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LINN BOYD BENTON

Born May 13, 1844

Linn Boyd Benton—The Man and His Work

BY HENRY LEWIS BULLEN



IN this series of biographies we have endeavored to make clear the causes and the personalities underlying epochal changes in the art and the machinery of printing. Thus far we have been concerned with men of the past. It is now our loving duty to acquaint this generation of printers with the services to them, and to succeeding generations, of a printer, now living, who is the greatest mechanical genius our art has fostered. If hitherto printers, in general, have been unaware of their indebtedness to the genius of Linn Boyd Benton, it is chiefly because of his modesty and the fact that his inventions are process machines, the use of which is limited to less than a score of manufacturing concerns, though the products of the machines are the most vital parts of the equipment of a majority of the printing houses of the world.

Gutenberg's inventions of movable types and a printing press were clever adaptations to printing purposes of appliances already in use in other crafts. König's invention of the flat-bed cylinder press was a successful adaptation of the unused and unusable invention of Nicholson. Bullock's invention of the web perfecting press was a successful adaptation of earlier inventions, including Nicholson's. Richard March Hoe's type-revolving press was similar in principle to at least three other presses, all of which failed through lack of an effective means of holding the types on the cylinders, which lack Hoe supplied by means of his wedge-shaped column rules. Mergenthaler had little originality—he was persistent in developing other men's ideas, but never satisfactorily, and was by no means a brilliant mechanic. When he severed his connection with those who had poured out nearly two million dollars in experiment, the linotype machine was a failure. It was made marketable by Philip T. Dodge, who utilized the inventions of Benton and Schuckers and Rogers to make it the huge success it ultimately became. This we declare on the highest authorities. It is the plain truth. Lanston invented a most ingenious composing machine, but he was not a good enough mechanic to make his ideas practicable. Lanston's ideas were made practicable by Sellers and Bancroft, who had the mechanical genius which Lanston lacked. But Benton's invention of the machine for cutting letter punches was entirely novel in conception, and perfect in execution at the beginning, leaving little room for improvement in doing the work for which it was specially designed, though the scope of its usefulness was greatly extended a few years after it had made practicable both the linotype and the monotype composing machines.

Benton, self-taught in typefoundry, had the imaginative genius to conceive an entirely original machine, and the mechanical genius to make his ideas practicable, even to the point of constructing every part of it himself. Benton's punch-cutting and matrix-cutting machines, with the various appliances he invented as accessories of these machines, have completely revolutionized the method of making typefounders' matrices. These machines have made the cutting of letter punches by hand almost a lost art. A generation ago the hand punch-cutters were the mainstay, the principal craftsmen of the typefoundry art; today we would be surprised to learn that more than two are employed in American typefoundries, and these men are not employed in cutting type faces.

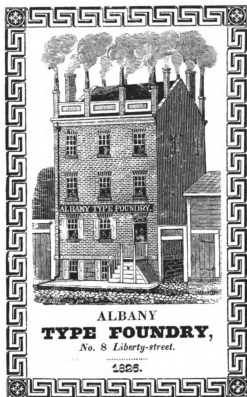
Linn Boyd Benton, whose portrait is the frontispiece of this issue, was born in Little Falls, New York, May 13, 1844. His father, Charles Swan Benton, was a lawyer, who estab-

lished in 1832 the *Mohawk Courier & Little Falls Gazette*, now owned by Stebbins & Barney under the name of *Journal & Courier*. From October 3, 1833, to July 3, 1834, the proprietors of the *Mohawk Courier* were C. S. Benton and J. Bartow. The next publisher was Josiah A. Noonan, with C. S. Benton as editor, until 1836 and probably later, or until C. S. Benton was elected to Congress, serving two terms. About 1853 the elder Benton went to Milwaukee and became editor and part owner of the *Milwaukee Daily News* (not the present *News*), the firm name being Huntsman, Clason & Benton. About the same time J. A. Noonan went to Milwaukee, became a partner in a paper mill and opened a paper warehouse and a typefoundry—the Northwestern Type Foundry. The tradition is that the plant of the typefoundry came from Albany. There was, after 1847, a small typefoundry plant for sale, one established in 1826 by Richard Starr, which afterwards came into the possession of Lemuel Little, a well known bookseller, under the name of the Albany Type Foundry. This is supposed to be the typefoundry which J. T. Reton took west in 1854, intending to use it in Chicago, which had no typefoundry at the time. When Reton arrived in Chicago it was a smaller town than Milwaukee, and he was persuaded to set up his typefoundry in the latter city, to his subsequent great regret. When Noonan acquired this typefoundry is not known, but it is known that Reton was on Noonan's payroll in 1866. As this typefoundry had a decisive influence in Linn Boyd Benton's career, we reproduce a picture of the cover of the 1826 specimen book of the Albany Type Foundry. J. T. Reton established a typefoundry in Kansas City in 1872. His son is now manager of the St. Louis branch of the American Type Founders Company.

