

AWA Review

ABSTRACT

The telegraph was the primary communication device of the 19th Century and continued to play an important role throughout the 20th Century. As concepts for teaching Morse code evolved throughout this period, entrepreneurs and manufacturers incorporated new technologies and offered an increasing variety of training instruments. This article presents a review of American teaching devices used for Morse code training after 1850. The devices discussed include: training keys, disk and drum devices, paper tape machines, audio visual trainers, oscillators, and phonograph and tape recordings. For over 150 years, these devices provided the means to teach and practice Morse code. They offered a way to replicate the code and provided variation in code speeds and timing for individual and group practice. Use of these devices enabled thousands of telegraphers and wireless operators to work towards achieving greater proficiency levels and standards of performance.

Morse Code Training Devices

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The following article is based on an ongoing research project offering the first comprehensive survey of the devices used, methods employed and the places where American telegraphers received their initial training and instruction in Morse code after 1850. This article presents a condensed summary of the opening section of an upcoming book on these subjects. A review of educational toys as well as a survey of the commercial, military and amateur training programs and the primary teaching methods used for first time instruction in Morse code will be published separately. Training on more advanced devices to accelerate transmission and reception speeds, such as the use of “bugs”, “iambic keys” or “paddles”, and the application of automatic transmission methods, such as the use of teletype machines, lie outside of the intended scope of this project.

TRAINING KEYS

American telegraphers have always emphasized fast, accurate and reliable transmission and receipt of Morse code and demand for skilled operators grew rapidly from the outset.¹ By the 1860s, entrepreneurs and manufacturers recognized an enormous market opportunity and designed training sets to help telegraphers learn uniform and standardized applications of the Morse code. Thereafter, new innovations brought increasing variation in these training keys and eventually spawned the development of ever more creative training devices.

Learner Sets. The earliest code training keys were used by both commercial and

private line telegraphers. The first of these sets may date from 1849 and included a complete telegraph key and a separate sounder mounted onto a single board to allow for greater portability (Reid, 1879). By the mid-1850s, small pocket sets incorporating a key and relay mechanism came into use as linemen's test sets.

Soon after the Civil War, manufacturers introduced a new class of instruments specifically targeting aspiring telegraphers. Initially termed "Learner Sets," "Learners Outfits," or "Learners Apparatus", these devices consisted of an inexpensive key and a sounder mounted on the same base. Today, many of these sets are referred to more generally as key-on-board sets, or KOBs.²

By the mid-1860s, manufacturers began targeting the private line telegraph market and the number of styles and types of Learner Sets and other KOBs began to increase (Prescott, 1866; Casale, 2006; see Figs. 1, 2).

Student manuals of the period stated that these sets could be used by the individual

telegrapher or could be wired together for use by two or more telegraphers at distances from 100 feet to 15 miles. Detailed instructions explained batteries, wiring and practice methods for learning the Morse code, including the best approaches for holding the telegraph key and the best methods for writing script to transcribe incoming messages.

As Learners Sets, private line sets and other KOBs achieved greater acceptance, manufacturers varied their styles, materials, intended durability and artistic design to meet the needs of their customers. A wide variety of KOBs were designed for use at home, in business circuits, or in commercial telegraph offices. The primary



Fig. 2. KOB design: Western Electric Co. Steiner set circa 1886.

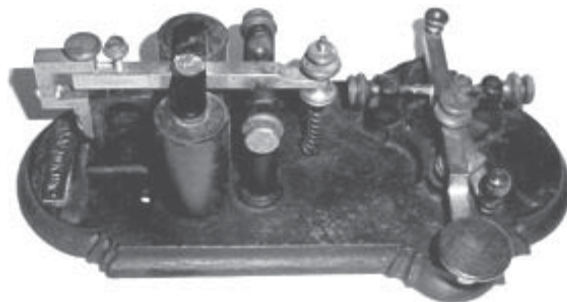


Fig. 1. Private Line Set: Patrick and Carter circa 1870.

differences can be seen in the changing telegraph key designs, sounder designs, and the location of the key, sounder and binding posts on the base. In very general terms, major design changes of the telegraph key lever help to date KOBs as follows: Straight Levers

(1844-1881), Camelback Levers (1850-1881), Step Levers (1850-1881) and Curved Steel Levers (after 1881) (Moreau, 1995; Perera, 1999).

All of these styles remained in use during the late 19th Century since operators generally owned their telegraph equipment. But by the turn of the century, the Curved Steel Levers proved to be the best design and remained the generally accepted standard. Major manufacturers of KOBs included Tillotson & Co., E.S. Greeley & Co., Partrick & Carter, Foote Pierson & Co., New Haven Clock Co., and Western Electric Company. J.H. Bunnell & Co. was the leading manufacturer of steel lever keys and produced its own highly successful line of KOBs.³ J.H. Bunnell also produced "Giant" combination KOBs used for training as well as commercial applications. Retail stores and mail order catalogue companies sold KOBs using both the manufacturer's name and the retailer's private label. Major catalogue houses such as Sears Roebuck and Company, Montgomery Ward



Fig. 4. Learner set leaflet for The Unique Combination Giant Key and Sounder set circa 1895.

and other mail order merchandisers offered KOBs along with technical books and other telegraphy products (see Figs. 3, 4).

By the First World War, the new wireless supply companies such as Electro-Importing Company of New York and Manhattan Electric Supply of-

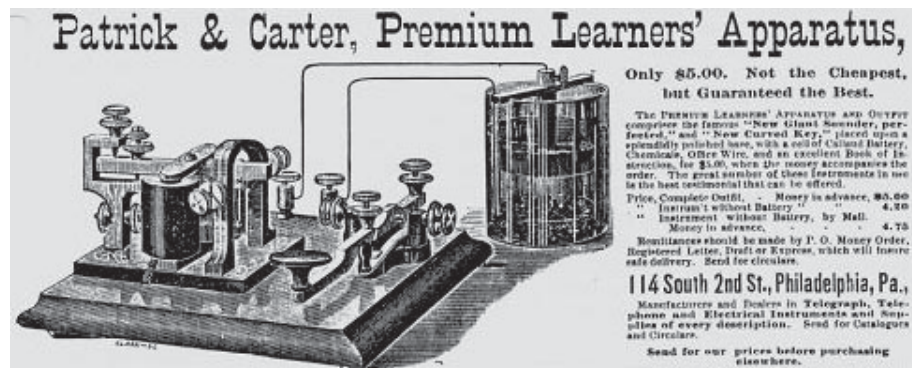


Fig. 3. Learner set advertising by Patrick and Carter, *The Electrician*, January 1883.

ferred complete telegraph training outfits with new instruction cards and directions explaining how KOBs could be adapted for wireless training.

Multiple makes and models appeared for each manufacturer. For example, in 1912, Manhattan Electric Supply offered its Student Telegraph Set, Eureka Telegraph Set, Learner's Excelsior Telegraph Set and the Wireless Practice Set (*MESCO No. 28*, 1912). Yet, of all the makes and models, J.H. Bunnell's inexpensive and durable sets dominated the industry from the 1880s into the 1920s.

Mechanical Sets. The first cable operated mechanical training devices date as early as 1870. D.W. Putt and Company and other manufacturers produced devices where the movements of the key mechanically pulled the sounder via a cable or wire that ran under the KOB platform. These training keys did not use electricity and relatively few of these sets were manufactured.

Between 1885 and 1890, the Anderson Guinan Mfg. Company of Cleveland, Ohio offered "The Telegrapher," a cast-iron non-electrical set employing a metal rod to operate the sounder from movements of the key.

Manhattan Electric Supply's *MESCO Catalogue Number 18* offered two late variations applying a connecting cable or rod between the key and sounder. The Eureka Combination Electric

and the Improved Giant Combination Electric each featured a KOB design with a separate key and sounder that came with an attachment for directly connecting the sounder's armature to the key, permitting mechanical practice without a power source. The main difference between these two MESCO sets arose from the location of the key on the base and the size of the sounder (see Figs. 5-7).

The *J.H. Bunnell Company Catalogue* for 1895 featured two J.H. Bunnell Mechanical Sets that physically joined the moving elements of the key and sounder into a single frame. Bunnell's Mechanical Set No. 1 allowed the operator to tap the sounder's armature directly up and down with a finger knob mounted to the side of the armature. Bunnell's Mechanical Set No. 2 separated the knob from the sounder's armature with a

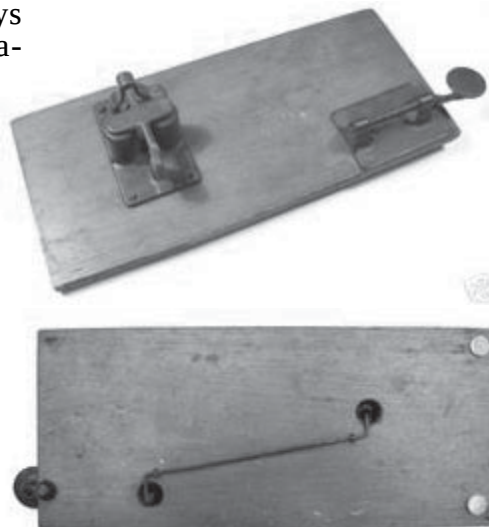


Fig. 5. Anderson Guinan Mfg. Co. "The Telegrapher" cable operated KOB circa 1890.



Fig. 6. One Piece Mechanical KOB: J.H. Bunnell No. 1 circa 1895.



Fig. 7. One Piece Mechanical KOB: J.H. Bunnell No. 2 circa 1895.

spring, thereby permitting the telegraph key's tension to be independently adjusted while also changing the sounder's acoustics to more closely resemble an actual operating sounder.

