

## GENERAL SCIENCE

# 'Nonprofit' Money-Makers

The Bureau of Engraving and Printing, which makes everything from a \$500 million treasury note to a half-cent postage stamp, has created its own science.

By WILLIAM Mc CANN

► THEY MAKE BILLIONS in money, yet they do not get to keep a single dollar.

They are the printers and others at the Government's Bureau of Engraving and Printing who make the paper currency that passes through our hands each day.

Many different aspects of science and technology enter into the money-making process. R. M. Williams, chief of the Office of Research and Development Engineering at the Bureau, is particularly proud of the research program, which is responsible for many technological developments in making money in the past few years.

The Bureau estimates that improvements during the past 12.5 years have resulted in annual savings of \$13,450,000.

The biggest advancement was the installation in 1957 of eight high-speed rotary presses using a dry intaglio printing process. These dry intaglio presses print relief impressions from plates having the design sunk below the plate surface. They provide a better reproduction from the engraving and simplify later trimming and cutting of the notes.

Use of the new presses has not only increased productivity, but has also lengthened the life of paper currency by about 30%, increasing the average life of a one-dollar bill from about 14 to 18 months.

About 70% of all the currency is now printed by the dry process, while the remaining 30% is printed by a wet process.

In the wet process all paper is moistened before being printed on one side. The paper must then be kept in a humidor overnight before being printed on the other side. All the printing by the wet process is done on flatbed presses that print currency in sheets of 18 notes.

## No Humidor Needed

With the dry process, using rotary presses, however, no humidor is needed. Rather than relying on moisture, these presses use about 5,000 pounds of pressure per lineal inch to obtain a good reproduction. Also the currency is printed in sheets of 32 notes, so production is more rapid.

Until recently the dry process was used only for printing one-dollar bills. Other currency, bonds and notes were produced by the wet process, the principal means of printing paper money for 95 years.

What denomination is produced depends on demand at the time.

"We print to our customers' orders," Mr. Williams said. "The greatest number of orders comes from the Treasury Department and the Federal Reserve Board."

One-dollar bills make up the bulk of the currency printed and nearly a billion of them are now in circulation. The \$100 note is the highest denomination that has been produced since 1945.

Printing currency is a day-to-day process that involves many steps in both the wet and dry systems. The first day the back side of the bills are printed; the following day the front sides are printed. The final operation is done later on a two-color rotary press that overprints the seals, series year, signatures and serial numbers. This is followed by the assembly-line cutting into individual notes, trimming, checking for defective notes, counting and packaging for delivery.

The average cost of making currency today is 8.9 cents per note.

Any defective notes are marked and reprinted by "star" notes. These "star" notes, which have their own special serial number and a star, save the cost and delay of re-printing a note with the same number as the defective one.

## Counterfeiting Difficult

By printing with the engraving sunk beneath the surface rather than above the plate, the intaglio process is an effective precaution against counterfeiting. Shadows would appear in photographing the currency printed in relief and would be effective in finding counterfeits.

Analyzing counterfeit bills for the U.S. Secret Service is a major task of the Bureau's Office of Research and Development Engineering.

"There has been an increase in the number of counterfeiting cases," Mr. Williams said. This increase may be due to the fact that so much duplicating equipment is now available.

A three-man staff checks for counterfeit currency by thoroughly studying the inks and the paper. These men use such instruments as a spectrograph to determine the elements in the inks and paper and a spectrophotometer to study the shades of the green inks on the backs of the bills.

These instruments can pick up many things that the eye cannot see.

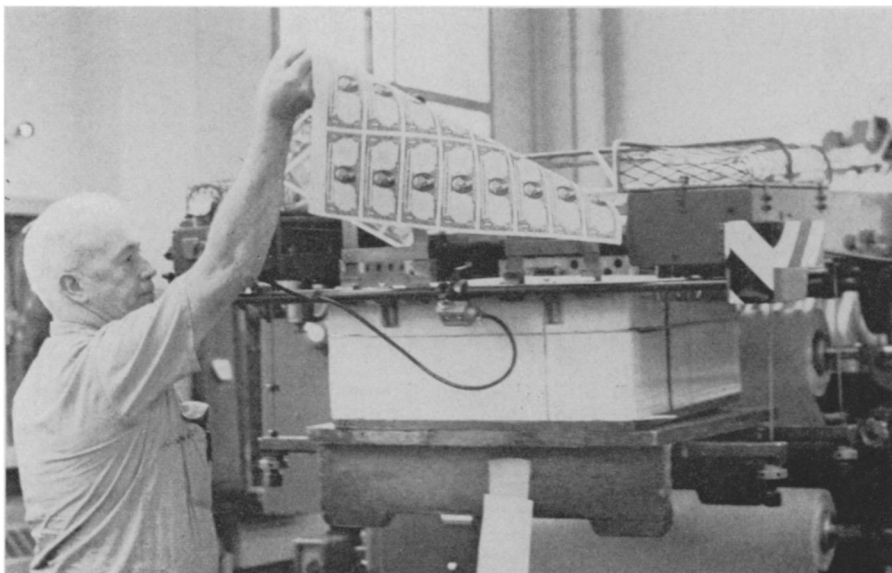
However, printing currency and detection of counterfeit currency are not the only areas of research and development at the Bureau of Engraving and Printing.

## Engravings Made

Even before the printing process can be undertaken, engravings must be made.

First, a hand-tooled design is reproduced in soft steel by the engraver. Separate portions, such as the portrait, ornaments and lettering are engraved individually by specialists.