In 1855 the younger Benton joined his father in Milwaukee and, as a pastime, learned to set types in the composing room of the *Daily News*. In 1856 the elder Benton was appointed United States registrar of lands and established his office in La Crosse, where he afterwards became a judge of the circuit court. The younger Benton's education was rather peripatetic. He remembers attending schools in Little Falls, Mohawk (near Little Falls) and Milwaukee. He was sent to Galesville College in Galesville, Wisconsin (which institution at that time called itself a university), and took lessons for about two years in Latin and Greek and other advanced subjects with a private tutor in La Crosse, "completing" his education at the age of sixteen, when he began to learn to print in the office of Charles Seymour's *La Crosse Republican*.

By the time young Benton was of age he had acquired an insight into the mystery of printing so far as Seymour could help him, but he preferred to earn his daily bread by book-keeping for a leather house in La Crosse. We can imagine that he made an exact bookkeeper. In 1866 he became bookkeeper for J. A. Noonan in the Northwestern Type Foundry. In 1873 Noonan went into bankruptcy, and Benton, with a partner named Cramer, purchased the type and electrotype foundry. Benton's knowledge of typefoundry and electrotyping was what he may have gained by observation while attending to his bookkeeping duties. In after years Benton said that if he had known anything about typefoundry he would have thrown the plant into the lake as a measure of economy. It was probably the worst equipped typefoundry in America. He was now twenty-nine years of age, and proceeded to master the mystery of typefoundry. In 1874 Cramer weakened, and his half interest was purchased by Lieutenant-Commander Frank M. Gove, a man utterly ignorant of the

business, but who in time proved to be a most efficient and popular salesman, eventually making it possible for Benton to devote himself mainly to manufacturing. The firm was now Benton & Gove. In 1882 Gove died, and his half interest was purchased by Benton, who in the same year sold a third interest to R. V. Waldo, formerly a wholesale grocer, who



Albany Type Foundry, 1826-1847. Reduced reproduction from cover of the 1826 specimen book. The plant equipment of this typefoundry was taken to Milwaukee early in the fifties of last century, where it was known as the Northwestern Type Foundry. Linn Boyd Benton became an owner of it in 1873.

eventually proved to be an ideal partner. The firm name was now Benton, Waldo & Co., but there were only two partners.

Benton and Gove had completed his self-instruction in typesetting and found himself on the most intimate terms with decimal fractions and measurements of ten thousandths of an inch. He had and still has a mania for accuracy to the vanishing point, not only knowing, as the books tell us, that a hot breath impinged on a small piece of steel changes its dimensions, but actually taking that solemn fact to heart, grieving that it can not be overcome. The bane of Benton's career has been the limitations of error which are made necessary by the disposition of all metals to refuse to resist molecular action. What other mortals cheerfully accept as accuracy Benton regards as a calamity. Mold and matrix makers and typesetters brought up under Benton's microvisioned direction were drilled in a hard school, and most of them believe that a Bentonian degree of accuracy is unobtainable. The only criticism of Benton we have heard in an acquaintance of nearly forty years is that he is "too accurate." No man can be perfect, so Benton had to have one fault.

