

Printing British Postage Stamps

THE BRITISH
POSTAL
MUSEUM
& ARCHIVE

Visit of Great Britain Philatelic Society

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Our history through the post

The 1840 Penny Black (right), the world's first adhesive postage stamp, was printed in intaglio (recess or line-engraving) on flat-bed presses, by Perkins, Bacon & Petch (below).



1. Printing the Penny Black

THE WORLD'S FIRST adhesive postage stamp, the Penny Black, was conceived, designed, engraved, printed and put on sale, all in the space of five months, from January to May 1840. The design was deceptively simple. Rowland Hill had stated before (with regard to security from fraudulent imitation) that "there is nothing in which minute differences of execution are so readily detected as in a representation of the human face. .. I would therefore advise that .. a head of the Queen by one of our first artists should be introduced". Other security devices and value were added, but no country name. With no other rival, there was no need. This privilege of the monarch alone representing the United Kingdom on stamps has remained to this day, unique in the world.

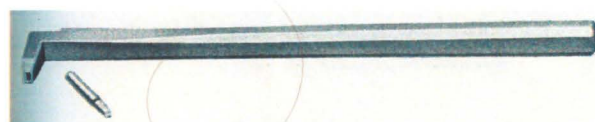


"Old Original" die, complete bar corner letters

Baring) had shown him an autograph letter from the Queen expressing her "high appreciation" of the stamp.

The method of printing by die and roller transfer was introduced into the security printing field by Jacob Perkins. The original design was engraved in reverse on a die of soft steel. This was then hardened in a furnace so that ordinary implements could not scratch it. A soft steel roller was put in a transfer press and rolled under great pressure backwards and forwards over the hardened die until the design was transferred to the roller. Sunk lines on the original die now became lines standing proud on the roller. In its turn the roller was hardened and from this any number of reproductions of the design were laid down on to a soft steel plate. For the postage stamps this plate contained 240 impressions of the die minus the corner letters. These were then punched individually on to the plate.

Punch for the corner check letters



Printing took place not at Perkins, Bacon & Petch's premises at 69 Fleet Street but at their works in Whitefriars Street. There were five (later six) flat-bed printing presses worked by a large diameter hand wheel (see page 1). Invented by Jacob Perkins, they



*Left: Wyon medal
Below: Corbould drawing*



To create the design stock engine-turning was transferred by Perkins, Bacon & Petch on to a die and an area was cleared for the engraving of the head. This die, together with a sketch by Henry Corbould based on William Wyon's City medal of 1838, was then given to Charles Heath for the head to be engraved, although it is likely that it was his son Frederick who carried out the work. However, the first die was a failure as it was too light to transfer and so in mid January 1840 a new die was begun. By 20 February 1840 it was complete bar the corners and a proof was sent to Queen Victoria for her approval. Shortly afterwards Hill wrote to the printers saying that the Chancellor of the Exchequer (Francis



Proof of new die of the head

were built by Messrs J & J Barrett of Finsbury and cost £70 each. Bacon has given a detailed description of the process:

*1840 Penny Black and
1841 Penny Red from
the same plates*



“The method of printing from the plate consists in mounting it on the bed of a hand printing press which has a gas-jet fixed underneath the plate in order to warm it. The colour (or ink as it is called) is then rolled or dabbed over the whole of the plate. All the ink lying in the parts that stand up has then to be cleaned off with a rag, taking care however that the ink is left in the lines forming the design. The plate is finally cleaned and polished by the palm of the hand, after the application of a little whiting, a manipulation that required a good deal of practice and skill, and the sheet of paper to receive the impression, which has been previously damped, is laid smoothly on the plate. On the printer turning the wheel of the press, the paper is pressed into the sunken lines by the elasticity of the material – usually a sort of felt or cloth, called the blanket – on the cylinder that makes the pressure, and the design on the plate is thus transferred to the paper, the design, so to speak, standing up on the surface of the paper. The presses were so constructed that after the plate had passed under the cylinder it returned automatically to the operator, who then removed the sheet of paper covered with the design, and at once proceeded to ink the plate again for printing another sheet.”

