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Joseph Saxton

AND HIS CONTRIBUTIONS TO THE MEDAL RULING AND PHOTOGRAPHIC ARTS

Arthur H. Frazier

Smithsonian Institution

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ABSTRACT

Frazier, Arthur H. Joseph Saxton and His Contributions to the Medal Ruling and Photographic Arts. *Smithsonian Studies in History and Technology*, number 32, 17 pages, 13 figures, 1975.—Medal ruling is a little known art by which pictures are mechanically produced from coins, medals, cameos, and other objects presented in relief. It made a sudden and spectacular appearance very early in the 19th century, but with the advent of daguerreotype photography near the middle of that century, it disappeared almost as suddenly. Joseph Saxton (1799–1873), an extraordinary mechanician was caught up in those arts, and made exceptional contributions to both of them. His medal ruling machines were the first of their kind to have eliminated distortions from the resulting pictures. Among the scientific uses to which his final model was applied was a diffraction grating made for John William Draper, who took the first photograph ever executed of the diffraction spectrum. The only remaining model of the three machines Saxton is known to have built is now at the National Museum of History and Technology, Smithsonian Institution.

The daguerreotype Saxton took of Philadelphia's first Central High School and the State Armory is perhaps the earliest daguerreotype ever taken in the United States, and certainly represents the oldest American daguerreotype extant. It is now in the custody of the Historical Society of Pennsylvania in Philadelphia. A combination of Saxton's medal ruling and daguerreotype skills helped to produce a remarkable illustration of the second United States Mint, which was published in 1842 in Eckfeldt and Du Bois' *Manual of Gold and Silver Coins*, and which has been republished in this present study.

OFFICIAL PUBLICATION DATE is handstamped in a limited number of initial copies and is recorded in the Institution's annual report, *Smithsonian Year*. SI PRESS NUMBER 5365. COVER DESIGN: Medal ruling of "Alexander, Emperor of all the Russias, in the costume of the Russian hero, Radomisl, of the 9th century." Apparently this medallic ruling was made from a medal identical to the one from which Christian Gobrecht, executed the first American-made medal ruling in 1817. See page 2. (Courtesy Library of Congress)

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AND HIS CONTRIBUTIONS TO THE MEDAL RULING AND PHOTOGRAPHIC ARTS

Arthur H. Frazier

Prologue

"Mr. Saxton is unquestionably one of the most Skilful and scientific mechanicians that our country has produced." That was the expression used by Dr. Robert M. Patterson, the sixth Director of the United States Mint in Philadelphia, and Isaiah Lukens, Vice President and charter member of the Franklin Institute, when they nominated Joseph Saxton (1799–1873) for membership in the American Philosophical Society.[1] Several years after having been elected into the Society, Saxton was selected as one of the original fifty members of the National Academy of Sciences. For the last thirty years of his life, he was in charge of the Office of Weights and Measures in the United States Coast Survey, the forerunner of the National Bureau of Standards. During the course of those events, he designed and built many remarkable machines and instruments. This story is concerned with his instruments for making medal rulings, one of which is shown in Figure 1, and with the camera with which he took, in 1839, America's oldest and most famous daguerreotype.[2]

When he was eighteen years old, Saxton was serving an apprenticeship under David Newingham, a local silversmith, watchmaker, and engraver, in his native village of Huntingdon, Pennsylvania. Newingham died the following year, however, and young Saxton, armed with a letter of recommendation from his neighbor John McCahan, publisher of the *Huntingdon Gazette*, saying that he was a lad of good character and very ingenious, journeyed to Philadelphia.[3] There he became acquainted with Christian Gobrecht, also an engraver and the first American to have built (in 1817) a medal ruling machine.

Ruling machines belong to a family of mechanized engraving devices, a few members of which are still used for decorating, with scrollwork designs, the margins of bank notes, bonds, and other financial and legal documents. *Medal*-ruling machines differ from other instruments of the genre in that they produce from a coin, medal, or from any model carved in relief, a drawing or an engraving that, upon being printed, resembles a photograph of it. The fact that such machines were capable of producing excellent pictures well before the advent of the daguerreotype, or any other photographic process, makes their invention a remarkable achievement.

Although Gobrecht was the first American to have constructed such a machine, the process had been known previously in France and England. An 1832 issue of the *Mechanics' Magazine* of London, for example, contains a translation from the *Manuel du Tourneur* (1816) in which an apparatus is described for producing copper engravings from medals and other objects in relief.[4] A drawing of the machine, based on that translation, appears in Figure 2.

No evidence has been found to indicate that

Arthur H. Frazier, 3636 Sixteenth Street, N.W., Washington, D.C. 20010. Honorary Research Associate, Smithsonian Institution.

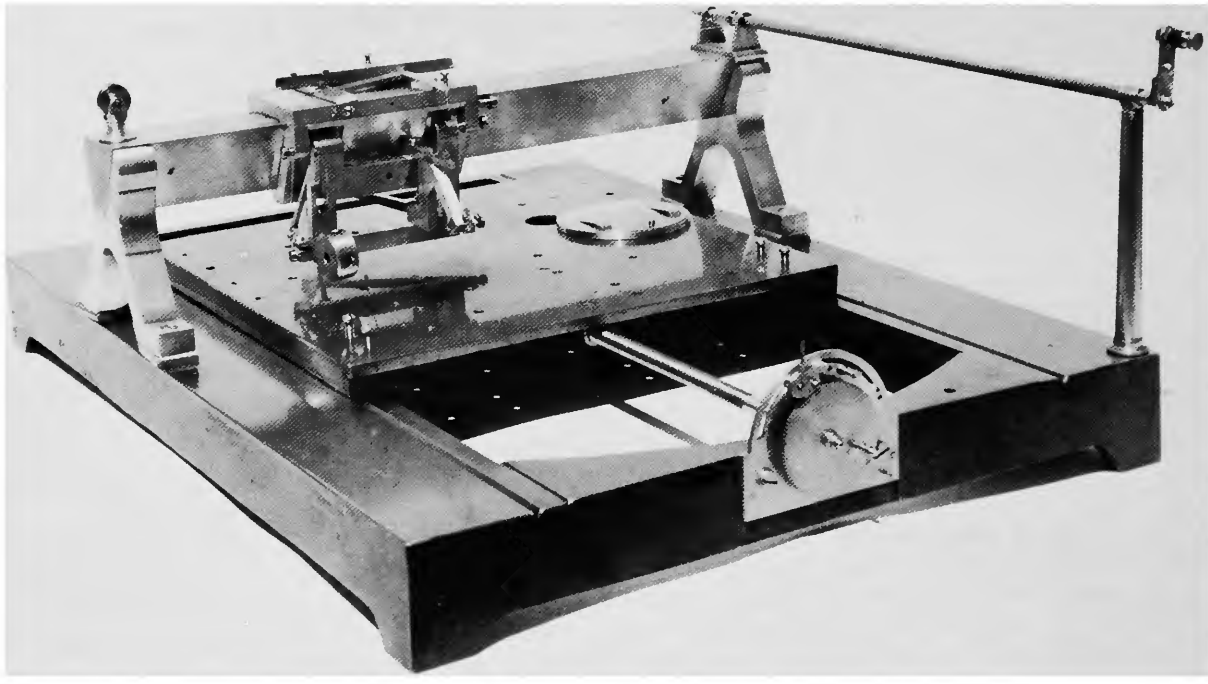


FIGURE 1.—Saxton's medal ruling machine (circa 1837) at the Smithsonian Institution on loan from the Franklin Institute. (Photograph by the author)

Gobrecht could have known about this European machine. As a matter of fact, his design differed greatly from it. Regretfully, the only thing that Gobrecht's and all other early models had in common was a fault—the images they produced were so badly distorted that they never received universal approval.

Joseph Saxton was still the 18-year-old apprentice in Huntingdon when Gobrecht exhibited the first engraving he had made with his invention—a likeness of the head of Alexander I, Czar of Russia (see cover). Since engravers of the old school were quick to call attention to its distortions, it seems possible that Saxton had learned of that fault even before the two met in Philadelphia.