The finished engraving, known as a die, is hardened by heating in potassium cyanide. In a method called the transfer process, the hardened die is placed into the bed of a transfer press and imprinted onto a roll of soft steel. This steel is then hardened and the design transferred to soft steel plates under great pressure to create the intaglio impression as on the original die.



Fremont Davis

**MAKING AN HONEST DOLLAR**—This plate printer at the Bureau of Engraving and Printing, James L. Connor of Alexandria, Va., lifts a 32-note sheet of one-dollar bills from the intaglio press. In this operation the front sides of the bills are being printed.

A later development in engraving has been the electrolytic process for duplicating plates.

Continued research is being done toward improving inks and paper.

Much of the original work in developing currency paper was done by the National Bureau of Standards in Washington, which created the basic standards for currency materials.

### Durable Paper

From research at the Bureau of Standards during many years, today's currency paper has evolved. It has the highest folding endurance of any paper made.

Paper used in the wet intaglio process is 50% linen and 50% cotton, known as "100% rag paper."

The dry process paper is 75% cotton and 25% linen.

The inks used in plate and surface printing are made at the Bureau of Engraving and Printing by blending dry colors, oils and extenders that dilute the blends. Each batch of new inks must first be tested at a testing laboratory to see that it conforms with standards.

Green and black inks for "non-offset" printing were developed for the dry intaglio process.

A recent development is a fluorescent ink that glows in the dark. This ink was first used on a stamp printed in late 1963 to check on whether or not mail coming to the post office had proper postage.

Figures for 1962 show that approximately 4,259 tons of paper and 1,162 tons of inks were used in producing more than 28 billion pieces, including currency, bonds, treasury notes and bills, postage and revenue stamps, checks and miscellaneous engraved work.

### Postage Stamps

Besides printing the nation's paper currency, about 30% of the Bureau's work centers around printing postage stamps.

All ordinary postage, postage due, special delivery, air mail, special handling and commemorative stamps used by the United States and its possessions are printed here.

These stamps, printed by the intaglio process, are made in essentially the same way as the currency.

About 90% of the stamps are printed on six single-color presses, while the remaining 10% are produced on three sheet-fed Giori presses, which can print up to three colors on a stamp with one pass through the press.

The Bureau produces its own adhesive, which is piped directly to the gum fountains on the rotary stamp presses in the production area.

As long as postage stamps remain important for mail delivery, new and more suitable ones will be developed, and as long as money is the important means of trade, the Bureau will continue to seek new and improved ways of making it. Making money has, indeed, become a science—a science that the American people certainly could not afford to do without.

• Science News Letter, 87:138 February 27, 1965

### TECHNOLOGY

## Computers Can Simplify Architect's Work

►THE FULL use of computers to take the drudgery out of architecture and to improve the logistics of building construction, although somewhat experimental, is not far off.

This is the belief of George A. Dudley, recently appointed dean of the new school of architecture and urban planning at the University of California at Los Angeles.

Mr. Dudley, who will go to UCLA after finishing the academic year as dean at Rensselaer Polytechnic Institute, New York, suggests that the new architectural curriculum will have to take into account such developments as:

1. Computers capable of designing all the steel work in a building after being fed the proportions of the building and a general description of the structure,

2. Programming of machines to convert loose sketches of buildings into nearly finished elevation studies, and

3. The writing of various other building specifications by computers, thus freeing designers for more creative efforts.

In the field of contracting, Dean Dudley suggested that computers are moving into "critical path" programming, which will predict when each of the building components, down to the last faucet and door-knob, will be needed in the construction.

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## Nature Note

### The Cowbird

► The eastern cowbird is a small conical billed member of the blackbird family, Icteridae.

The iridescent male is the only blackbird with dull brown head feathers. His mate is solid gray.

Riding on the backs of cows or walking behind them, the creaky-voiced cowbird eats insects on the bovines or those stirred up from the ground.

Common throughout the United States, the eastern cowbird has several habits unusual to birds. For example, after mating, the male deserts the female.

The abandoned female lays her eggs in nests of other birds and flies away, never to return. Her choice of foster parents may be any of 200 species, but the small chipping sparrow is one of the most common victims.

The orphaned egg has a short incubation period of about 11 days, so that the baby cowbird hatches earlier than its nest mates and grows much larger. The rightful young birds of the foster mother are deprived of food while the intruder eats more than its share.

Often, the smaller birds either starve or are bumped out of the nest by their uninvited guest.

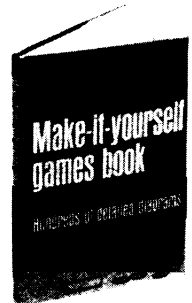
Left with only one child, tiny parent sparrows may be seen protecting and feeding a cowbird fledgling twice their size.

• Science News Letter, 87:139 February 27, 1965

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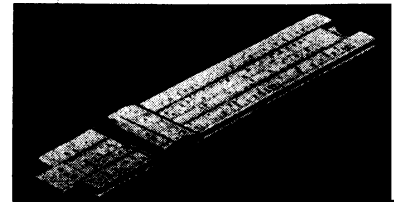


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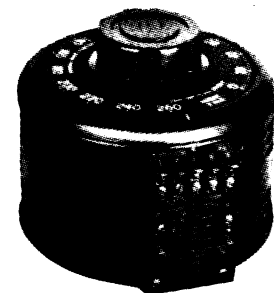
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