In 1900, Manhattan Electric Supply Company adapted Bunnell's designs with its own MESCO Training Key also known as the Mechanical Telegraph Instrument (MESCO No. 28, 1912; *The Telegraph Office*, 2005). The

MESCO key used wooden spools in the shape of a sounder's electromagnetic coils. (*The Telegraph Office*, 2005) Depressing the key directly pulled down the steel contact bar onto the spools, creating the sound and feel of live Morse code. A 1915 catalogue from Central Electric Company offered the Ludwig Mechanical Telegraph Instrument following a similar concept.

Buzzer Sets. After Guglielmo Marconi's 1895 radio demonstrations, the emergence of wireless telegraphy led to even greater marketing and application of the original KOB designs to a new audience. By World War I, manufacturers began substituting a buzzer for the more traditional sounder in wireless training sets. Gernsback's Wireless Course first advertised its new buzzer KOB in 1914, targeting the growing market for amateur radio enthusiasts. Gernsback's 1918 wireless training device, the Electro-Codaphone, featured an adjustable buzzer located above the key which provided "*the only instrument made that will imitate a 500*

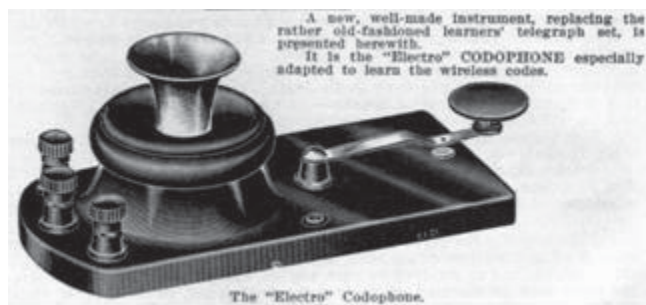


Fig. 8. The Codaphone buzzer set by Gernsback, 1918.



Fig. 9. Combination buzzer and blinker set: Frank B. Perry and Sons Radio Blinker Signal Set dated September 4, 1917.

cycle note exactly as heard in a wireless receiver, so closely and wonderfully clear, that radio operators gasp in astonishment when they first hear it" (Gernsback, 1918).

The set could be adjusted to sound like an army training buzzer or an individual practice set. It could also provide the volume necessary for classroom demonstration. Multiple students could use this set for practice by linking two or more sets together on a common circuit. Other buzzer sets included the 1917 Frank Perry and Sons Radio Buzzer Blinker Signal Set and the 1921 Ajax Electric Company Learner's Key and Buzzer Set (see Figs. 8, 9).

Late Model Trainers and Toys. In the 1920s, traditional KOBs with a key and sounder continued to be produced for both commercial and private line telegraphers. New wireless training keys also included a light for blinker or visual train-

ing. The most prominent manufacturers of the 1920s who provided traditional KOBs, buzzers and lights for wireless training included Manhattan Electric Supply Company, J.H. Bunnell Company, Electro-Importing Company of New York and Electrical Supply Company. Newly developed plastic technologies eventually brought many lightweight variations to these devices, replacing many components with bakelite or other forms of molded plastics. These less expensive sets include Les Logan's Speed X line and keys manufactured by E.F. Johnson, William M. Nye Company, Philmore and M.M. Fleron (see Fig. 10).

After the First World War, the market for toys exploded and many manufacturers capitalized on the public's fascination with radio by providing toy telegraph sets to learn Morse code. Many toy sets combined both buzzer and light training. They targeted the growing amateur markets as well as offering novelties for children. Although these toys achieved popularity, they never gained acceptance as serious tools for learning code. Yet, toy sets included a number of



Fig. 10. Manhattan Electric Supply Company (MESCO) amateur KOB circa 1920.

buzzer, light, sounder, and even oscillator innovations, and they were widely used. Many amateur radio enthusiasts recall receiving their first exposure to Morse code on toy sets.

As the 19th Century closed, the primary means of practicing code for new telegraphers was the basic key and sounder of the original Learner Sets, or KOBs. Their continued use well into the 20th Century demonstrated their enduring and practical design. But, these simple sets offered no means to consistently control the student's rate and timing of the individual dots and dashes. A more sophisticated approach was needed to instill greater uniformity among both telegraphers and wireless operators, who increasingly expected consistent performance and reliable proficiency with Morse code as common industry practice.

DISKS AND DRUMS

By the turn of the century, new training devices employed standardized methods of controlling the key-to-sounder circuit, thus regulating the timing of the student's code transmission. These devices used notched disks or pre-cut drums and a moving stylus to trigger the current in the circuit. By providing pre-made disks and drums that specified timing for the dots, dashes and spaces, budding telegraphers could learn and practice Morse code to achieve the expected standards of acceptable performance.

Omnigraphs. The Omnigraph Manufacturing Company of New York was established in 1900 and made its first sales of a new training device, the Omnigraph, through a J.H. Bunnell Co. catalogue that same year (Pennes, 2002 and 2006). Omnigraph promised to teach both the wireless and Morse codes "in half the usual time" and the Omnigraph came to be used extensively by the government, universities, colleges and trade schools (Omnigraph, 1918).

The *Sears Catalogue* offered the earliest versions of the Omnigraph beginning in 1902 (Sears, 1902). The Sears single-disk model included a hand cranked single aluminum disk with a key and sounder mounted as a KOB on a mahogany base. The disk read "JOHN QUICKLY EXTEMPO- RIZED FIVE TOW BAGS." An optional battery-powered motor and pulley system were also available to rotate the disk making the Omnigraph the first fully automatic training device. It generated code from the movement of an electrical contact that tracked along the raised edge of a flat aluminum disk. As the disk rotated, notches on the rim opened and closed the electrical contact enabling a sounder, buzzer, or headphones to operate. Early Omnigraphs came with the instructional booklet, *How to Become an Excellent Operator*. Extra disks for this first Omnigraph were available at five cents each (Pennes, 2002 and 2006).

Morse Code Training Devices

The Omnigraph Company primarily focused its advertising in land line telegraph journals until about 1910 when it began selling its products as wireless training devices. By World War I, the company succeeded in its efforts to have the Omnigraph become the first device used for testing national proficiency standards in transmitting and receiving Morse code (Friedman, 1984). Both the 1914 and 1919 rule-books of the new U.S. Department of Commerce's Radio Service stated that each amateur and commercial operator license code test be "conducted by means of the Omnigraph or other automatic instrument" (Omnigraph, 1918). As the U.S. entered World War I, the U.S. military purchased large numbers of Omnigraphs to train both its telegraph and wireless operators (Friedman, 1984; Pierpont, 2002; see Figs. 11-13).

As demand grew, Omnigraph produced different models that provided up to 60 practice disks. By 1917, the

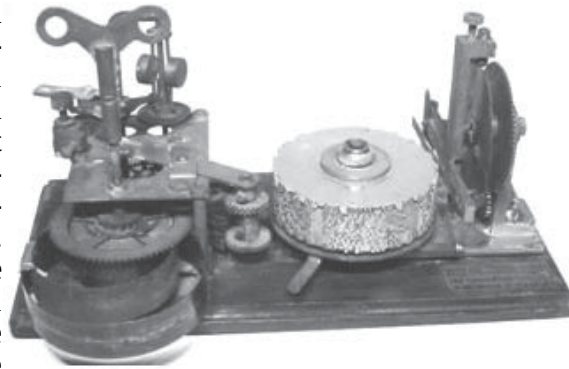


Fig. 12. Omnigraph No. 2 circa 1909, 15-disc model.

Electro-Importing Co. of New York advertised Omnigraphs for amateur wireless code training featuring a five disk "junior" model and the larger 15 disk model. J. H. Bunnell, Manhattan Electric Supply Company and Radio Service Company also sold Omnigraphs (Pennes, 2002 and 2006).

By 1922, a larger 5 disk practice set complete with a key and buzzer became available. These larger versions employed a spring driven clockwork mechanism to automatically push the contact arm up and then down the stack of disks. Speeds from 5 to 100 words per minute could be achieved by adjusting the motor's governor (Omnigraph, 1918; Friedman,

1984; Pennes, 2002 and 2006). Omnigraph company advertisements stated that the Omnigraph could "send unlimited messages by the hour at any speed". The company claimed the Omnigraph could



Fig. 11. Omnigraph Mechanical Disk Learner's Set No. 1 circa 1902.

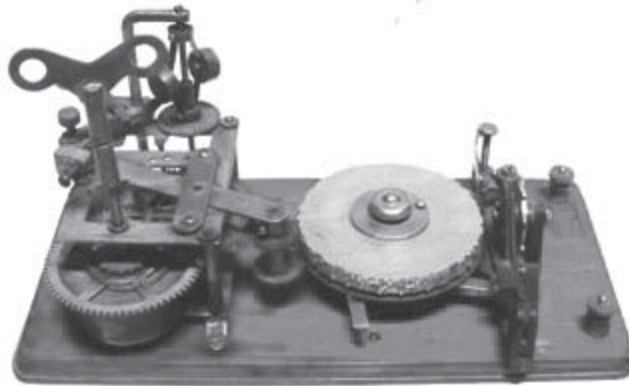


Fig. 13. Omnigraph 5-disk No. 2 "Junior" model circa 1924.

run for 45 minutes with a single winding of the clockwork motor. (Omnigraph, 1918) Practical experience showed that the sets actually began to slow down after 20 to 30 minutes of use (Friedman, 1984; Pennes, 2006). Changing the order of the disks and the speeds provided variation for practice while always maintaining the uniform timing of the individual dots and dashes. Each disk contained from 12 to 36 characters and disks were available in both American Morse and Continental code. Additional disks could be purchased in groups of five for \$1.00. Available disks included the alphabet, single letter disks, numerals, punctuation, railroad, commercial, press systems and interchangeable messages (Omnigraph, 1918; Friedman, 1984; Pennes, 2002 and 2006).