Correction of Distortion Effects

All mechanical devices were fascinating to Saxton, so it is not surprising that soon after they became acquainted, Saxton built a machine for himself similar to Gobrecht's. From then on, he gave much thought to eliminating the distortion in the images it produced, but it was to take more than ten years and a trip to England before he managed to do so. As shown in Figure 3*a*, the arms which held the tracing pointers on both Gobrecht's and Saxton's first machines, were positioned horizontally. In August 1829, just a short time after Saxton arrived in London, he drew a sketch (now in the Archives of the Smithsonian Institution) showing how the problem had been solved. A

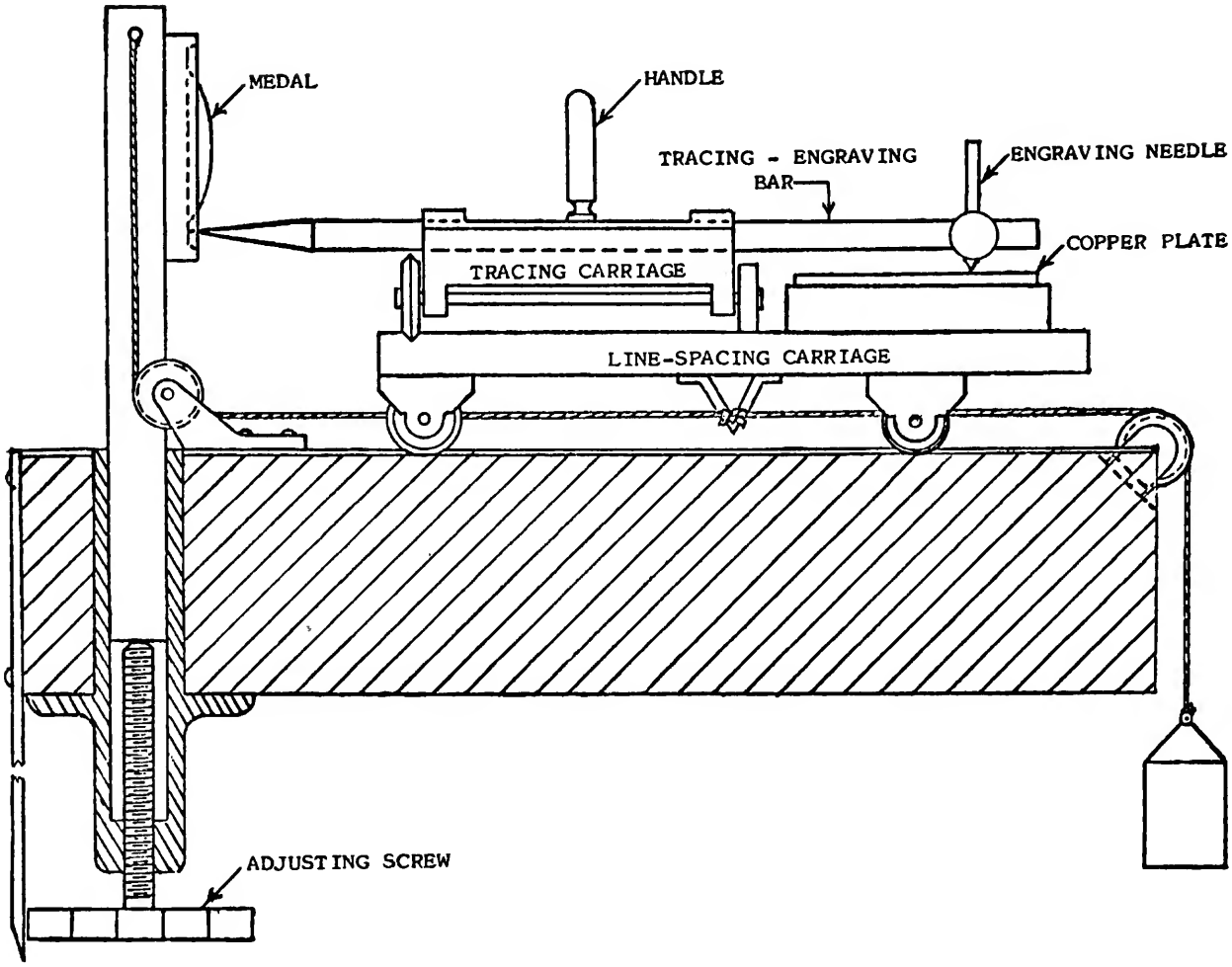


FIGURE 2.—Author's conception of the medal ruling machine described in the *Manuel du Tourneur* (1816).

copy of it appears in Figure 3*b*. As may be seen, the horizontal arm has been tilted downward at an angle of 45 degrees. He called the altered part a "diagonal tracer arm." It was the only change needed to convert his and Gobrecht's machines from failures to successes, and to eliminate the growing criticism about distortion that had been directed at the new art of medal ruling.

Saxton never patented his improvement and never received any monetary benefits commensurate with its importance. To be sure, he did execute a few engravings with his machine, but his income from them must have been very little. His London diaries, also preserved in the Smithsonian Insitution Archives, contain only thirteen brief references to the machine. Interestingly, they show that the medal he was employed to copy most frequently was that commemorating Dr. Franz Gall (1758–1828), the founder of the pseudoscience of phrenology. The final entry reveals that Saxton had been called on by Sir John Trevellyan and his son to see the machine for copying medals. Walter Trevellyan, presumably Sir John's son, purchased the machine from Saxton not long afterward.

The Saxton-Bate Controversy

It seems strange that Saxton made no mention in those diaries about the visits he had exchanged with

