The Art and Skill of Radio-Telegraphy

A Manual For Learning, Using, Mastering And Enjoying
The International Morse Code As A Means Of Communication

William G. Pierpont N0HFF
"What Hath God Wrought!"

"For those who are interested in telegraphy, for those who would like to learn it, for those who love it, and for those who want to improve their skills in it."

N0HFF

The art and skill of telegraphy is unique. The psychologists who have seriously studied those who have developed this skill have been fascinated and challenged to try to understand it. Isn't the very idea of being able to communicate your thoughts to another by means of intermittent tones something intriguing in itself?

Third Revised Edition
Last edit – April 20, 2002

Table of Contents

Title Page

Table of Contents

Preface

Introduction

Is the Radiotelegraph Code Obsolete?

An Overview - Where are we are going?

Part One – Learning the Morse Code

Chapter One	How to go about it efficiently
Chapter Two	Principles of Skill Building and Attitudes for Success
Chapter Three	Let's Begin With The A-B-C's - Laying the Foundation
Chapter Four	Building the first floor on the solid foundation
Chapter Five	Practice To Gain Proficiency
Chapter Six	How Fast? The Wrong Question - How Well!
Chapter Seven	Listening or "Reading"
Chapter Eight	Copying- Getting it Written Down
Chapter Nine	Sending and the "Straight" Key
Chapter Ten	Other Keying Devices and Their Use
Chapter Eleven	Further Development of Skills
Chapter Twelve	How Long Will It Take To Learn?
Chapter Thirteen	The Role of Memory in Telegraphy
Chapter Fourteen	The "Ear"
Chapter Fifteen	Timing
Chapter Sixteen	Other Methods
Chapter Seventeen	Common Errors and What to Do about Them
Chapter Eighteen	Computer Programs and Tapes for Learning and Improving Skill in Code

Part Two – Chapters on Subject of Morse Code …

Chapter Nineteen	A Brief History of Morse Telegraphy
Chapter Twenty	Learning the American Morse Code
Chapter Twenty-One	Methods Not Recommended
Chapter Twenty-Two	Word Lists for Practice
Chapter Twenty-Three	Making Sure You're Understood
Chapter Twenty-Four	Bandwidths and Key Clicks
Chapter Twenty-Five	Code Courses and Devices Advertised in the Older Days
Chapter Twenty-Six	Speed Contests
Chapter Twenty-Seven	Abbreviations
Chapter Twenty-Eight	Letter Frequency Counts
Chapter Twenty-Nine	The Koch Researches
Chapter Thirty	The Candler System
Chapter Thirty-One	The So-Called "Farnsworth" or Spacing Method
Chapter Thirty-Two	Other Alphabets
Chapter Thirty-Three	A Brief History of United States Operator Licensing Requirements and Military Training
Chapter Thirty-Four	Examples which Illustrate the Nature of Real Skills
Appendix	Sources of Material
Appendix Two	High-Speed Appendix

A French translation of this book is available courtesy of Maurice, F6IIE.

Edited by Fred Adsit, NY2V.

Typography by Michael Dinelli, N9BOR.

Cover Design by Norman Wald, W9VQ

Download site : http://www.qsl.net/n9bor/n0hff.htm

The Art & Skill of Radio-Telegraphy

William G.Pierpont N0HFF
-Third Revised Edition-

Preface

The first edition of this book was prepared under a strong time-pressure to collect and preserve the results of years of reading and research into the best ways to learn the code initially, to gain skill -- how the experts say they do it -- together with a number of other associated aspects of interest. The urge was to get the major principles and features organized before they got lost or buried in my files.

Diskettes of that first edition were shared with a very few people. It was soon replaced by a revised first edition in which a number of accidental errors were corrected and some clarifications made in wording. It was also produced under considerable pressure, leaving quite a number of additional items of general or specific interest lying unincorporated in the files.

Many diskette copies of the second edition were distributed. A thousand diskette copies were made and distributed free by the Virginia Beach Hamfest and Convention. It was copied and printed by the FISTS CW Club of North America and by several others, including my friend James (Jim) Farrior, W4FOK, who has reproduced it in his MILL code learning programs.

This Third Revised Edition fills in selected new items, and adds a new High-Speed Appendix. It is hoped that this new edition will be welcomed by those who love the subject of telegraphy and will continue to be helpful to those wishing to learn or perfect this fascinating and worthwhile skill.

It is my hope that you, as the reader, will find it both interesting and useful. I make no claim that it is complete, perfect or final, or that it contains everything of possible value or interest. I have had to leave out some interesting items, especially of history. Perhaps some of these, plus anything you, as reader, may wish to contribute, could be added in further editions.

N0HFF

Introduction

The research behind this booklet would probably never have been done at all if I had not been so eager to learn the telegraphic code, but made such a terrible flop of it. I just barely qualified for a license in early 1930, and for a very long time could not receive it well enough to really enjoy using it. Like most others in those past days, I memorized the "dots and dashes" from a printed table.

A good teacher might have helped, but.... If only I could have had just the following key paragraph from the QST article of July 1923, it would have at least gotten me off on the right foot:

"The first step in learning the code is to memorize the dot and dash combinations representing the letters. They must not be visualized as dots and dashes, however, but rather should be "auralized" as sounds. There is no such word as auralized, but if there were it would express the correct method of grasping the code. The sound dit-dah (meaning a dot followed by a dash) in the head telephones must impress your mind directly as being the letter A, for instance, without causing black dots and dashes to float before your eyes for an instant. This is a point that always troubles beginners, but if you learn from the first to recognize the sounds as letters immediately without reverting to dots and dashes, you will make much better progress."

More succinctly: "Don't try to teach the Ears through the Eyes." (Wireless Press 1922)

I was not alone in making this first false step: very many others did it that way, too, and probably some today still do. It was and is the inevitable reason why most people who start this way get stuck at some speed, around ten words per minute or less, and can't seem to get beyond it.

The second mistake, even in learning by hearing, is in hearing the characters sent so slowly that the learner tends to analyze each one into dits and dahs, and even counts them mentally. (It is wise indeed for the beginner never to hear code characters sent at speeds below about 13 wpm.) These two errors largely account for getting stuck at higher speeds also -- they mean we have not really learned the characters.

Today, there are many tapes and computer programs available which teach the Morse code in ways that avoid making either of these basic errors. This booklet has been written to share the results of this research of the literature -- also including talks with skilled operators -- with those who want to learn or teach the Morse code, or to improve their own skills. It majors on the methods that have proved most successful, but also discusses some, which should be avoided. It offers guidance for those just beginning, and help for those who are stuck and want to improve. It also tells how those who are proficient and those who are experts operate.

Some history and related items are included in the later chapters for those who are interested in telegraphic communication. My hope is that you will find it not only interesting but helpful. This is a "How To" book, not a scientific treatise. Source credits for individual items have rarely been noted. Many a contribution has come from multiple sources. Most of the significant sources are listed under Sources.

"I have never known a person who was truly proficient with code to dislike it: on the contrary, the more proficient they are, the more they love it." The Morse code is a means of communication, a new way to enjoy expressing yourself.

N0HFF

Is the Radiotelegraph Code Obsolete?

Outsiders and some of those looking into Amateur Radio often ask this question: "Isn't the Morse code obsolete? Hasn't modern technology displaced it?"

Back in 1912 nobody balked at learning the code: it was simple then -- if you didn't know the code you couldn't even listen and understand, much less communicate, by wireless.

But today it refuses to lie down and die. Why? Not only old timers, but many newcomers have found that it is a skill worth learning, a pleasure just as any other skill. There is a real sense of pleasure and achievement in communicating this way. Some find it an excellent means of escape, a way to forget immediate work-a-day problems and completely absorb one's attention.

There is practical value also. It can get a message though where other methods fail. Operators have long known that Morse code signals penetrate distance, and go through interference and static where voice signals can't hack it. This is why low power (QRP) enthusiasts find that it is far superior to voice. Besides this, the equipment required, both transmitting and receiving, is much simpler and smaller, uses less power, and in an emergency can often be built up from simple, available parts.

These factors did not escape the Russian communists. They were also deeply impressed with the reliability, simplicity and lower cost of equipment for code communication and ease in maintaining it. (In the same line of thinking, their military radio gear has all been vacuum tube type to avoid potential damage due to radiation.) Therefore, through the years they have popularized and promoted learning the Morse code and developing skill in its use. It was included among their civilian "sports" activities. Contests and prizes were offered to the best and fastest operators. This would assure them of a pool of skilled, high-speed operators in event of war. Several years ago a couple of American soldiers who were amateurs were taken captive from a ship which was too close to North Korean shores. They were surprised to find that very many civilians in that country readily understood code.

In recent years our own military seem to have awakened to all this, and have re-begun to train some personnel for Morse code operation. In addition, they have realized that Morse is an effective means of communicating during periods when the enemy is jamming. There are other advantages also. It uses the next to narrowest signal bandwidth (PSK31 uses less but requires a computer) , which for amateur use means more channels are available within a band. It has much superior signal-to-noise ratio, and in addition, an operator can soon learn to separate (mentally "filter") signals, which are very close together by differences in pitch, speed and style of sending.

Learning the Morse code
An Overview - Where are we going?

If you are looking for any magic, any secrets, any tricks here -- or hypnotism -- you won't find it. What we do offer is just practical, time-tested working methods, which together take advantage of all that has been learned over the years about how to teach and learn the Morse code efficiently and well.

George Hart, long time code expert with ARRL, put it this way: "The greatest obstacle in learning code is the method used."

Ted R. McElroy, teacher and long time code speed champion, said that any normal person can easily achieve 25-wpm. This is an easily achievable and reasonable goal. One who can handle this speed comfortably is a good operator.

The original American Morse code of 1845 was designed to communicate: to transmit over the telegraph wires any and every kind of written message or information in letter-perfect, number-perfect, and punctuation-perfect form. It was recorded as a wiggly line on a strip of paper tape to be read or interpreted by eye. Very soon the operators discovered that they could read the recorder's noises accurately by ear, and so in time sounders slowly began to replace the recorders.

Not very long after this, beginning operators became so skilled that they began to chit-chat easily over the wires among themselves, much like radio amateurs do today when they "chew the rag". That kind of freedom should be our goal - easy, natural use of the code to communicate, similar to the way we read and talk. That's where we are headed.

The code is not a new language. It is the language you already know, "written" in sound patterns instead of patterns of ink on paper - it is your own language. You will learn to "read" by ear the language you already read so well by eye.

This is lesson one -- it is most important always to think of it this way: -- EVERY CODE LETTER, NUMBER AND SYMBOL IS A UNIQUE PATTERN OF SOUND.

Psychology teaches us that when we start to learn something new, if we think of it as being EASY, it will be easy. The best teachers never hint or suggest that there is anything hard about it, and their students learn it quickly, usually within a week or two. They also make learning it FUN. We learn much faster that way; so think of learning it as fun -- enjoyable. If you want to learn it -- you can.

Our FOUNDATION is the alphabet, numbers and punctuation marks. Learn these SOUND PATTERNS so well that when, for example, you hear "dahdahdit" you immediately recognize it is "G". This is basic, but don't stop there. Code is to communicate: and we don't talk in letters, but in words. Words are our smallest thinking units. Even while we are still learning to master

the alphabet we can begin to recognize small common words, such as "the" and "of" as words when we hear them.

When we first learned to read, we could already talk, but reading was something new, and it took a little effort to learn. At first we had to spell out each word, then try to figure out how to pronounce it, and then remember what we had already deciphered while we tackled the next words until we had laboriously "read" the whole sentence. The beginning stage of learning the code is that way, too, but it doesn't need to stay that way. Words are written as strings of letters, one letter after another. But we don't read them that way -- we read the word. If we couldn't spell we couldn't write either -- or else we would have to use hieroglyphics. Words must become our units of thought in Morse because words make sense and they are easy to remember.

Reading code, like reading print, becomes much easier and faster when we have learned to RECOGNIZE WORDS instead of spelling them out as strings of letters. A good reader reads words, and even strings of words at a glance. We can learn to do it: many, many others have. We are hardly conscious of the letters, which spell out the words we read so easily now. Our attention is focused on the THOUGHTS written in print, and our reactions are to the ideas expressed.

When we begin to reach this stage with Morse code, we are beginning to become proficient. So our plans are

- to learn the alphabet of sound patterns so well that we recognize each letter instantly, then
- to learn to recognize most of the words we hear as words, and finally
- to learn to listen to the stream of code as we would to someone speaking to us in words and ideas.

That is proficiency, whatever the speed is being received. We can learn to do this at any speed. Our goal should be to learn to use the code so that it becomes easy and natural, like the way we read and talk.

Chapter 1

How to Go About it Efficiently

This Chapter Is A Summary to Prepare You to Learn

Learning the Morse code is acquiring a NEW set of HABITS. It is a skill subject governed by the same principles that apply to learning tennis, shorthand, typing, playing a musical instrument, etc. Regular consistent, repetitive PRACTICE sets in concrete what we do and the way we do it.

Some people have managed to master the Morse code without any help. Others have used poor methods, and both have all too often given up when they came to a plateau, short of proficiency. Today methods are available which almost guarantee success, and a number of fine courses exist using these methods.

These principles are outlined below and will get the beginner off on the right foot and bring him to proficiency. If you are one who has gotten stuck, use them to get back on track. They offer the most rapid way to success in learning the telegraph code and achieving a real mastery of it.

PREPARED - prepared with the right ATTITUDES, and with knowing WHAT to do and HOW do it. This can mean the difference between success and failure.

1) Your ATTITUDE toward learning is crucially important: It is essential PREPARATION for success.

- Have a "CAN-DO-IT" attitude, because it is easy to learn. If you don't tell people that learning the code is hard, it won't be. If you really want to learn it, you can. Approach it as if it were impossible to fail. Motivate yourself.
- Keep a RELAXED ATMOSPHERE, free of tension, pressure, and any sense of hurry and anxiety.
- ENJOY the learning process itself.
- PICTURE YOURSELF BEING SUCCESSFUL.

Comments: Whenever we think of anything as "hard," it creates a stumbling block, and that tends to discourage us. - Most people find that competition during the initial stages hinders learning. - In actual reading and copying code, any anxiety or undue concern about "getting it all", or too intense interest in what is being received, or trying to outguess what is coming next, can cause us to miss out some of what follows. - People who do things well do not struggle with them. - "Relaxed receptiveness" works.

2) Get your first impression of the code characters by LISTENING to them - BY EAR - the way you will actually use them.

Throw away all printed code charts and any trick memory methods people offer - they will inevitably slow you down and may even discourage you as you advance.

Comments: The reason learning the code by eye or by mental pictures will slow you down is because our visual and auditory (hearing) memories are completely separate from and unrelated to each other. Trying to learn by charts or "sounds likes" slows down learning because they make us go through one or more needless steps each time we hear a character. In both cases the mind has to go through a conscious analytical or translation exercise for each signal. See Chapters 4 and 13.

3) From the very first, learn to hear each code character as a UNIT OF SOUND, a whole pattern, a rhythm.

At first each character should be sent fast enough, preferably from about 18 to 25 wpm or even faster, for us to hear it as a unit, and with a wide space before and after it. Never, never try to analyze it into parts. This is most important.

4) The Code Character is the Letter.

For example, when you hear "didah" and recognize it immediately as being "A" - you are "hearing" the letter "A." Associate the code signal with the printed letter so intimately that when you hear or think of the one, the other immediately pops into mind. Our mental "equation" should be immediate, like this:

"didah" "A",
and "A" "didah".

Instant recognition is what we strive for.

THESE FOUR PRINCIPLES ARE ABSOLUTELY ESSENTIAL.

5) Concentrate On One Aspect at A Time.

For example, don't try to learn to block print or typewrite while you are learning to copy.

6) Learn To Receive the Code Accurately - this is our primary goal.

In receiving we must wait until each character or word has been completely sent before we can correctly recognize it. We must develop that patient, receptive state of mind that allows us to recognize each character instantly and accurately as soon as it has been completed.

7) Listen only to ACCURATELY SENT CODE.

Accurate character formation - timing - is essential for efficient learning. Proper spacing between letters and words is as important as the correct formation of the characters themselves and becomes even more important as speeds increase. At first it is best to listen to cassette tapes, computer or keyboard generated code. If you have a teacher follow his advice.

If you listen to poorly sent code you will needlessly distract the mind by forcing it to try consciously to figure out what the characters are supposed to be. (Once you become proficient, you can learn to read such sending.) Likewise, in the early stages of learning avoid all distracting noises, and interference, such as static and other signals.

Sending becomes relatively easy after you have a good timing sense. It is also easier because you know in advance what is coming next. However, listening to your own sending at too early a stage may hinder learning because the characters are not being sent accurately enough.

8) Plan for regular daily PRACTICE PERIODS.

The learner needs to know exactly WHAT he is going to do and WHEN. Make them SHORT ENOUGH to prevent fatigue, boredom or discouragement. SPACE them widely enough apart to let what you have gained sink in. Practice is building habits: let's practice only what is right.