During their heyday, Omnigraphs heavily advertised in the major telegraph, wireless and radio journals of the period including *QST*, *Radio Amateur News*, *Radio News*, *Electrical Experimenter*, *The Wireless*

Age, *Western Union Tariff Circular*, *Journal of The Telegraph*, and *Radio*. Many classroom correspondence schools also advertised Omnigraphs and sometimes distributed them to students under proprietary trade names. The National Wireless In-

stitute and the New York Wireless Institute sold or used Omnigraphs in their training programs under private labels, putting their name on the instrument (Pennes, 2006). International sales were made through A.W. Gamages, Ltd. in London under the Gamages label. Omnigraph advertisements appeared as late as 1927 and the company ceased operations in 1931. During its lifetime, the Omnigraph Company produced at least 15 models of the Omnigraph training device (Pennes, 2002 and 2006).

Homemade Devices. During World War I, amateur radio operators were prohibited from broadcasting due to national security concerns and the emerging monopoly placed on radio by the U.S. Government. Effective April 17, 1917 through October 1, 1919, the government ordered all amateur equipment dismantled and prohibited amateurs from receiving and transmitting radio signals (DeSoto, 1936; Pierpont, 2002). Though prohibited from radio

operations, amateurs who did not join the military were encouraged to make their own practice devices to maintain their code skills.

One popular device included an award-winning homemade paper disk trainer featured in the September, 1918 issue of *Wireless Age*. Strips of tin foil pasted to cardboard disks were connected to a copper wire and a motor. The tin foil was cut by the user into code patterns for practice (*Apparatus For Self Instruction*, 1918). The need for homemade devices waned after the war when amateur operating rights were restored.

Natrometers. First advertised in 1920, the National Radio Institute (NRI) in Washington, D.C. exclusively manufactured a new device called the Natrometer for teaching Morse code to both private line and commercial operators. The Natrometer succeeded the Omnigraph with its new technology, but NRI only featured it for only a few years in its courses.

Advertised as “the most efficient instrument ever devised for teaching wireless code”, the Natrometer allowed both random code generation and speed adjustment (*Practical Radio*, 1927). A clock-work movement controlled the mechanism. The circuit operated with an aluminum drum that had 9 levels of insulated (blackened) and un-insulated (exposed) patterns painted on the sides. As the drum rotated,

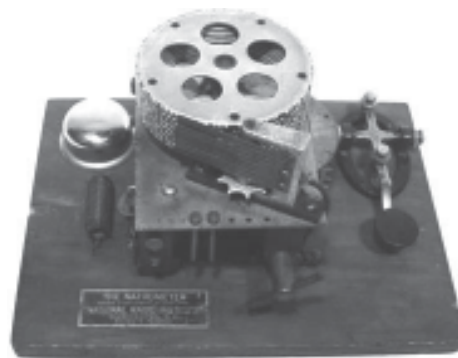


Fig. 14. Natrometer as sold by the National Radio Institute circa 1926.

the patterned sections passed under copper contacts, opening and closing the circuit to operate a sounder, buzzer or headphones. Contacts could be selected by inserting or removing wooden pins. Like the Omnigraph, overall speed was adjusted using a brake on the motor's governor while the spacing between the individual dots and dashes remained uniform. Additional drums with different patterns of letters and numbers were also available for purchase and several models featured a key and buzzer (see Fig. 14).

NRI featured the Natrometer in its 1927 guide *Practical Radio: Be A Radio Expert* and offered the Natrometer as a supplement to its radio courses for more specialized Morse code training. It provided the Natrometer, headphones and a learner's KOB at no cost to students claiming “...the Natrometer gives you code-speed in half the usual time... [and] will send messages in a human and not a mechanical manner at a rate which you can vary from 3 to

30 words per minute...The effect of static interference may be added to the messages being copied...." (*Practical Radio*, 1927) Natrometers were not separately advertised for sale outside of the NRI courses and were never used in official testing.

Other Devices. In 1940 an unusual device combined the features of both the Omnigraph and Natrometer. Of unknown manufacture, the Santa Fe Railroad used this device to train its operators. It incorporated the code onto a pattern of elevated surfaces on the side of a large aluminum drum. Nothing more is known about this device (*The Telegraph Office*, 2005).

The June, 1960 *QST* featured advertising from the Teleplex Co. offering its own copper engraved code drum device to teach the code by sound. Teleplex's "Automatic Transmitter" had seven lessons available and Teleplex claimed to teach individual letters in "seconds". *QST* and *CQ Magazine* both advertised the Parks Code Wheel from Park Electronics Laboratories in 1963 (*QST*, May, 1963; *CQ*, May, 1963). The Parks Code Wheel offered an "exceedingly rugged" motorized disk machine with Morse code characters cut into the edge of the disk much like the Omnigraph. The advertisements proclaimed it as self-contained and ideal for contests (*QST*, May, 1963; *CQ*, May, 1963).

As late as 1970, another hand cranked disk device, the



Fig. 15. Teleplex ad from *QST* August 1960.

Co-Tutor, was advertised by Romney Engineering Laboratories. Essentially a hand held whistle, sounds were made by blowing into the device while simultaneously turning a crank to rotate one of six snap-on code disks. The Co-Tutor came with American Radio Relay League's book *Learning the Radio Telegraph Code*. (*QST*, October, 1970; see Fig. 15)

Of all the disk and drum teaching devices, the Omnigraph's simple mechanism was easier to operate, more durable and less fickle than the Natrometer. The U.S. government's early selection of the Omnigraph for radio operator testing by 1914 helped ensure its commercial success. Consequently, the Omnigraph became the preferred disk/drum wireless training device throughout the 1920s. As a result, Natrometers and the other cylinder type devices never achieved wide acceptance, and Omnigraphs dominated the early trade schools and training programs. But even the Omnigraph had its limitations, and by the 1930s, the

Omnigraph was being replaced by more efficient and effective paper tape devices (*The Telegraph Office*, 2005).

PAPER TAPE DEVICES

Paper tape training devices date as early as 1901. By the 1930s, these devices dominated the market, offering simplified mechanical designs that provided greater variation in recorded training sessions at significantly lower cost. These devices maintained a strong presence in the market for training sets well into the 1960s.

Audible Alphabet Transmitter. The Audible Alphabet Transmitter was the first training device to use paper tapes with perforated holes to operate a sounding mechanism. C.S. Cumins patented the transmitter in 1901 intending it for private study and practice. The Audible Alphabet Company of Boston manufactured it, and Theo A. Edison's 1902 book *Telegraphy Self Taught* featured its use (Edison, 1902). The A.A. Transmitter pulled a perforated paper tape through the instrument with a hand-cranked mechanism. The holes in the paper permitted an electrical signal to be transmitted as each hole moved over an exposed electrical contact. The rate of manual turns controlled the speed. A battery and sounder completed the circuit. Edison postulated: "It is not the speed at which the letter is sounded that perplexes the learner, but the rapid succession in which

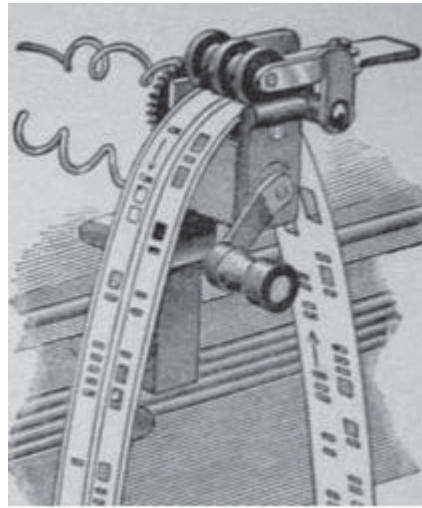


Fig. 16. Audible Alphabet Automatic Transmitter, Edison, 1902.

they [the letters] follow each other" (Edison, 1902).

The paper tapes provided uniformity in the spacing between the transmitted letters regardless of the speed at which the tape was played. Beginner tapes used wider spacing between the letters. More advanced tapes used shorter spacing between the letters. Through practice, the student would progress to ever shorter intervals until attaining "normal telegraph spacing" and an expected proficiency of 25 words per minute in five letter character groups. The device came with six perforated paper tapes and an instructional booklet (Edison, 1902). The Audible Alphabet may have been available as late as 1920 (Smith, 1997; *The Telegraph Office*, 2005; see Fig. 16).

Automatic Telegraph Transmitter. The National

Automatic Transmitter Company produced its own “auto-alphabet instrument”, the Automatic Telegraph Transmitter, based on a concept originated by R.W. Elam of Valparaiso, Indiana.⁴ First offered in a 1900 J.H. Bunnell Catalogue, this device included a key, sounder and batteries together with a clockwork mechanism that automatically pulled a strip of perforated paper across the electrical contacts to activate the sounder. Manipulation of the governor on the clockwork mechanism controlled the speed similar to the operation of the Omnigraph. Speeds could range from five to forty words per minute and each tape could hold from 300-500 words. The entire series of tapes offered 10,000 words. The key could also independently operate the sounder. (J.H. Bunnell, 1900) *An Electric Telegraph Course* accompanied the Automatic Transmitter. Students of the American School of Corre-

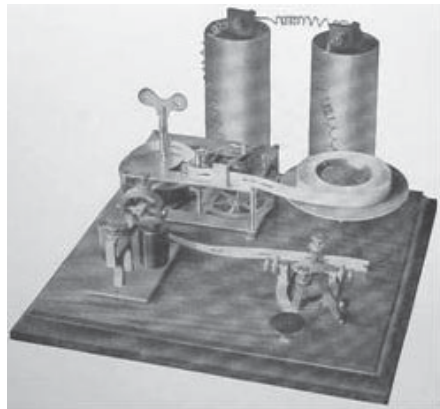


Fig. 17. Automatic Telegraph Transmitter produced by the National Automatic Transmitter Company, 1909.

spondence received both the transmitter and instructional course materials (“The Electric Telegraph”, 1909; see Fig. 17).