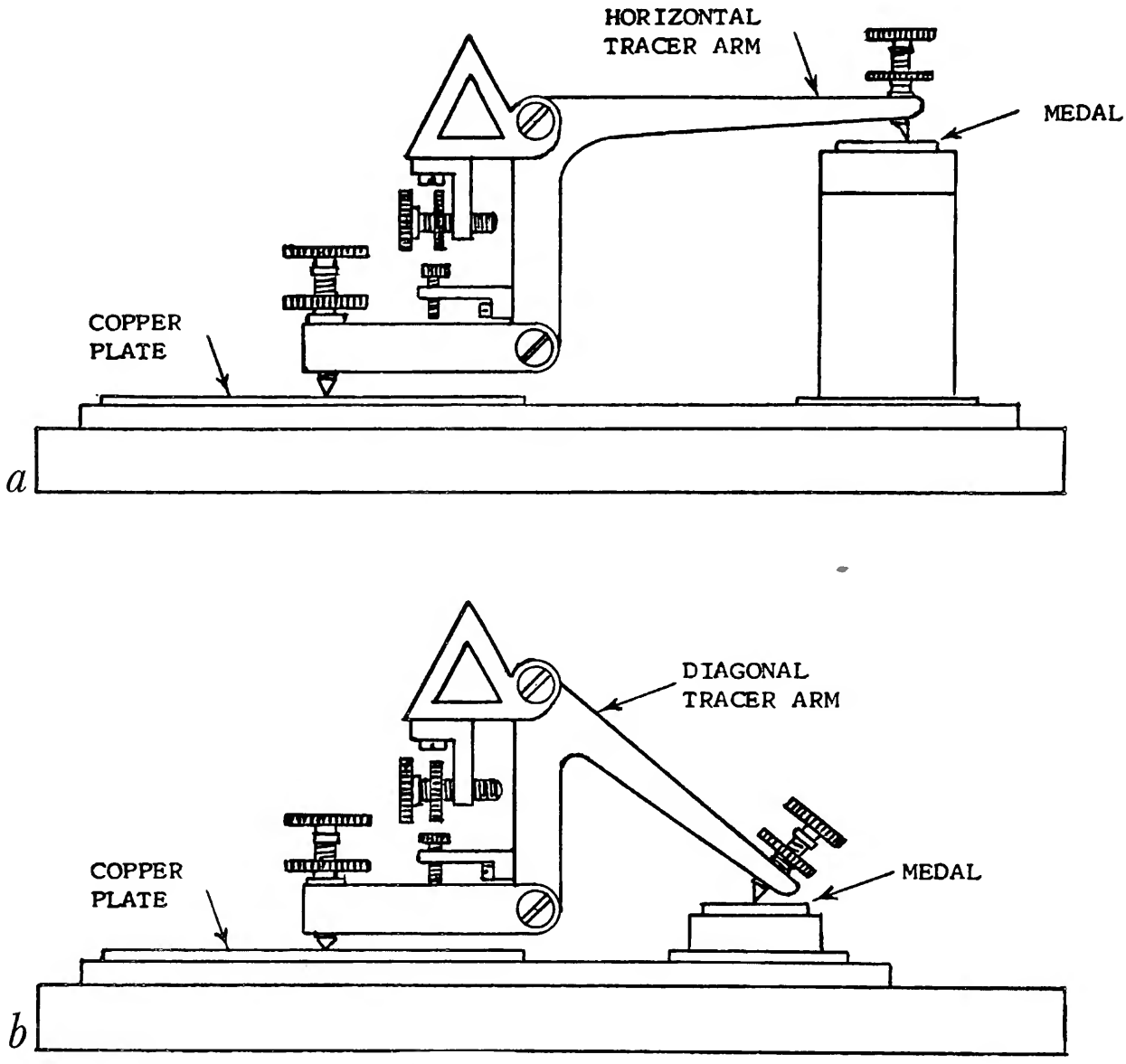


FIGURE 3.—*a*, Author's conception of Gobrecht's medal ruling machine (1817); *b*, Saxton's drawing, showing his "diagonal tracer" (1829).

a Mr. Bate and his son, and how they had secretly applied Saxton's diagonal tracer to their own ruling machine and patented the idea before Saxton learned about their intention to do so, thus depriving Saxton of the benefits he might have received by taking out such a patent. Many of those circumstances are described in the following extracts of a letter by Saxton published in 1838 in Vincent Nolte's booklet *Memorial of Facts Connected with the History of Medallic Engraving:*

No. 24 Sussex Street,
London University
May 6, 1837

Sir, —

In compliance with your request that I should state some facts with reference to the improvements I have made in the machine for copying medals by ruling, I beg to state that the original machine was invented so far back as 1817 by Mr. Christian Gobrecht, an engraver in Philadelphia who accidentally discovered that by ruling over a hammered plate, the

FIGURE 4.—Medal rulings executed with the Collas machine in response to a challenge from John Bate's supporters. (Courtesy Library of Congress)

whole of the marks were correctly transferred to the copper plate; and hence the idea of copying a medal . . . . In 1818, I contrived a similar machine to that of Mr. Gobrecht, and soon after my arrival in this country I made an improvement in the machine, by which the whole or any given part of the distortion could be prevented . . . .

Mr. Petty Vaughan being of the opinion that I might introduce this kind of ruling with success on eye-glasses and on jewelery, gave me letters of introduction to various persons, to whom I shewed the specimens ruled on metal and glass, among others, Messrs. Rundell and Bridge, Messers. Green and Ward, also Mr. Bate. When I called on Mr. Bate with this introduction in 1829, and shewed to him the specimen ruled by my improved machine, he at that time had not seen any machine at all for this object. Although pleased with the specimens, he discouraged me as to introducing it profitably for the objects then proposed. After several unsuccessful attempts to introduce this species of ruling, I applied myself to other objects, and allowed the subject to remain dormant . . . .

In the year 1832, Mr. Gill . . . informed me that Mr. Bate's son was taking out a patent for an improvement in the medal ruling machine; and very soon after, Mr. Bate and his son called on me, having been informed by Mr. Gill that I had made an improvement in the medal ruling machine, and stated that if it was similar to his machine, he was unwilling to do anything that would be injurious to my interest. I then shewed to them a specimen ruled on glass without distortion, and it was agreed that I should rule further specimens on copper plate, and shew it to them. A few days afterwards I ruled on an etching ground a head of Franklin and a head of Minerva. I called with this plate on Mr. Bate, and saw his son, who admitted that it was very well done, but he thought he saw a little distortion. As you are in possession of an impression taken from this plate, you can judge whether he was correct or not in his opinion. He expressed a wish that I should rule a head of Ariadne by my machine, and he would also rule the same head by his machine, in order that he might see whether my machine did really perform what I stated that it would do, viz. rule without any distortion. Mr. Bate promised to send me a cast impression in glass, in order that we might both rule from exactly the same original. Mr. Bate did not keep his promise to send the head of Ariadne as proposed. Soon after, I was informed . . . that Mr. Bate had abandoned all idea of taking out a patent; I therefore did not consider it necessary to take any steps to prevent the patent being taken out. It however, afterwards turned out that I had been deceived, as the patent was very shortly afterwards sealed . . . .

I am Sir, your obedient Servant,

(Signed) J. Saxton

To Vincent Nolte, Esq., Tavistock House, Tavistock Square.[5]

Nolte, the recipient of the foregoing letter, was the principle shareholder in the firm of Lachevardiere and Company of Paris, a firm which had purchased the rights to the French patent on Achille Collas' medal ruling machine. His booklet was filled with bitter accusations against John Bate for having "wantonly set aside all rules of ordinary courtesy" at the hearings conducted by a committee of the House of Commons on a proposal to print copies of some 3000 rulings obtained from historical medals in the collection of the British Museum. To disprove a claim by Bate's supporters that the Collas machine was incapable of producing an undistorted image of a cameo like that of the familiar Greek Goddess Ariadne, Nolte included in his booklet, the illustration shown on the cover and that in Figure 4. The lowermost ruling in Figure 4, captioned "Answer to Mr. Bate's Challenge," and the three uppermost rulings are free from any noticeable distortion, but Nolte went a step farther. As if to express the contempt he felt for Mr. Bate, he included six additional views of the Ariadne cameo which were deliberately distorted in such a way that they obviously "made faces" at his tormentor! In any event, those hearings produced no immediate action.

Of somewhat more importance here are the statements in Saxton's letter about Bate's patent. British patent No. 6254, entitled "Machinery to Produce Imitations of Medals, Sculptures, &c." was awarded him on 9 October 1832. A side view of the machine, substantially as shown in the patent drawings, appears in Figure 5. A comparison of it with the machine shown in Figure 2, indicates that basically its design was the same as the one described in the *Manuel du Tourneur*, although Bate had added a diagonal tracer much like Saxton's except that it tilted 45 degrees upward rather than 45 degrees downward.

A flurry of activity in the manufacture of medal ruling machines followed the granting of the Bate patent. Besides the one patented in France by Collas, a number of custom-made models which did not conflict with the Bate patent showed up in England, and others began to appear in Germany. This spurt of activity reached a peak in the early 1840s, but for reasons explained later, lost momentum during the next ten years.

Saxton's Return to America

Saxton apparently paid little attention to medal ruling machines for several years after he sold his original model to Trevellyan. In 1835, his American friend, Franklin Peale, son of the famous artist, Charles Willson Peale, paid him a visit which not only diverted his energies to other matters, but foreshadowed his departure from London. Peale had been sent by the United States Mint to study the methods