We all have our ups and downs. Some days we will do better than others- this is just a part of normal learning, so don't let it discourage you. It's better to put off practicing to advance at a "bad" time (if you're tired out, sick, down in the dumps). Make practice material enjoyable - interesting in variety and content.

9) LISTENING and COPYING.

If you are studying alone, start out by just listening without writing down anything. (See section 2 above.) Listen to the signal and say the name of the letter or number out loud immediately after you hear it. After you get familiar with all the letters and numbers so you feel somewhat comfortable recognizing them, then practice writing down each letter or number immediately after hearing and recognizing it (that's called "copying"). See Chapters 7and 8.

Teachers differ on the best way to start out. Your teacher or course may start out having you write down each character as you hear it. Either way is to help you associate the sound with the letter or number. Sooner or later you will want to be able to do both.

In any event, as skill increases we are going to have to learn to copy. At first it will be letter by letter. But that will prove to be too slow as our skills increase. - In order to advance we need to learn to copy behind: that is, to be writing down what has been heard while listening to what is being sent. This only needs to be a syllable or two or a word or two behind, even at high speeds - this takes the pressure off. For many people it seems to develop almost automatically as they practice and use the code, but most of us need help. There are several exercises, which can help us. See Chapter 8.

Some hams started out copying everything, and have become so tied to their pencils that they just can't seem to understand anything without writing it down first. That is an awkward way to converse! "Throw Away Your Pencil" is good advice. It forces us to learn to receive by just listening. (I knew a ham who for over 60 years couldn't receive without a pencil. When he became almost blind, he had to learn - and he did, very quickly!) We need to learn both ways - to copy and to listen. So what if we miss a few words here or there? - We can still get the gist of it. Remember - even the best operators sometimes miss a word or two.

10) We gain SPEED by the right kind of practice.

It depends on more and more nearly instant recognition, first of characters, then of words and finally of larger units of speech and thought. To advance in receiving speed we must push ourselves. Short bursts of speed work best - even as short as a single minute at a time, rarely more than 3 to 5 minutes. If you want to increase your speed, listen to code at a speed faster than you can get it all, and pick out all the words you can recognize. In copying, pick a speed just a little too fast for at least part of your practice time. How fast you want to be able to receive is up to you. Set your own goal.

Remember, however, that the goal is COMMUNICATION of intelligence, not just speed for the sake of speed.

11) We advance in skill after mastering the letters, numbers, etc., by learning to HEAR WORDS AS WORDS instead of just strings of letters.

This is the second stage in mastering the code. Most people find it already beginning even while still working to master the alphabet, as they recognize little words like "of" and "the." We need to extend it to include at least the words we use most often. Start by deliberately listening for and practicing them until they become units of sound and recognition- heard and sent as words.

Our list of 100 most common words is a good place to begin (see end of Chapter 4). Practice them by listening to them, and as you send them over and over - until when you think of the word it just seems to flow naturally as if you were reading or writing it. Practicing with these common words seems to help the brain begin to learn to handle many other words as words, too. We can extend this skill by practicing some of the word prefixes and suffixes, such as pro-, per-, com-, -ing, -tion, etc. The bigger the units of sound we recognize as units the easier receiving and sending become.

This kind of practice, with careful regard for spacing and timing, will prevent forming the sloppy habits some hams have fallen into as they run the letters of short words together like a single complex character, and also when they forget to space between words. These things make reading and copying very difficult, and as speeds increase, can make it almost impossible.

12) OVERLEARNING is the secret of real proficiency.

It is achieved when we simply receive and send in code with the freedom and ease that we have when we talk, read and write, virtually unconscious of the code as code at all. One old-time

operator, when asked whether the other ham had used a certain word, replied that he didn't remember the actual word - he had the thought clearly in mind, but he couldn't remember the exact word. That is a mark of the expert.

From the language arts we learn how people become fluent in a foreign language. It is by R E P E T I T I O N, saying the same sentences over and over, with or without little variations until they become automatic. Or in other words, just BECOMING SO FAMILIAR WITH IT that it seems natural. When we reach that point, no matter what our top speed may be, we have achieved a mastery of the code. It is a goal well worth our efforts.

These points are expanded and explained in considerable detail in the rest of Part I. If you are a beginner, go immediately to Chapter 3.

Chapter 2 will help you understand the whys of our recommendations, and the further chapters are yours to grow on.

Experience has shown that under normal conditions, like riding a bicycle, once your code skill has reached about 13 or more words per minute (wpm) it is never forgotten. You may become "rusty" but the skill quickly returns.

How Long Will It Take Me to Learn?

Those who have been taught using these principles and methods have taken from a minimum of one week to an average of about three up to eight weeks to achieve a satisfying 15 to 20-wpm working speed. People are different in background, in attitude, in approach to learning, in interest, enthusiasm and drive, and in what they want to do with the Morse code once they have learned it. All of these factors play a part in the time it will take. The main thing is to WANT to learn it, whatever time it may take, to realize that it is EASY and to want to USE it when it has been learned. Those who just learn it to get a license, and do not intend to use it will probably find it not useful within a year or two. Yet some of them may even find that it is interesting - really interesting and worth while. Some have done this already. Read Chapter 12.

Code is a pleasure when we know it well. It is an art worth acquiring.

It Is To Be Enjoyed

Chapter 2

Principles of Skill Building and Attitudes for Success

Two factors are of primary importance in building a skill efficiently:

1) Right mental attitudes
2) Practice - doing it the right way from the very start.

Neither one alone will maximize success. Here we apply these principles to learning the code.

We Are Building A Set Of Habits

Skill-building is generating a set of habits. It begins at the highly conscious levels of letter by letter, number by number, etc. Gradually your skill will build up - sometimes by sudden breakthroughs. More and more sub-conscious control takes over and there will be less and less conscious thought about it. As it becomes more and more automatic, your full attention can be given over to the thought content, the ideas expressed while listening, and when copying, you may find yourself thinking of something altogether different.

Telegraphy is a skill somewhat like playing golf, a musical instrument, typewriting, etc. It is learning a set of habits, which can be called into operation whenever desired, and which work automatically and without conscious effort when we want them. It has an active and a passive aspect. It is active when we are sending, and passive when receiving. The goal is to become able to receive and send as easily as the expert does - he is comfortable about it - just as if he were carrying on a conversation.

Skill is developed by consistent, repetitive practice of materials which become increasingly familiar (letters, numbers, words, punctuation, etc.). Never practice error! Only correct practice is beneficial. This builds confidence and proficiency.

Our major focus will be on learning to receive (which is listening with understanding or by writing it down). Ultimately conscious thinking of the code must be eliminated, and we respond automatically. Then sending will be easy, too.

Anything 1) that produces tension or 2) requires thinking, interferes both with the learning process and with using the code.

Relax!

In the process of learning, minimize tensions by having a clear picture of where you are headed - the goal, what you are going to do and the steps you're going to take to get there. Take little steps, one at a time - small enough that you know you can do each one. Introduce new material little by little, in small enough bites that you don't feel overwhelmed - yet not so slowly that it

becomes boring. Provide enough variety to keep it interesting, and introduce new items as soon as you are ready.

Take it easy. Especially in the early learning stages keep things at low key, comfortable and free from strain. Some people learn faster than others, so it is a good idea to avoid all competition (because it tenses us up) while you are learning the new game of the A B Cs in sound - learn at your own rate.

Avoid all unnecessary tensions because they tend to distract our attention. That also means we need to get rid of all kinds of distractions, worries, duties and anything else that makes us feel concerned, so that we can concentrate on what we are doing. That makes learning easy.

Relaxation and confidence go hand in hand. Each promotes the other. Easy does it. When you know you are doing the right thing in the right way, this promotes confidence, and that makes learning easier.

There are many schemes to learn how to relax. They generally begin by learning to pay attention to specific parts of the body one after another, such as starting with the toes and feet and going upwards, to legs, abdomen, chest, arms, hands, neck, head, face, eyes, etc. As you concentrate on each part, first tense it so that you know what tension feels like, and then deliberately release that tension and recognize what relaxing it feels like. With practice this can be done in a relatively short time, an almost all at once action. Breathing can also be coordinated so that deep inhalation, followed by exhaling easily is thought of as producing relaxation. Try it.

Develop A Good Mental Attitude

Anticipate success. "Nothing succeeds like success." In order to succeed you must first believe that you can do it. Everything possible must be done to guarantee success at every step, and to prevent any sense of discouragement or failure from developing. Never even suggest that learning it could be hard. - As for errors, ignore them, except that when they are persistent they merely point out where more practice is needed. With the right approach and right practice you can't fail.

Mental attitude is critical: We should approach every aspect of learning with interest, enthusiasm and a positive "can do" outlook. Anyone who really wants to learn the code can learn it. If you have the ambition to learn it you have the ability to do it. A feeling of confidence is vital to achievement, and must be guarded carefully. "If you think you can, you can."

Don't fight negative attitudes, such as anxiety, fear, worry and doubt. But if you do feel any of them, admit it, and then ignore it and let it die of inattention.

Make learning fun. Enjoy the learning process itself. When I am so eager to learn that I can hardly wait to get going, how receptive I am and what energy surges up! Watch how youngsters play and learn as they play. They are good models: they're relaxed and having fun. They don't pay any attention to mistakes. Imitate them and enjoy learning the code. That makes it even easier, and more enjoyable.

Stage One - Learning the A-B-C's

Our first impressions are the strongest and most long lasting. So be sure your very first exposure to the code signals is right - by hearing it. Otherwise, it may raise a roadblock, a "plateau", somewhere along the path which will require us to go back to line one in order to advance.

- Code is sound - heard with the ears, not read with the eyes.
- Listen from the very beginning only to perfectly sent code until you have mastered it.

To advance rapidly your mind should hear only consistent patterns of sound. This hammers it into the mind, hearing the same character formed exactly the same way each time. Poor quality code will tend to confuse the mind, distract your attention, and slow down your rate of learning.

A recent study by Dr. Henry Holcomb of Johns Hopkins University on learning new skills says that after first learning "how to do it", engage in routine activities of some other kind to allow a five hour time period in which no other new skill learning is attempted. He claims that experiments show that it takes about six hours to permanently transfer the new learning from the front brain to permanent storage in the rear brain. This is something to try and see if it helps speed up Morse code learning. He also added something we already should know: that it takes lots of practice to learn rapid, complex, and precise hand motor-skills.

Develop a sustained attention. Attention to the thing in hand is the starting point of all learning.

- identify what needs attention, and
- do that, focusing on it alone, and
- do it early in the practice period when energy levels are highest.

The more interesting the subject is, the easier it will be to concentrate on it. Direct your mind to go where you want it to go by stimulating your interest.

A stop-start technique will help you gain control of your attention span and lengthen it. It works this way: When attention lags, don't fight it, but stop all thoughts and clear the mind, then let your interest and enthusiasm start it up again fresh and naturally. If the distraction is one that you can identify, clear the mind by either settling it at once, or by setting it aside to handle later.

It is impossible to try NOT to attend to something, such as a distraction. Attention to it will only make it more distracting.

It has been suggested that the mind resembles a portable built-in computer, but it is far superior. It can do feats of information processing and recall unequaled by the largest computers. First we must debug it and get rid of any old bad attitudes about the code and replace them with a positive "can do" and "enjoy it" outlook. Next, feed it with a "lookup" table of sound-equivalents for the various characters, and we're in business: an automatic motor-response to the audio signals: we hear didah and immediately visualize and write "A". Don't put an artificial limit on your speed of comprehension.

Stage Two - Practice

Once the fundamentals are well in hand and our speed is increasing, we need to apply pressure in short bursts in order to advance. At this stage begin with a few minutes of warm-up at a comfortable speed, and then use familiar materials to try for a burst of speed for a minute or two at first. Keep it short to minimize the discomfort. Then drop back to a more comfortable speed, and you will find the mind responding faster.

Avoid practicing when too tired, ill, or all upset and distracted - little or nothing will be gained and it may even discourage you.

It takes time for associations to develop. Be patient and learn at your own rate. Some days will be better than others for various reasons. Progress will not be uniform, but that should not bother you because you know about it beforehand. When you feel good and can enjoy it you will advance the fastest. On days when you don't feel very good it is best not to push, but rather to work at a comfortable level which will give you some sense of accomplishment.

As these processes improve, conscious thinking tends to drift away, and we need to keep the mind focussed on what we are doing in order to advance. But ultimately, conscious thinking must be completely eliminated and response become automatic (we no longer even think of the code itself). That's proficiency.

More About Attitudes for Success

Achieving our best performance in any skill, including telegraphy, is a personal matter. We need to: l) observe how we think and act when doing our best, and then 2) learn to control those attitudes and actions so that we can use them when we want them.

While each of us behaves as an individual, there are definite principles, which will greatly speed up our success as we adapt them to ourselves. At first they may seem awkward and unproductive, but if we stick with them - improvement will begin and grow much more rapidly than without them. Attitudes are critical, and for best results we need to individualize them, fit them to our very own needs. We can lay a foundation for positive attitudes if we do the following:

Feel confident, it promotes learning. If you have an opportunity, watch a skilled operator; observe how calmly and quietly he goes about it. He is in no rush, and is not concerned about missing anything. He goes about it just as if it were everyday listening and talking. Instead of filling the mind with problems, worries and concerns occupy the mind with the way things should be done. In learning, build confidence by taking one firm step at a time, telling yourself, "I can do this".

Build a sense of achievement, that good feeling of doing something well. As a guard against frustration be sure to provide periodic successes, with simple little rewards for each. Keep a record of the goals and your progress: as you see your progress it will help build positive attitudes. Give yourself some little reward after each practice session.

Picturing Success Is Strong Preparation For It

Mentally practice the thoughts, feelings and actions necessary for good performance and you will greatly speed up achievement - a valuable tool to accelerate learning. How can it be done? In a general over-all way you may picture yourself quietly and without strain listening to the incoming signals and easily recognizing them as the printed or spoken letters and words they represent, and as sending well-formed characters without hurry or strain. Picture yourself doing it, and doing it well, like an expert. It helps to have a real model in mind. Watch or imagine a skilled performer (a telegrapher if you can find one) at work. He isn't in any hurry. He isn't flustered or concerned, he just does it and enjoys it. Repeat and rehearse this picture often in your mind.

There are at least two ways to use this tool. One is to sit back and relax and deliberately form the picture. To get started, set up a general over-all picture first. As you continue practicing the mental picture of how you want to do, add details, making it more and more realistic until you have a solid lifelike picture in mind. See yourself doing it, how you will do it step by step. The more vividly you can mentally see, hear, and feel it as you rehearse the picture, the better the results will be, how doing it right looks, and how it feels. This is not mere wishful thinking, it is building up a working pattern to become realized in time as you continue actual receiving and sending practice. This kind of mental picturing can have much the same effect as real practice. It creates memories, models of the behavior as you want it to be - but it is, of course, no substitute for real practice –actually doing it.

Another way is now and then to "see" brief "snapshots" of yourself receiving and sending while you are doing other things (such as driving, walking, working, etc.), not making any particular effort to fill in details.

You may want to try it right after you have learned the sounds of the first group of letters. Sit quietly in a chair, close your eyes, relax, and imagine you are hearing each letter sound (just as you heard it), taking them one at a time, and immediately recognizing it or writing it down with a pencil. Make the picture as realistic and vivid as you can, even to imagining the "feeling" the pencil writing on the paper. Feel a sense of satisfaction of doing it right. Three to five minutes practice this way at any one time is probably enough. You can then repeat this kind of mental practice with each new group of characters as you learn them, and it will greatly strengthen the habit you are trying to build.

When you know the whole alphabet and have a clear mental picture of how each character should sound, you can mentally practice visualizing short printed words and then imagine "hearing" them spelled out in code. Feel it in your mind as if it were actual - a mental "sending" practice.

Mental picturing practice may be extended to prepare you to minimize distractions, such as static, interfering signals, noisy people in the vicinity milling around, being watched closely, etc. Prepare for these by picturing yourself calmly receiving and sending while extraneous noises - talking, shouting, crashes - are all around you Think of what a war-front operator would have to

contend with! It may also be used to help learn to copy on a "mill" (typewriter or keyboard), and other aspects you may need to meet.

All this is preparatory and supportive of real practice, not a substitute for actual practice by doing. The goal we seek is for the use of the code to be as natural and easy as talking, reading, and writing. These mental images take some real effort and practice. Don't expect instant results, give it time to grow.

Chapter 3

Part I: Laying the Foundation

Let's Begin With The A-B-C's - Laying the Foundation Many good ways have been developed through the years for learning the telegraph code easily and efficiently. Our purpose here is to present the very best ways to learn it efficiently and to compress the learning time to a minimum. It is too bad that so many hams have learned poorly and as a result have not been able to enjoy it, as they should. The trouble often began by imagining that code would be hard to learn, or by learning it in an inefficient, or round-about way, such as visually, by sight, rather than by sound or by "sound alikes."