The transmitter’s paper strips followed the six advertised course programs including groups of letters, numbers and words. The transmitter and course materials were provided to students for a deposit which was refunded when the instrument was returned in good condition (“The Electric Telegraph”, 1909). The Automatic Transmitter was also available through Manhattan Electric Supply Company Catalogues and Dodge’s Telegraph and Railway Institute where it came with the book *The Telegraph Instructor* (MESCO No. 18; *Telegraphy Successfully Learned*, 1912).

Teleplex. By 1927, the Teleplex Corporation marketed a new training device to commercial, private and military audiences that used rolls of punched double-sided wax paper tape to generate hundreds of code patterns for sounder, buzzer or headphone operation (QST, April, 1927). Initially sold with a spring driven motor, later models used an electric motor to drive the tape winding mechanism. In both models, a lengthy single paper tape provided more code practice than dozens of Omnigraph disks or Natrometer drums at far less cost, and the offerings greatly exceeded those available from the Automatic Telegraph Transmitter (Friedman, 1984; Pierpont, 2002).

Morse Code Training Devices



THE Perfectograph

WITH THE PERFECTOGRAPH you can easily become a Broker, Press or Expert Relay Operator—right in your own office, and without embarrassment or hard knocks. The Perfectograph reproduces actual sending of EXPERT operators—5 to 20 words a minute. It sends you quotations, market reports, gossip, executes orders the way it is done in broker offices. It sends you "Phillips" code as it is sent over fast Press wires. It sends you routine business handled in large relay offices. It will POSITIVELY make you proficient in any branch of telegraphy in a short time. A recent purchaser writes that The Perfectograph has already improved his ability 100 per cent and increased his salary 25%. YOU can do as well or better.

Members of O. R. T., write for particulars about beginners' course in Morse Telegraphy.

PERFECTOGRAPH COMPANY
11 Cortlandt St. New York, N. Y.

Fig. 18. The Perfectograph (*The Railroad Telegrapher*, September 1927).

By 1932, Teleplex advertised an all electric Master Teleplex code Teaching Machine that came with an instruction book and either a telegraph



Wireless or Morse TELEGRAPHY
Quickly and Easily Learned with the **INSTRUCTOGRAPH**

Big Demand for Operators
Here's your big chance! The chance you've hoped for, longed for, waited for. The chance to get into the crowded field where the work is easy and fast—where the opportunities unlimited, the pay good and where you can pick the job you want on land . . . or . . . at sea.

Learn in a Few Weeks
The Instructograph saves you both time and money. Instead of months by other methods—it teaches you in a few weeks. It is ready at any time or all the time to practice with you—to teach you how to be a good sender—a good receiver, and a good operator. Simple as A, B, C.

True Wireless Tone
The use of Radio Tube and Head-Phones is plan of Instructograph is an exclusive feature of the Instructograph and gives you the true wireless tone. You don't have to learn all over again to get your license when you learn with the Instructograph.

Big, Full Tapes
Plenty of them. Wireless or Morse. For beginners or advanced students. Big full tapes. 200 Set of signals on each. Alphabets . . . words . . . numbers . . . messages . . . telegrams . . . etc. Run at any speed. Tapes are perfectly cut after the Standard prescribed by the Dept. of Commerce, Radio Div., and are a big help to the student in getting his license. Our handsome Free Brochure "A World of Opportunity" explains everything. Don't turn this page until you've told us where to send. Your copy.

INSTRUCTOGRAPH INSTITUTE
404 South Dearborn Street, CHICAGO, ILL., U. S. A.

Fig. 20. Instructograph advertising (*QST*, March 1930).



It Teaches the Code!

WARNING!
A Personal Message to Every Fair-Minded Reader of *QST*
from R. G. MILLER, Inventor of Teleplex, the original code instructor Manager, Teleplex Company

Learn Telegraphy with TELEPLEX

TELEPLEX TEACHES YOU THE CODE (Morse or Radio) — quickly, easily and efficiently. A practical machine that works automatically. Course covers send signals like a real operator. Complete code instructions included. Endorsed by U. S. Army, U. S. Navy and Leading Schools.

FREE 15 DAY TRIAL
You can try the TELEPLEX in your own home for 15 Days Free Trial. If it doesn't teach you the code—if it does not disengage its superiority over any other device—it means you nothing. Can be used by advanced students as well as beginners. Write today for full details of Free Trial Offer.

TELEPLEX COMPANY
24 Cortlandt St., Dept. Q-12 New York, N. Y.

DON'T BE MISLED BY IMITATIONS.
TELEPLEX IS THE GENUINE CODE INSTRUCTOR. It is the instrument that is used by the U. S. Dept. of Commerce, Schools Everywhere, Navies (Our Own Navy), Radio and Telegraph Institutes.

Fig. 19. Teleplex advertising (*QST*, April 1930).

key or right angle “bug” for high speed practice. The Master Teleplex could record and replay the student’s code transmission, enabling the student to study errors and practice receiving the student’s own messages. (*Radio News*, December, 1932)

By 1940, the Improved Master Teleplex was equipped with copper tapes on which the code was embossed for error-free operation (*QST*, March, 1935). Teleplex later offered



Fig. 21. Improved Master Teleplex Code Training Machine, (ARRL, 1940).

similar models. Improved calibration of speeds, elimination of the mechanical disk changer, greater variety and extended duration of the paper tapes all contributed to the success of the paper tape instruction machines over the disk and drum machines. Advertisements for

the Teleplex paper tape machines appear through 1965 (N7CFO, October 30, 1992; see Figs. 18-21).

Perfectograph and Instruct-O-Graph. The success of the Teleplex spawned numerous competitors. The Perfectograph Company of New York advertised its competing machine in 1927. Their *Beginner's Course in Telegraphy* used a hand cranked paper tape machine similar to the original Teleplex. The Perfectograph’s paper tapes permitted practice speeds ranging from 5-80 words per minute. (*The Railroad Telegrapher*, September, 1927).

Beginning in 1930, the Instruct-O-Graph Company of Chicago offered a similar instrument that used a thin single paper tape which provided even more code practice at still lower cost (*QST*, March, 1930; N7CFO, October 30, 1992). Instruct-O-Graph offered both the Standard and Junior models using either an electric motor drive or a spring drive to wind the punched paper tapes onto collecting spools (*Practical Radio*, 1927). The Instruct-O-Graph was designed for use with KOBs, free standing sounders, buzzers and headphones. (Kirkpatrick, 1947) Perforated paper tape rolls and an instruction booklet by O.B. Kirkpatrick provided the training program. Speeds ranged from 3-40 words per minute. As a general rule, students were told when they could copy at 90% accuracy, they could move

Morse Code Training Devices

on to the next tape. (Instruct-O-Graph, 1947; Kirkpatrick, 1947) The number of words per minute was controlled by the spacing on the tape and not by motor speed to enable the student to receive “clear, concise and correctly made signals, regardless of whether the speed is four or forty words per minute.” (Instruct-O-Graph, 1947; Kirkpatrick, 1947)

Tapes were available in both American and International Morse and additional tapes could be purchased. Instruct-O-Graph recommended practice at a pace of one tape per month for part time study or one tape every two weeks for dedicated full time study with multiple separate 15 minute practice sessions suggested. (Kirkpatrick, 1947) Instruct-O-Graph offered to rent its machines for as little at \$5 per month with the tapes and instruction booklet. Rentals including an oscillator, headphones and telegraph key cost \$6 per month. (Instruct-O-Graph, 1947) Advertising for the Instruct-O-Graph continued as late as 1974 (N7CFO, October 30, 1992; Pierpont, 2002).

National Radio Institute (NRI) courses featured a similar instrument to the Instruct-O-Graph beginning in 1934 called the Nacometer. The Nacometer operated with a spring wound motor and came with instruction manuals and training literature. NRI offered the Nacometer together with a tube driven audio oscillator kit which used parts from NRI’s

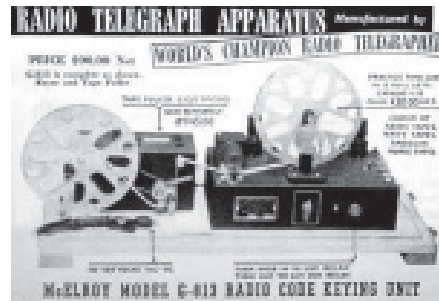


Fig. 22. McElroy Manufacturing Corporation Radio Code Keying Unit (ARRL, 1942).

Home Experimental Outfits. (*Rich Rewards*, 1934; N7CFO, July 7, 1994).

Automatic Keyers. During World War II, new automatic keyers were developed for the U.S. military that soon became available to the general public. These automatic keyers relied on an oscillator tube and keying tube triggered photo-electri-



Fig. 23. McElroy Manufacturing Corporation Code Recording Device (*Radio News*, November 1942).

cally by light variations through a moving inked paper tape. They had sufficient power to operate practice handsets or practice tables for classrooms. Multiple practice tapes were available as well as take-up reels. They could also be used by small groups in the field or could be used as an oscillator for hand keying practice (*War Dept. TM 11-443*, 1943; *War Dept. TM 11-447*, 1943). Many of these devices were commercially produced for the public by McElroy Manufacturing Company and Gardiner-Levering Company (see Figs. 24, 25).