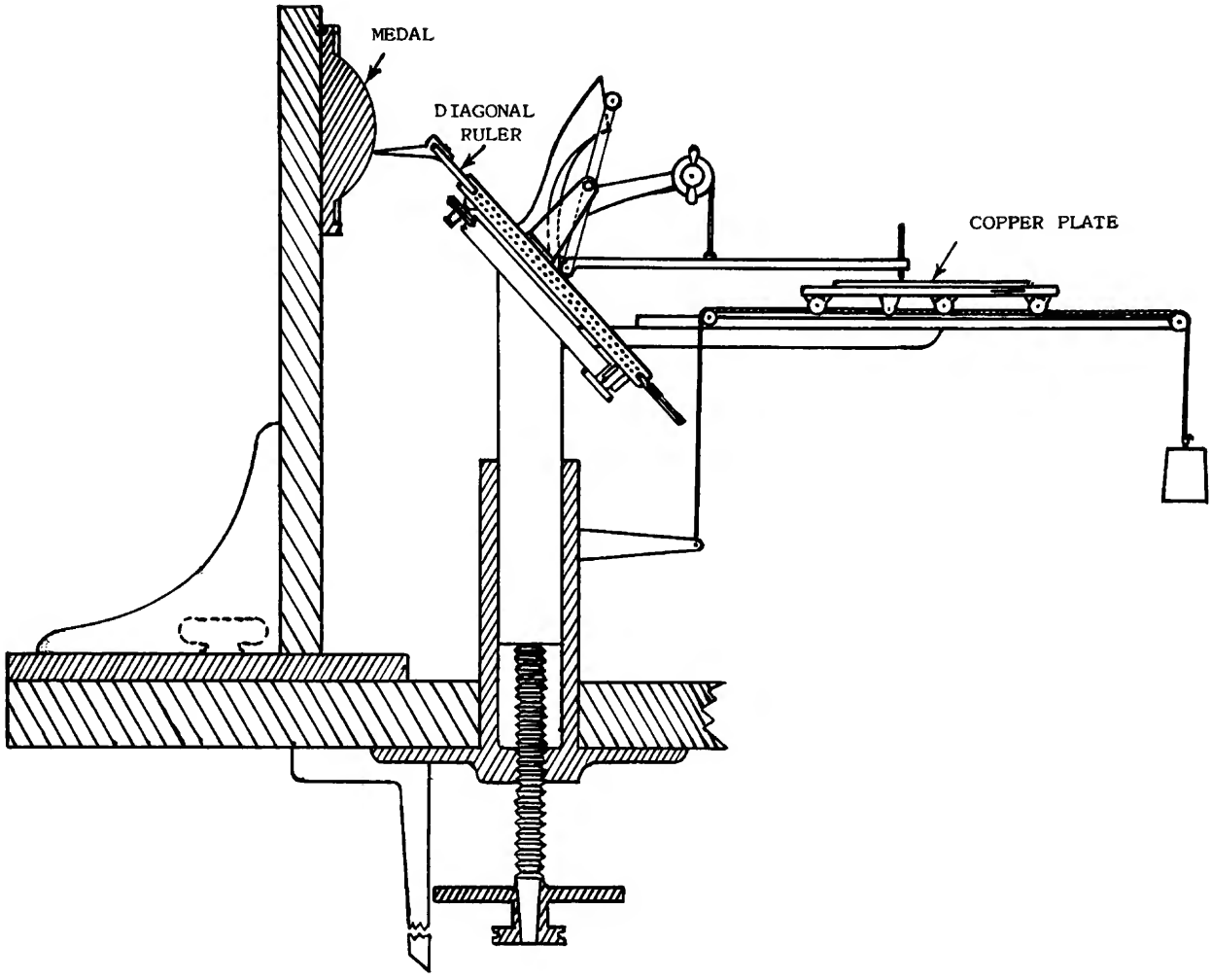


FIGURE 5.—The Bate medal ruling machine (1832).

of operation at European mints, and in connection with that mission, placed an order with Saxton on 21 January 1835 for a large assay balance scale. When it was delivered, Dr. Robert M. Patterson, the Mint's Director, was so pleased with it, that he promptly ordered five more of them, and offered Saxton "a good job to begin with" if he would return to Philadelphia and take charge of the balances at the Mint.[6] The offer was accepted, and Saxton began his homeward trip during the first week in May 1837.

Upon his arrival in Philadelphia, Saxton obtained room and board in what was then the 200 block of Walnut Street, within reasonable walking distance to the Mint. Among the old friends who welcomed him home was Christian Gobrecht, who had become the Mint's Assistant Chief Engraver. No doubt they again held long discussions about the medal ruling machine. Probably to demonstrate the effectiveness of the improvement he had devised, Saxton soon began building the second of his three models (Figure 1).

Restudy of Distortion Effects

Having been afforded an opportunity to use this machine, the author has executed, for comparison purposes, several images with it when equipped with its present diagonal arm, and a number of other images with a temporary horizontal arm like the one Gobrecht had originally installed on his machine.

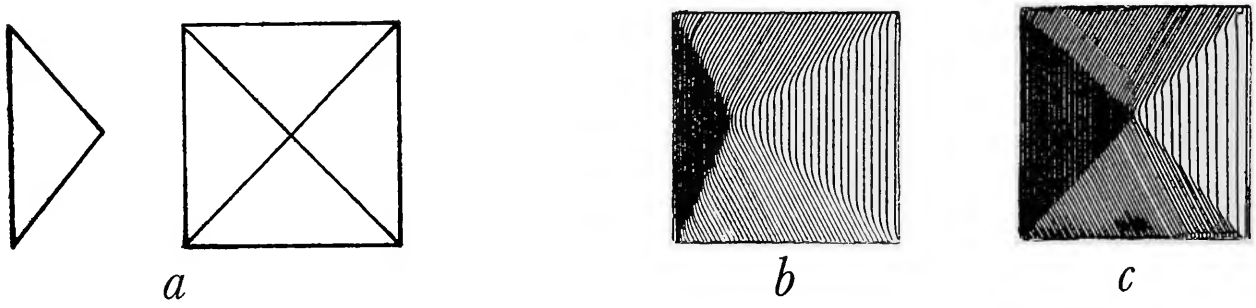


FIGURE 6.—Images produced with the Saxton medal ruling machine: *a*, side and top views of pyramid-shaped model used in tests; *b*, image produced with a horizontal arm simulating Gobrecht's design; *c*, image produced with Saxton's improved diagonal tracer.

The model used on this present occasion was a simple pyramid, one-half inch in height, with a base $1\frac{5}{16}$ inches square. The results appear in Figure 6. It shows that when the horizontal tracing arm was used (Figure 6*b*), the peak of the pyramid became translated far to the left; when the diagonal tracing arm was used (Figure 6*c*), the peak appeared, as it should, close to the center. During this experiment it was found that if the angle of the arm exceeded 45 degrees, the peak would be translated over to the opposite side. It follows, then, that by properly adjusting the angle, the operator can completely eliminate distortion. In this connection, it may be noted that Saxton's machine contained no special provision for making fine adjustments of the angle, although his 1829 drawing (Figure 3*b*) illustrates how he obviously intended them to be made. The drawing shows the medal resting upon one or more flat plates. By the simple expedient of increasing or decreasing the thickness of the stack of plates, the angle of depression could be varied until the desired results were produced.

Comparison of the Saxton and Bate Machines

A comparison of Saxton's machine with the one shown in Bate's patent drawing (Figure 5) indicates that Saxton's was superior in every respect. To work the Bate machine, the operator first had to bring the tracing carriage to the starting side of the medal. He then had to bring the tracing point into gentle contact with the medal and maintain that contact continuously while moving the carriage across the medal's entire width. After having completed the traverse, he had to back the engraving needle away from the copper plate and the tracing point away from the medal before returning the carriage to its point of beginning. For every inch of medal, those operations had to be repeated some two hundred times, a tiring and time-consuming effort. Any muscular jerk, any failure to perform each traverse smoothly, or any operation performed out of proper sequence could spoil the engraving. Much practice and concentration would be required to produce satisfactory results.

Saxton's machine was not only simpler and more rugged in construction, but was easier to work. After the medal and the copper plate had been set up, all the operator had to manipulate were two small cranks, first one and then the other, over and over again. The motions of the cranks were controlled mechanically to prevent their being turned beyond the proper distance. The amount of pressure applied against the medal and copper plate during the engraving phase of each traverse was also mechanically controlled; the tracing point and engraving needle were raised automatically during the return trip, and automatically lowered. Most beginners could learn the necessary techniques in less than two hours. After becoming skilled, an operator could probably execute any job in about one-third the time required by the Bate machine. As far as the final products were concerned, there should have been no distinguishable differences.