In 1882 Benton's thoughts turned toward the invention of a typesetting machine, in which a near approach to self-justification was to be effected by casting all the characters and spaces and quads of a complete body type font of roman and italic on nine widths, instead of on the more than one hundred widths found in the average font of body types. This was an important time-saving idea, basically the same as that

which Lanston successfully employed in later years on his monotype machine. We all agree that when types and spaces are cast on one width, that is, a unit of twelve points, as we find it in typewriter types, the time of composition is greatly reduced. Thus time was saved in setting Benton's "self-spacing" types—the time required for justification was reduced to a minimum by reducing the widths to a minimum consistent with even spacing. The term "self-spacing," as applied to hand setting is, of course, a misnomer. It was applied to Benton's invention by a compositor, Walter Stoddard, afterwards known to thousands as chief guide in the establishment of the Curtis Publishing Company in Philadelphia. Stoddard was employed, to ascertain what gain, if any, was to be had by the use of unit-width types in comparison with that obtained from a non-unit font of the same width of lower-case alphabet. Three comparative trials showed that Stoddard set the unit-width types thirty-three and a third per cent faster than the non-unit types. Stoddard's average with unit widths, per one thousand ems, was forty-five and one-half minutes as against an average of sixty minutes. When asked what he thought of the justification, he pondered a while and said, "I never thought of that—why, the d—d—d thing spaces itself!" The types had not been named, and thus it came to be called "self-spacing." Benton was granted a strong pioneer patent for this system of making types. This unexpected merit of unit-width types, first invented by Benton, caused him to defer the creation of the typesetting machine for which they had been made to be used. In any case, fonts of various bodies, old style and modern, had to be made before the machine could be utilized. Punches for every character were required to be engraved and matrices made. There were more than three thousand punches to be cut and not one punch-cutter was available either in America or in Europe. This dilemma was the turning point of Benton's career—it eventually disclosed to himself that he had mechanical genius of the highest order.

Benton determined to make a machine to cut punches. He had never cut a punch, and punch-cutting was the most difficult work in typesetting. What experience could Benton draw on to aid in his ambitious project? We must go back a few years to answer that question. For three years he was tutored by the learned clergyman at La Crosse. It was agreed that if he recited his lessons correctly in the forenoon he could do as he liked with his afternoons. What he liked to do, and did, was to work with the local tombstone maker. Thus he learned to design letters and cut them in stone in relief and in intaglio. Thus Baskerville learned to make letters on tombstones, laying the foundation of his fame as a letter designer and typefounder. Meanwhile a jeweler settled in La Crosse, and young Benton left the tombstones to work on watches. He learned to repair watches at a time when there were no interchangeable parts and every broken part had to be remade.

In 1884 Mr. Benton had his first punch-cutting machine in use. It worked perfectly, showing that the principle was correct. The second machine did no better work but was easier to manipulate. His third machine is the machine as now sold. In 1885 he was granted a patent. By that time "self-spacing" types were selling freely. Benton's typefoundry was steadily enlarged, but for a long period it was necessary to run night and day. The price was higher than for non-unit types, but in many parts of the West the scale for setting "self-spacing" types was 5 cents less than for other body types. How was this notable success achieved?

Benton had to design thousands of characters to fit his width units. The punch-cutting machine had to have a pattern for each character. Benton, the ex-tombstone letterer and manipulator of jewelers' tools, had to design each letter on a large scale and cut metal patterns to the same scale. That was a strenuous task. Mr. Benton, working night and

day, looked older than he does now, and his face was then much more furrowed than it is now, forty years after. He was a hero of the same character as Palissy, the renowned potter. At that time, like Palissy, he was ready to "burn his furniture," and to let his inventive ardor "know no brother," if need be, to accomplish his self-imposed task. William Ferdinand Lietke, the first and still the most expert operator of Benton engraving machines, began work as a boy with Benton. He grew up with the machine. When Benton was designing his "self-spacing" types, Will's earliest important task was to sharpen fifteen pencils and have them on Benton's drawing table early each morning. Benton's first work was to examine the pencil points under a magnifying glass. If five of the fifteen were accepted Will was lucky—most of them would be too flat or too round or too sharp. Benton knew what he wanted and trained his people to give it to him, without compromise. Will thought it hard then, but it makes his work easy now—superaccuracy has become his natural habit. He is truly a master workman.