The Army designated these paper tape keyers as TG-10-A or TG-10-B depending on the type of power supplies they used. Demand was low for the TG-10-A type keyer compared to the Gray Manufacturing Company's TG-10-B. The Army introduced a third keyer that combined the automatic paper tape keying system with a tone

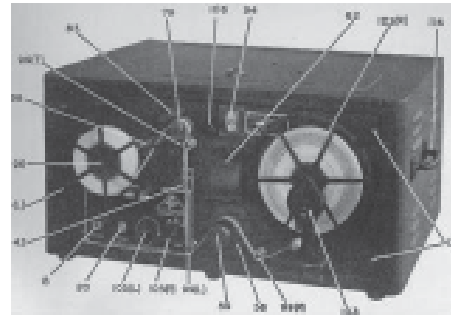


Fig. 25. U.S. Army TG-10-J Code Keyer by Gray Manufacturing Co. (*War Dept. TM 11-447*, 1943).

oscillator in a single unit known as the Lon-Ga-Tone Automatic Keyer. McElroy and Company produced its own Recorded Model RRD-900-742 for the Army as well as its civilian counterparts that could record and playback student transmissions at speeds up to 20 word per minute (*War Dept. TM 11-432*, 1942). The fifteen practice tapes provided were based on training tapes furnished by the U.S. Signal Corps (ARRL, 1942 and 1962; *War Dept. TM 11-432*, 1942; Smith, 1997). The McElroy machines remained available into the mid-1960s.

McElroy may have had some involvement in developing the all electric Ayers Automatic Code Machine, available from 1941-1943 (QST, April 1942; N7CFO, October 30, 1992). These machines could be rented along with recording slip tapes and special tapes using custom inks. The Ayers Code Machines used a photo-electric tube to read the paper tape, similar to the McElroy devices (N7CFO, February 12, 1993; see Figs. 22, 23).

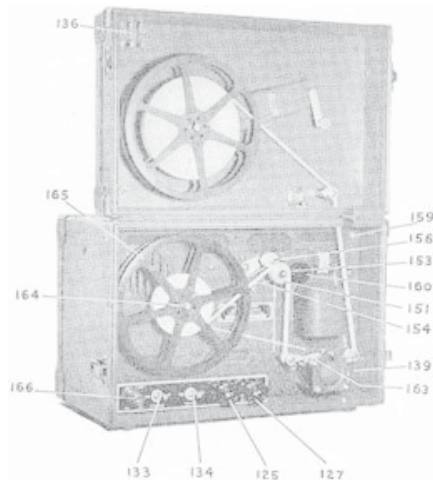


Fig. 24. U.S. Army TG-34-A Code Keyer (*War Dept. TM 11-443*, 1943).

Gardiner-Levering Company, known as Gardiner and Company after 1942, introduced its own paper tape machine, the “Robot Radio Key,” in 1936 (*QST*, November 1936; N7CFO, October 30, 1992). The Robot Radio Key had a loop for the perforated paper tape that allowed messages to repeat indefinitely. By 1940, Gardiner offered the Type J and Type S models. The Type J model included a built-in code perforator together with the automatic sender. Gardiner claimed the Type S model was the most compact code teaching machine available (*QST*, November 1940; N7CFO, October 30, 1992). These devices allowed adjustable speeds up to 70 words per minute to record the student’s transmissions for play back, and were relatively compact and quiet due to the use of a new “induction motor” (Smith, 1997). Gardiner advertised its machines until 1965 (N7CFO, October 30, 1992; Smith, 1997). Both the McElroy and the Gardiner Automatic Sender came with pre-cut practice tapes as well as blank tapes.

Telegraph Keyer Corp. and other companies made similar competing paper tape machines into the 1960s. Automatic Telegraph Keyer Corporation offered one of the last models in 1964. Model A provided tapes promoting Automatic Telegraph Keyer Corporation’s own ATKO Method of learning code. The less expensive Model B did not come with a tone source or speaker (*CQ*, December 1964).

AUDIO VISUAL TRAINERS

With the arrival of 20th Century, training philosophies shifted away from rote memorization and moved toward multi-sensory approaches which led to new products that combined auditory, visual and even tactile learning experiences. Audio-visual trainers mimicked the sound and/or sight of radio-telegraphy signals by offering blinking lights and electronic sound reproduction. Raised pattern, traceable outlines of the Morse code also made possible a multi-sensory training experience for the novice operator by providing visual stimulation, auditory queues and tactile experiences.

Clickers. The simplest devices for auditory training were handheld clickers which produced a sharp sound when the clicker was depressed between the student’s fingers. The 1912 *Manhattan Electric Supply Catalogue No. 18* offered the unique Snapper Sounder, a version of the common toy grass-



Fig. 26. “St. J.” Wireless Codegraph code plate trainer with Continental Alphabet, stamped August 13, 1912.

hopper clicker for audible practice.

Code Plate Trainers. Code Plate Trainers provided an electrically conductive transmitter plate that the student could trace, thereby completing a circuit with a stylus wired to a buzzer, light or oscillator. The plate had metal contacts patterned after the Morse code signals for each letter of the alphabet, numbers and some punctuation symbols. The student could thereby see, feel and hear the patterns of dots and dashes as the raised, or engraved, surface was traced and the student read the pattern and heard the sounds (see Fig. 26).

The first of the Code Plate Trainers appeared in 1910 as advertised by Thomas M. St. John. His new Codegraph provided a plate, stylus, key and sounder, and instruction book. As the stylus, or pen, is “drawn over the plate, the sounder responds and shows exactly how every letter and signal should sound” (St. John, 1910). Insulating material covered the surface of the plate with bare spots corresponding to the dots and dashes of the Morse code including letters, numbers and some punctuation marks.

The Codegraph also came with an optional “Duplex” sounder that incorporated a switch allowing a buzzer to simultaneously operate with the sounder. (St. John, 1910). St. John produced two different “St. J.” Wireless Codegraphs in 1912. A stand alone unit featured the Morse Telegraph Code

and a combination unit with a simple strap style telegraph key featured the Wireless Continental Telegraph Alphabet. The St. J. Wireless Codegraphs were also sold under the Manhattan Electrical Supply Company “MESCO” name as the MESCO Codegraph together with an optional wireless practice KOB (MESCO, 1912).

Other Trainers. Few other Code Plates were produced in the 1930s and 1940s. One unnamed Code Plate in the AWA Electronic Communication Museum’s collection likely dates from the mid-1930s. This device shows that a Code Plate could be made by painting the conductive surface of the transmitter bars, providing the necessary insulation to define the dots and dashes. However, the available signal patterns do not correspond to the Morse or other telegraph alphabets, and this device simply offers practice with differing sounds (see Fig. 27).

The 1943 Code-Tutor by International Electric Company offered greater versatility since it came with a buzzer and J-37 style U.S. military telegraph key. The 1958 Easy Code Jr. by

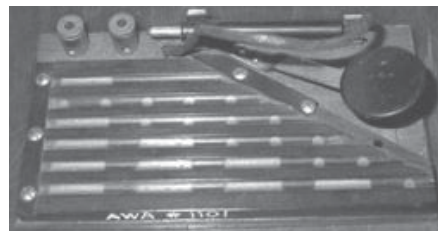


Fig. 27. Unmarked code plate circa mid-1930s.

Aerovox Corporation more closely resembled a toy with its lightweight construction, telegraph stencil pad and hide-away practice key that folded under the main assembly. Finally, in 1970, the Stuhlman Engineering Company offered its Code Board using printed circuit board technology and changing the direction of stylus movements from left/right to up/down (*QST*, April, 1970).

OSCILLATORS

Oscillators also offered a multi-sensory approach for teaching Morse code that sought to reinforce the visual and auditory sensations available for embedding the code into the operator's memory. Manufacturers handbooks stressed that significant code practice would automate the operator's facility with Morse code as a language, and would move the operator away from counting the individual dots and dashes. Generally, code practice oscillators provided either or both audio-tone and visual blinker light reproduction of the signal. Many manufacturers made oscillators and sold them under various brand names. Historically, they fall into four broad groups: (i) tube oscillators driven by radio tubes primarily for sound reproduction; (ii) solid state oscillators relying on transistors and solid state technology for both light and sound reproduction; (iii) combination sets featuring telegraph key and oscillator combinations utilizing either tube or

solid state technology; and, (iv) home-made oscillators.

Tube Driven Oscillators.

Tube driven oscillators first emerged in the 1940s and 1950s for the amateur ham radio markets. Many varieties of these oscillators became available, but all maintained a simple design and provided similar features. These sets typically came in a metal case and used a one tube circuit which could be connected to a separate telegraph key. The oscillator came with a built-in speaker or could be connected to a separate speaker or headphones. Popular brands included AMECO, BUD, Codemaster, ICA (Insuline Corporation of America), TAC (Telegraph Apparatus Company) and others. Manufacturers sold tube oscillators both as finished products and as kits to be constructed by the user. Key features included adjustable resonators, volume control, tone frequency adjustments, optional headphone connections and separate or built-in telegraph keys.

Solid State Oscillators.

Changes in technology led to the conversion of tube driven oscillators into solid state and integrated circuit devices. Less expensive manufacturing in the 1960s combined with the use of integrated circuits to make oscillators smaller and more lightweight. The addition of a light permitted the sender to practice with visual queues as well as audio reinforcement. These oscillators came in both kit form

and as pre-assembled units ready for use with either headphones or external speakers and often came with a separate external telegraph key. Notable examples include the Heathkit line; Knight Code Oscillators for light, speaker and headphones; Electronic Instrument Corporation's EICO line; and AMECO's CW brand for use with headphones or speaker.

Combination Sets. Combination sets either contained their own speakers or utilized radio speakers for sound reproduction. The oscillator typically had its own tube driven audio output circuit providing its own amplification for the radio's speaker, or could rely on the radio's circuits for amplification by simply providing the audio signal for the radio. In both cases, the oscillator came equipped with its own key for closing the circuit. In the 1930s, Bud Radio of Chicago offered a training oscillator featuring a sideswipe key for connection into a radio circuit (*W1TP Tele-*

graph & Scientific Instrument Museums, 2005).