The third medal ruling machine made by Saxton, in about 1840, was a power-driven model using the recently installed steam engine at the Mint. After setting up the machine and making the necessary adjustments, Saxton would connect it to the steam engine, take one last look to see that everything was

functioning properly, then go about his other duties. The machine would shut itself off when the job was finished. Joseph Henry, the first Secretary of the Smithsonian Institution, presented a "Biographical Memoir of Joseph Saxton" before the National Academy of Sciences in 1874, in which he devoted considerable attention to Saxton's medal ruling machine. His comments summarize that achievement:

> By . . changes requiring inventive powers of high order, he [Saxton] removed entirely the distortion and rendered the [Gobrecht] ruling machine capable of engraving facsimiles of medals, as well of high as of low relief. He subsequently rendered the apparatus entirely automatic by applying to it the motive power of water and steam, so that when once set in motion it would faithfully perform its task with unerring precision; and when the ruling was completed, it would stop on the instant, cutting off the motive power. The rapidity of the execution was another feature of the apparatus; one face of a coin, an inch in diameter, ruled with lines one two-hundredths of an inch apart, was completely engraved in about half an hour.
>
> Dr. Patterson was fond of exhibiting and explaining Saxton's ruling machine to the distinguished visitors of the Mint. It was, indeed, an interesting exhibition to see this machine engraving its fine lines, moving its tracer backward and forward without aid, or even the observation of a superintendent, and stopping when its task was accomplished, and, by the sound of a bell, calling for more work.[7]

The most ambitious project undertaken with Saxton's steam-driven machine was the preparation of engravings of all the coins in the "Cabinet" of the Mint for publication in a book entitled *A Manual of Gold and Silver Coins of All Nations Struck within the Past Century*, by Jacob R. Eckfeldt and William E. Du Bois, two assayers at the Mint. The first edition (1842) of that work contains illustrations of hundreds of coins, all from engravings Saxton made with his machine.[8] One page of those illustrations appears in Figure 7. The frontispiece of the book, showing the Mint itself, was also engraved with Saxton's machine. Before discussing it in detail, however, mention should be made of the advent of the daguerreotype.

Advent of the Daguerreotype

The daguerreotype process was described and made available for unrestricted world wide use at a historic meeting of the French Academy of Sciences in Paris on 19 August 1839. News articles about that event began appearing in Philadelphia between September and November 1839 in the *United States Gazette*, the *Journal of the Franklin Institute*, and the *American Daily Advertiser*. After reading one or more of those accounts, Saxton improvised, from a cigar box and an ordinary reading glass, a daguerreotype camera, and on 16 October 1839 took a picture with it from a second-story window of the Mint. It has been said that instead of a copper plate, he used a strip of polished silver such as that from which coin blanks were cut.[9] His efforts were rewarded with a $1\frac{3}{4} \times 2\frac{5}{16}$ inch daguerreotype of the State Armory and the Philadelphia Central High School, both of which were then located just across Juniper Street from the Mint. The event was reported in the 25 October 1839 issue of the *United States Gazette:*

> There was on Tuesday (the 22nd) exhibited to us a photographic plate of the Central High School made by Joseph Saxton. It is the first attempt, and is sufficiently successful to demonstrate the beauty of the art when perfected; and we add that the success also shows the art to be quite susceptible of great and immediate improvement.

Saxton's daguerreotype, one of the first ever made in this country and the oldest extant American-made picture by any photographic process, is being preserved in the Museum of the Historical Society of Pennsylvania. Historically, it is one of the most famous pictures in all of American photography (Figure 8).

An interesting sidelight on this picture is that the scene it portrays is "reversed." A modern photograph of the two buildings, if taken from the same location, would show the Armory at the observer's right, and the school (identified by the astronomical observatory) at his left. On the daguerreotype, however, they appear in the opposite order. Saxton had used an ordinary reading glass for the lens of his makeshift camera, and the images produced with such a lens on an opaque surface are always reversed. Probably the first method attempting to correct this condition appeared in a U.S. patent entitled "For an Improved Apparatus for Taking Daguerreotype Likenesses," granted to Alexander S. Wolcott, a dentist in New York City, 8 May 1844. In it, a large concave mirror, located inside the rear end of the camera, was used instead of a lens. When the front of the camera was opened, the rays of light entering it became focused on a small sensitized plate situated about midway between the mirror and the camera's open end. This was the first patent on photography to have been awarded in the United States.[10]

A reproduction of Saxton's daguerreotype (some refer to it as a transcript, others as a woodcut, and still others as a metal engraving) made its first ap-

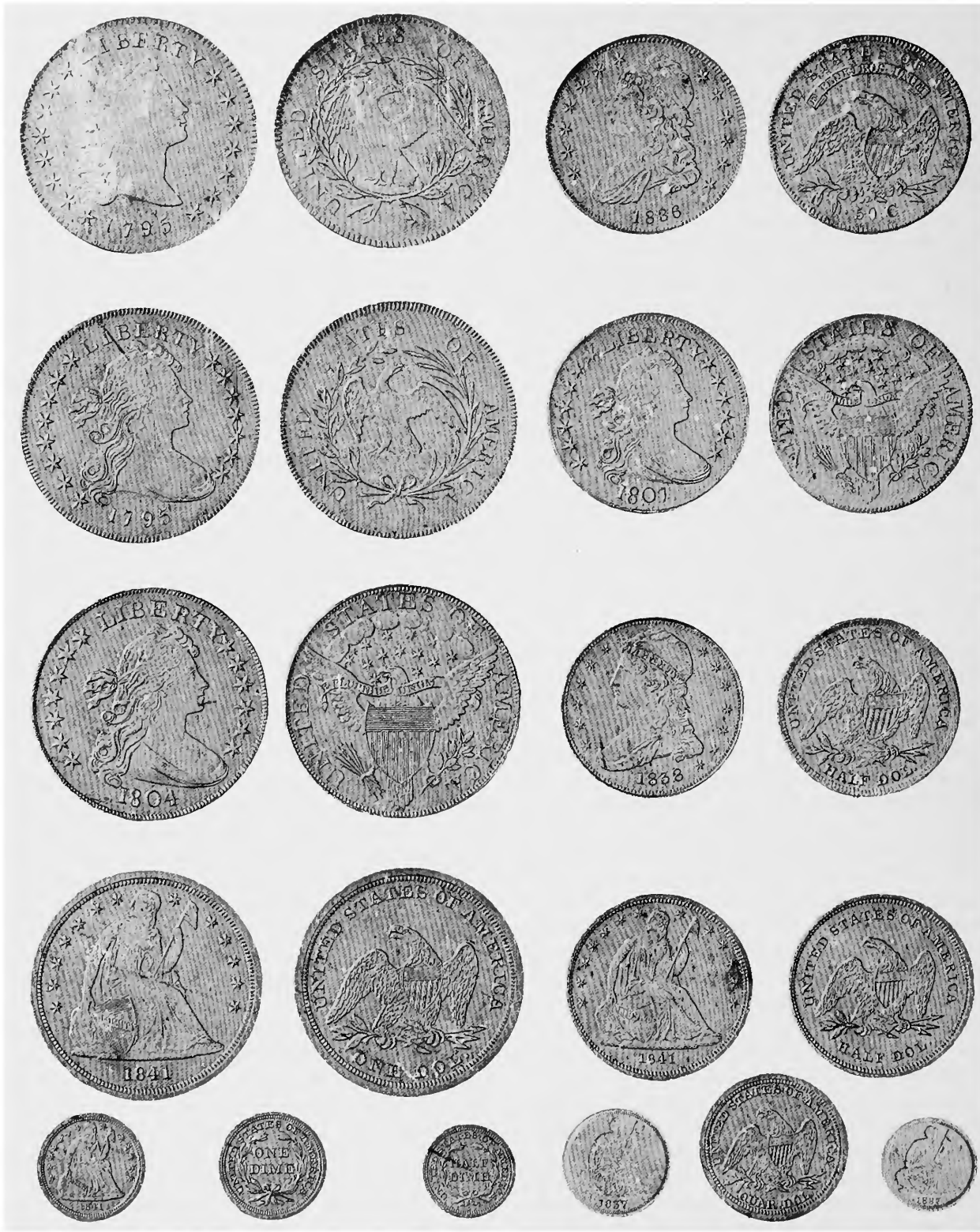
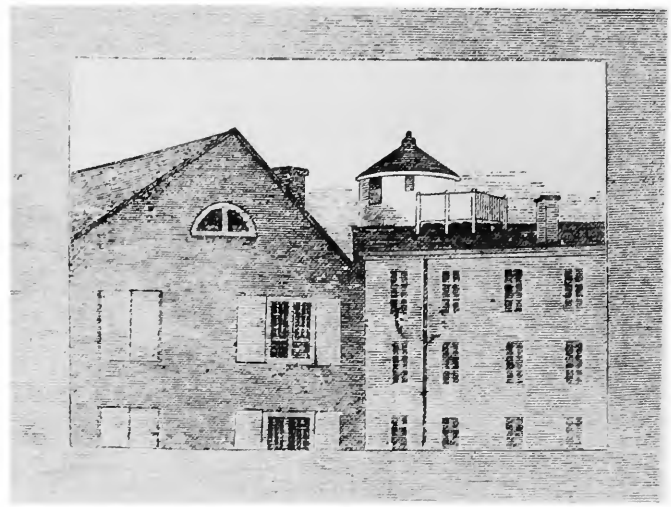