These presses were each capable of printing some 800 sheets of stamps in 24 hours. Hill recorded on 10 May that “the demand for labels is such that the contractors (Perkins Bacon), though they now have five presses, are obliged to work night and day; they are now producing 600,000 (stamps) daily.”

The first plate for the Penny Black was put to press on 11 April, with the second following on 22 April. In all, there were 11 plates used from which over 68 million Penny Blacks were printed by the end of January 1841. Printing of the twopenny blue stamps did not begin until 1 May 1840. Two plates were used between then

and 29 August, and the total quantity printed was only 6,460,000.

Later it was found that the red ink cancellations could be removed from the black stamp and so, after many trials changes were made to the ink of both the label and the cancellation. The label changed from black to red (the Penny Red) and the cancellation from red to black. In various formats these remained the standard low value definitives, and the basic method of printing, for the next 40 years.

2. Production of Mulready Stationery



WHEN ROWLAND HILL first suggested that mail be prepaid various proposals were made as to how this could be achieved. Labels (eventually the 1d black) were only one option, and not the most favoured. What was regarded as the best idea was postal stationery – envelopes and letter-sheets. Before 1840 envelopes in Britain were very rare. It would have cost double the postage to use one. Now, charging was by weight and so envelopes, common on the continent, came into use. A design was created by William Mulready RA showing an imperial vision. When published it caused derision and gave rise to a host of caricatures, before having to be withdrawn. However, initially, it was regarded very highly by Rowland Hill and Henry Cole (“highly poetic”). They arranged for the best wood engraver of the time, John Thompson, to work on it.

Thompson, who had been consulted by Cole about the design, made enquiries of various printers as to how the covers and envelopes should be printed. As a result he suggested that they should be printed from stereotype plates moulded from a brass original. Stereotype is a word compounded from two Greek words – *stereos* solid, and *tupos* impress. Thus, stereotype printing takes impressions from a fixed, immovable forme. A mould is made from the relief surface. Molten metal is then poured upon this to obtain a cast of which the surface is in relief, identical to the original. As many of these casts or stereotypes are taken as are required to create the printing forme. The quality of the final product would depend on the original

plate, and on the care taken by skilled workmen in the production of the various stages, and on the purity of the materials. A mobile foundry could be set up to produce the stereotypes without great difficulty.

One of those Thompson asked about printing was Robert Branston, son of the wood engraver of the same name to whom Thompson had been apprenticed. Robert Edward Branston was a noted engraver who had formed a partnership with Charles Whiting. By 1840 he had left Whiting and had set up with James Henry Vizetelly in Fleet Street.



Thompson's original woodcut

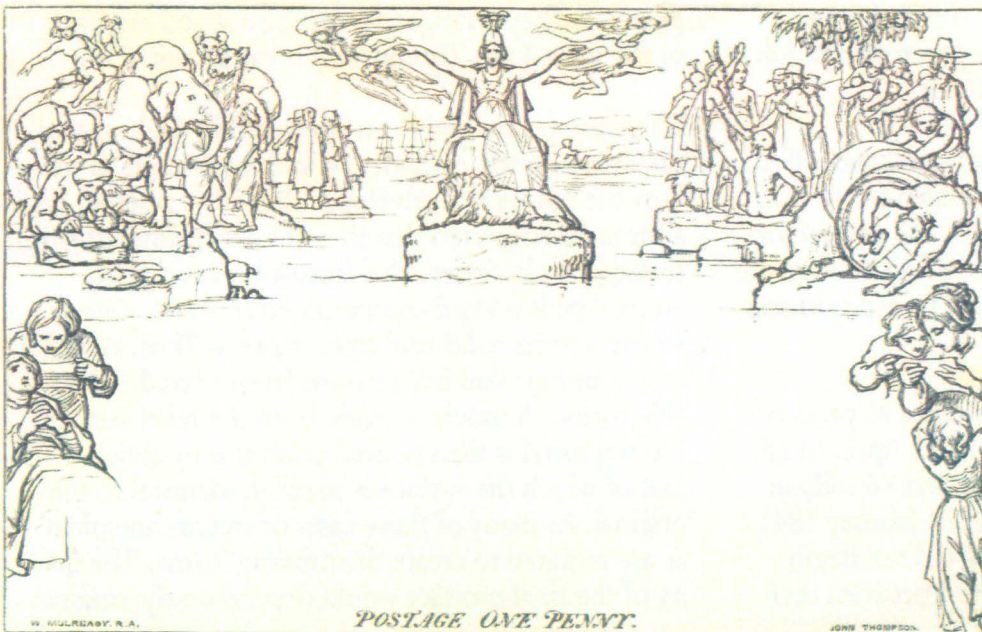
Branston suggested hard metal rather than stereotype moulds which did not deliver the ink as well. However, the lozenge-shaped envelope might be poly-typed in two pieces. He gave a series of detailed answers to questions about stereotyping, particularly in reference to their quality and wear. If type were to be used it would be best to have it stereotyped first and then fixed up with the brass original to be moulded from. He also quoted the price of brass required for the original die (5s).