T.R. McElroy Company and its sister company Telegraph Apparatus Company (TAC) produced their own combination sets beginning in the 1940s (*ARRL* 1940; *QST*, July 1946; see Fig. 28). By 1962, Accentronome Corporation in Collingswood, New Jersey, produced the CODEME practice oscillator which could be used for tone and light practice and had a built-in key. It also featured a preset alphabet and preset Morse code combinations for practice (*CQ*, May 1962).

The McElroy, TAC and Codeme combination oscillators all included a built-in telegraph key. Most other manufacturers abandoned the built-in key designs and merely included a separate telegraph key mounted on a platform base together with the oscillator. This design continues to be popular today as shown by the ongoing demand for the William Nye oscillators which included a separate Speed X telegraph key.

After World War II, the U.S. Army and U.S. Air Force jointly developed their 1954 portable Code Training Set AN/GSC-T1A made by Taffet Radio Television Company. This set produced an audio tone or blinker flashes for up to ten students to practice transmission and reception. Ten practice keys were directly wired to the main control unit. This multi-user audio oscillator unit was intended for classroom, small groups and field training. (*War Dept. TM 11-437A*, 1954).



Fig. 28. T.R. McElroy Telegraph Apparatus Company circa 1948.

Homemade Oscillators. By the late 1930s, instructions for homemade oscillators were provided in many hobbyist and amateur project magazines and books. Toy promoters recommended constructing oscillators to learn basic wiring and to make wireless practice a feature of their toy sets. In 1945, *Radio For The Millions* offered a typical design for amateur hobbyists, incorporating a separate telegraph key, one tube power supply, simple audio circuit and used either headphones or a speaker assembly. Homemade practice oscillators continued to be recommended into the 1950s for use with phonograph and other training programs. For example, the 1951 Electronic Technical Institute (ETI) *Photosound Course* provided instructions for building a practice oscillator and connecting speakers through a radio circuit.

A Note On Keyers. By the late 1960s, practice designs combined sideswipe keys and variable oscillators into small portable devices known as keyers. These devices generally fall outside the scope of introductory Morse code training and use paddles instead of a traditional telegraph key. They also use electronic semi-conductor technology to modify the sender's transmission allowing perfectly timed signals and spacing, self-completing dots, dot-memory and semi-automatic transmission. Some keyers employ iambic keying (squeezing motions

between the fingers) to produce alternating dots and dashes (Pierpont, 2002). Practice transmission speeds can be greatly enhanced with these devices up to 50 words per minute (Palomar, 1969). Although early keyers had been in existence since the late 1930s using tube driven circuitry, the emergence of solid state technology allowed the circuits to dramatically shrink in size. By combining this new solid state circuitry with an internal speaker, keyers formed a new generation of practice devices that brought the novice to even greater proficiency levels. Thus, keyers are generally used for advanced practice by those already familiar with the code.

PHONOGRAPH AND TAPE RECORDINGS

Of all the Morse code training methods, the use of phonograph and tape recordings offered the most easily accessible and least expensive approach for both professional and amateur operators. The growth of the phonograph industry in the early 1900s enabled entrepreneurs to develop training programs that did not require specialized devices like the Omnigraph. Mass production of inexpensive recordings featuring actual Morse code enabled students to learn at home using their home phonograph. The low cost of selling and shipping phonograph records made the development of mail order code training courses possible and increased the selection of

training programs available to the public.

Pre World War Two. A joint venture between the Marconi Wireless Telegraph Company and Victor Phonograph Company produced the first set of American Morse code training records in 1917 (Chadwick, 1918; Pierpont, 2002). This set consisted of 12 lessons recorded on six 78 RPM records. Lessons included letters and signs, sentences, press messages, messages with static interference, messages with errors and mixed character groups. Harry Chadwick, the Marconi Institute's Code and Traffic Instructor, authored an instruction manual issued by the Institute in 1918 and prepared the records himself (Chadwick, 1918). Though primarily intended for commercial wireless training, amateur radio operators and professional land line telegraphers also used the records.

The student began by listening to the records while reading code from the manual. After memorizing the code, sending practice followed, using a key and buzzer assembly sold separately by the Marconi Institute. Thereafter, the student played the record while simultaneously operating the key and buzzer. Lessons included individual characters, conventional signs and phrases, words and sentences, punctuation, practice with static, practice with signal interference, and speed and volume variations, press messages and standard signals

used in maritime communications. The records were transcribed at 15 words per minute. (Chadwick, 1918).

A competing phonograph course emerged in 1922. The American Code Company of New York City advertised its phonograph course recorded by the celebrity wireless operator Jack Binns. An instructional textbook accompanied the course and claimed it could teach the Code in one evening.⁵

World War Two Era. New approaches to phonograph recordings were developed in World War II. Both the U.S. Army Signal Corps' and the U.S. Navy employed the unusual 1942 Gray Audograph Code Trainer by The Gray Manufacturing Company. This device introduced paper thin plastic records. Advertisements feature this instrument in photographs but nothing more is known of this early record training device. (*Telephony*, 1942; see Fig. 29)

Code teaching concepts underwent dramatic development during the War as the U.S.



Fig. 29. U.S. Signal Corps' Gray Audograph Code Trainer, 1942.

government sponsored research to find ways of quickly training large numbers of radio operators. In 1942, the Linguaphone Institute in New York offered *A Course of Practical Instruction* containing 78 RPM records and an instruction booklet with ten lessons. The course targeted 15 words per minute proficiency by providing phonetic instruction where the student learned to recognize each character as a complete sound rather than individual dots and dashes. It also taught the student to “copy behind” the incoming code rather than “copying ahead.” Copying behind meant simply that the student wrote the message after hearing complete words. But despite its modern approach, Linguaphone still instructed its students to make flash cards for memorization (Tuthill and Battey, 1942).

Dr. Fred S. Keller’s studies for the U.S. Army in World War II resulted in the development of the “Code-Voice Method”. Based on new concepts of audio-perception training, this method also taught the student to hear the unified sound pattern of the letter or character, as opposed to counting the individual dots and dashes, but carefully avoided rote memorization techniques. Keller’s methods were adopted by the Army and the basic structure of his program was transferred onto paper tapes and records for large scale application (*War Dept. TM 11-459*, 1943). “Mastery” requirements for high speed and low speed

operators began at 12 words per minute and progressed up to 25 words per minute for 75 words without error. (*War Dept. TM 11-443*, 1943). Keller’s method emphasized the benefits of motivating the student through directing their own achievement of competency.

In 1943, The American Foundation for the Blind applied Keller’s concepts with the *Talking Book: The Radio Code By The Voice-Code Method*. The 1959 *Rider Sound-N-Sight Code Course* also used the Code-Voice Method in its “Reinforced Learning System.” The Rider course claimed students could reach 5 words per minute in approximately 13 hours of instruction; 13 words per minute in 20 hours; and 20 words per minute in 40 hours. It recommended two hours per day as the amount of daily practice that was most effective. (*Rider Sound-N-Sight*, 1959) That same year, the *Raybrun Code-Voice Method* 78 RPM two record set came available. Raybrun Company offered a similar course for the Boy Scouts that year entitled the *International Morse Code*.

1950s Expansion of Phonograph Recordings. The 1950s witnessed the tremendous growth of Morse code phonograph recordings that applied a wide variety of teaching approaches. At least fifteen different courses were offered by the U.S. government, radio supply manufacturers, and private entrepreneurs. Formats expanded to include the new 33

1/3 RPM Long Play (LP) record as well as 45 RPM short play records. The U.S. Navy continued producing its 78 RPM records, the *Morse Code Training Course* (Bureau of Naval Personnel, NAVPERS 11030).

The Insuline Corporation produced its *International Morse Code Course* based on the Navy's program using the Navy's "Phonetic Method of Instruction" (Tuthill and Battey, undated 1950s). Here the student memorized the dit-dah sound patterns making up each character by using the records in conjunction with homemade flash cards. Maximum practice speeds of 20 words per minute could be achieved by running the phonograph at higher revolutions per minute (Tuthill and Battey, undated 1950s).

The Electronic Technical Institute (ETI) offered its *Photosound Course* beginning in 1950 simultaneously teaching penmanship and typewriting skills along with code instruction. ETI's mail-order testing program spanned 72 recorded lessons to bring skill levels up to 20 words per minute including training with static and interference. The course expanded in 1955 to 150 lessons. (*Photosound*, 1950 and 1955) The U.S. Navy later offered the *Photosound Course* under the auspices of its *Radio Code Instructional Recordings* (*Radio Code*, undated 1950s).

Many commercial recordings in the 1950s and 1960s duplicated these methods. Allied Radio Corporation's 1957 *International Morse Code*

Course followed almost the same lesson order as Insuline Corporation's course. Herman H. Smith's *International Morse Code Course* simply copied the Allied Radio Corporation's instruction manual including its schematics and diagrams (Smith, 1959). The Tandy Corporation produced Radio Shack's *Learning The International Morse Code* records in 1969 following a similar format to the Allied Radio and Herman Smith courses.

45 RPM Formats. Despite the popularity of 45 RPM records for single play music sales to the general public in the 1950s and 1960s, the 45 RPM format contained few offerings for Morse code instruction. In 1950, Brumberger included a 45 RPM *Morse Code Instruction Course* with its Codemaster Telegraph Signal Set. In 1956, *Uncle Sam's Morse Code Records* provided seven 45 RPM records incorporated the Dit-Dah Method used by the U.S. Air Force. This approach employed a mnemonic alphabet to memorize the individual code characters as auditory phrases or sound patterns. Practice examinations were given at 5,8,10,12,15, and 20 words per minute. (*Uncle Sam's*, 1956) American Electronics Company of New York (AMECO), also offered its Junior, Advanced and Senior Code Courses in 45 RPM formats.