The earlier "self-spacing" designs had the defects which are inherent to a system in which the character had to fit a prescribed width. It is the difficulty the makers of the monotype punches necessarily encounter. Benton, as he went on, learned to bring the design and its width into better correlation. As they now appear in the specimen books, after some fonts had been rejected, the "self-spacing" designs are notably clear, have a lively appearance and are easy to read. Benton's italics are sloping romans—a not displeasing innovation. In the old style series of roman and italic, based on the Ronaldson Old Style design, and in Self-Spacing Old Style Bold, the characters are adjusted to their prescribed widths so judiciously as to leave no room for criticism. "Self-spacing" types were primarily designed for newspaper use, and reduction of the cost of composition was the chief objective. They had a short but profitable life, immediately before the linotype machines destroyed their chief market and at the same time killed the project of inventing the typesetting machine for which they were originally designed. We would not give them so much space if this relation did not lead up to an unexpected and most important climax to Benton's good work.

During the time Benton was attacking and conquering his obstacles, the linotype machine was being developed in Baltimore by Ottmar Mergenthaler. After several years of experiment and the expenditure of hundreds of thousands of dollars, Mergenthaler severed his connection with his employers, leaving with them a machine from which little if any profitable returns could be realized. To Philip T. Dodge, a patent attorney, was given the problem of giving the linotype machine a commercial value. Mergenthaler seemed to have lost faith in the machine, as we may infer from the fact that when he left the employ of the Mergenthaler Linotype Company he sold all his stock in it for a small sum. Apart from serious defects in the mechanisms for assembling the matrices, Mergenthaler's linotype machine had no satisfactory justifying device. The spacing wedge now in use was invented by Schuckers and also (independently) by Rogers. The courts, after long litigation, decided that the spacing wedge used on the first few hundred linotypes was an infringement upon Schucker's wedge, whereupon Mr. Dodge lost no time in purchasing that invaluable patent, with which the matrix-assembling machine was made entirely practicable. But this was not the end of Mr. Dodge's difficulties. Mergenthaler had made no provision for supplying the unlimited quantities of matrices which were required. The linotype machine without adequate means of providing matrices was no more effective than a machine gun without unlimited cartridges. As an investment, the owners of the linotype machine faced failure.

The dilemma of the linotype was exactly the same as the dilemma Benton had overcome, but it was of infinitely greater magnitude. Each linotype matrix is driven from a steel letter-punch. A typefounder used his steel letter-punches very little, because he rarely made more than one matrix for his own use, and matrices seldom required to be renewed. But in making linotype matrices the letter-punches are in constant use, and a seriously large proportion of them are broken under constant use. Not infrequently a punch would break on its first using. In fact, the enormous task of furnishing the original punches for a number of linotype faces was not nearly so great as the work of replacing the broken punches. Mergenthaler had relied upon hand punch-cutters, not realizing that there were not enough of them in the whole world to meet a tenth of the needs of the linotype. He quickly discovered that when a punch broke no hand punch-cutter could duplicate it with sufficient accuracy. Punch-cutting was an art few could master; it required a special aptitude and temperament; thus it was ever an undervalued profession. We remember, as some of our readers may, the peculiar appearance of the *New York Tribune* when it was first set by linotypes. Each line had wrong font characters in it. There would be two or three kinds of letters e or c or t in each line, each change of character indicating the breakage of a punch. This inability to get a sufficient number of punches and matrices, thus restricting the sales of the machine, was "a seemingly insurmountable obstacle" to the financial success of the Mergenthaler Linotype Company, though a number of linotype machines were in use. As this unfortunate outlook confronted the stockholders, relief came from an unexpected source. R. V. Waldo, Benton's partner, came to New York to interest the newspaper publishers in "self-spacing" types. He had never heard of the linotype, and knew nothing of its difficulties. He eventually entered the *Tribune* composing room, the superintendent of which was little interested in the story, until Waldo made the claim that better stereotype matrices could be made from "self-spacing" types, "because the punches from which the matrices were made were cut by a machine which finished the bevels below the face of the letters as smoothly as the faces of the letters." A machine to cut letter punches! This interested Mr. Milholland mightily. He knew of "the seemingly insurmountable obstacle" to the success of the linotype. He asked Waldo to repeat his story to Whitelaw Reid, who represented the majority of the stockholders. Reid informed Waldo that the *Tribune* was not interested in his types—it had got beyond the need of typefounders' types. Not a word was said about punches. Waldo was mystified and considered his visit a failure, whereas it was the beginning of the success of the linotype and the origin of many large fortunes.