FIGURE 7.—Plate 2 from Eckfeldt and Du Bois' 1842 edition of *A Manual of Gold and Silver Coins.* (Courtesy Library of Congress)

a



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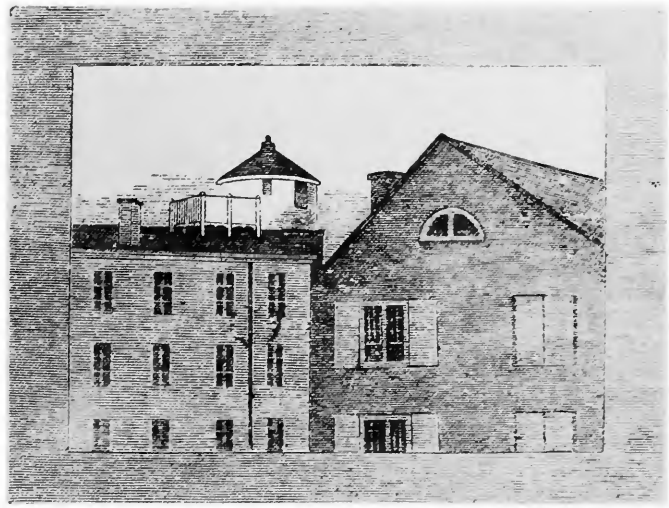

d

FIGURE 8.—*a*, The daguerreotype taken by Saxton 16 October 1839 (courtesy Historical Society of Pennsylvania); *b*, same scene, as published in 1864 in *The Camera and the Pencil* (courtesy Library of Congress); *c–d*, reversed versions of the above, with the buildings in their correct positions.

pearance, presumably, in 1864 in a book entitled *The Camera and the Pencil*, by Marcus Aurelius Root.[11] It presented a much clearer image of the school and the arsenal, but those buildings still remained in their reversed positions. That same reproduction has been published again and again; for example, in the July 1892 issue of the *American Journal of Photography*, and in the magazine section of the 17 November 1963 issue of the *Philadelphia Enquirer*.[12]

Modern photography affords a simple method whereby such scenes can be portrayed in both their correct and reversed positions, so advantage has been taken of that method to prepare Figure 8, wherein the original and the later reproduction are presented both ways.

None of the buildings discussed above are still standing, and the area has changed so much that one might have difficulty trying to re-establish their actual

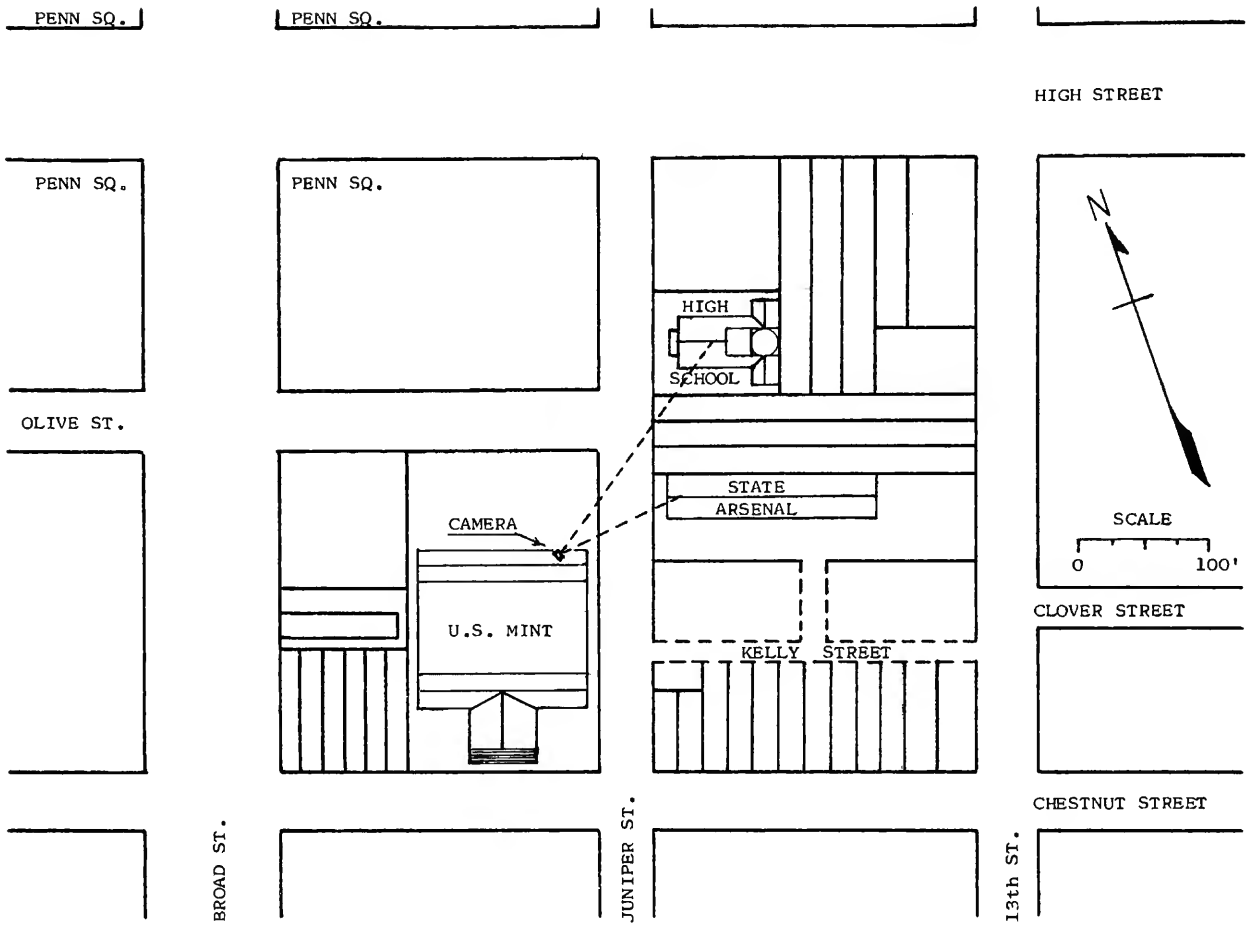

FIGURE 9.—Location from which Saxton took the oldest surviving American daguerreotype (see Figure 8).

locations. Figure 9, based on contemporary city maps, shows those locations and the position of the camera at the time the daguerreotype was taken. It may be noted that the Mint was in the block now occupied by the Widener Building; both the Central High School and the State Armory were in the block now occupied by the John Wanamaker store; and that both of these blocks presently surround the southeast corner of Philadelphia's present City Hall Square.