Edward Cowper gave a detailed and critical description of the problems of stereotyping:

of bad materials or not well mixed, & the consequence is that either the lead becomes rotten from the presence of Sulphur, or the Antimony remains in separate small hard particles that when the plate wears instead of wearing with an even surface, it has a surface like *Chalky Sand* by the sea shore, the Antimony forming innumerable little *rocks*, which you may not [find] very good for Printing – I have spoken to Messrs Clowes frequently on the subject but although their plates are better than they used to be, still I do not venture to print more than 20,000 from them.”

“unfortunately stereotype Metal is often either made

He then referred to Thompson’s original wood cut. If it were clichéd in a modified version of stereotype metal, this would last nearly as long as type.



Thompson was primarily a wood engraver, though he could, and did, work in hard metals such as brass and steel. His first wood engraving still exists, exquisitely engraved with the skill for which Thompson was famous. Names of the artist and engraver are finely cut, as is the legend ‘POSTAGE ONE PENNY’ exactly in the style

Mulready's printed design

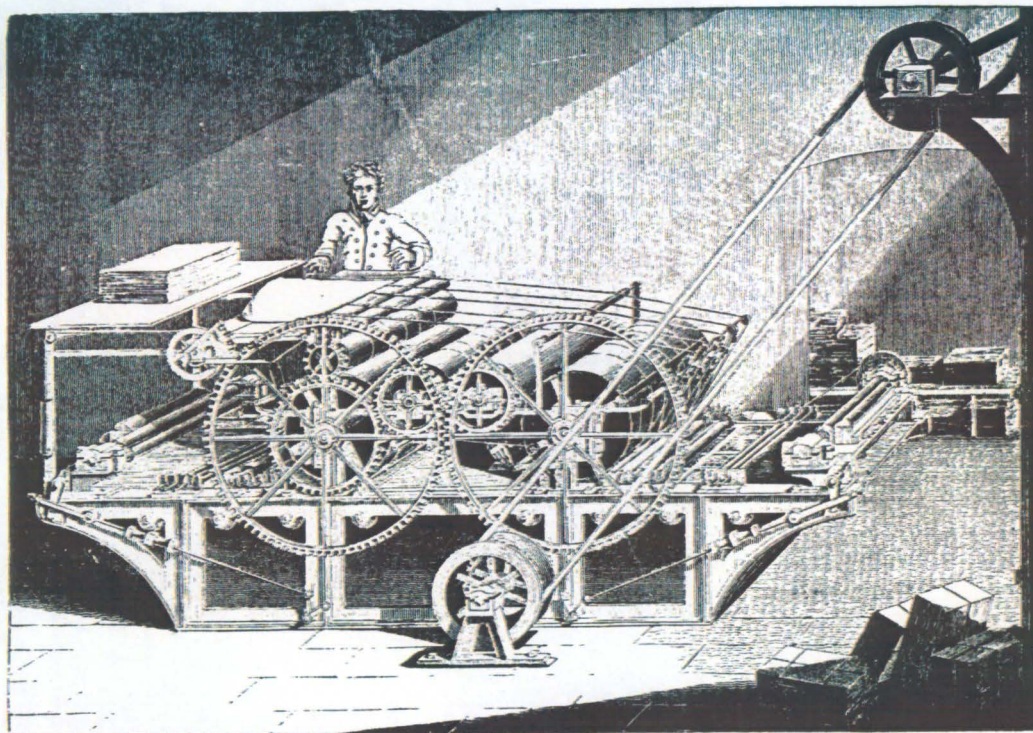
as finally printed. The next stage was to produce a mould and from this a brass plate, with some of the finer points engraved out.