Everything depends on how you set about learning it. It is much more difficult to go back and unlearn something, which was learned wrong, than it is to learn the right way from the very start. Trying to learn by oneself without any guidance as to how to do it can make things all the more difficult later. Most learning trouble is due to one's attitude, the method, or the teacher. One expert wrote: The most difficult students at Harvard were those who had learned the code by themselves by practicing alone without guidance.

The Telegraph Code is an Alphabet of Sound. It is learned by hearing it. When we learned to read our language, it was, or should have begun by first learning to recognize the ABC's by sight. Telegraphy begins by learning to hear and recognize the ABC's by sound. This difference is important. Code is learned by hearing it. Recognition of the sound patterns is the name of the game. For example, when you hear "didah" as "A," without translating, you are thinking in code. The sound is the letter. There is no reason ever to see the code in written form. **So throw away those code charts-- all of them. Burn them!**

Saying the letter immediately, or writing it down immediately, each time the ear hears it is one of the ways to build the code habit quickly. We need direct association between sound and letter. Anyone who is stuck on a "plateau" because of having learned it visually or some other inefficient way will have to learn it all over again by sound. It is unfortunate that some still try to learn it this way. To teach it this way today is inexcusable.

It is Easier Than You Think. Someone wrote: "*Mastering the art of code communication is ten times easier than learning to talk -- which you did by about the age of two*." You aren't learning a new language, a whole dictionary full of strange words, and sentences where the words are all scrambled up. You are just learning how to "read" your own language BY EAR instead of by eye. It's no big job.

Almost anyone who can learn to read can learn the code. There is no such thing as a normal person who wanted to learn the code and couldn't. "I can't learn the code" nearly always translates into "I won't commit myself to the time necessary to learn it," or that a person doesn't really want to, even though he may think he does. Age, whether young or old, and intelligence, bright or dull, are no barriers. Youngsters of four or five can learn quickly, and oldsters of 90

have succeeded, too. You wouldn't want to admit that a four-year old or a 90-year-old could outdo you, would you? It doesn't require superior intelligence, just right application.

Most handicaps, such as blindness or even deafness, have not stopped those who want to learn. Deaf people have been able to learn and receive using their fingers on the driver of a speaker at 30 wpm or on the knob of an electromagnetically driven "key knob" bouncing up and down at 20-wpm. (Even some people with dislexia have been able to learn to a useful extent.) It is easy if you really want to learn it and then go about learning it in the right way. Any person of reasonable intelligence can learn the Morse code and become a very good operator, able to copy it with a pencil at 25-wpm and send it clearly, smoothly and readably.

There is no real justification for the statement that "some people just can't learn the code." (They don't want to.) It's a matter of motivation, the secret of learning any skill. If you are one of those who tried in the past and somehow didn't make it, or got stuck at 8 or 10 or 12-wpm, take heart. Forget what you previously "learned", and start over with the principles set forth here, and you will succeed.

Some Naturally Learn Faster than Others, just as some people have a knack for learning to play golf or tennis more quickly than others, so some have a special knack for learning the code. They catch on more quickly, but most of us take a bit longer. Kids tend to pick out the sound patterns easily and naturally without straining, so they learn very fast

MOTIVATION

Nothing beats enthusiasm to learn. Stir it up - eagerness. Couple that with determination, and failure is impossible. If you want to so badly that you can almost taste it, you can do it. If you are teaching it, take advantage of any latent fascination with the idea of a special skill, secret code for communicating: many youngsters have it and maybe some older people, too. One lady who later became a code teacher said she got started because "the code sounded like fun." One man found that the very idea of communicating his mind to another by intermittent tones is most fascinating.

A sense of achievement and the intimacy found in code communication make the effort a lot of fun. CW is fun if you take the time to learn and to be comfortable with it. Be motivated. Fix it in your mind that you can do it. Then relax, be willing to learn at your own rate, refusing to compare yourself with others, and take time to enjoy the learning process. Make it fun. (Trying too hard or trying to hurry can create a kind of tension, which impedes progress.) Take it easy. Keep it leisurely. The more you expose yourself to it and the less hard you "try" the better and faster you'll become good at it. You can't help succeeding. Enthusiasm and determination will win out

The sudden beginning of WWII required a lot of operators in a hurry. Many Amateurs volunteered and served directly as operators or by teaching new recruits. However, the attitude of some recruits was often indifferent or poor: many of the draftees had no desire to learn it, and some even disliked the idea of learning it at all. No wonder it took them so long to learn and a good many failed! -- Telegraphy is a skill whose success depends greatly upon the right attitude.

One schoolteacher demonstrated the code, both sending and receiving. The class got so fascinated that they managed to learn 14 characters in that one class period. No-code students, no longer under pressure to certify code ability, who have been given "a taste of the way it used to be" by listening, have often gotten interested and want to learn at least a few letters to start with. Quite a few no-code licensees, after having had some fun operating, are looking for more ways to enjoy ham radio: the Morse code doesn't look so abstract to them as it did before.

Learning the Morse Code Is Similar to Learning To Read

Learning the Morse code is much like to learning to read by eye. Learning to read print has several stages of skill level.

- First we learned to recognize the individual letters, and could slowly spell and sound out words.
- Next we began to recognize and read many common short words as words, instead of having to spell them all out.
- Before long we learned to recognize short phrases ("of the", etc.) and some of the longer words as whole words.
- Finally an expert reader can read whole clauses, sentences and even a paragraph as a unit of thought, almost at a glance.

This gives us a clue as to how to go about learning and improving Morse code skill. The essence of code learning, like language learning, is familiarity -- which means overlearning. That is, learning to the point where it has become automatic, without thinking about what you are doing: the dits and dahs, or even the words. The highest skill comes when you just seem to be hearing words and sentences and you are conscious only of the ideas being expressed -- that makes communicating: a most worthwhile and gratifying goal. But it doesn't mean you have to become a speed demon.

THE MORSE A-B-C 'S ARE PATTERNS OF SOUND

The Best Beginning is by Listening. Phase One is **Learning To Recognize Each Letter And Number As Soon As We Hear It**: the "A-B-C's" of the alphabet of sound. This is the goal of stage one of code learning- building the foundation. The code must be thought of as sound patterns.

If you have been having trouble, the moment you begin to think of code solely in terms of sound patterns, you will have made much progress. A printed letter is a combination of lines, which form a shape. But children are not taught to recognize the letters of the alphabet by pointing out the various lines which make it up, they are taught to recognize each letter as a whole, at a glance. The same principle applies to learning code: each letter and number is a unit of sound, a unique sound pattern, a rhythm, different from every other letter or number. Each code character has its own unique sound pattern, just like spoken vowels and consonants do.

Morse code is SOUND PATTERNS, to be heard by the ear. Any method of learning the code which uses the eyes (such as charts for "memorizing the code", or some other scheme (such as rhymes or "sound-alikes", etc.) will prove to be a serious handicap to later progress. This is because it makes us "translate", something we must do consciously. If you have been doing it by

thinking: "dit dah stands for 'A', " you have been thinking in terms of separate "dits" and "dahs". That makes it hard. So forget that there are such things as "dits" and "dahs" and learn to think in code sound-patterns. Start training yourself like this: every time the ear hears the sound pattern "didah" you think "A", and if you are copying, the hand writes "A". With some practice, like a good operator, you will find that the character just seems to come to mind from nowhere. Proceed directly from sound pattern to letter, with no intermediate interpretation of any kind. It may help if you whistle or hum the sound patterns.

Chapter 3

Part II: Laying the Foundation

DELAYED PERCEPTION and INSTANT RECOGNITION

There is one obvious difference between reading by eye and reading by ear. While a printed letter is to be instantly recognized at a glance, a code character cannot be recognized until the whole pattern has been heard -- at the end of the short time it takes to send it. We must "hear it out".

Two important factors are involved here:

- The characters must be heard at speeds that compel us to hear them as complete patterns, as wholes, not as strings of "dits" and "dahs" -- Tests have shown that speeds of at least about 13 wpm are required and that faster speeds are preferable (18 -25)
- The spaces around them must be long enough to make the sound patterns stand out clearly and distinctly

This is why the so-called Farnsworth method is used: making the spaces between characters quite wide at first and then gradually reducing them to the standard. Combining these two ways we soon recognize that, while we know that the sound patterns are formed of "dits" and "dahs", we never allow ourselves to try to analyze or count them.

We must first consciously listen to each letter until the mind accepts it as a complete letter without there being any kind of conscious thinking about it involved. We forget the dits and dahs and just listen to the patterns, the rhythms. So, the ear's "glance" is a little longer than the eye's -- it hears each sound pattern separately because of the wider spaces which separate it from the preceding and following sound patterns.

These spaces are very important -- they make the sound pattern stand out. That pattern or rhythm of the letter is to be heard as a whole over a short period of time, and cannot be recognized until the whole pattern has been heard as a complete pattern. We must "hear it out" before we can identify it. When we get the sound patterns well fixed in mind it is good to listen to faster and slower speeds and hear the letters roll out.

Listen Only To the Best Quality of Code

In the early stages it is very important to listen only to the most perfectly formed code you can find. The ear and mind need to get intimately familiar with the rhythm pattern, consistently formed. Poorly sent code gives a sloppy, irregular rhythm which tends to confuse the mind and slow down learning. Don't expect to develop any real speed listening to hash. Listening to poor sending on the radio has sometimes-discouraged learners because it distracts the mind by compelling us to think consciously about the details instead of the wholeness. We have to slow down. Listening to poorly sent code defeats the learning process. (Later, with improved skill, you will probably be able to understand most of the poorly sent code. But for now avoid it.) This is also why you should not try to send code yourself until you have a good sense of timing.

Getting Started

There are several ways to introduce the student to the code. One highly effective way to create the right impressions for the beginner is to dictate a sentence or two, spelling each word out in ordinary letters at about a 20-wpm rate for him to write down, like this:

Y O U A R E G O I N G T O F I N D I T I S E A S Y T O L E A R N T H E M O R S E C O D E.

The teacher then assures the students that they will do equally well as they learn the code. "All we are going to do is to change the names of the letters-- instead of 'Y', that letter is going to sound 'dahdidahdah'," and so on. Now the student is ready to learn the first few letters by sound.

Another good way, because nearly everybody can quickly recognize the difference between a few words sent at about 20-wpm, to begin the first session, is word recognition:-- send a simple word or greeting such as "Hi" and a good-bye, such as "73." Send each one at say 20 wpm half a dozen times until everyone gets familiar with its sound, then send them randomly and have them say the words. Then stick in a different word like "the" and see if they protest. Tell them what it is and send it few more times. This can whet their appetite and show that them that it isn't hard - those sound patterns really mean something.

For people who are afraid that they can't learn to identify sound patterns, some have suggested that "V" and "B" be compared by sound initially by sending them alternately.

What Characters Shall We Begin With?

Teachers disagree on this. Some suggest that taking the simplest characters first (such as E I S H 5, and then E T I M, etc.) helps to build up a feeling of confidence. Others point out that this may lead some students to try to analyze the longer characters, so they recommend beginning with longer characters (such as (Q 7 Z G, 0 9 8 J P, or the numbers 1 2 3...). This has the advantage of compelling the student to wait until the whole character is completed before identifying it.

Perhaps a good way would be to start with a couple of short letters first, and then go to the longer ones and meet both goals. No matter what order is used in teaching, each character must "stand on its own feet" and not depend on comparing it with some other character in order to learn and identify it.

The important thing, of course, is to hear the characters at speeds high enough that they are heard as complete unified patterns, and preferably at first to present in the same lesson characters which have quite different patterns of sound so that there will be no attempt to compare them.

Methods to Go about Teaching

There are at least two ways to start out: a) listening only at first, and 2) listening and writing it down. For those who learn by themselves, one experienced old time teacher wrote: "The beginner should listen to the sounds until he becomes sound conscious. He should not write anything down for a week or two, but concentrate his efforts on recognizing the sounds. He can

already write, but he cannot write with any degree of ease, if at the same time he is trying to do something else which he is not familiar with [recognizing code characters].
"As a beginner, he would hear a letter, take a short interval of time to decide what it is; with the result that when it comes to him, he quickly tries to write it down and misses the next letter. Wait on learning to write it down until you can recognize the letters as letters, and this confusion will vanish. Learning to read code is recognizing the sounds immediately, that is, the letters." This is wise advice if you are studying by yourself.

Probably most teachers prefer the second approach in a class situation. Such might be, for example, the following (taken from actual teaching procedures):

A. The teacher says: "This is F" and then F is sent. Then he says: "Now here it is again. Write it down with your pencil each time you hear it." He repeats it several seconds apart quite a few times before taking up the next letter, which ought to have a quite different rhythm pattern, such as G, introduced in the same way. Then he sends these letters in random order until the students get them right about 95% of the time. Next, he introduces a third letter followed by random letters learned, and so on for a half dozen or so at a session, however many the students can do without confusion or becoming fatigued or bored. Note: Each one should write or print the way he usually does.

B. The teacher sends a dit and says: "This is a dit. It is the letter 'E.' Now here it is again: write it down each time you hear it. Forget that it is a dit -- it is the letter 'E'." Then he simply sends "E" a number of times as the students almost automatically write it down. Then: "Now we will hear the letter 'I'. Listen." He sends 'I.' and says "This is a 'I'. Now here it is again. Write it down when you hear it." And so on through the group for that lesson. After each new letter has been drilled in, there is random letter practice, using all the letters previously learned. Finally, because even for the first lesson he has chosen letters that can be used to construct small words, he sends these words with the instructions: "Now here is a word. Write down the letters just as you did before." He waits a few moments while the class writes it down and says: "Now then, you have copied the word . . ." And so on to the end of the first lesson of 30 - 45 minutes. Subsequent lessons follow this general pattern until the alphabet is completed, etc.

Chapter 3

Part III: Laying the Foundation

Most sound recordings for self-study introduce each letter something like this: "when you hear 'didah', say "A" to yourself each time you hear it, as soon as you have heard it. Do the same thing for each new character as it is introduced." Then they begin, for example with the first letter 'F': sending dididahdit and saying "F", dididahdit "F," and then follow with a long string of "F's" alone for the student to say "F" after each one, before taking up the next letter.

Whether learning with a teacher or in private study, repetition to the point of familiarity is vital. A teacher can usually judge quickly from student behavior how many repetitions are needed. For the self-study student it is probably good to over-do the number of repetitions of each character before going on, but don't do it thoughtlessly. Some teachers use up to a dozen to two dozen such repetitions of each new character before going on. Since the whole superstructure of telegraphy is built on this foundation -- be sure it is solid and secure. Repetition sets in concrete what we practice. Do it wisely. Repetition with attention builds expert skill, making the connection between stimulus and response so strong that the response automatically follows the stimulus.

In these early lessons a little game of "odd-ball" may help. It goes like this: the same character is sent 5 or 6 times in succession, but at one place a different character is sent. The students, who are just listening, not writing, are to hold up their hand when the "odd-ball" is heard. A few minutes of this can liven things up and give variety. It can be extended to short words, too.

Learning on a one-to-one basis with a good teacher who can tailor each lesson to the student makes possible the strongest initial impressions of the sounds and rhythms of the code characters and to concentrate on any weak areas. The teacher can also safely introduce use of a key earlier than otherwise. Character "echoing" method to reinforce learning:

1. Teacher says: "Listen as I send the character .. ." He sends it and says its name as he sends it. "Now listen as I send again and again, and say its name each time as soon as I finish sending it." --

2. Next, "Now listen and write the letter down each time as soon as I finish sending it." -- 3. Lastly, "Take your key now and send it back to me each time I send it, and say its name as you send it." It is important that steps 1 and 2 have enough repeats of the letter so that the student has a clear "feel" for the proper timing when he comes to step.

3. The teacher will insist on accuracy of sending. For those studying alone, there are a number of good code-learning tapes and courses, as well as computer programs, which have great flexibility. E.g., a code computer program, which can project the printed character on the screen an instant after the character is heard, can encourage the student to mentally "see" the letter as soon as it is heard. See Chapter 18.

If some students think that certain characters sound alike, send them several times alternately so the real differences stand out. Typically the alphabet and numbers may be covered in a series of no more than five lessons. Everything possible should be done to make learning interesting and fun, and to avoid any sense of boredom or needless tension. One teacher says: "I write words on the board and the students sound them in unison. It is like directing a choir, a fun class, where everyone feels good about practicing the code."

If one is expecting to do a lot of copying in use, starting out by copying on a typewriter has the advantage of a better link up between code, brain and typewriter key than between the brain and a pencil. When this stage of learning has been completed, the foundation -- quick recognition of every character by its sound pattern -- should have been laid, and a speed of at least about 5 - 6 wpm achieved. All the pieces are now in hand for the students to be able to practice with normal English words and sentences, ready to build up speed and greater confidence by practice. One may then begin to reduce the spaces between words, which will speed up the overall rate of copying.