Waldo returned to Milwaukee, and soon after Philip T. Dodge appeared on the scene. The Benton punch-cutter was shown to him. It had never cut in steel. It was cutting in type metal, for Benton was using electrotyped matrices. When asked if his machine could cut in steel, Benton said he did not know. He was not eager to stop work to experiment for other folks. He did not know how much of good or evil depended upon the answer to Dodge's question. However, he was persuaded to try, Dodge agreeing to pay him \$50 if he did not succeed, as compensation for wasted time.

When Dodge saw Benton the next day that memorable punch was ready for him. By a slight change in the cutters the steel was cut and Dodge's question was answered affirmatively. Soon after Benton received an order to cut ninety steel punches. These were satisfactory. The Mergenthaler Linotype Company and Benton entered into an agreement for leases of Benton's machines. In a report submitted to the directors of the Mergenthaler Linotype Company at that time it was written that "BY THE ACQUISITION OF THE BENTON PUNCH-CUTTING MACHINE WE HAVE OVERCOME A SEEMINGLY

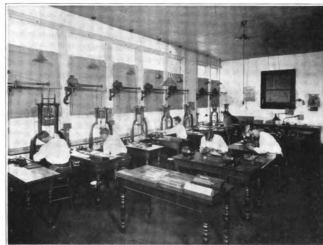
INSURMOUNTABLE OBSTACLE TO OUR SUCCESS." Nothing is surer than that without the Benton machine, or a similar invention (apparently not in any other man's mind) the Mergenthaler Linotype Company could not have recovered the cost of its long series of experiments before its patents had expired—if at all. The same is true of the Lanston Monotype Machine, which also depended upon Benton's wonderful invention to make it practicable. Benton had achieved greater things than he ever imagined.

In 1892 the Northwestern Type Foundry was merged into the American Type Founders Company, of which Benton became a director. In 1894 the Northwestern Type Foundry was removed to New York, Benton having been appointed New York manager of the American Type Founders Company in 1893. Until that time the Benton machine had not been used in any other typefoundry. The old-fashioned typefounders "didn't believe it could be done," just as they didn't believe that types could be composed from matrices. In New York Benton's first work was to cut a series of punches in collaboration with Theodore L. De Vinne. This was named the Century series, and was used in the *Century Magazine*. When Robert W. Nelson became general manager of the American Type Founders Company he gave Benton the authority to establish a letter-designing department, in which Morris Benton was (and is) chief designer. This department soon became a most important asset of the type company, and soon after it was established it was determined to abandon the use of punches and engrave the matrices on the machine in intaglio, thus eliminating the punch, and the driving of the punch to form a matrix, besides saving much time in fitting the matrix. When the Benton punch-cutting machine is required to cut a punch the outside of the pattern is used; when it is required to engrave a matrix the inside of the pattern is used. The first font of type to be made from matrices directly engraved on the Benton machine was twenty-four-point Roycroft, October 4, 1900. Next month eleven-point Cheltenham Old Style was engraved. Since that time the Benton machines have produced the matrices for an extensive and admirable procession of type designs. The hand punch-cutters' occupation was gone. It would have been impossible to carry out Mr. Nelson's policy of issuing great families of type designs, with which to provide a market to replace that which the composing machines had taken away—the bulk of the body types—if he had been compelled to rely upon hand punch-cutters.

The Benton method of making matrices has not yet been explained in text books, although it has been in use in the more advanced typefoundries for a quarter of a century. The best description of typemaking in the English language is found in De Vinne's "Treatise on the Processes of Type-making, the Point System, the Names, Sizes, Styles and Prices of Plain Printing Types," one of the series of four books on "The Practice of Typography," issued in 1899. In this work the processes of punch and matrix making are described as being identical with the processes used when Moxon described typemaking, in 1683, in his "Mechanic Exercises." In De Vinne's treatise Benton's invention receives brief mention, towards the end of the book. De Vinne evidently did not foresee that what he had written about punch and matrix making was being made obsolete by the Benton methods. We will now describe how Mr. Benton makes matrices in the central plant of the American Type Founders Company.