Refutation of Moser's Photographic Theory

Photographers of the 1840s did much speculating over the manner in which photographic effects were produced. Many false theories were expressed, and it is interesting to note that Saxton refuted at least one of them. In 1842, the German *Handbuch der Photographie* contained an article describing experiments performed by a Königsberg scientist named Moser, who claimed that all objects radiated invisible photographic rays which, even in total darkness, were capable of transferring their images onto nearby surfaces. Dr. Paul Beck Goddard, then a leading daguerreotype innovator and photographer in Philadelphia, called the article to the attention of the members who attended the 30 May 1843 meeting of the American Philosophical Society. Aside from Dr. Goddard, those who entered the subsequent discussion were Joseph Saxton, Professor Joseph Henry, and Professor James Rogers. During the course of that discussion, an account was given of experiments that Saxton had performed on the subject. He claimed

that the transfer of images which Moser had observed probably resulted from the gradual evaporation of unnoticed oily or other organic substances on the surfaces of the objects under observation. Perhaps the most convincing experiment he had performed was one in which the tested objects had been cleaned in acid of every trace of such oily or organic substances before placing them close to plane surfaces. Not one of them so treated produced any image of itself upon the neighboring surface regardless of the length of time it was allowed to do so.[13]

The "U.S. Mint"

The illustration of the second United States Mint which Eckfeldt and Du Bois had published in their *Manual of Gold and Silver Coins* was produced from a photograph Saxton had taken in 1841 with his daguerreotype camera pointed northward from the south side of Chestnut Street, the street toward which the Mint building faced. Christian Gobrecht, who by then had become the Mint's Chief Engraver, made a bas-relief from the daguerreotype, and a facsimile of that bas-relief (which was of soft metal) was produced by the newly discovered art of electrotyping. Saxton then made an engraving of the electrotype with his medal ruling machine. This illustration (Figure 10) accordingly represents a combination of the three most scientific advances in graphic arts up to that time.[14] Moreover, it could well be considered a "missing link" in the evolution of the methods used to make pictures. It was produced during the transition from medal ruling methods to daguerreotype photography, and it contains elements of both stages of that development. Just beneath the left side of this illustration of the building, in letters barely visible, one can detect the name "Gobrecht," and beneath the right side, the name "Saxton."

When it was found that *photographs* of coins, medals, cameos, etc., could be produced just as accurately, and could be made with less effort and more speed than was possible by the medal ruling process, that process, stripped of its primary function, was headed for obsolescence. It now seems obvious that if photography had been invented a few years earlier, *medal ruling* would never have made an appearance.

Although Saxton became a daguerreotype "buff," he did not immediately abandon his medal ruling activities. Figure 11, for example, contains two outstanding rulings of his friends and benefactors, Dr. Robert M. Patterson and Franklin Peale, both of which he produced with his steam-driven machine. Figure 12 shows his rulings, published in *Godey's Lady's Book*,[15] of a medal which Congress awarded Commodore Edward Preble for having performed eminent services in the Tripolitan War of 1804.

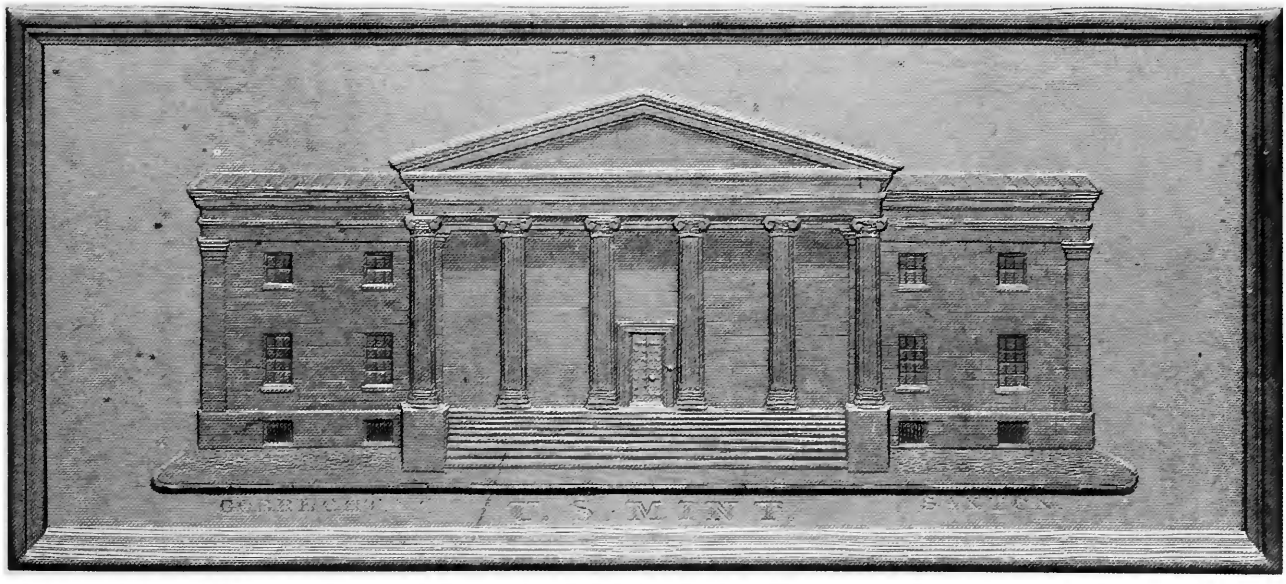

FIGURE 10.—The second United States Mint, from Eckfeldt and Du Bois' 1842 edition of *A Manual of Gold and Silver Coins*. (Courtesy Library of Congress)

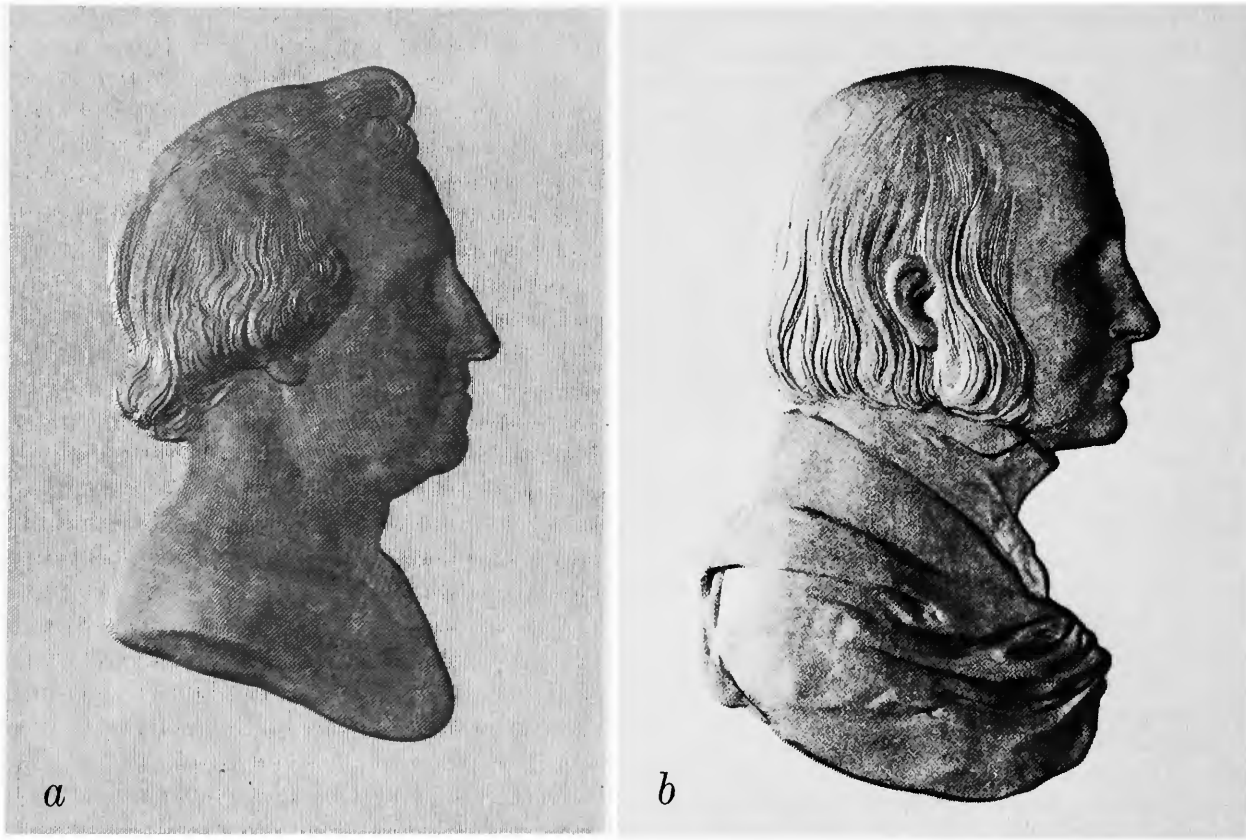

FIGURE 11.—Engravings made by Saxton with his steam-driven medal ruling machine: *a*, Robert M. Patterson (courtesy Historical Society of Pennsylvania); *b*, Franklin Peale (courtesy American Philosophical Society).