Every effort should be made to stimulate a sense of success in the student all along the way. This makes learning so much easier and faster. Let them taste success. Forget errors: praise achievements. The goal is INSTANT RECOGNITION OF EVERY CHARACTER. That is what the next stage is to carry us forward to. If there are letters you don't recognize quickly enough now, go back and practice listening to them until you do. This will save you time later.

Some of the published orders for learning the characters are: 5 0 E T A R - S L U Q J - H O N C V - I B Y P - W K Z M - D X F G. F G H M J R U - B D K N T V Y - C E I L O S - A P Q X Z W. E T A I M N - S O D R C U - K P H G W L - Q H F Y - Z V X J. E I S H - T M O - A N W G - D U V J B - R K L F - P X Z C Y Q. F K B Q T C Z H W X M D Y U P A J O E R S G N L V I. E T I M S O H - A W U J V F - C G K Q F Z - R Y L B X D N. A E I O U - vowels first, then some of most frequent consonants, such as T N R S D L H, etc., so that many words can be practiced from almost the first consonant letters learned.

Note: The teacher should explain at each new step exactly what is to be done and why, so the student will know what is expected of him. Back in 1895 some psychologists asked expert telegraphers: "What is the learner's attention mainly directed to as he progresses?" Their answer was:

1. At first you hustle to get letters,
2. next you look for words,
3. later as a fair operator, you are not held so closely to words, but can take in several words, a phrase or even a short sentence as a 'mouthful', and
4. Finally as a real expert, you have such automatic perfection that you pay practically no conscious attention at all to the details of the code, but concentrate on the sense of the message, or to transcribing (copying) it while our mind thinks about other things.

Chapter 4

Building the first floor on the solid foundation

Gaining Fluency in Code to a useful 15 wpm Level

By the time you have reached a steady speed of about 15-wpm you will have a useful and comfortable communicating tool. This will require practice of what you already know, and you will have to push yourself in little spurts to speeds where you cannot get it all at first to reach this goal. Such bursts in speed should be no longer than about one minute at a time, and you will be surprised how effectively this will help raise your receiving speeds.

Instant Recognition

The first secret of increasing your receiving speed is to shorten the time it takes you to recognize each code character as soon as it has been completely heard. The shorter that time interval is, the faster you will be able to receive. Aim to make it instantaneous. **If You Do Not Instantly Recognize the Sound of Any Character, You Have Not Really Learned It Yet**. (That is the one character you need to practice on until you know it immediately.) The goal of practice and drill from here on is to speed up your recognition of characters, and then of words, to the point where you can both "read" them easily without writing, and copy them down more and more automatically.

Anticipating

In ordinary listening and reading many of us habitually anticipate what the next word or sentence is going to be, and we are ready to jump ahead or help out. Most of us can do this without losing anything that actually comes next: what actually does follow just replaces whatever we anticipated. By contrast, even at high speeds, the code signals are so slow compared with the speed we think that for some of us anticipation can create a severe mental block, causing us to miss out completely what actually comes next. In the very slow speed learning stages this risk is greatest.

If you become conscious that this habit is interfering with your receiving at any point in learning or later use, you should take immediate steps to prevent it. This is most important in the early stages when we are forming code habits. It will require discipline to concentrate on listening strictly to the incoming signals. (See next section for help in preventing anticipation.) However, if you are conscious of anticipating but that it is not in any way interfering with actual reception, the best thing is to forget it and keep concentrating on the incoming signals. In this case, anticipation will not hurt. (We also tend to evaluate what we are hearing or reading. This is natural and should not be discouraged if it does not interfere with reception.) A tendency to anticipate does tell us one good thing: we haven't reached out limit yet and can learn to read code faster if we go at it in the right way. (See Chapter 11 for further discussion of this.)

What Kind Of Material to Practice

Most of the materials for practice should be in regular English and as INTERESTING as possible. Have a VARIETY in every practice period so that nothing becomes monotonous. Select the kind

of material you intend to be working with as you use the code. To prevent anticipating what is coming next, during the early phase of learning, some practice material in each session should consist of non-English. Three to five minutes per session is long enough for this, unless you intend to be working with enciphered messages -- it must not be used to a point where it becomes boring.

International amateur call signs, Q-signals and common abbreviations make good practice, because they are somewhat "random," but realistic and also useful. "Reverse English" is good because it keeps normal letter frequencies by sending words and sentences backwards: e.g. "my antenna is up 50 feet" becomes "ym annetna si pu 05 teef," or "teef 05 pu si annetna ym." - You can hardly anticipate those "words"! The 100 most common words, listed at the end of this section, make excellent practice. This not only makes you familiar with them and gives you a boost in feeling at home with the code, but also it will help you gain further proficiency as you continue to advance. Work with them alongside other practice materials until you recognize these words, or most of them, at once as words -- patterns of sound that have meaning in code. Along with the 100 most common words practice with some of the common phrases, such as "of the" "I am," etc. See Chapter 22. Once again we must emphasize the importance of REPETITION.

The best way to get these common words impressed as units of sound to the mind is to repeat each one a number of times before going on to the next one. Use a keyboard or computer to generate a tape, on which each word is repeated from at least three to five times. Space the words widely enough apart that you will be able to say the word each time after you have heard it. Then listen to that tape over and over again, saying each word to yourself as soon as it has been sent. Practice listening to it until the words come as easily and naturally as if you were sitting, listening and talking. Make yourself thoroughly familiar with them.

Other Ways:

Several other simple practices can help you gain familiarity and confidence. One of these is to read road signs and ads you see while driving or riding, whistling them aloud or mentally to yourself in code. If you have friends also learning, try whistling code back and forth among yourselves as conversation. There are lots of other possibilities -- find them and make it fun. For example: The Two-Way Word Game This is a good speed builder, and works this way: the instructor sends a word and student sounds out the word to himself (see phonics, Chapter 7) as the letters follow one after the other to build up the word until a space comes to show that the word is completed.

For example, the instructor sends the word "was". As the student hears W he thinks "w-", then as he hears A he combines them (WA) to think "way", and finally as he hears S and then silence, he thinks the word "was". Then the student immediately sends it back to the instructor. The student writes nothing down. Begin with two-letter words, then four or more letters as the student catches on and speeds improve. Remember that it is a game. Make it fun. Never again will you try just to retain the letters in a word; but rather the sounds of those letters, putting the sounds represented by the letters together as they come in.

How Long And What Kind Of Practice?

Keep practice sessions short and with some RESTING time in between -- doing something else -- such as into ten minute practice periods, followed by a five minute rests. Three or four such

periods per session are adequate at the early stages. They can be lengthened gradually so long as fatigue does not set in. Remember that fatigue and boredom tend to defeat rapid advancement.

Teachers are divided as to whether it is better to major on receiving practice without copying or to major on copying. The best course would seem to be to do some of both. Some teachers insist that the student not copy for some time after initially learning the characters. They prefer for him just to listen. The idea is to build up and strengthen sound pattern recognition without the distraction of writing. (See Chapter 7 and Chapter 8.)

As for sending practice, it is best not begun until the student knows how good code sounds. The sound patterns need to be firmly enough established in mind that the student can imitate them without the discouragement of hearing his own poor character formation and bad or irregular spacing, and also to minimize criticism. It seems best to defer using a key until a receiving speed of about 10-wpm is reached. At all times aim for beautiful, perfect sending, where the timing and rhythm produce accurately formed characters and spacings. Aim for it, and don't be satisfied with anything less. (See Chapter 9.)

One good form of early practice sending is to listen to a character, then send it; hear the next and then send it, etc. Another helpful way is for the student and teacher to send a short series of words or sentences simultaneously, aiming to be in unison.

Copying has the advantage of verifying accuracy of recognition and identifying areas needing improvement. In the early stages the use of random groups is best because it avoids anticipation. Listening practice, without writing anything down is of great importance and value. To gain skill this should be done at speeds almost as fast as you can receive by just listening, and with frequent short burst of listening to still faster sending. This will help the mind get used to more rapid recognition.

It has been found that it is GROUPING which largely determines how fast one can receive code. What doesn't "MAKE SENSE" tends to slow us down. At almost any skill level, random characters will be the slowest, and isolated, unrelated or unfamiliar words come next. The highest receiving speeds are achieved with connected text, and it tends to be receivable at twice or more the speed of scrambled letters. (Even nonsense sentences can be received fairly fast because they have a familiar pattern.) It is the coherence of a grouping that helps speed up its recognition.

There is another factor, which we should be aware of. It is this: when we are practicing by listening to the radio and must strain to "get" the signals -- because of weak signals, interference, static or poor sending (trying to figure out a bad combination) or to recall some word previously sent, this brings the conscious mind into action, to try to reason things out. As the conscious mind works harder and harder, the receptivity of the unconscious mind tends to cease. This mental friction interferes with advancement in the earlier stages of gaining speed, and may even bring all receptivity to a stop. Whenever you must strain to "get" the signals -- because of interference, static or poor sending -- to try to figure out something being sent, this brings the conscious mind into action to try to reason things out. As the conscious mind works harder and harder, the receptivity of the unconscious mind tends to cease. This mental friction may bring all receptivity to a stop.

FAMILIARITY with what is being sent makes learning easier and faster. Words that are unfamiliar to the operator are more likely to be read and copied wrong. Progress is about 50% faster using connected text than words alone. Many more mistakes are made with non-word letter groups, which are not words than with normal texts.

Getting Stuck

To have a "plateau" means to be stuck at some speed. It may be just a temporary condition, which is passed over with a little more practice, or it may be something that stubbornly refuses to yield. Several different factors may cause the stubborn kind of plateau. A plateau is the result of interpreting the sound as something other than the letter itself. Someone has written that it is the condition" where the conscious mind is fighting to translate, while the subconscious mind is quietly trying to get through and tell you it's got perfect copy." A plateau is a battle in the mind, with the conscious mind trying to translate the dits and dahs and not being able to keep up, while the subconscious mind is quietly trying to get through and tell you it's got perfect copy.

At speeds of around 7 - 10 or so wpm it usually occurs because one is "translating" the code characters first into some intermediate form (such as a mental picture) and then translating that again into the ordinary letters. That is a two-step operation which takes more time than the proper one-step operation does (e.g. "didah" is "A"). Such a situation is often the result of using one of the old and obsolete learning methods Again, when the characters are initially sent too slowly the student tends to count the dits and dahs and analyze them in this way. I have known old time operators who by long practice routinely counted the components of all the longer characters to identify them at speeds up to as high as 20 wpm, or faster! That's the way they learned them, but what a waste of time and effort! Counting and analyzing both tend to keep the conscious, analytical mind involved where it should not be. This will slow us down and tend to bring on needless fatigue. One experienced old timer wrote: "Once you start becoming familiar with [code] sounds as in speech, there are no plateaus."

The 100 Most Common Words In English

go am me on by to up so it no of as he if an us or in is at my we do be and man him out not but can who has may was one she all you how any its say are now two for men her had the our his been some then like well made when have only your work over such time were with into very what then more will they come that from must said them this upon great about other shall every these first their could which would there before should little people

(Six of these words take the same time to send as the number zero (0): are him men on so no. Fourteen more of them are shorter still: the its to; us am if; as be we an; me at is; it.) Twenty short words. Listening to, copying and sending the 100 most common words is good daily practice. Also the 100 words makes good typing practice.

Passing Examinations

Our primary interest here is to help you learn and use Morse code so you can fully enjoy this beautiful mode of communication. Passing exams is of secondary interest, though necessary to obtain full licensing so you can enjoy conversing by means of Morse code on the air. Many students who have started out with the recommended 20 wpm minimum character speeds have

found that they were able to achieve 13-wpm within as little as a week or two of intense guided practice. It is important to know what to expect in a license examination: the format of an exam, the types of questions asked, etc., so you can practice them and not be surprised. Such materials are available for current examinations from the ARRL and other sources. These things will not be treated here. The only one who fails is the one who does not try again until he succeeds. If this is your problem, learn where your weaknesses lie and practice to overcome them for the next test. Many a ham has tried two, three or more times before he passes. Don't give up.

CHAPTER 5

Practice To Gain Proficiency

When you have reached about 15-wpm code will have become a useful tool for communication: You will have become an operator.
However, it is pretty slow, but now you have come to feel some satisfaction of mastery, and can see that to be able to handle somewhat higher speeds will greatly improve your communication skills. How shall we go about it? -- Mere repetition won't do it. We need intelligently directed practice -- it must be done in the right way. This is what we discuss now.

How Far Do You Want To Go?
For the sake of discussion, we may divide advancement somewhat arbitrarily into four stages, which we will call:

- a "good" operator up to about 25-wpm,
- a "skilled" operator up to around 35 - 40 wpm,
- an "expert" up to about 60-wpm, and
- over 60-wpm a "super-expert."

Each stage should bring increasing personal pleasure in accomplishment up to whatever point you feel satisfied with and have no desire to go further.

You determine where that point is. Advancing is by "changing gears" like going from"low gear" where we recognize characters, to 2nd gear where we recognize small words and some common syllable as units of sound, 3rd gear where we have increasing freedom from conscious spelling and sense of increasing pleasure as one hears and sends words pretty much as words, and then finally "overdrive" where we are hardly conscious of spelling except occasional rare words or proper names, and are hardly conscious of exactly which words are used, but mainly of the ideas.

Reaching higher speeds will turn out to be easier than you might suppose. It is mostly a matter of determination, right approach and practice, and building on what you already know. Your rate of gain will depend mostly on how you go about it, and will be about proportional to the square of the time invested. So, how far do you want to go? (Remember: it is not speed, but accuracy that counts --. We want to communicate. Time is lost by mistakes, whether in sending or copying.) So take one step at a time, and when satisfied, stop. When we read a book, the bigger the "bites" we take, the faster we can read and understand. It is the same in telegraphy: how much can we take in and immediately perceive as a "unit?" How big are the units? This determines how fast we can receive the code. It is the COHERENCE of the groupings --what makes sense -- which makes for rapid recognition. Whenever something doesn't make sense it tends to slow us down.

Word recognition is what makes a proficient operator. The real "alphabet" of the expert telegrapher is largely one of words; it is his "language," and interpreting it is as easy for him as talking and listening. (See "Kinds of Practicing" for an exercise to help develop this.) It cannot be

stated too often that: The skilled operator does not hear the dits and dahs, but only the letters, words, sentences. R E L A X and E N J O Y I T. We need to remind ourselves, that if anyone else can do it, we probably can too. How? The "pro" in code is completely relaxed: he knows he can read and copy it, even while doing something else. He hears it like the spoken word and often can even remember it well enough to copy it down later if he needs to. He doesn't get get tensed up. He is a good model, whatever speed he has achieved. If you know one, imitate him and keep relaxed and enjoy the challenge of advancing all the while you are progressing. If you don't know any expert code operators, watch any skilled performer, a violinist, a pianist, a tennis player. See how easily he goes about it.

ENJOY the experience of learning. Make each practice period fun. Those who engage in the learning process with a carefree, unhurried, unworried attitude and enjoy it progress the fastest. So don't press your ultimate objectives, don't try too hard, this will hinder our advancement. Be content to go ahead a step at a time. We need to let go any unconscious resistance, and permit our subconscious minds to function without interference. The more we give ourselves permission to let go of any concern and the more fun it is, the better we will do. Someone has written: "When I'm fresh and right on it [which means he is all keyed up and going to try too hard], my code speed is really bad, but when I'm tired I can keep up with the best of them [because he has let go]." (Please review Chapter 2 for details.)

One ham who is a doctor wrote: "Communicating in Morse is special. With my headphones on listening, usually with eyes shut, I feel that I'm communicating without talking or hearing voices. After a long day of talking and listening it's pleasant. The message seems to come in a whisper or even represents to me something I'm remembering rather than hearing. I no longer formulate what I want to say and then translate into code for my fingers to send. It doesn't feel like it is coming from the conventional speech centers. The thoughts just come out -- relaxed communication."

Make Each Practice Period A Step Forward

In pushing for higher speeds, advancement is pretty much up to you. So what follows is directed to you. However, the principles expressed here are fully applicable to a teacher at any level from beginning to the highest level. Try to plan your practice periods so that you can see or feel you have accomplished something in each and every session. Maintain a positive attitude. See how far you have come. Imitate the good beginning teacher who shows his students how the bits and pieces will soon fit together to make words, and how the context can help to fill in what's missing; and how to learn from failures -- things that need more practice -- and to learn from them how to do better next time.

Encourage yourself to keep going and not give up. Know you can succeed. Visualize success and be encouraged. It also helps to provide some small reward after each practice session. In developing speed, we need to push without pushing too hard or for too long at a time, just a minute or two. It seems best to start a practice period with speeds faster than you are comfortable with, pushing when your energy is initially high (to recognize sound patterns more quickly), then slowing down a bit to a more comfortable rate. This way you will be able to see your improvement -- growing. Keeping a record will help you see your progress.