The original drawing of a letter or ornament may be of any size, but preferably not larger than ninety-six typographic points. Each character of the artist's design is placed under the microscope on the Benton delineating apparatus, a refined pantograph, with microscope attachment. On the face of the microscope two single filaments of silk are placed, crossing each other in the center of the focal point. A sheet of drawing paper is placed on the bed of the apparatus, under the

tracing point of the pantograph, which holds a small pencil lead. Grasping the pencil holder, and keeping his eyes entirely on the focal point of the microscope, the operator focuses the intersection point of the silk threads on the outline of the design, which he follows by moving the pencil holder, the lead in which traces an enlargement of the design, usually ten inches high on a capital H. This enlarged reproduction of the outline of the original design may be made with micro-



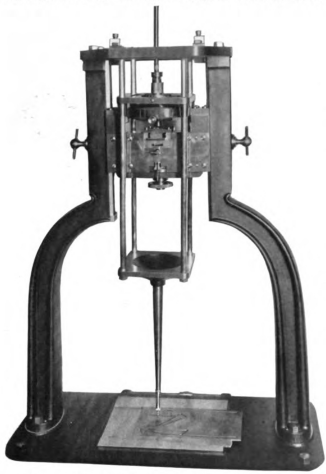
The Matrix Engraving Room of the American Type Founders Company, with seven Benton Matrix-Cutting Machines. At the left is W. F. Lierke, foreman, who grew up with the machine. He is measuring the chisel edge of a tool through a microscope. Next to him is an operator sharpening a cutting tool on the Benton Tool Sharpener.

scopic accuracy, if desired. With this outline before him, a type designer proceeds to adjust it to the limitations which the standard lining system and the point system and the exigencies of typesetting prescribe. The drawings of a letter designer not thoroughly trained and experienced in the type-making art must always be adjusted by a type designer. When the enlarged outline drawing is adjusted, it is again placed on the bed of the Benton Delineator, from which the microscope attachment is removed, and in place of it a tracing pen is attached. The operator now proceeds to reduce the design to a practicable size. He may choose to know how it will look on thirty-six-point body or on any other body. He puts a tracing pointer (instead of the pencil) in the tracing end, and guides the pointer carefully over the ten-inch outline design, whereupon the tracing pen makes a reduction in outline on a small piece of paper. When this reduced outline is inked in it has all the appearance of a sharp impression from a type. If upon the first reduction the design is not satisfactory, alterations are made in the ten-inch outline drawing, and the process of reduction and inking-in is repeated until the letter or ornament is approved.

This seems simple enough, but many mechanisms in the Delineator are unique. It has a tracing pen that inks in a line of equal thickness in whichever direction it is guided; from one drawing it can enlarge a letter normal with the drawing, or condensed, or extended, or italic, or back slope, and during these extraordinary performances the microscope attachment automatically conforms with the varying focal points. One Benton's Delineating Apparatus is sufficient for the purposes of the American Type Founders Company, and thus a second has never been built. It is a miracle of accuracy and flexibility. When Mr. Benton applied for a patent his application was promptly rejected on the ground that he was trying to patent "a mechanical impossibility." He showed the patent office that "the mechanical impossibility" had been in use for months, and quickly received his patent. Prior to this ingenious invention new designs of types had to be

cast and printed before they could be criticized. With Mr. Benton's invention each letter may be examined separately and in combination with other characters before the matrix has been made, thus saving a great deal of time and expense.

When the ten-inch outline drawing of a letter has been tested on the Benton Delineator and has been approved, it is placed on the bed of Benton's Wax Plate Machine. This also is a pantograph machine. It holds a brass plate, coated with electrolytic ozokerite, face down, while a tracing tool attached to the pantograph engraves an outline of the design in the wax, as the operator carefully follows the outline drawing with a pointer. As the design is reproduced in the wax it is reduced about one-third. When the design is thus reproduced on the wax plate, it is electrotyped, with the result that all the lines cut in the wax come out as raised surfaces, forming a pattern about three points deep, in which the letters



The Benton Matrix-Cutting Machine. The follower is engaged in a pattern of a Japanese word character. Photograph is from one of two machines sold to the Imperial Printing House of Japan for use in its typesetting. This is one of the most perfect mechanisms made in America.

are three inches from head to foot. This pattern may be used to cut punches or matrices, as desired.