The original brass plate is still extant [in the Victoria & Albert Museum] with a hole for the value. From this brass die, together with the typecast text panels, stereotypes were taken to make up into the printing forme. It took a long time to prepare the die, and Thompson had only finished all the rough work by 8 March 1840, having been working on it since the beginning of January. The work was obviously hard but little evidence of the effort involved remained in the finished product. When Thompson appended an

Thompson insisted that only he could clear and pick the stereotype casts himself. He did not trust the pickers employed by the printers. So when the stereotypes were made, he cleared and picked them at home, removing any imperfections.

Stereotyping and Printing

William Clowes was one of the largest printers in London, based in Duke Street, off Stamford Street, Blackfriars. He had printed many of Charles Knight's publications and had come into contact with Rowland Hill in connection with his rotary printing press.



Steam-driven printing machine at Clowes (hands of the second operator can be seen in the middle of the machine removing the printed sheets)

explanatory note to Queen Victoria on 3 April to accompany the proof he was rather defensive:

“the Engraving, though having the appearance of a slight etching, is produced by a very difficult and tedious process, being done in relief in brass. The lines from which the impression is produced stand up above the general surface. This mode of engraving is necessary for the purpose of working at the common printing machine.”

Clowes had some 20 steam presses driven by shafts and belts from two steam engines. There was also a foundry where the stereotype casts were made. The tender agreed specified that Clowes would produce the stereotypes from Thompson's brass die and print the covers and envelopes at the rate of £25 per million. A special room had to be set aside for Post Office work and Edwin Hill, a brother of Rowland, was present to supervise production of the plates.

Production of casts commenced on 6 April (1840) and the registration of the die took place the next day. It was directed that the die and

plates made from it had to be deposited at the end of each day in a box with two keys, one kept by Clowes and the other by Edwin Hill.

When the casts were made they were sent to Thompson for picking and then returned to Clowes for proofing and putting into formes. The printing formes of the lettersheets and envelopes both consisted of 12 stereotypes. Proofs exist taken at various stages, from the original die, and from the stereotype casts.

On 14 April printing began at the rate of 70,000 per hour. Some six formes of the 1d lettersheets were

made, with four of the 1d envelopes. Only one each of the 2d lettersheets and envelopes were made up.

Problems arose with both printing and cutting. A total of 22½ million of the four types of lettersheets and envelopes was printed, but most had to be destroyed in the end, a special machine having to be constructed, as it proved impossible to burn them in secure conditions.

3. George V letterpress stamp printing

FROM 1880 UNTIL 1910 all British stamps were printed letterpress by the security printers Thomas De La Rue. The printers also created the dies and plates in-house. Before that a few values higher than 2d were also printed letterpress by them from 1854. This was connected with the introduction of perforations. A wet printing process (line-engraving) caused problems of registration for the perforating combs. So a dry process (letterpress) was preferred, although denominations up to 2d still continued to be printed by Perkins, Bacon with dampened sheets until 1879.

In 1910, after 30 years of domination by De La Rue, the contract for printing stamps was given to new printers Harrison & Sons Ltd but they were unable to make dies or plates. So that aspect of printing was handed to the Royal Mint. A detailed description has been given of what happened.

“Early in 1910 an Inter-departmental Committee on Inland Revenue Contracts appointed by the Treasury recommended that the Board of Inland Revenue should establish a permanent arrangement for the supply of adhesive stamp dies and plates by The Royal Mint. Treasury approval was given on the 28th of April and the Mint was to undertake the work from the expiry of the current contract with Messrs. De La Rue at the end of the year..... The production of dies and plates for adhesive stamp printing differs in many essential respects from the production of embossing and coinage dies and no one at the Mint had any previous experience of the new work, nor were there any facilities for this class of work avail-

able. The special machinery could not be bought ‘off the shelf’ and some had to be obtained from abroad. The Transfer Press, an indispensable piece of equipment whichever method of production was to be used, could only be obtained from America and delivery was not expected before the beginning of October 1910. Temporary accommodation had to be built to house the new equipment pending the erection of permanent buildings. Additional staff were required and difficulty was experienced in engaging suitably qualified engravers. By the time that the preparations had been completed there was little time left in which to carry out preliminary experiments in order to develop a satisfactory procedure for production.