Learning does not stop when a practice period ends -- it continues on for a while afterward as the mind continues to digest it, provided that we relax or do something quite different. So space your practice periods widely enough apart to give learning a chance to maximize.

Kinds Of Practicing

There are several kinds of practicing we can do:

- listening practice,
- copying practice,
- sending practice, and
- "mental" practice.

Let's consider each one:

Listening Practice Listen, Listen, Listen to well-sent code. Listen at every opportunity as well as at planned practice sessions. Listen to the radio, to tapes, to computer-generated materials. Do it whenever you don't have something else to do which requires conscious mental activity: try it during lunch, while driving -- listen and enjoy it. There are several kinds of listening -- first, listening at any speed where we can understand all or nearly all of what is sent; next, there is listening at speeds where we can "read" maybe 75% of it; and finally there is listening to sending so fast that we can only catch some letters or a word here and there.

Each kind is valuable to us. Our purpose in listening at "easy" speeds is two-fold. We want to feel comfortable with the code, just as we normally read and talk without struggling with how we do it. To become comfortable we need to get familiar with the everyday day words and expressions, how they sound. (Engaging in personal QSO's -- over the air or through a wire -- is one way, and it provides a strong motivation.) We need to feel comfortable, too, at various speeds, from slow to as fast as we can handle it. Listening over this range helps gain this familiarity. This is a second goal. But take it easy.

When we let the mind be quiet and just listen to very fast code, letters and words will soon begin jumping out at us. Want to hear them. This stimulates the mind. Learn to see them on your "mental blackboard." (There is a limit as to how fast we can spell words.) Give yourself permission to let go of the need to consciously recognize each letter. The less we "try," the better and faster we can become. That is, let the subconscious, automatic mind operate without restraining it by conscious interference and control.

Listen at every opportunity to good sending even if it is somewhat too fast for you to get it all. Listen. Listen. Listen while doing other things that do not require close mental attention. Let your "ears be filled" with good code signals. Don't let ourself get all wound up: keep relaxed. -- The mind is strange -- it relaxes when asked to perform at a rate lower than it is used to, but tends to tighten up when asked to perform at a level which it thinks it can't quite hack. The essence of code learning, like language, is FAMILIARITY -- which means overlearning. That is, learning to the point where it is automatic, without thinking about how we are doing it: the dits and dahs, or even the words. The highest skill comes when in reading by ear, we are conscious only of the ideas being expressed, just as if we were talking. This is communicating at the highest level.

Word Recognition Practice Are anticipation and delayed perception related? We previously noted that we must not attempt to identify a character, particularly a longer one, until the whole character has been received. Here we are concerned with word recognition in the same way. Not jumping to a conclusion about what the total word will be when it is a long or compound word but waiting until it is complete before identifying it. Suggested drills are with compound words such as "wayside, mockingbird, chairman, salesman, notebook, lifetime, customhouse, morningglory hereabouts doorbell, nevertheless watermelon household", etc. and words with suffixes such as "cheerful, personable, fellowship. finality, dictionary, mechanically, characteristic", etc., or where the first part make look like an independent word, but with a totally different meaning as it stands or e.g. "axiom, category, handicap, climax, magnificent".

Copying Practice Copying at easy speeds is of some, but not great, value for improving speed. To improve we must keep working at short bursts of a minute or so at a time, at speeds where we can get maybe only 50 - 75% of it -- where it is just too fast for us -- speeds where we write down what we can get and ignore the rest. ***If You Don't Recognize A Sound Pattern Immediately, Just Skip It, Leave A Space and Go Ahead***. -- Never let yourself stop to try to figure it out, because if you do, you will miss what immediately follows. Don't frustrate yourself this way. Keep pressing on, copying what you immediately recognize and ignoring the rest. Remember that here we are only practicing -- missing out is no big deal -- at this point we're still learning. We must condition ourselves to this. Gradually the holes will fill in and we will be getting it all, and without straining.

Often, even when we're trying to make good copy, missing a letter here and there won't matter much. If we are interested, the gaps can often be filled in later from the context. After reaching a fair speed, it is helpful to copy long enough to become tired and then still keep on copying. As the conscious mind gives up and stops guessing, this lets the subconscious mind more and more take over. Then any mental strain you feel will subside, and you can copy page after page, and yet may hardly be aware of a single sentence in it.

For teachers: Sometimes it may prove best to let the student think the speed is slower that it actually is. That way he may just go ahead and copy it anyway!

Random character practice at speeds above about 15 - 20 wpm is of questionable value unless you are planning to do a lot of copying of enciphered messages. It tends to prevent the development of the important sense of word recognition, something that we must develop for normal use of the code in communication. Practicing with words spelled backwards is a good substitute for random groups: it eliminates anticipation, yet gives give normal letter distribution and the feeling that one is dealing with words, not nonsense. Foreign language texts may also be used profitably, where no special characters used diacritical marks, etc.

Sending Practice - Using a Key To Practice "It is more blessed to send good code than to receive it. **"*Most CW Operators Are More Impressed By Quality Of The Code Than By Speed*."** Readability is the number one requirement. It is the sender with his key who has control of this. If it isn't intelligible, what's the use of sending it in the first place? Most people consider sending easier than receiving. This is hardly surprising, because we already know ahead

of time what we are going to send before we send it. However, we may be fooling ourselves unless we have developed accurate sending habits. There is no excuse for sending sloppy cw. When we get in a hurry we may tend to shorten or eliminate spaces between characters in familiar words and between words - this makes it very difficult to read. (When static or interference is present, it is even harder.) And -- if we think we can send faster than we can receive it is very often hard stuff to copy.

Remember that WHAT WE DO REPEATEDLY IS PRACTISE, whether we are learning or using code. We need to watch the quality of our sending as we use the code, not to slip into bad habits. Most bad fists have probably come about from imperceptible shifts away from good timing. Avoid the use of buzzers for practice, as they have a delayed start and promote bad sending habits. Use an oscillator instead.

Mental Practice Thinking between regular practice periods is one of the many valuable means of learning. It is both thinking about the skill you are developing and thinking the skill itself. One way is to think the code to yourself when you see a street sign, car license plate or other printing. It is even more effective to whistle it or say it out loud in rapid dit-dahs. Another valuable form of mental practice is the picturing of yourself using the code, as described in Chapter 2.

On The Air Practice: "Reality Listening" and QSO Practice. Don't hesitate after you get your license to go on the air. If you flub up, remember that just about everybody's first few contacts are more or less "failures". Stumble through them, muddle through and make it as easy as you can.

If you miss, stay calm; ask for repeat if it seems important. If you don't understand some abbreviation or word (he may have spelled it wrong) muddle through. Laugh off your blunders. Become comfortable about it. You have no job to lose. Listening by pulling weak stations out of interference and static is a skill to be learned. A good IF or audio cw filter will help. If you have one, practice using it. Static crashes which take out pieces of text is another problem: filters can sometimes help, but some have found that by using speeds up to around 20-25 wpm the characters may be squeezed in between crashes, and so less may be lost. This is one incentive for advancing in speed.

Chapter 6

How Fast? The Wrong Question - How Well!

"How fast?" -- that's really the wrong question when standing all by itself. The question, which ought to be asked, is "How well?" or perhaps "How effectively?" or "How intelligently"

The telegraph code is simply a means of communication, and communication is transferring ideas from one person to another in the form of words and sentences. If a person talks too slowly, attention tends to lag and comprehension becomes difficult. If too rapidly, things may be missed or misunderstood. Mumbling is usually inexcusable. Speed itself is not usually the object, except perhaps in case of emergency, such as "Help!" and even then it may hurt rather than help communication. The normal goal is coherency and accuracy. Speed for us is just convenience.

Commercial operators have always prided themselves in their ability to handle a large volume of traffic with dispatch and 100% accuracy. One operator wrote: "Over 50 years ago as a trainee commercial operator I was told that it is better to send at 20-wpm, and be received 100% the first time, than to send at 28-wpm and be involved in time wasting repeats."

The U.S. Navy insisted on accuracy above everything else: speed was always secondary. Battles, lives and expensive ships -- often the outcome of the battle itself -- depend upon perfect accuracy in communication. A single erroneous word or number during wartime or emergency might be ruinous and tragic. Accuracy comes first always, at all times there. The telegraph code was devised to communicate - that is its sole purpose.

If the code is not understood it is a waste of time and effort. If we send personal "dialect" or in a strongly personalized manner we make it hard, or even impossible for the receiving operator to make sense out of it. How do you like to struggle to make sense out of what a speaker with strong dialectical speech, or with a serious speech defect, says to you? If there is anything that causes downright joy in an amateur's heart, it is the pleasure of communicating with an operator who really knows how to send and how to receive. Aim to be one of these.

Copyability

How fast can you copy? Even for a highly skilled operator this is almost wholly dependent on the sender's quality of articulation -- his rhythm, spacing and keyer weighting. One of them said: "I can read a super operator at 50-wpm, but there are some hams I strain to copy at 10 wpm - some old timers hard to copy because of bad habits." The key to high-speed reception is to recognize the pauses between letters and between words. This means that the sender must not run things together. It is this split second it is the space which gives the time needed to get the mind set for the next word. One of first things that often happens when we try to send faster is to run the letters and words together. For example, when "of" comes out "dahdahdahdididahdit". We can learn to read that stuff, but when longer and less familiar words are sent and word spaces also are neglected, we can quickly get lost in a maze of letters, which make no sense. (It seems to

me that as speeds get really high fewer and fewer abbreviations are used.)

Fast Enough to Communicate Satisfyingly

It is possible to creep along at five wpm, the minimum FCC amateur qualifying speed -- communicating, but just barely. Many hams in the past found lots of enjoyment plugging along at ten wpm, which for many years was the minimum requirement for an amateur operator's license. Perhaps a majority of hams have found 15 - 18 wpm to be comfortable, adequate and quite pleasant to satisfy their desires to communicate.

Back in the days of landline telegraphy sixteen wpm was considered the minimum to qualify a new operator, while 25 - 30 was considered a "standard" range of speed. For very many years the ARRL bulletins have been at 18 wpm, which is a comfortable speed for most of us to read and copy. It should be clear that speed, in itself, should not be an object, but rather proficiency and ease of operation. (One does not usually buy a racing car just to drive to work each day.) On the other hand, when there is a lot to say, or when there is a need for extensive personal interchange, a minimum speed of 25 - 30 wpm is really needed to keep the thought moving.

From listening in the bands it would appear that in the CW mode this speed range seems to be very common. Even when one is contesting, and ragchewing is out of the question, if one moves too slowly, he is going to have a rather low score. But here also, speed, in itself, is not of much value: intelligibility and accuracy are required, and correct call signs, etc., are vital for qualification. There must be a balance.

All through the history of telegraphy, from almost the earliest days to the present, there has been the challenge for speed. The high-speed skilled operators achieved a sort of prestige, which was salable and commercially was rewarded by higher pay. The beginner and the plug were looked down upon with more or less scorn. But as radio amateurs, CW is one element of our hobby, something we do because we like to do it. We are subject to neither monetary incentive for proficiency nor threats for mediocrity. It is our own sense of need and desire that motivates us. Those among us who can race along at buzz-saw rates should not look down upon the rest of us who are content to enjoy lower rates, and we slower guys, in turn should not despise the newcomer, the handicapped or the ham content with thirteen wpm. We don't have to communicate with those above or below our state of proficiency unless we want to. So, the word we ought to emphasize here is "proficiency" -- proficiency at a speed that satisfies our enjoyment -- a pleasant speed which we feel is comfortable and satisfying.

The Proficient Operator

He is "at home" with the code up to his limiting speed. He is quite comfortable sending and receiving in this range and except for excessive QRM and QRN feels no sense of strain. To him or her the code is just another, and particularly enjoyable, way to converse. He understands what he hears without any particular effort, and of course he hears it as words, not just strings of letters. Some of our best-written examples come from the old wire line RR telegraphers in small stations across the country.

These men (few women held such jobs because of the other duties required) also had responsibility for delivering train orders to the train crews, maintaining RR property associated

with their stations, operating the semaphore signals and track switches for passing trains, answering customers' questions, selling tickets, handling baggage and freight shipments, etc. In short, telegraphy, while of great importance, was but one aspect of their jobs. They were not just sitting beside their sounders waiting for something to come through on the line. Their ears were attuned to the sounder, and they would have to be ready to interrupt other duties if something important was heard. Their sounders were continuously on the line and they could and did hear, almost unconsciously listening to everything that was said to anyone on the line: they knew everything going on. (It was like a big party line.) Very many skilled radio operators of the past and present do the same thing.

One of them who operated commercially for many years and was also a ham wrote: "During my time as a RR telegrapher, and as a [radio] operator, I could and can do several other things while still knowing what is going on the wire or on the radio. As a matter of fact, right now, I have 20-meter cw on and I am fully aware of what is going on, who is there, what they are saying, etc., while writing this letter. With speeds of up to 30 - 40 wpm, I have always been able to carry on a complete conversation while copying the code on a mill, servicing the message ahead of time, etc., etc."

Set Your Own Goal

So, how high should you set your goal of speed? - Set it to meet your own temperament and desires, what you think will be comfortable and enjoyable to you. Set it realistically -- not so high that you get discouraged by how long it takes to get there. But not so low that you are unable to enjoy much that is on the air, available to be read or copied. If you feel challenged to go to the top, fine, but maybe you should divide it into stages of growth along the lines suggested here.

Ted McElroy, long the code speed champion and a teacher, said that 25 wpm is an easily achievable and reasonable goal -- one who can handle this speed comfortably is a "good" operator. But if you can read or copy at 30-35 wpm this added margin will allow you to correct for errors, static and other kinds of interference or losses, as well as widening your contacts. We have tried here to lay out for all to see what has been done and what can be done. Pick what you yourself want. You don't have to keep up with the fastest Joneses you may hear.

First and foremost, have fun: enjoy it. “Good" operator? "Skilled" operator? "Expert?" "Super-expert?" Up to some point each stage brings increasing pleasure as one becomes more and more free from conscious effort. Reaching higher speeds will turn out to be easier than you might suppose. It is mostly a matter of right approach and practice, continuing what we have already started. Your rate of gain will depend mostly on how you go about it, and will be more or less proportional to the square of the time invested. What do you want?

Shortening Things Up

At too low a code speed it takes so long to say things in ordinary English that it may become tedious or even boring. This can be a major roadblock to the real enjoyment of slower cw operating, but it is not the only reason for tedious QSO's. This can be partly overcome by certain shortcuts. In the early days of wireless, code speeds were necessarily slow for a number of reasons, and so three ideas were borrowed from landline telegraphy to help speed things up:

- special signals -- including the special three-letter "Q" signals providing short forms for common radio communicating needs,
- omitting words not really necessary to convey the sense,
- using standard or easily understood abbreviations.

"Q" signals allow us to cover a lot of ground with only three letters. If they are followed by a question mark, the sender is asking a question; without it he is making a statement. "QTH", for example, says "My location is ...", while "QTH?" says "What is your location?" (It is a waste of time to send: "My QTH is ..." as we sometimes hear, or "What is your QTH?") See the ARRL Operating Manual for a list of the most useful of these. (A similar but much more extensive set of special commercial three-letter signals was once devised, called the "Z-code." This system never attained wide popularity, but it is much easier to remember.)

In most sentences certain words can be left out completely without altering the meaning of a sentence. Words such as "I". "the", "that", etc., can often be dropped without causing any confusion. Several words or a whole phrase can often be ignored without detracting anything of importance. These were the kinds of things commonly done in writing commercial telegrams to reduce the cost.

Various kinds of abbreviations, a sort of shorthand, have been in common use over the years. Many of them were used extensively by people making brief notes, etc., others were devised by old time telegraphers for their special purposes. Several different schemes have been devised to form them:

- short words may be represented by their first and last letters: e.g. "now" by NW, "would" by WD, "check" by CK, etc.
- short words may be spelled "phonetically": e.g. "some" by SUM, "says" by SEZ, "good" by GUD, "because" by BECUZ, etc.
- other words may simply omit all their vowels and just use the consonants: e.g. "letter" by LTR, "message" by MSG, etc.
- easily suggested parts of longer words may be represented by a single letter: e.g. in amateur practice "transmitter" may be sent as XMTR, "weather" by WX, "distance" by DX, etc.
- those who handle considerable message traffic have devised some very brief forms, such as "aa" for "all after".

Amateurs must, however, remember the government regulation that we may not use secret codes or ciphers -- our communications must be open, which means something generally used and understandable. (The old Phillips code, for example, would qualify because it is public information.) The older handbooks contained lists of the more common abbreviations, a sort of standard list. Some were for general use, others were for handling heavy message traffic, etc.