The electrotype pattern is now placed on the bed of a Benton Matrix-Cutting Machine, of which we show a picture. From this large pattern matrices are cut in any desired size in an alloy much harder and more durable than the copper formerly used in matrices. Letters are cut for souvenirs to visitors to Mr. Benton's department which are small enough to go on a half-point (144th of an inch) body, if a type mold so small were made, which are readable only through a powerful microscope. From the same pattern the same letters may be cut to fill a 144-point (2-inch) body. With the Benton Punch-Cutting Machine the sixty-eight words of the complete 4's Prayer have been cut and matrices made for casting

them on the square of twelve points. There are various cutting tools—some for clearing and others for cutting in corners and also for smoothing the bottom of the matrices to give a perfect printing surface. These tools have chisel edges, and vary in length from one one-thousandth to eighty one-thousandths of an inch. They revolve at a speed of from eight thousand to twelve thousand a minute, sinking about one-eighth inch into the hard metal. As the accuracy of the matrices depends upon the accuracy of the cutting tools, Mr. Benton invented a special grinding machine which grinds with automatic accuracy when the gage is properly set. The dimensions of these cutting tools are so minute that they can only be gaged under microscopes. Across the center of the lenses of these microscopes a fine scale is arranged, the spacing between the lines being one-half of one one-thousandth of an inch, about half the thickness of a cigarette paper. As a tool with a cutting edge of eight one-thousandths of an inch looks like a heavy nail under these microscopes, the cutting tools are easily gaged by the eye—the 0.025 tool covering 160 lines on the lens, the 0.001 tool two lines.

When the matrix metal and the proper cutting tool are in position and the machine is adjusted for the size of type required to be cast in the matrix, the cutter is directed by means of the follower or pointer resting within the electrotyped pattern on the bed of the machine. It would be tedious to explain fully the marvelous mechanical movements of Mr. Benton's machine—even if we were competent to do so, which we are not—but one marvel may be readily grasped: With a pattern which may be as large as five by nine inches, in tracing which the pointer is deflected to all points of the compass, the cutter is made automatically to adjust itself, so that at all times it makes a cut of equal depth, insuring uniformity of height of the types to be cast from the matrix. When the matrix leaves the Benton machine it is complete, but not quite ready for casting purposes. It goes to a matrix fitter, who gives it its final adjustments for line, width and depth. These adjustments are effected in a much shorter time than was possible with punch-driven matrices.

As head of the general manufacturing department of the American Type Founders Company, Mr. Benton has constantly applied his inventive genius to the improvement of the product and of manufacturing methods. He has made important improvements in the Barth Automatic Typecasting Machines and in type molds. One of his important inventions is a machine for making brass rules. During the past century many brass rule machines have been invented at great cost, but not one of them proved practicable until Mr. Benton undertook to solve the difficulties in the way. He achieved complete success in a comparatively short time with very few changes from the first plans he put on paper.

American types, as now made, are the most accurate of any manufactures produced in great quantities. This distinction is largely due to Mr. Benton's inventions and his devotion to an unprecedented degree of accuracy in all the work done under his direction. He knows no way of doing anything but the right way, and believes that in the end that way is the cheapest.

At the age of seventy-eight years, Mr. Benton outdoes his youthful years in humor and geniality. An observant man, he has accumulated a great fund of genial anecdotes. With a clean life, based upon absolute probity, he commands the admiration and respect of all his associates. He has as ardent an interest now in every detail of typesetting as ever he had when confronting his most difficult problems in earlier years. He permits nothing to interfere with a most punctual attention to his duties, though these are largely self-imposed. His vocation knows no avocation. The printing industry has been immensely benefited by this, the most modest of inventors, whose name will live forever in the annals of typography.