unfortunately, original 16th-century punches are only rarely available in as great a number as in the Netherlands, not to speak of the related archival relics. The suggested mechanized method, however, seems to be a realistic solution to trace back the mostly destructed original material.

To register the printing material outlined above, it is sufficient to develop one special computer. It could then store and register all the printing types and ornaments used by printing offices which were active in almost a thousand of towns, from Lima to Moscow, and from Fez to Nagasaki, during the 16th century. After a certain preliminary survey of printed material necessary for serving as input, and adopting the method of determining as outlined above, it would be possible to set up a computerized international registration of 16th-century publications which would be similar to — but would necessarily involve several times as much information as — the *Gesamtkatalog der Wiegendrucke*.

[13] Op. cit. p. 14.