When commercial telegraphers were sending press (news) at relatively high speeds they used a very extensive set of abbreviations called the Phillips code. Here the sending operator translated many of the words and phrases of a news dispatch into this code, and the receiving operator

retranslated them back into normal English as he copied the news. This procedure reduced the total number of letters to be sent and received by around 40% (estimated from samples given). When speaking of the speed of press dispatches this factor must be factored in (the counts were based on normal English spelling). Some of the Phillips abbreviations were adopted by amateurs.

The important thing about using abbreviations is that they must be obvious to the receiving operator. That means they must be common words in normal amateur or everyday use. We must use common sense with them -- not overdoing it or using them excessively, just being careful that they will be understood. Refer to Chapter 27 for examples and lists of abbreviations.

Chapter 7

Listening or "Reading"

"Copying in Your Head" Just listening to good code sending is perhaps the very best way, both to learn the code and to advance in skill.

It is surely the simplest and easiest -- no distractions -- you can give your whole attention to just listening to and trying to understand -- no struggling to write at at the same time. Isn't that the way we all learned our language? Watch how little children learn.

Listen!
Many experienced teachers consider that just listening to good code without writing anything down is the very best form of code practice at all stages. It serves a number of purposes. First, it keeps our attention to the fact that code is sound, and we are learning to recognize the sound patterns of each character and of some words. Second, and very important, it helps to reduce any tension associated with getting every letter written down (no distractions) But there is more -- it helps us get very familiar with using the code.

So, listen, listen, listen to improve. As soon as you have some mastery of the alphabet, start listening at every opportunity to good sending, even while doing other things that do not require your close attention (e.g., cooking, eating, working with hands on routine things). Don't think you need lots of new recordings. Remember that: "To repeat often is to learn." Replaying of the same familiar materials over and over, day after day, is especially helpful if you do it creatively, really listening to it. Play them over and over, paying close attention, trying to understand. As you listen, let your mind be open and receptive -- intent on listening to each signal as it arrives. Not anticipating or trying to remember what it said before. – So, let yourself get familiar with the code by taking some time every day to relax and enjoy just listening to good CW.

This kind of listening is listening creatively, constructively, as it comes along. This has several distinct advantages, not the least of which is to take away any tension or strain -- you know what it is talking about -- you are already familiar with it in general and you feel more comfortable with it. And -- you are getting really familiar with the sound of code -- it is becoming increasingly meaningful to you. So, you can benefit greatly by listening to the same things over and over in this constructive way -- just listening as it comes along. But as you advance mix in a pattern of new and unfamiliar recordings, too. The new material will become easier and easier with this kind of practice. You can make your own recordings: -- a few ARRL bulletin broadcasts, quality QSO's -- Bible passages are good -- or other text material and play them back over and over.

Especially in the early stages of receiving, when things go very slowly, and often again when you have gained considerable skill, the mind may tend to wander off somewhere else, or go galloping ahead (jumping to conclusions). As you listen, hang onto every letter, word and phrase -- hang on like a leech (that is, concentrate on it), really listening to it. (This also helps; take off any strain, knowing something of what is being said.) Remember that in practical

communications, when we listen to the radio, the signals are here and then gone and cannot be brought back unless they were recorded. You are learning to get so familiar with the sound of code that doing it right the first time will be easy. Easy familiarity will help us to do that.

We are more likely to rush ahead when we are fresh and alert. Don't let your mind try to outrun the sender. We must resist letting our minds wander off, or anticipate, or pause to try to figure something out. Some of us do this in normal conversation and reading, but we need to be especially on guard against this in code reception. Don't let it become a habit with Morse. As we listen, we need to disconnect all conscious analytical processes, and instead maintain an eager readiness to receive -- to hear each letter, word and phrase as it comes along, willing for it to be whatever it will be. That means we hang on to every letter, word and phrase as it comes along, ready for the next one. Listen, keep listening and want to understand. Let's develop the desire and feel for doing this. There is no need ever to become embarrassed (or panic) because you can't read or copy everything you hear.

Whatever You Miss, Let It Go

Am I afraid of losing something? I must let go of that fear, and relax and learn to trust the mind and to enjoy listening. It is a fact that the less hard we try, the better we will receive. Don't ever stop to try to figure out something you didn't catch. Keep following the sender -- keep listening and you will soon be getting enough to make sense out of every sentence, and in time you will get all of it. But even when you are quite good there will be some words, which don't make sense at first -- in most cases you will make sense out of it as you go on following the sender, and without even trying. The context and redundancy both help fill in the gaps -- just keep focussed on the signals. (And don't forget that the sender sometimes may have made a mistake.) If you have learned only to write things down, it will take some practice to learn to "copy in your head" without writing. Listen to understand. Keep listening, not worrying about losing here and there. Soon the signals seem to be slowing down as they parade before your mind or "inner eye" as meaningful words and phrases. Learn to listen for whole words, phrases and the meaning of messages rather than single letters.

"Throw Away Your Pencil!"

Many an old-timer has always copied down everything he receives: he has never learned to sit back and relax and just enjoy conversing. He needs to throw away his pencil and learn to enjoy listening for listening's sake. Many a newer-comer likewise feels tied to his pencil and paper out of fear he may miss something if he doesn't get it all written down, every letter of it. This creates a tension, a strain that impedes the normal functioning of the telegraphic "habit" of mind. "Throw away your pencil and enjoy just listening" is good advice.

Concentrate

In receiving, we must learn more and more to shut off all distractions and concentrate our attention on the signals we are listening to, what is being said. We need to learn to center our attention consciously on the signals and ignore all else, until it becomes a habit -- automatic. Prepare yourself to do this immediately before starting to listen and whenever there are lulls. Make it a habitual mental clearing-for-action, so you can pay attention solely to the signals you hear. When we are interested in what we are hearing this will help us concentrate. So let's want

to know what is being said -- yet not so intensely interested that we begin to guess what is going to be said and miss out on what is actually being transmitted.
An agent who was responsible for hiring shipboard operators was himself a dyed-in-the-wool cw operator. He connected a telegraph key in his office with a buzzer in the waiting room. Then whenever there was an opening, he would send an appropriate name from his prospect list in Morse code. If the man didn't answer promptly, he simply skipped him and went to the next name. He believed that a good shipboard operator should be alert, able to respond to cw. Isn't that an interesting way to get a good operator? -- Is he listening, alert?

Learn To Hear Words As Words They Are The Building Blocks Of Thought

As you become more familiar with the code alphabet, you will soon be hearing letters easily enough -- it is time to begin to think in terms of meaning -- that means starting to hear words instead of strings of letters. But as speeds go up, there is a limit to our ability to spell out words. Our next goal is to hear words. Let each word or code group develop on the internal monitor screen of your mind. Begin to develop sound consciousness of words. This does not mean you have to relearn words, but only change your approach from visual to sound. Practicing with lists of words, replaying texts or QSO's -- this kind of practice can help you gain that familiarity with words commonly used.

There is a limit to our ability to spell words out mentally and remember them. As long as we hear only letter-by-letter, we almost have to copy them down to understand what is being sent. To hear code as we talk, we have to learn to hear words as words -- that makes the code readable or "conversational," and not just short or long strings of letters. This is stage two. If you have learned to hear and think of at least some of the 100 most common words as words, you already have taken the first steps. Words are the building blocks of language, so we need to begin to hear not code or letters, but more and more in words as perception units. (Step three, the expert stage, is to learn to hear more by ideas -- total content -- than by words.)

How Can We Learn To Do This? Listen For Meaning

When we begin to hear and send in words instead of individual letters our receiving ability and speeds are going to improve. That is part of our goal in making the code more useful and enjoyable. Hearing words instead of strings of letters will make speeding up natural and easy. It will require some practice and effort. The mind has to be pushed, but not too hard. Let's do it the easy way, in short practice periods. Learning to recognize whole words becomes an automatic process of decoding, something that lets us understand as we hear. This is no big job -- the word "the", for example, is no longer than the number 9.

Start learning to hear common short words until they have become indelibly fixed in mind as word sounds. Learn to read by words as readily as you recognize letters. First learn to hear common short words over and over until they have become indelibly fixed in mind as word sounds, as if someone had actually spoken them to you. Extend this to longer words by such methods as the following, which some people have found helpful:

A "MENTAL SCREEN" is like a typewriter writing -- visualize a typewriter or blackboard on which writing out each word as it comes, writing it along letter by letter along the line, or like one of those lighted display signs where the words walk slowly across the screen. Let each word

develop on the internal monitor screen or blackboard of your mind so you "see" it being written in context. Try "projecting" the letter or number, etc., for split second on your mental screen as you listen to it to encourage instantly "seeing" it in your mind when you hear it. Learn to write on your mental blackboard. This helps focus our attention on the signals forming words and learning to "see" them as words. Let you mind be blank as you listen to fast code, and soon the letters jump out at you.

Some have found that PHONICS can make comprehension and speed building easy and natural this way: --. Relax and think of the sounds of the code letters, not as letter names, but as they are pronounced in words. Like this -- while the word "west" is being received -- as each letter comes along one after the other say out loud, or to yourself: "wuh, wuh...wee, wee...wes, wes...west", progressively building up the word in mind by sound. This makes it easier to hear their sounds. Sound them out one after another as they come along until we get syllables and finally the sound of the whole word itself. It teaches the mind to decode the dit-space-dah patterns and combinations into their sound values, the way we hear words.

This system doesn't work perfectly, of course, because English is not written in a perfectly phonetic way. Some of the letters are "silent", like final "e." Let the letters combine into words as you hear them in code, much as we recognize words as we hear their sounds You can help by practicing with the common letter combinations (br, gl, ng, etc.) and syllables (com-. ex-, inter-, -ment, -ing, -tion, etc.) to get familiar with them. Reading whole words this way then becomes a process of decoding from something we hear in bits and pieces into something we hear and understand as meaningful units. It even can help with abbreviations. You may like to try this approach and let it become automatic. When we have learned to hear words as words, we can often also mentally correct a sender's errors or signal drop-outs while listening.

The importance of PROPER WORD SPACING should become more obvious now. It gives the mind a split second to make sense out of the stimuli it has just received. Those word-separating spaces are vital. The following exercise is worth a try -- as soon as you recognize a word by the space which follows it (if the sending is not too fast, and the spaces between words are long enough), try saying each word out loud (or mentally to yourself) as you recognize it. You may want to make up some practice materials, which leave wider spaces between words to allow time to say them. (It may also be useful to practice this way with short groups of numbers, such as 2 or 3 digits.) Notice how, as you listen, the silence before says, "start here" and as the following space says "it is finished", sort of islands of rest. That is why gaining familiarity with the sound of code words is so helpful. It makes the word a meaningful unit, and you get to feeling easy about receiving what makes sense. The more words you are familiar with the easier it is to receive. It banishes tension.

One ham put it this way: "the code just flows into my ear and comes out as words." Just as we have learned to let the mind recognize each code character and present it to us consciously and automatically, now we must take that next step and trust the same mind to store these letters and put them together into words without demanding to be conscious of the process and "hear" each letter individually. We have to learn to let our subconscious mind present us with the words they form. As long as we insist on recognizing each individual letter, we are interfering, meddling with our normal habitual mind's functioning, and misdirecting our attention.

The goal is to learn to listen to the code as you would to the spoken word. Eventually the sound will trigger your consciousness just as the spoken word does and then, when you can do this, it will also be easier to copy it down.

We Must Listen At Higher Speeds To Improve

To improve we must begin by listening at a speed higher than we are comfortable with, in order to get used to it and speed up our recognition. We ought to listen at different speeds, both slower and faster than we can easily read. We need to be flexible -- to avoid staying at any one speed too long at a time. Along with this, let's practice listening to lots of standard English at speeds close to our limit. This limit should keep going up as we continue to practice this way. A total of a half-hour a day spent just listening at speeds we can barely follow will work wonders in a couple of weeks. Listen as you would at a concert, enjoying it as you go.

Sometimes we should pick speeds so high that we can only make out a character here and there. This kind of listening will quickly help us to begin to get more and more. Small words will start jumping out -- as soon as they have been sent we will know what the words are, although we didn't consciously spell them out as they were coming in. We need to continue this kind of practice, and soon we will be getting enough of each sentence to make sense out of it. Learning Is Variable. Some days you'll do better than others, but don't let this trouble you -- that's normal. All of us are like that for a while at each speed.

You will discover that sometimes you can read several words solid, and then not be able to read anything more than a letter here and there for some space. All this is part of normal learning. Keep on listening: give the incoming signals your undivided attention and keep relaxed, as though listening to a friend talk. Soon you will be catching not only small words, but longer ones . . . until you are getting it all. You will discover, with practice, that the signals, which were too fast before, will seem to be slowing down as they parade before your inner eye as meaningful words and phrases. -- An interesting example is the blind amateur who could copy 35 wpm, and came across some code practice and listened. He lost a letter here or there, and then was startled when they said it was 55-wpm practice!

MISSING WORDS, LONG WORDS, DECAPITATED WORDS and BROKEN WORDS

Static, interference or fading can momentarily wipe out a letter or two, a small word or part of a longer word. Momentary inattention (due to mental fatigue, distraction or something else) on our part while sending or receiving can do this, too. When a word is decapitated the first several letters are missing. This makes things particularly difficult in English, because word beginnings are so important for us to be able to make sense of a word -- and worse, this is often the accented part. In fact, when we can get the first several letters of a word don't we often know pretty well what the whole word is likely to be?

When reception is solid as we are just listening, some strange things may happen: a little word or the first part of a long word comes along which seems unfamiliar -- has no recognizable shape -- and we stumble a moment trying to make sense of it. This tends to blank our minds against hearing the next few letters and then we are likely to lose the what immediately follows, in the case of a long word, the whole word. At other times our minds sometimes seem to go into

reverse after the first few letters of a long word, then misses a couple of letters in the middle, tries to pick them up, and finally loses the whole word.

How to can we stop this? We mustn't let missing out first part of a word distract us so that we stop hearing the rest of it. -- How can we prevent this? Is part of the tension caused by missing out or losing first part due to recognizing a time gap with nothing recognizable to fill it? -- We may be able to recapture long words if we just keep on listening. (When we are copying we can often fill it in afterwards from the context.) A broken word (interrupted, disjointed) results when the missing letter (or letters) occurs in the middle of the word. Sometimes this break is due to the sender who inadvertently hesitates an instant too long between two letters. In either case, the space between letters is too wide and our minds interpret this as a break, marking it as the end of one word and the beginning of the next. Since it doesn't make sense, we realize something is wrong and wonder what word that last group of letters was. (Let this be a warning to avoid it our own sending.)

When a wrong letter (mis-spelling) or a non-character is sent or a word is left out it may distract us in much the same way. Really, isn't this much like a misprint in reading? Don't we often skip right over a misprint or missing word and hardly notice it? How do we do that? Isn't it because we understand it in the context? Can't we learn to do this in telegraphy also? -- Where one or more letters or even words are wrong or missing, can't we often fill them in correctly? We can learn to do this for missing or extra dits, etc., mentally correcting them as we listen. As we have emphasized before we must just let it go and keep on listening. If we pause try to figure it out at this point, it will divert our attention from reception to analysis, and seriously disrupt with our automatic reception as we try to make sense out of it. Frequently we discover that as we go it will clear itself up.

First, we must keep focussed on the incoming signals without struggling to make sense out of them. TRYING to make sense is a conscious activity, interfering with the automatic mental functioning. A sense of concern is involved - concern that we won't be able to remember the first part until the word is finished, or that its beginning is peculiar, has no recognizable shape (e.g. technical or medical terms), or that it is going to be a word we won't be able to recognize at all (doesn't seem familiar). For many words, one way to help is to get familiar with the common prefixes and suffixes so that they are "heard" as units instead of separate letters. We must learn not to let conscious thought block further reception.

On-The-Air Listening

When we listen on the radio, static, fading and interference tend to slow us down. Under these conditions high quality sending (accurate timing) will get through far better than sloppy sending. But there are certain adjustments or changes which can be made in our receiving equipment which will help: e.g. the use of RF and audio filters, changing the tuning of IF amplifiers, etc.. These will help separate signals and reduce noise.

Static and irregular non-signal types of electric interference can often be reduced by turning down RF gain and increasing AF gain to bring the signal up. Some noises can be canceled in the brain by using headphones wired so that they are out of phase with each other. Dual-diversity reception can greatly reduce or eliminate fading, but this requires a major equipment change: two

separate antennas and two identical RF front ends are necessary. The ear is an excellent discriminator of CW signals in QRM, noise and other interference, much superior to any equipment available today.

We can train our ears to minimize interference by focussing our attention to the one signal we want to hear. The musical pitch and quality, so long as two signals are not identical, can help us separate them, while the speed and style of sending also help greatly to separate the one we want from the other. In addition, the ear can be trained to read incredibly weak signals in the midst of strong distractions. Some operators have learned to get almost 100% copy in spite of all these. Some have found that by listening in the dark, or closing their eyes, they can focus more sharply on signals, which are in the midst of interference and other distractions. You may want to try it and see if it helps you develop or improve this skill. Finally, sometimes writing it -- copying -- may help us to concentrate.