Engraver's drawing (on metal) in reverse for a letterpress stamp

“... In a letter to the Board of Inland Revenue dated 10th September 1910 the process is briefly outlined as follows: ‘... as soon as the engraved Effigy of His Majesty and the engraved dies of the several frames have been received they will be combined by means of a Transfer Press for the purpose of producing working dies, in precisely the same manner as is now done by Messrs. De La Rue ... the working dies will be used for the preparation of lead blocks either in a press or by means of a type founding machine, and

experiments are now in progress in regard to both these methods. From these blocks the electros will be produced in copper.' In actual fact the method of producing working dies which was adopted was not exactly as described, and the process of combining head and frame dies was not perfected until the middle of 1912.

“... the Mint was unable to produce the first Working Plates until the middle of May 1911. These early plates were of copper with an iron surface coating and did not produce the required results. The surface soon wore away and during the printing process flakes of gum were pressed into the soft copper. The poor impression obtained from these plates was not entirely the fault of the Mint. The printers were new to the work, having obtained the contract for printing



The engraver J A C Harrison at work

from 1st January 1911 without any previous experience of this class of printing, and it is more than probable that much of the fault must rest with them.

“... The model for the Original (Downey) Head Die, was a photograph of His Majesty which had been taken by Messrs W. and D. Downey specifically for the purpose. From this photograph J.A.C. Harrison produced a black and white line drawing considerably larger than the engraved effigy was to be. This was the engraver's sketch, a very carefully drawn 'plan' showing every line that was to appear upon the die in its correct weight, or tone value. [in reverse] This line drawing was photographed onto a glass plate so that

the negative image was of the required dimensions of the die. The thin photographic film was then stripped from the glass plate and turned over onto another glass so that the image was in the original direction of the drawing. [in reverse] The next stage was the transfer of the image to a polished softened steel block.

“The steel block was coated with a solution of albumen, water and bichromate of ammonia, which hardens and becomes insoluble in water after being exposed to light. The photographic plate was placed with the film side in close contact with the sensitized steel block and exposed to a powerful light. The dark lines on the original drawing which were clear glass on the negative, appeared on the surface of the steel block as hardened albumen. After applying a thin film of special ink to the surface the block was washed in running water and soluble albumen over the areas which were white on the original drawing was washed away. The block was then warmed and dusted with an acid-resisting powder which adhered to the inked lines, leaving the white portions of the design as unprotected steel. The back and sides of the block were varnished and it was immersed in acid for a short period so that the design was lightly etched onto the surface. After the block had been cleaned of albumen Harrison engraved the die by hand using the lightly etched design as a guide. The design was of course reversed in relation to the original model [yes] and the engraver's sketch. [no]

“When the engraving had been completed the die was hardened and placed in the Transfer Press where three impressions were taken onto a Transfer Roller. The design was transferred from the hard steel die to the softened steel roller under great pressure. The impressions obtained were each an exact replica of the die but in reverse, and the non-printing parts of the design now stood up in relief. The roller was then hardened and from it eight steel Head Plates were produced in the Transfer Press each with one impression of the die. These Head Plates were each to become Master Dies for the various groups of stamp designs.

“Harrison took the Head Plate for the Group 'A' dies and etched and engraved the frame design on to it around the head in exactly the same way that the head design has been done on the Original Head Die. This

was the Dolphins design for the ½d and 1½d duty but at this stage the duties were not included. This, the Master Die for the Group ‘A’ dies was numbered ‘1A’. ... After the die had been hardened it went to the Transfer Press and three impressions were taken from it on to a Transfer Roller. ...

“The three impressions on the roller were numbered 2A, 3A and 4A. The first of these was not satisfactory as it was marked on the crown. The second impression, number 3A, was used after the roller had been hardened, to transfer two flat dies without duty, one for each of the duties in Group ‘A’. the first of these was numbered 5A and the second 6A. After Harrison had engraved the respective duties on to these, 5A became the Original ½d Die and 6A the Original 1½d Die.