FIGURE 12.—Saxton's ruling of the Commodore Preble medal.
(Courtesy Library of Congress)

America's First Diffraction Grating

Although the main purpose for Saxton's machines was to make rulings from coins and medals, they were also capable of engraving straight, equally spaced lines exceedingly close together, such as are required for diffraction gratings. The steam-driven model was particularly well adapted for that purpose because of its even, steady motion, free from any of the irregularities which inevitably accompany manual operation. This machine was probably the best in the world for that purpose during the 1840s. As to how John William Draper (1811–1882), then America's leading scientist on the subject of the nature of light, learned about it does not appear in the records, but the combination of Saxton's machine and Draper's investigations are responsible for a major photographic achievement.

Draper was then a professor of chemistry at New York University. In May 1843 he prevailed upon Saxton to rule for him a diffraction grating—probably the first of its kind to be made in America. The use he made of it was explained in his article, "Popular Exposition of Some Scientific Experiments, Part V.—the Diffraction Spectrum," which appeared in the 1877 volume of *Harper's New Monthly Magazine*, extracts of which follow:

> a good grating or gitter is one of the most delicate and difficult of mechanical problems; it has exercised the ingenuity of the most skillful mechanical artists. The surfaces of the glass must be truly plane, and the screw of the ruling apparatus perfect in its form and correct in its action; it must be driven by a uniformly acting motor power. The quality of the diamond is very important; it must not lose its point or edge too readily, or the lines of the grating it is making will not be similar to each other. The figure of its cutting part is of the utmost moment, as on it depends the figure or form of the groove or scratch that is made. . . . The grating I employed . . . was made for me by Mr. Saxton, at the United States Mint in Philadelphia, more than thirty years ago. . . . The work it did for me I cannot but speak of it with admiration—it enabled me to make [in 1844] the first photograph that was ever executed of the diffraction spectrum. . . .[16]

There is in the National Museum of History and Technology in Washington, a "Draper Collection," which the museum received from the National Academy of Sciences. In that collection is an assortment of diffraction gratings. One of them, ruled on a spectacle lens blank, with rulings occupying a space of about ⅓ by ⅝ inch, appears in Figure 13. It might well have been one of the lot which Saxton ruled for Draper on that historic occasion.

FIGURE 13.—A diffraction grating (about actual size) from the Draper Collection, National Museum of History and Technology, Smithsonian Institution.

Epilogue

The sudden death, on 20 November 1843, of Ferdinand Rudolph Hassler, Superintendent of the United States Coast Survey, led to Saxton's rather abrupt departure from the Mint at Philadelphia. Professor Alexander Dallas Bache, Benjamin Franklin's great-grandson, had been appointed by President Tyler to succeed Hassler, whereupon Bache prevailed upon Saxton, a close friend, to move to Washington and to assume under his supervision immediate charge of the Office of Weights and Measures.[17] Saxton took over that position on 28 February 1844, and held it until his death on 26 October 1873.

Although Saxton took his manually operated ruling machine with him to Washington, no records have been found to indicate that he made any further use of it. On the day he died, his daughter gave birth to his only grandchild, Joseph Saxton Pendleton. By the time the boy reached the age of fourteen, the machine had become his property, and he deposited it with the Smithsonian Institution. It remained there from 1887 until 1935. By that time Joseph Pendleton had reached the age of 62, and had become a member of the Board of Directors of the Carpenter Steel Company in Reading, Pennsylvania. About this same time, the Franklin Institute in nearby Philadelphia had acquired the quarters it now occupies. Impressed with that organization and its excellent new facilities, and recalling his grandfather's interest and lifetime membership in it, Pendleton requested the Smithsonian to transfer the medal ruling machine, along with many other items which had belonged to his grandfather, to the Franklin Institute. The items were placed on exhibit there for a considerable period, but eventually the medal ruling machine was moved into storage where it remained until 1967, when it was sent back to the Smithsonian Institution. There it presently remains—in the storeroom of the Division of Graphic Arts at the National Museum of History and Technology.[18]

Notes

[1] Saxton's nomination for membership, presented 18 August 1837, continues graciously: "After an absence in Europe of several years, where he gained great reputation, he returned to his native city, and we think his introduction into our Society a welcome of which he is every way worthy." Nomination No. 1074, American Philosophical Society.

[2] For other aspects of Saxton's career, see ARTHUR H. FRAZIER, "Joseph Saxton's First Sojourn at Philadelphia, 1818–1831, and His Contributions to the Independence Hall Clock," *The Smithsonian Journal of History*, 3 (1968):45–76.

[3] Ibid., p. 48. The original letter is in the National Archives.

[4] *Mechanics' Magazine* (London), No. 490 (29 December 1832):194–196.

[5] VINCENT NOLTE, *Memorial of Facts Connected with the History of Medallic Engraving and the Process of M. Collas* (London, 1838), p. 17. See also, "Medallic Engraving," *The Athenaeum, Journal of British and Foreign Literature* (London), No. 466 (1 October 1836):706–707.

[6] Dr. Patterson's letter is in the National Archives, Record Group 104, Records of the Bureau of the Mint, "Peale" Correspondence 1829–1886.

[7] "Memoir of Joseph Saxton, 1799–1873, by Joseph Henry. Read before the National Academy, Oct. 4, 1874," *Biographical Memoirs of the National Academy of Sciences*, 1 (1877):219–316.

[8] The book was first published in Philadelphia at the Assay Office of the Mint, and the title page notes that it was "Illustrated by numerous engravings of coins executed by the Medal Ruling Machine, and under the direction of Joseph Saxton of the United States Mint."

[9] JULIUS F. SACHSE, "Early Daguerreotype Days: An Historical Reminiscence," *The American Journal of Photography*, 13 (July 1892):306–307. Sachse's article appeared serially from June through December 1892. See also D. JAY CULVER, "The Camera Opens Its Eye on America," *American Heritage*, 8 (December 1956):49 et seq.

[10] SACHSE, op. cit., p. 408.

[11] MARCUS AURELIUS ROOT, *The Camera and the Pencil* (Philadelphia: Root & Lippincott, 1864), p. 352. [Republished by Helios, 1971.]

[12] Loc. cit. [note 10]. See also the magazine section of the *Philadelphia Inquirer* (17 November 1963), p. 12, in an article by WAYNE E. HOMAN, entitled "Pennsylvania Heritage—Photography's Beginnings."

[13] SACHSE, op. cit. [note 9], 13 (October 1892): 455–459.

[14] JACOB R. ECKFELDT and WILLIAM E. DU BOIS, *A Manual of Gold and Silver Coins* (Philadelphia: A. Hart, 1851), p. 189.

[15] "The Preble Medal," *Godey's Lady's Book* (September 1842): 109–111.

[16] JOHN WILLIAM DRAPER, "Popular Exposition of Some Scientific Experiments, Part V.—The Diffraction Spectrum," *Harper's New Monthly Magazine*, LV (June–November 1877): 417–428. See also JOHN WILLIAM DRAPER, *Scientific Memoirs—Being Experimental Contributions to a Knowledge of Radiant Energy* (1878): 117.

[17] *Biographical Memoirs of the National Academy of Sciences*, I (1877): 310.

[18] The accession papers and card records maintained at the Franklin Institute and the Smithsonian Institution contain the data used to trace Saxton's medal ruling machine from 1887 to the present.

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