Any experienced telegrapher, regardless of what he is doing, effortlessly hears what is being said on the air or on the wires.

Chapter 8

Copying - Getting it Written Down

This is really an extension of Chapter 7 To the principles given there add these: If you are going the easy way, copying is the next step after "listening" -- advancing in code skill by adding the new action of writing it down.

What we hear as letters and words are now to be written with pencil and paper or with typewriter. It is learning to co-ordinate ear-to-mind-to-hand. Copying by hand exposes all the senses to what you are hearing, and it is nothing more than listening to and writing down what is being received. An old 1854 book on telegraphy described it as "taking dictation" -- at first letter-by-letter, later as word-by-word, etc. That is a good way to think of it. So, hunt up that pencil again. Operating ability is measured by copying: if you don't write it down -- putting down everything you hear exactly as you hear it -- you aren't copying.

A skilled operator is trained to copy what he hears 100% perfect. . Most people can learn to copy with a pencil up to about 25-wpm (a few can reach 35, rarely 45), but above that speed almost everybody needs a typewriter ("mill"). (On a typewriter it may also be done "mechanically" by direct ear-to-typewriter-key transfer without processing it through the letter stage to the typewriter key. -- See later in chapter) Remember - don't try to do more than one new thing at a time. You already know how to write. When you copy by hand, make it easy by writing the way you usually do. For example, don't try to block print unless this is natural and easy. Likewise, don't try to copy on a typewriter ("mill") before you have learned how to touch-type.

While most of us would like to know what we are copying as we copy, this isn't necessary. It can become so automatic that we copy something correctly without realizing what we are copying. (I usually like to know what I am copying, don't you?) People who do these things well do not struggle with them -- they have learned so well that it has become second natural for them.

Here is an interesting example of copying properly: - One night, as I was copying mixed groups in a very relaxed manner, and feeling quite comfortable with the code, I asked my friend if he would speed up to 25-wpm from the 20-wpm he had been sending. He started sending them at 25-wpm, and I was vexed at his misunderstanding, but began to copy anyway, wondering why he was using voice to send these simple data. -- Voice? What voice? He was sending clear code with letter-number combinations at 25-wpm and I was copying it easily." Aha! The listener was now thinking in terms of letters and numbers, not as code characters at all. He had become proficient.

To copy just WRITE DOWN what you hear, everything you hear -- not what you think your hear -- and you will make progress. The faculties of hearing and understanding code signals work best in learning to coordinate this way to create a useful copying ability.

Practice with Familiar Text Helps

As in listening, this helps by dispelling the fear of missing something, because we already know what it is about. By using things, which we have read, or recorded material we are already

familiar with, we feel more comfortable. When we know, at least in general, what it's about or what it says, we know what to expect and not worry about not understanding and losing out. It helps build confidence in learning to copy behind. The more familiar we are with what we are copying, the easier it all becomes. This confidence will begin to carry over into receiving new and unfamiliar materials also.

Pay No Attention to Any Errors

Condition yourself to copy what comes easily. As you practice, copy everything you instantly recognize and pay no attention to any errors -- just forget them and go on. ***If You Miss Anything Just Go On*** -- Let it go, forget it and keep going on. Train yourself to leave a blank space and go on, because if you stop for even an instant to puzzle over a signal you didn't recognize, you will miss at least some of what follows. We must condition ourselves to do this. After all, we're learning.

The holes in your copy will gradually fill up and you will be keeping relaxed while you go, just leaving blanks for each missed letter or word. (However, characters we habitually miss do point out what needs more practice.) Remember also that we may sometimes mis-hear, or mis-identify a character or a word -- and also it is always possible that the sender may have made a mistake. -- Count these things as of no importance, and keep at it until you can do it easily. Don 't work so long at a time during these learning stages that you get tired or bored. Use a wide variety of material and choose it to be as interesting as possible.

One student, speaking of ARRL practice materials, said: "I made more progress in learning code in weeks than I did in years previously, because it is more interesting to copy and understand solid copy." Some practice copying random 5-character groups is good in the early stages to make sure we are recognizing the characters correctly and to prevent anticipation, but because it is meaningless it soon tends to become boring. -- Too much of this may also lead the mind to expect a break after each five letters when we are trying to copy normal English. This has happened! (Practice with "Backward English" -- provided in some computer programs -- is better because the letter groups are of variable length and have normal letter distribution.)

IF YOU WANT TO BECOME MORE PROFICIENT

Who Doesn’t? If you are able to copy every letter, you are not learning -- but if you are only getting two letters out of every three, or four out of every five, your mind will be motivated to get that extra letter. There is always some speed at which for the time being each of us falls apart -- so what? It need not become a barrier. If you want to become more proficient, don't practice at such a slow speed that it becomes a fixed habit.

Keep trying in short bursts of not over a minute or two at a time at higher speeds 2 - 5 (or more) wpm faster in order to force the mind to respond faster -- it will. This is especially important when we are at a speed where we getting about 95% of it, so that we don't become satisfied to stay there. It is often best to begin a practice period, when the mind is fresh, at a speed too fast to get more than about half of it, and then slow down. -- Keep moving up faster to improve, because then copying at a little slower speed than your maximum will become easy and enjoyable. Alternating with some practice at 2, 5 or more wpm above your limit for brief periods will challenge the mind, then dropping back a little will show you are really improving. Every

operator soon develops enough awareness of what he is writing down, that he doesn't need to wonder whether it is copied correctly.

In The Beginning

If you begin copying early, you will be copying letter-by-letter, sticking close behind the sender: you hear the character and write it down, then forget it and listen to the next and write it down, and so on. But to copy this way for very long, in step with each letter being sent, tends to tense us up. It becomes tedious and tiring because it is meaningless and so much conscious effort is involved. Then you usually have to read what you have written in order to understand it. (If we look back while copying we may lose out.) In practicing to speed up copying, try not to stop if you fall behind, just keep going.

The beginner is afraid of losing something, because he can't get it all down fast enough. He is frantically struggling to keep up, "tail-gating" the incoming signals, so as not to lose any of them. This is because he is still not recognizing some characters quickly enough. The problem is made worse because the characters are received at very unequal rates of speed as compared to writing them down. The letters "E," "I" and "T", for example, are the shortest letters, while C, J, Q and Y are the longest ones. A beginner copying letter-by-letter can get panicky trying to write down an "E" or other short letter before the next one arrives. It is worse when two E's, or EI, IE, TT or other short letters occur together, and we frantically try to write them down before the next one comes along. As we advance most people can copy letter-by-letter up to about 25 wpm or even faster, but above that we simply have to find a better way.

A Better Way -- Copying Behind

The first step to making copying easy is to learn to copy behind. That means training the mind to act as a buffer, or short-term memory, between hearing the incoming signals and what we are writing down. Several characters or words are automatically held in mind after hearing them and before writing them down, meanwhile continuing to listen to the next ones coming along. This helps smooth out the uneven rate at which characters are received as compared to writing them down, and also it relieves the mental strain of copying. It serves as a cushion. In this way we can also make much better looking copy and can even capitalize proper names as we hear them.

Copying behind is another good way to beat anticipation. It puts a premium on listening before you write A good operator seldom starts writing a word down until it is completed. By starting out using things, which we have read, or recorded material we are already familiar with, we feel more comfortable. When we know what it's about or what it says, we know what to expect and not worry about losing out.

Above about 25-wpm, we need to build up vocabulary of at least the most common words and syllables. Practice waiting until a syllable or short word is finished before starting to write it down, then try it for two syllables. Writing down more than that behind what has been sent may be risky -- the word may turnout to be longer -- unexpected letters may still be coming and surprise you, making you miss them or even more (If you're still going at 40-wpm you will have to copy word by word.) Some people seem to develop this ability without any special effort as they progress. But for most of us it just doesn't seem to come at all without some help.

How can we learn to copy behind? Is there something we can do specifically? There certainly is. Here is one way to begin: start out with random two-character groups at first, until you get the hang of it, keeping the spacing between groups wider than normal. Listen until both characters have been heard before starting to write them down. As this becomes easier, try groups of three, then of four and if you wish up to five or more. Practice also with decreasing spacing between groups until it is normal. Another approach with any kind of text, is this way: listen to the first character, but wait until the next one has been completed before writing the first one down; write down the second one after hearing the third one, etc. Then increase the number of intermediate characters between hearing and writing to two, then three, etc., as far as you wish.

This kind of practice should be extended to include short syllables and short words (such as the 100 most common words), in each case waiting until the whole syllable or word is completed before starting to write it down, and while listening to what follows. To extend this to more than a couple of syllables or short words can be risky, because, as noted before, something unexpected may come along and throw you off balance, and cause you to miss some of what follows.

An interesting example is this comment (from the time when a government inspector had to test each individual applicant for an operator's license): - "I can remember the benefits of copying behind. The inspector giving the test started and sent 'of' and then added an 'f.' I immediately thought of 'off' and got set for the next word, but to my dismay, without a pause he sent an 'i' and so immediately I tried to outfox him by prewriting the word 'office' To my consternation he kept on going with 'cia' and I quickly revised my thinking to 'official.' But I was wrong, because he finally ended up with the word 'officially.' Listening first and copying behind are beneficial." So, copying a word or two behind is a leisurely pace, but too much more may produce some mental strain, especially if an unusual word comes along.

Copying behind has many advantages besides making it easy. It allows us to make a neat, finished-looking copy with a proper appearance, capitalization and punctuation. When it is at speeds well below our limit, it gives us time to fill in gaps and flaws due to static, etc., and to correct errors in sending. Context can help. (Numbers, however, have no context and generally must be copied without delay.) The purpose of copying behind is to relieve the mind of the compulsive pressure, the strain, of keeping up letter by letter.

Most high speed operators who have discussed this subject tell us that we need not copy more than one or two syllables or words behind, and in fact as speeds go up this is about the safe limit. (Some experts, such as Ted McElroy seem to have been able to copy 6 or more words -- even whole sentences -- behind with no trouble at all, but most of us probably cannot.) Copying letter-by-letter forces one to write with conscious effort and this in turn blocks our attempts to copy behind.

What Makes Sense Is Easier

We can hold in mind only a few individual numbers or random characters at a time because they usually have no coherence, no meaning - they don't make sense as syllables and words do. Words and phrases are much easier to remember than a string of letters or numbers (or a call sign) because they form meaningful groups, not a lot of little unrelated pieces. This is why

Walter Candler, who in earlier days taught many operators to become experts, was convinced that learning to hear words as words was essential for efficient copying behind. (He was a strong proponent of listening practice.) We can learn to copy by words as readily as by letters. For example, the word "the" takes no longer time than the number "9."

Copying behind by syllables, words and even by longer expressions is merely an extension of this. If we build up our working vocabulary (word-familiarity) as already discussed in Chapter 7, listening, this will help us a great deal. As speeds go up you will find that, by around 40 wpm you're copying word by word and by 60 wpm (if you go that far) it will be more like copying phrase by phrase.

Old time telegraphers used to say that their "alphabet" was words. That is, they had a wide working vocabulary of words that they instantly recognized when they heard them. When they heard a word coming in on the line in code, they heard the word, not the individual letters, unless it was some proper name or something unusual that they had to spell out. They had a familiarity with words. That is why one of them, who also was a well-known teacher of Morse code, said that by listening and re-listening over and over again to the same recorded code tapes of regular English text, this will help us to become intimately familiar with the words -- that is, over-learning. We need to get familiar with words as they sound in code.

Conquering Our Fears of Losing Out

Law 3- if you miss something: condition yourself to skip it. Keep copying everything you recognize instantly and easily and shrug off the holes left over. You'll soon be surprised to find the holes gradually filling up. If you are frightened you lose much of your ability to copy code well and --surprisingly --your sending speed also tends to go up (as much as 25%). The parts of brain that copy normally are pretty much shut down.

At first it may not be easy to let go, and allow some characters or words, which we can't quite consciously identify, pass by. That doesn't mean we stop listening or paying attention: it means we are learning to trust the mind to store them safely in its immediate, retrievable memory and not get panicky or confused because we are not conscious that they are there. So, especially in practice, if you miss a few letters or a word here or there, don't worry.

Overcome this fear by just continuing to go ahead -- including more practice on the sticky characters -- and you will surprise yourself to find you will recall them. Because our fear of losing out is the greatest barrier to copying behind, Candler devised some special exercises to help us get started with a minimum of strain. It goes like this--- take a list of short words in two parallel columns, preferably words with about the same number of letters each, and:

a) With pencil or typewriter write down the first word in the first column while simultaneously spelling out loud the parallel word in the second column, and so on down the columns. (We may do it again, reversing the column order.) Try it with 2-letter words first, then longer words till you get the knack of it. -- As a useful variation, try sending the one word with your key while spelling the other out loud.
b) Have someone "read" easy printed matter to you by spelling out each word at a regular, even rate of speed and a level tone of voice. Don't begin writing the first word until the third starts,

and keep on two words behind, and then if you wish, with three words behind, etc. Finally you may repeat it using code instead of voice spelling. Do these exercises slowly enough that you don't feel rushed or have any fear of losing out. Don't do it too long at a time: a couple minutes at a time are enough to get the hang of it.

Other Suggestions - Finger Writing

Try some "copying" this way: -- sit as though were going to write, using your index finger instead of a pencil (or your hand as though you held a pencil), letting it rest lightly on paper while listening to the code. You may try it as motionless copying, not moving your finger, "copying in your head" only, or you may prefer to "write" with your finger. Either way, it can help wean us away from that baby step of letter-by-letter copying, and graduate us into seeing several letters or words as a unit in the mind's eye.

Once we've gotten the knack of it, we will discover that visualizing and holding the letters, even for just an instant, will help us to copy better and faster than the old on-the-edge way -- almost a reflex action. All this is training the mind to dig up the images of words that have already been sent. It will develop a sort of automatic response: ears, mind, hand all coordinating together. Remember: to ignore any errors, not to work too long at a time, and -- don't forget: you're just practicing. So give yourself a chance. In learning to copy on typewriter, go slowly at first. You may find it easier to use either caps or lower case altogether at first. Until the typewriter became practical old time Morse telegraphers copied all messages with pen and ink in beautiful longhand up to 30 - 35 wpm -- solid deliverable copy, while a real good operator using a mill later could take 50 -60 wpm without overextending himself. Most copied 5 - 6 words behind to do this. (OT bulletin Jn 92 p 13)

How Long Shall I Practice?

Until you have gained considerable skill in copying, avoid working too long at a time. But after this point it is good to practice copying for longer periods without fatigue. When you have reached a fair speed, long copying practice can be helpful because by the time we are getting somewhat tired, our subconscious mind is translating the dits and dahs so that we do not feel that terrific mental strain that is the cause of guessing at certain letters. Under these conditions one can copy page after page and not be aware of a single sentence in it.

Fading - Static - Interference - Poor "Fists"

In the old days when all ships used spark only it took a lot of concentration and skill to copy a station a thousand miles away when another ship 150 miles away was transmitting. When there were static crashes it was hard (and they also often sounded like parts of code letters). Learning to copy a weak station through static and interference and fading is an art in itself, and to master it takes quite a bit of practice. It taxes the skill of the operator to the utmost, as it is often necessary to retune the receiver and go back and fill in missing letters in the copy without actually losing a word of a signal that can hardly be read. Signal fading is something to contend with, but during practice even that may prove to be a benefit to us. Copy what you do hear and leave a space for what you can't. It can help us learn to ignore lost sounds.

Quality of sending and on-the-air receiving conditions have a marked effect on copyability. An operator who can copy solid code at 25-wpm may drop to about 15-wpm when static or

interference is present. Bursts of static can take out gobs of information. Old time commercial operators copied solid right through static, interference and fading so bad that others had to ask for repeats, and they kept right on copying when most us wouldn't even have heard the signal at all. Their jobs depended on it. That is skill, and CW does get through. Some hams have learned to do this just as skillfully -- they have learned to copy signals against intolerable background noise, noise to signal ratios of 10 dB or more.

It takes practice and patience to learn to hear the weak stations under the loud ones, but we can learn to copy a weak station buried under several strong ones. This is a truly remarkable ability of the human operator: to read incredibly weak signals in the face of strong distractions. It does take concentration, and the advancing operator should be developing some of it. Bum "fists", bad sending, is something else again. A skilled operator who can copy solid at 50-wpm with good quality sending might be able to copy only at 10-wpm with poor spacing, poor rhythm or poor weighting.

Correcting Imperfect Copy

Holes and errors in one-time copy can often be corrected, whether they originated in the sending or receiving (including interference, etc.), by rereading and analyzing the entire message. Look for key words, clause and sentence boundaries, linking words, etc., for clues. The context can help greatly in filling in and correcting things. Where a word is strange, look for the letter which might have been warped, mis-sent or mis-heard. Examining our practice copy in this way can also be a valuable tool and encouragement as we are learning.