“Original Dies were not generally used for striking the leads for the Master Plate moulds. The amount of work which had gone to their production made them too valuable to risk their being damaged in any way. The Transfer Press was again used to produce a roller, and this in turn was used to produce the Working Dies. From 5A the Original ½d Die four impressions were taken on to a transfer roller and the best of these was used to produce three separate Working Dies for lead striking, numbered 11A, 12A and 13A. These were hardened after they had been machined so that they would fit in to the striking collar of a hand operated hydraulic press. Working Die number 13A was deepened by Lewis and this die was used for striking the leads for the 264 stamp set Master Plate for Booklet panes. The other two Working Dies were used to strike leads for the 240 stamp set Post Office sheets Master Plate.

“... The stages in the process of plate manufacture may be summarised as follows:

- a. The production of the Working Die. This process has already been described. It should be remembered that the design appears reversed in relation to the printed stamp image, and the parts which are required to print are in relief.
- b. Preparation of the Master Plate Mould. Here the design appears normal but the non-printing portions are in relief.
- c. Production of the Master Plate. The design is in reverse and the printing portions in relief.

- d. Preparation of the Working Plate Mould. Again the design is normal and the non-printing portions in relief.

- e. Production of the Working Plate. As with the Master Plate and the die, the design is reversed and the printing surface of the plate is in relief.

Preparation of electros

“The Working Die was used to impress the design into 240 separate rectangular blocks of lead, of standard size and thickness, in a hand-operated hydraulic press. The ‘leads’, as they were called, were arranged into panes of ten rows of twelve one above the other, separated by a horizontal ladder and surrounded by guard lines, in a shallow metal box with two movable sides called a foundry chase. Metal ‘furniture’ was also placed in the chase to give the required outer margin, this was below type height and included blocks to give ‘MASTER plate’, ‘R/M’ and the date, together with ‘points’ at type height in the upper and lower margins between the sixth and seventh vertical rows of stamp images. After being firmly locked together in the case the assembly was prepared for the depositing bath.

“Electrodes were attached to the mould and the mould face was blacklead in order to increase its electrical conductivity. The depositing bath was filled with a solution of copper sulphate and sulphuric acid in which the mould and a sheet of pure copper were totally immersed. The electrodes of the mould were connected to the negative terminal and the copper sheet to the positive terminal of an external power source. The electro-chemical reaction set up in the depositing bath caused a film of copper to be evenly deposited upon the surface of the mould. This process is known as electrotyping and the copper shell so deposited is said to be ‘grown’ upon the mould. The thickness of this copper shell is dependent upon the time allowed in growing it.

“When the shell was of the required thickness the mould was removed from the depositing bath and the shell and mould were separated. The shell was rough on the back but its face side was smooth and bore an exact replica of the mould in reverse. In this state it was thin and flexible and in order to give it the necessary rigidity and to bring it to the required thickness it

was backed with type-metal, an alloy of lead, tin and antimony. The back of the shell was tinned and the molten type-metal was poured on to the back of the shell with a ladle. This process required considerable care in order to avoid distortion of the thin copper shell. The edges of the backed shell, or electro, were then trimmed and the back was planed in preparation for 'slabbing'.

"The operation of slabbing ensured that the surface of the electro was perfectly flat. The electro was placed face downwards on a perfectly flat polished steel slab and hollows in the plate face were gently tapped up from the back with a serrated steel punch and a slabbing hammer. Carelessness in this operation, or the use of excessive force could very easily bruise or damage the electro face. When the face was perfectly flat the back was planed to bring the electro to the required final thickness. Any burrs on the plate surface were removed and the plate was then 'proved'.

"Plate proofs were always taken in black on high quality white paper. Each impression was very carefully examined and any defect was ringed in red ink and its position indicated in the sheet margin. The defects were then repaired and the plate was again proofed. Should there have been any defects remaining the process would be repeated until every stamp image was perfect. This then was the Master Plate from which any number of Working Plates could be produced each being identical in all details.