Other Approaches and Formats. One of the most well known phonograph record sys-

tems was produced by Russell Farnsworth and released in LP format in 1959 by Epsilon Records. His records combined the application of teaching technologies by relying on original paper tapes to produce the master phonograph recordings of Morse code. The course included three LPs that ran at a code speed of 13 words per minute. Operation of the phonograph at 45 RPM increased the code speed to 17.5 words per minute. (*Revolutionary New Word Method*, 1959) Farnsworth's method reduced the audible spacing between the letters more quickly than the spacing between the words, much like the Audible Alphabet paper tape system did in 1902 (Smith, 1997). Still in use today on computer training programs, Farnsworth's method continues to be one of the most popular code teaching approaches (Smith, 1997).

By the 1960s, the recording industry had converted to the LP format. AMECO offered its new LP training records as part of a complete home study program, *Learn The Code With AMECO*. As late as 1962, advertisements indicated that AMECO's original four code courses were still available on 45 or 78 RPM formats (QST, January, 1962). However, most AMECO records through the rest of the decade came in LP format and the advanced supplemental practice records were only available on LPs. AMECO provided the broadest offering of any Morse code training records. All records

were supplied with course instruction books and sample FCC license examinations. Lessons progressively moved the student up from 5 words per minute to 24 words per minute proficiency.

In 1963, Howard W. Sams and Company released its *International Code Training System* providing a complete programmed course for learning International Code. Materials included three 45 RPM records, three LP records and a comprehensive instruction guide developed by International Teaching Systems, Inc. Their so-called Programmed Method offered a unique approach to teaching Morse code based on increasing the complexity of each character to move from simple to more difficult letters, while instilling a sense that the code was an oral language to be learned in sound groups. (Howard W. Sam's, 1963)

Conversa-phone Institute's 1965 *International Morse Code* formalized a unique approach to code instruction. Conversa-phone provided instructions for changing the phonograph's turntable speed in order to obtain different code transmission rates for practice with their course materials. The recorded transmission speed could be increased proportionately when moving from 33 1/3 to 45 to 78 RPM speeds. For example, practice at 5 words per minute played at 33 1/3 RPM would become 7 words per minute at 45 RPM and 12 words per minute at 78

RPM. In this manner, Conversa-phone's single record with 11 practice bands could be utilized as though the record presented 33 different practice sessions. (*International Morse Code*, 1965) The 1959 *Rider Sound-N-Sight Code Course* and the Farnsworth recordings had previously experimented with a similar concept but only for selected bands on their records (*Rider Sound-N-Sight*, 1959; *Revolutionary New Word Method*, 1959).

Magnetic Tape Recordings.

Magnetic tape recordings used for teaching Morse code first emerged in the 1940s. The McElroy Company offered free copies of their *Morse Code Course* as early as 1945 (QST, November, 1945). Ted McElroy made the hour long tape recording with the characters sent at 20 words per minute using ever decreasing spacing between each character. It is unclear whether the course was associated with any particular McElroy training device or whether instructions accompanied the tape (Pierpont, 2002).

In 1962, TapedCode offered magnetic tapes based on "Western Union, Railroad, Navy and Amateur experience". Their novice tape provided one hour of practice and an advanced tape provided two hours of practice at speeds up to 18 words per minute in five-character coded groups. The recordings were made on 1,200 foot lengths of Acetate tape stored on seven inch reels recorded in

dual track at 3 ¾ inches per second. (QST, January, 1962)

Sound History Recording's 1964 course for the complete study of the *International Morse Code* claimed to teach copy speeds of 35 words per minute. Their two hour practice tapes were also available on seven inch reels accompanied by an instruction manual. (QST, April, 1964).

Cassettes and Computers.

With the emergence of the compact cassette tape technology in the 1970s, many of the earlier phonograph and magnetic tape recordings of Morse code training programs were simply transcribed onto the new format. Together, phonograph LP records and cassette tape recordings targeted amateur radio hobbyists and maintained their popularity throughout the 1980s. Instructional recordings heavily marketed related products to amateurs, combining their LP or cassette recordings with other devices such as flashcards or inexpensive buzzer sets. A number of products were advertised as children's toys.

By the mid-1990s, cassette tape manufacturers continued to offer training courses no longer produced in phonograph record formats. But with the emergence of the home computer, the cassette tape recordings themselves began to be replaced by the newer floppy disk, and eventually the CDROM formats.

The growth of the internet by the late 1990s

opened an entirely new arena for free and even commercial software exchange of Morse code training programs. Today, many of the most popular courses can still be found in both cassette tape and CDROM formats, such as the broad product offerings of AMECO. Regardless of the format, however, the basic courses of instruction have remained the same. For example, the Amateur Radio Relay League still produces *Your Introduction to Morse Code* for both cassette tape and CDROM; providing the same 2.5 hours of practice lessons at speeds of 5 to 18 words per minute for both formats.

CONCLUSION

Together, Learner Sets, KOBs, disk and drum devices, paper tape machines and audio-visual trainers offered a range of effective mechanical means to teach and practice Morse code. Their simple designs and easy application permitted thousands of operators to learn the code for almost 150 years. The growth of the phonograph industry in the first third of the 20th Century and the use of ever more sophisticated electronics after World War II enabled manufacturers and entrepreneurs to develop new devices for teaching code. By the turn of the 20th Century, oscillators, electronic keyers and programs for the home computer dominated the market. While these 21st Century modern electronic tools offer greater variation in code speeds and timing practice

than their mechanical predecessors, they foster standards in expected code proficiency similar to those first developed by telegraph and radio operators during the preceding 150 years.

Notes

1. By the time of their historic 1844 telegraph demonstrations, Samuel Morse and Alfred Vail had developed and then refined their code of dots and dashes commonly referred to as “Morse” code (Pope, 1888; Munro, 1891; Calvert, 2004). Certain changes were later adopted at international conferences in 1851 and 1854. The revised code came to be known as the “Continental” or “International” code and the original Morse code with slight modifications was known as the “American” or “American Morse” code (Coe, 1993; Calvert, 2004). Throughout this text, the term “Morse” code will be used broadly and will not distinguish between the applications of International, American or other derivative codes.

2. After the turn of the 20th Century, combination sets became more widely known as key-on-board, or KOB sets, to broadly describe all instruments consisting of a telegraph key mounted to the same base as some other item, such as a sounder. The term KOB was infrequently used before the 20th Century (Casale, 2006).

3. See Moreau, 1995; Perera, 1999; W1TP Telegraph & Scientific Instrument Museums, 2005; Casale, 2006.

4. See J.H. Bunnell, 1900; “The Electric Telegraph”, 1909; MESCO No. 18; Telegraphy Successfully Learned At Home, 1912.

5. Jack Binns was the Marconi Wireless Operator aboard the liner Republic when it collided with the Italian cargo ship Florida on January 22, 1909. Binns made repairs and stayed at his station for the next 36 hours. He succeeded in guiding the rescue ship Baltic, through dense fog to save more than 1,500 passengers and crew. Binns became an instant

celebrity and later recorded a Morse code training course for the American Code Company. (Hancock, 1950; Loeterman, 1999; Pierpont, 2002)

Acknowledgements

We are greatly indebted to the many people who contributed their time, energy and enthusiasm to this research project. We would like to thank the following people who offered information, photographs or other documentation relating to the topics in this article including: Tom Perera, James Kreuzer, John Casale, Tom French, Gerry Maira, Russ Kleinman, Neal McEwen, Dave Meier, Michael Ross, the U.S. Army, U.S. Navy, U.S. Air Force and the Smithsonian Institution. We would also like to thank the Editor of the AWA Review, Robert Murray, as well as Michael Davros, a Professor at Northeastern Illinois University, for their editorial assistance with the text. Special thanks are given to John and Michael Bart who assisted with the photography.

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References

(1) Product Advertisements Contained In The Following:

ARRL Radio Amateurs Handbook, American Radio Relay League: 1940, 1942, 1956, 1962.
Commercial Telegraphers Journal: July, 1906.
CQ Magazine: May, 1962; May, 1963; December, 1964.
The Electrician: January, 1883.

Journal of the Telegraph: July 15, 1873; August 1, 1873.
Popular Mechanics: May, 1920.
QST: April, 1927; March, 1930; April, 1930; March, 1935; July, 1936; September, 1937; November, 1936; November, 1940; April, 1942; November, 1945; July, 1946; June, 1960; August, 1960; January, 1962; May, 1963; April, 1964; April, 1970; October, 1970.
Radio News: March, 1921; December, 1932.
Railroad Telegrapher: September, 1927; December, 1927.

(2) Online Internet Resources:

Code practice oscillator museum. Internet Site. Dave Meier. See <http://www.n4mw.com>.
Sparks telegraph key review. Internet Site. Russ Kleinman. See <http://www.zianet.com/sparks/>.
The telegraph office., Internet Site. Neal McEwen. See <http://fohnix.metronet.com/~nmcewen/ref.html>.
W1TP telegraph & scientific instrument museums. Internet Site. Tom Perera. See <http://www.chss.montclair.edu/~pererat/telegraph.html>.