Making the Working Plate

"To produce a Working Plate an impression of the Master Plate was taken in warmed mineral wax known as 'ozokerite' by means of a hydraulic press. This wax mould would of course have the words 'MASTER PLATE' and the date of manufacture of the Master Plate impressed in it. These were filled with wax and the Working Plate serial number and date were impressed in their place probably by the use of heated metal stamps. The preparation of the mould, growth of the electrotype, and the slabbing and finishing were then carried out exactly as has already been described. ...

"After proofing the plate was surfaced. The first ninety Working Plates were described as being 'steel-

faced'. This facing was in fact electrolytically deposited iron and only a very thin 'flash' coating. The iron surfacing could be easily removed and the plate re-surfaced in a very short time. In fact, a plate delivered to the Mint in the morning could be re-surfaced and be back with the printers by the afternoon of the same day.

"After Sir Edward Rigg's second visit to the Government Printing Works in Europe during July 1911 the methods of plate production were improved. The wax mould now passed through two depositing baths. In the first a shell of nickel was grown upon the mould and in the second bath a thicker coating of copper was grown upon the nickel. Backing, slabbing and finishing were carried out as before. These nickel plates were far more durable than the earlier 'steel-faced' copper plates and it is recorded that they were capable of printing over a million sheets of stamps before beginning to show signs of wear. The first nickel Working Plate was issued by The Royal Mint on 25th November 1911, and by the end of that year all Postage and Revenue Working Plates were being made by the improved method. Some Master Plates were also made of nickel but these generally continued to be made of copper as did the Overprint Plates."

Printing by Harrisons was not initially satisfactory and controversy arose as to who was at fault. Harrisons blamed the Royal Mint and their plates; the Mint blamed the inexperienced printers. After investigation it was recommended that Harrisons change their method of production and an Inland Revenue report detailed existing methods and proposed changes. It was dated 9 August 1912.

"The main processes carried on at the factory at Hayes are four: - Gumming, calendaring, printing and perforating, and it is in connection with the calendaring and printing that we desire changes to be made.

"From the outset Messrs Harrison have used for calendaring purposes three rotary machines of modern type, and for printing four Miehle presses, those being excellent presses for general printing work. Registration sheets of stamps calendered and printed by these machines and presses have been delivered under clause 3 of the Contract, and the stamps supplied by Messrs. Harrison since their contract came into

force have all been produced by these methods. Experiments, however, conducted at Somerset House during the past year in connection with the manufacture of the stamps for which we are responsible have satisfied us that rotary calendering and rapid printing by machines of the Miehle type do not produce stamps equal in quality to those, the paper for which has been plate-glazed (a process which consists of placing each sheet between two plates of metal prior to the application of pressure in a power-driven machine), and the printing of which has been performed by slower running machines with a more even ink distribution, such as the Wharfedale presses used by Messrs. De La Rue when they were the Contractors for postage stamps, by Messrs. Waterlow Brothers and Layton, the present Contractors for the Insurance Stamps, and in our own Stamping Department.

“We have therefore approached Messrs Harrison with a view to induce them to substitute, during the remaining period of their contract, plate-glazing and printing by Wharfedale machines for their existing processes. The contractors are prepared to effect these changes for an extra payment of 1s 3d. per ream to cover the cost of the new machinery and extra labour required. As we are of opinion that this extra payment will be amply justified by the improvement in the stamps that will be obtained, we ask Your Lordships to sanction this addition to the existing contract ...

“Messrs Harrison will be ready to start plate-glazing

Original die for recess-printed high value Seahorses



on approval of the increase in prices, and will introduce the Wharfedale presses as soon as they can be obtained from the makers. At present they have one such press, and pending the putting in of the others we propose that they be paid an extra 1s per ream for the plate-glazing alone.”

On 23 August 1912 the Postmaster General agreed.

4. Later Developments

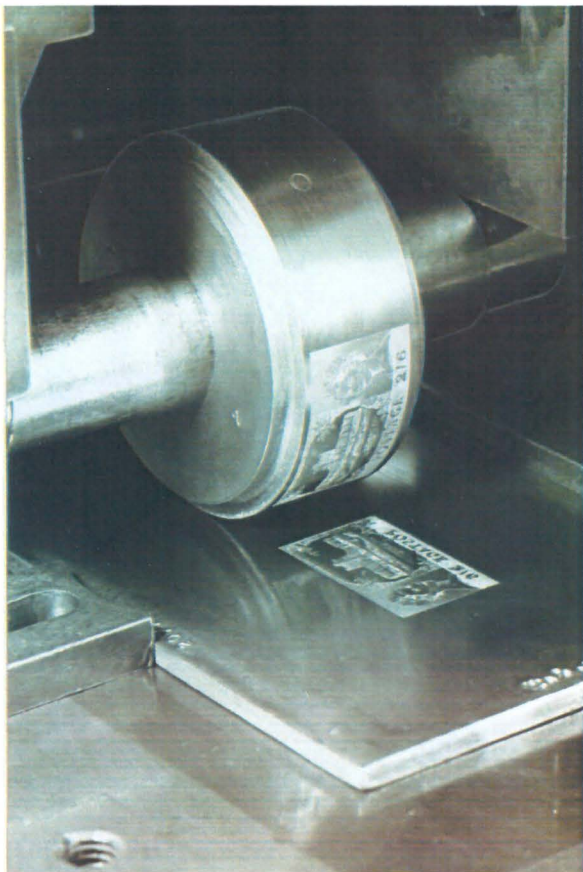
WHEN IT CAME to produce high value stamps for George V, the King, a keen philatelist, suggested that they be printed by



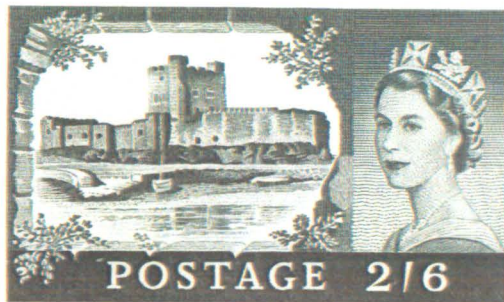
Transfer roller for the Seahorses £ 1 design

line-engraving, imitating the 1d black. The design selected was by Bertram Mackennal and was termed the “Seahorse” design. This was an imperial image of Britannia being pulled in a chariot by horses through the waves, and not marine seahorses as would be more commonly understood.

Royal Mint did not initially have the machinery to produce dies or plates for line-engraved printing so tenders were sought from printers of engraved stamps. The contract went initially to Waterlow Brothers & Layton for whom J A C Harrison had worked for some years and who were experienced stamp printers. He therefore produced



Left: transfer roller taking an image from the original die of the QE II Castles high values of 1955



Above: die proof from the 2/6d Castles high value die of 1955.

the recess dies though the Royal Mint then produced the plates. Later some four different printers were used to print them.

High value stamps continued to be produced by this intaglio method through till the 1970s, and several thereafter. In 1934 printing of low values changed to gravure.

Douglas N. Muir
Curator, Philately

Below: transfer roller rocking the image of the Castles 2/6d to create the plate



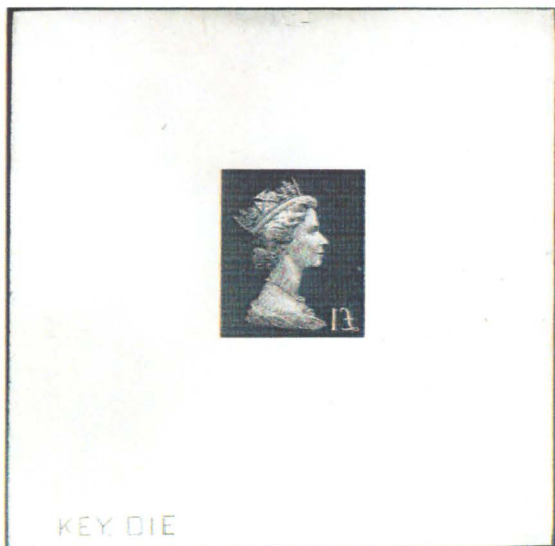


Recess printing plate for the 1968 high value Machin £1 stamp, curved to be attached to the printing cylinder

Below Original die for the Machin £1 stamp of 1968



Die proof



The Royal Mail Archive records four centuries of the British postal service. It is an outstanding resource for social - and postal - history, and collections in the archive have been Designated by the Museums, Libraries and Archives Council as nationally important. It is managed on behalf of Royal Mail Group plc by The British Postal Museum & Archive (BPMA).

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