(3) Jacket Notes and Instruction Manuals From Audio Recordings:

Chadwick, H. (1918). *Handbook of instructions and guide to Marconi wireless telegraph records for the Marconi Institute of New York*. New Jersey: Victor Talking Machine Co.
How to send and receive international Morse code. (1951). Raybrun code voice method. Orangeburg, New York: Raybrun Company.
Howard W. Sam's international code training system. (1963). International teaching systems, photofact publication no. 20138. Indianapolis,

Morse Code Training Devices

- Indiana: Howard W. Sam's and Co. Inc., The Bobbs-Merrill Company, Inc.
- International Morse code course.* (1957). Chicago: Allied Radio Corporation.
- International Morse code.* (1965). Farmingville, NY: Conversation Institute, Inc.
- Learn the International Morse code.* (1951). Raybrun code voice method. Orangeburg, New York: Raybrun Company.
- Learning the international Morse code: Archer international Morse code beginner's course.* (1969). Fort Worth, Texas: Prepared for Radio Shack by Bob Gunderson. Bates Music Publishing Corp.
- Mastering the Morse code.* (1957). Martin Schwartz. Mineola, Long Island, New York: American Electronics Co. "AMECO".
- Morse code instruction course.* (1950). Brooklyn, New York: Brumberger Corporation.
- Photosound course.* (1950). Phonograph recording jacket notes. Los Angeles: Electronic Technical Institute.
- Photosound training.* (1955). Phonograph recording jacket notes. Los Angeles: Electronic Technical Institute.
- Radio code instructional recordings.* (Undated 1950s). Bureau of Naval Personnel Training Aids No. 11035, U.S. Navy. Los Angeles: Electronic Technical Institute.
- Revolutionary new word method to learn radio code.* (1959). Donald Russell Farnsworth. Redwood City, California: Epsilon Records.
- The Rider Sound-N-Sight code course instruction book.* (1959). New York: John F. Rider.
- Smith, Herman H. (1959). *Beginner's International Morse code course: the modern practical method.* Brooklyn, New York: Herman H. Smith, Inc.
- Tuthill, Lt. Cdr. F.R.L. and Battey, Lt.(J.G.) E.L., (1942). *International Morse code: a course of practical instruction.* New York: Linguaphone Institute.
- Tuthill, Lt. Commander F.R.L. and Battey, Lt. (J.G.) E. (undated 1950s). *International Morse code course.* Long Island City, New York: Insuline Corporation of America.
- Uncle Sam's Morse code records.* (1956). Chicago: ReCupidio Enterprises.
- Your introduction to Morse code.* (1997). West Hartford Connecticut: Amateur Radio Relay League.

(4) Other Resources:

- Apparatus for self instruction in the continental telegraph code (1918, September). *The Wireless Age.* New York: The Wireless Press, Inc.
- Calvert, J.B. (2004, May). The electro magnetic telegraph. *Telegraph: The history of telecommunications and related matters.* Denver: University of Denver see www.du.edu/~jcalvert/tel/telhom.htm.
- Casale, J. (2006, May 14). Email Correspondence Re: Draft Book Review.
- Coe, L. (1993). *The telegraph: a history of Morse's invention and its predecessors in the United States.* Jefferson, North Carolina: McFarland & Company.
- Central Electric Company catalog* (1915). Chicago: Central Electric Company.
- Department of the Army technical manual no. TM 11-437A and Department of the Air Force technical order TO28-30GSC1-6 jointly issued manual for code training set AN/GSC-T1A* (1954, Novem-

- ber 1). Washington, D.C.: US Army.
- DeSoto, C. (1936). *Two hundred meters and down: the story of amateur radio*. West Hartford, Connecticut: The American Radio Relay League, Inc.
- Edison, T. (1902). *Telegraphy self taught*. Chicago: Frederick Drake and Co.
- The electric telegraph (1909). *Cyclopedia of applied electricity*. Chicago: American School of Correspondence.
- Wireless and electrical cyclopedia no. 20* (1912). New York: The Electro-Importing Company.
- Friedman, N. (1984, February). A clockwork omnigraph. *CQ Magazine*.
- Gernsback, S., Secor, H.W. and Lescarbours, A. (1918). *Wireless course in twenty lessons*. New York: The Electro-Importing Company.
- Hancock, H.E. (1950), *Wireless at sea: the first fifty years*. Chelmsford, England: Marconi International Marine Communications Company, Ltd.
- The Instruct-O-Graph (Advertising literature) (1947). Chicago: Instruct-O-Graph Co.
- J.H. Bunnell & Company catalogue and manual of telegraphy* (1895). New York: J.H. Bunnell & Company.
- J.H. Bunnell & Company catalogue and manual of telegraphy* (1900). New York: J.H. Bunnell & Company.
- Kirkpatrick, O.B. (1947). *Telegraphy: Continental and American Morse instruction for wireless and wire*. Chicago: Instruct-O-Graph Company.
- Loeterman, Ben (Producer) (1999). "Rescue at sea", *The American Experience* (Television Series). Boston: WGBH Educational Foundation.
- MESCO catalogue no. 18* (Undated). New York: Manhattan Electrical Supply Company.
- MESCO catalogue no. 28* (1912). Something electrical for everybody. New York: Manhattan Electrical Supply Company.
- MESCO manual of wireless telegraphy and catalogue of radio telegraph apparatus* (Undated). New York: Manhattan Electrical Supply Company, Inc.
- Moreau, L.R. (1995). *The story of the key*. Hertfordshire, England: Morsum Magnificat.
- Munro, J. (1891). *Heroes of the telegraph*. London: The Religious Tract Society.
- N7CFO keyletter: a newsletter for telegraph key collectors* (June 8, 1992 to May 22, 2005), Bellevue, Washington: Lynn Burlingame.
- Omnigraph Manufacturing Co. (Advertising literature) (1918). New York: Omnigraph Manufacturing Co.
- Palomar engineers IC keyer* (Technical data sheet) (1969). Escondido, California: Palomar Engineers.
- Pennes, Dr. D. R. (2002, April and June). The omnigraph instruments. *Morsum Magnificat*.
- Pennes, D. (2006, January). The omnigraph instruments. Key and telegraph column. *AWA Journal*. Vol. 47 No. 1.
- Perera, T. (1999). *Telegraph collector's guide*. Maynard, Massachusetts: Artifax Books.
- Pierpont, W. (2002, April 20). *The art & skill of radio-telegraphy*. Retrieved June 2005 from <http://www.qsl.net/n9bor/n0hff.htm>.
- Pope, F. (1888, April). American inventors of the telegraph. *Century Magazine*. Vol. XXXV.

Morse Code Training Devices

- Practical radio: be a radio expert* (1927). Washington, D.C.: National Radio Institute.
- Prescott, G. (1866). *The history, theory and practice of the electric telegraph*. Boston: Ticknor and Fields.
- Radio for the millions* (1945). Popular Science Editorial Staff. New York: Popular Science Publishing Company.
- Reid, J. D. (1879). *The telegraph in America*. New York: Derby Brothers.
- Rich rewards in radio: be a radio expert* (1934). Washington, D.C.: National Radio Institute.
- Sears catalogue* (1902). Chicago: Sears Roebuck and Company.
- Smith, T. (1997, February-June-August-October). Morse learning methods. *Morsum Magnificat*.
- St. John, T. (1910). *Things a boy should know about wireless*. New York: Thomas M. St. John.
- Telegraphy successfully learned at home* (1912, December). Valparaiso, Indiana: Dodge's Telegraph and Railway Institute.
- Telephony: Special U.S. Army Signal Corps Issue (1942, November 28). *Telephony*.
- War Department technical manual no. TM 11-432 code practice equipment* (1942, February 2). Washington, D.C.: U.S. Government Printing Office.
- War Department technical manual no. TM 11-443 for keyer TG-34-A* (1943, October 25). Washington, D.C.: U.S. Government Printing Office.
- War Department technical manual no. TM 11-447 for keyer TG-10-J* (1943, May 15). Washington, D.C.: U.S. Government Printing Office.
- War Department technical manual no. TM 11-45. Instructions for learning International Morse characters* (1943,

June 2). Washington, D.C.: U.S. Government Printing Office.

About The Authors

David and Julia Bart are both from the Chicago area where they continue to reside with their two sons, John and Michael. They first met at the University of Chicago where they took a year long course in the history of science and natural philosophy.

David received both his Bachelor of Arts Degree in Anthropology and Statistics in 1985 and his Masters Degree in Business Administration in Finance and Accounting in 1993 at the University of Chicago. His career as a financial consultant and expert witness in corporate bankruptcy and commercial litigation has offered David many perspectives on the successes and failures of business enterprises. He has maintained a strong interest in the history of science and early communications since childhood, and has collected radio, telephone, phonograph and telegraph devices for over 20 years. David's interests now focus on the history of telegraphy and the application of this technology. His current research on the history of teaching the Morse code in America is being compiled into the first comprehensive book on the subject. David holds a Ham Radio License and is a long time member of the Antique Wireless Association. He is the President of the Antique Radio Club of Illinois and is an active member of the Michigan Antique Radio Club and the Indiana Historic Radio Society. He is the Chairman of the Museum Advisory Council for the Museum of Broadcast Communications in Chicago and has been recently named as Curator of its radio and television collections. David is currently consulting with the Newberry Library of Chicago on future exhibits exploring the impact of science and technology on society and the humanities.

Julia received her Bachelor of Arts Degree in Behavioral Sciences in 1987 from the University of Chicago.

She is an elementary school teacher with a Certification in Early Childhood Education and is working toward her Masters Degree as a Reading Education Specialist at Concordia University. Julia's interests focus on literature and the arts, the sciences and the process of language acquisition. She is currently involved in designing procedures for the assessment and identification of special needs children to facilitate the delivery of early intervention educational services. For the past five years, Julia has served as a judge for the Illinois Junior Science Academy regional and state competitions. Julia is a long time member and past Treasurer of the Antique Radio Club of Illinois where she continues to play an active role as a volunteer. Julia is also an active member of the Michigan Antique Radio Club and the Indiana Historic Radio Society.

Together, David and Julia have enjoyed building their collection of communication devices and provided numerous demonstrations and programs for the Boy Scouts of America, school groups and local historical societies.



Julia and David Bart.