Other Observations

At the expert stage where copying is automatic, the most common copying error is said to be getting so personally interested in what is being received that we begin to anticipate what is coming next, and then if it turns out to be something unexpected, we may lose out something. Learning to copy on the "mill" (typewriter) without knowing what is being copied was actually used during WW2 in Africa, when operators were in short supply. Native Africans, who knew no English at all, were taught to associate each code signal with its corresponding typewriter key. They quickly learned to hear the character and punch the proper keys, and became quite proficient.

When making notes just for our own use, we don't need to copy every single letter or word-- we can use any kind of shorthand or abbreviations we know, such as "rcvr" for receiver, "ant" for antenna, etc., just enough to remind us later. The extra time lets us take it easy.

During WW-II many operators found it was no more difficult to copy code by pencil in block letters at 25-wpm than copying English text at the same speed. Some of those messages lasted over an hour! But proficiency in copying coded groups can be a detriment to copying plain language. Coded groups are usually exactly so-many (usually 5) letters long, but plain language words are expected by the operator to vary in length. When such an operator moved from coded groups to plain language operation, he often tended to split the words into 5 character groups. Background music or other soft rhythmic sounds, which do not distract, have sometimes been found useful to relieve the tedium for high-speed operators making lots of copy.

98 of The 100 Most Common Words Arranged for Candler's Practice:

go he and how been into great about first their before should am if man any some very other shall could which little people me an him its then what every these would there on us out may like than by or not are well more to in but now made will of do was had work must up is can two when they as be one the over said so at who for have come she our such them it my has men only that all his time this no we say her your from were upon

Chapter 9

Sending and the "Straight" Key - Part I

Quality of Sending

RULE ONE: Never send faster than you can send accurately.
Quality must always come first, and speed second. Stated another way -- It is more blessed to send good code than to receive it. Aim to make your sending as nearly perfect as possible. Smooth, uniform characters and spacing penetrate static and interference far better than individual sending styles. We should learn to send so clearly and accurately that the receiving operator gets perfect copy every time. (Most of the difficulty in reading and copying code is due to irregularities in spacing between letters and words. See Chapter 15, Timing.)

"Over 50 years ago as a trainee" said one commercial operator, "I was told that it is better to send at 20 wpm, and be received 100% the first time, than to send at 28-wpm and waste time with repeats."

RULE TWO: Never send faster than you can receive properly.
Break either rule, and you may end up sending poorly formed characters or a choppy, jerky style that is hard to copy, and establish a habit that will be very difficult to overcome later. Bad sending is not cured by changing keys, but by correcting wrong mental impressions.

Keying And What It Means

The genius of the Morse code lies in its simple modulation requirements -- only two "states" are needed: 0 and 1 (binary code). These two states may be any sort of distinct differences in condition or quality of the modulation: ON\OFF, and for electrical and audio signals may include pitch and quality, as well. This greatly simplifies the equipment required for transmission and reception. Any form of two-position switch which can be operated at a satisfactory rate of speed by a human operator or mechanical or electrical device will serve the purpose. For electrical and radio telegraphic communication the switch may simply control the "on" and "off" conditions (single-pole-single-throw switch).

This opens a wide range of possibilities for mechanical designs, the simplest being just touching two wires together and separating them (which has served in emergencies), to electronic "switches" which have no mechanically moving parts, but rather control their conductivity between very high and low values by electronic means. For code transmission we generally call such switches "keys", "keyers", or "keying devices". In this chapter we are primarily concerned with hand keying, that is, using the simple up-and-down hand key "straight key". (See Chapter 10 for other types and their use.)

The First Morse Key

Alfred Vail designed the first "straight" key and called it a "correspondent". It consisted of a board on which was mounted a simple flat metal strap spring attached to the board at one end

and on the other end having a small knob on its top side and an electrical contact on its bottom side. This contact was arranged so that when the knob was depressed it would make connection with a second contact mounted directly below it on the board, thus permitting the closing and opening of a circuit. When the pressure was released the spring caused the circuit to open again. It had no stops or adjustments of any kind.

This "classic" pattern of up-and-down movement has governed the design of all "standard" keys ever since. Later models have simply been "improvements", variations and elaborations of this basic concept.

Recommendations To The Beginner

Sending with any kind of hand-operated key is an art that takes some time and practice to develop properly. For this reason some teachers today recommend that, if possible, the beginner start out sending preferably with a keyboard (or code-programmed computer). With a keyboard it is impossible to send poorly formed characters. A keyboard is a typewriter-like device, which produces the code character corresponding to the key pressed. There is no way you can misform a character with a keyboard -- you can only push the wrong button. (See Chapter 10.)

A keyer (see Chapter 10) always produces perfectly timed signal elements and inter-element spacings. However, the operator must control the sequence of the spacing of letters and words. This requires considerable skill and may discourage the beginner. It is easy to send well-formed characters, but unintended or even non-existent ones may also be created. Therefore it seems wisest to begin learning to send with either a straight key or a keyboard. (A straight key does help to reinforce the rhythm patterns of the characters more effectively.) In any event, it is well for the beginner to heed the advice of a wise teacher who said: - "Do not touch a hand-key at any time until I tell you that you may."

This advice has a two-fold purpose:

1) to make sure that the student has an accurate mental impression of the correct sound and rhythm of the code characters before trying to send them, and
2) listening to one's own poor sending may actually hinder learning (as noted in Chapter 3).

So the best way is not to touch a key until you have developed a good feel for the proper rhythm of the letters. This usually means by the time you can receive at about 10 -12 wpm or more. When you begin with a straight key you must have a good feel for timing -- that is, the three building blocks of code: the dit, the dah and the several lengths of spaces. (Those who have poor hand control should avoid the use of any handkeys, at least while they are gaining in receiving skill.)

After you have learned the proper rhythms, sending with a straight-key, whether for practice or in actual use, sending with it is quite beneficial for building up your receiving ability in all its aspects. In addition it develops muscular memories which further strengthen our perception and recognition of characters and words. Constant practice in sending this way does help build our copying ability. Sending practice also prepares the hand and arm for transmitting over long periods of time without fatigue. Finger and arm exercises may also be devised to help gain needed flexibility and strength.

The "Straight" Key

A standard "straight" key is one having a simple up-and-down movement. In American usage the key should be aligned so that key lever is in a straight line with the forearm. To control it, the operator moves the knob by a pivoting up-and-down wrist motion. (The hand and arm muscles do not favor the very small movements needed to control key motion.) The design of a key, its location on the operating table and manipulation tend to vary from country to country, and its adjustments in the final analysis depend almost entirely on the references of the individual operator. Here we can only give the generalities and some instructions by experienced users.

The American Straight Key And Its Use

The key lever is generally relatively thin and typically pivoted so that its front section is longer than the back section, and often droops downward toward the knob end. Its control knob is flat on top and may have an underskirt (originally designed to protect the operator from high voltages on the key lever). The top of the knob should be about 1-1/2 to 2 inches above the table, and have firm adjustments for up-and-down movement (nominally about 1/16 inch movement at the knob, but adjusted to whatever suits the operator best).

The key should be located far enough back from the edge of the operating table (about 18 inches) that the elbow is just off the edge of the table. The operator's arm rests lightly on the table with his wrist off the table and more or less "flat". His first finger rests on the top of the key knob and his second finger generally on top near the edge. His thumb may rest lightly against the other edge of the knob, or not touch it at all. (The student should find his own most comfortable way.) Downward movement of the knob to close the key and upward movement to open it are by rocking the hand, pivoting it from the wrist: the finger end moving down while the wrist moves slightly upward, and vice-versa, without any accompanying independent finger motion. The upward key knob movement is produced by the built-in spring in the key, but may be helped by the thumb.

Walter Candler's advice to professional telegraphers in training (to avoid developing a painful "glass arm") was:

- Hold the knob between the thumb and first two fingers much as you would hold a pencil. Hold it firmly, but do not squeeze it or let go of it while sending.
- The wrist -- not the fingers or the whole arm -- does the work as the key goes down and up. Keep the wrist off the table.
- Take care of the sending arm -- the forearm muscle carries the weight of the arm. Otherwise, keep the arm itself relaxed and at ease as you move the key down and up. -- Immediately below the elbow on the lower side of the arm there is a nerve which comes close to the surface. If that nerve presses against the table it may begin to make the arm cramp and produce telegrapher's paralysis ("glass arm" or writer's cramp). If this happens put a soft pad under it there to relieve this condition.
- There is no need to waste energy on springs. The key return spring does not need to be stiff -- just enough to keep the contacts apart.
- Contacts should be spaced only wide enough apart to be easily opened and closed. A key is obviously a highly personal object. Every one who has gotten his own key adjusted till

it feels just right will be uncomfortable and fail to send as well if he uses a different key, even though it looks exactly like his own. If you set up two different keys of identical design, with the same tension, and gaps, they will nevertheless "feel" different. They are as individual as violins.

Gaining Skill, Errors, and Automaticity

For the skilled telegrapher the characters and words flow without conscious thought as to their details. Proper and adequate practice has made the action habitual, automatic and virtually effortless -- almost like just talking. However, if something interferes, the conscious mind jumps in and tries to make the correction and take over control. If this conscious interference continues, it may displace the habitual coordination, resulting in expending more effort than needed to send accurately. This in turn produces strain, and soon one finds he working against himself and (with a straight key) if he sends for long periods of time this may develop into "glass arm". (See Walter Candler's Advice) The master operator does not send a single needless dit or dah.

What About Mistakes Made During Sending? If you make a mistake while sending, just correct it, if necessary, then forget it and calmly continue on. Don't let ourself get all tensed up and start to worry about making more mistakes (such as: "Now I mustn't do that again!"). If this keeps bothering you, focus your attention for a just few moments on sending each word (or maybe even each letter) as it comes along, sending evenly and with proper spacing, and then go on normally as if nothing happened. This will help create a positive, constructive attitude rather than a negative one. As for correcting mistakes, general practice varies: -- eight dits (like HH sent without space between the letters) is the official standard, but it is more common to use the question mark and then send the word (or with the preceding word also) again correctly. If you are chewing the rag, you may just a pause a moment and then repeat what was sent wrongly and go on. On the other hand, since it is usually the beginnings of words that are most important, if enough of the word has been correctly sent to be recognizable it may be best just to pause a moment and then proceed without comment. We wouldn't do this, of course, in the midst of a formal message.

Personal Characteristics - Fists

All sending with any kind of a handkey will show little personal quirks, or characteristics collectively called one's "fist", which unconsciously develop as one's skill and experience grows, no matter how precise an operator may try to be. This is why a receiving operator may immediately recognize a sender and say: "I know that fist," even before he identifies himself. Our fist may also betray our mood or state of mind -- excitement, fatigue, boredom or laziness -- much as our tone of voice often does.

Someone said of one operator: "his code almost seems to yawn". But there is more to it than that. The type of hand-key being used which may also affect the sending. This does not mean that high quality code cannot be made on any of these types of keys, but rather that their particular construction and use tend to produce certain characteristics.

With a straight key, side-swiper or bug it is easy to send a jerky or "choppy" sort of code, as well as to make inconsistently longer or shorter dits or dahs overall or in certain characters. A common fault with using a bug is to make the dits too fast as compared with the dahs.

Sideswipers tend to encourage to some very oddly timed characters, inconsistent formations. The type of key in use may greatly influence one's fist as it sounds to the receiving operator.

Chapter 9

Sending and the "Straight" Key - Part II

Keys

The design of the key and where it is placed on the operating table are important for comfort and ease of operation. The height of the knob or paddle or its feel may not feel quite right, or the key movement may be too much or too little, or be too stiff or too soft. (One British examiner said of candidates coming for their sending test: "It never ceases to amaze examiners that some candidates come for a Morse test without one [their own].

Attempting to send perfect Morse on a strange key is an obstacle that candidates should never burden themselves with on the day of the test.") -- How does this key "feel"? Could I enjoy using it? One skilled operator said: "When using a new key, for a few weeks all is well, and I love it. Then, suddenly, I hate it. Then I try another... yes, the cycle repeats itself! Why do I feel this way?" -- It is not hard to see why some commercial operators always took their keys home with them or locked them up! Nor is it surprising that the absolutely inviolable rule of the old time telegraph office was: *Never, never, never, under any circumstances whatever, touch the adjustments of another man's key.*

Not only the key itself, but also the height of the table on which it rests can also be an important factor. Some have, often out of sheer necessity, used a key mounted on their leg, on a handle, etc. Cramped and awkward operating positions have often been necessary. And then there is the matter of what we are used to.

The Traditional British Key And Its Usage

The first impression of this type of key to an American is the massive ruggedness of its key lever and the height of its control knob. These notable features derive from a late 19th century Government Post Office design (they operated the telegraphs). Its key lever is a straight and heavy-looking brass bar pivoted somewhat toward the rear of the mid-point. The major part of the weight of the lever works against the return spring. Its control knob is smoothly contoured and generally resembles a wooden drawer-pull, somewhat pear-shaped, or crank-handle shaped, usually with a distinctly rounded top surface. Its diameter swells from its base to a maximum somewhat below the top. Its maximum diameter is similar to or may be somewhat greater than the typical American key knob. All versions are taller than the typical American knob.

The net effect of its straight lever and taller knob means that in controlling this key it is not suitable for any part of the arm to rest on the operating table. Therefore it is typically mounted so that its knob is close to the edge of the table, with the arm extending out fairly high in front of the table.

As the years have gone by there have been many variations of this type of key, different spring arrangements, different dimension ratios, different knob contours, bearing supports, etc., but the heavy style lever and high knob have remained as more or less permanent characteristics.

The traditional way of using this type of key is:

- to hold the key knob with the first finger on top, the thumb underneath its maximum diameter on the one side, and the third finger on the opposite side from the thumb;
- the operator's lower arm extends outward approximately in line with the key lever (horizontally and vertically), unsupported by the table, several inches from the side of the body, and forming an angle of approximately 90 degrees relative to the upper arm;
- the main keying movement is at the wrist, not at the fingertips, with the wrist acting as a hinge between the arm and the hand.

The hand, wrist and arm are not strained or rigid, in spite of the seemingly awkward appearance of such an operator's arm position to us in America. Beginners usually adjust the key for a large gap so as to hear the sound of the key closing and opening. They generally reduce this gap as their speed increases (some reduce it to the barest minimum). Some operators control the knob delicately with their fingertips, while others grip it with the whole hand. Again, some operators prefer very light spring force and use the thumb to help open the key by their wrist movement; others rely entirely on the spring return action.

As the beginners progress, they adapt their keying style to whatever is comfortable to them individually. There are many variations in adjustment, depending on the particular key design details and the operator's preferences. The Australians and New Zealanders appear to have followed the British practice, but other European countries have not necessarily done so. Australians have said they found it very hard to send properly with the American keys -- with their flat topped key-knobs, located far back from the edge of the table -- as installed in air-ground-air stations during WW-II. They called these keying arrangements "a flaming nuisance!" In summary, with all these variations in basic and detail design, it seems obvious that there must be more than one way to design a good key and use it.

Using A Straight Key

It is, of course, impossible to send absolutely perfect code with any purely manual device, but we should learn to imitate perfect sending as best we can. If you have an instructor, he should demonstrate quality sending for you to imitate something like this, for example: "*Listen as I send the character... and then you say its name as you send it back to me just like you hear it.*" This is repeated several times until the teacher is satisfied, and so on throughout the alphabet and numbers during the early sending-practice periods.

Another way, which can be used without a teacher, is to use split headphones: one phone carries the recorded code signals, while the other phone lets the student hear his own sending using an oscillator as he reads from a printed copy of the recorded text. He endeavors to send in unison, and can compare his own sending with that of the recording.

There is at least one computer teaching program (see below) which has an option which will evaluate the learner's sending.

Most teachers recommend beginning with relatively slow hand movements. About 12 consciously controlled hand movements per second is average, but some people cannot exceed

10. It is the often-repeated reversals, which limit performance. Total reaction time from external instruction until the hand reacts is about 150-200 milliseconds (ear- or eye-brain-muscle). Responses must be much faster than this for sending code, playing the piano, etc. This is where the automatic mental functions take over.

A good beginning practice with a straight key is to make a string of dits at a slow, even rate for a minute or two, and then gradually to speed up to a comfortable rate. Then send a series of 20 - 30 S's evenly and smoothly, with proper spaces between them. After that, send a corresponding string of dahs, followed by 20 or more O's the same way. This will develop a proper feel and a sense of control of the key. After that, try a short sentence in a slow and uniform way, with wide spaces between letters and words, something like:

"I always send evenly and smoothly"

Try this several times, gradually shortening the spaces until they are about normal. Listen as you send it for accuracy of timing. Try recording it so you can listen later to it without distraction and evaluate how it sounds to others.

With a clear, easy and correct style of sending it will take about ten minutes to get warmed up, and from then on you should be able to send for a long time without the slightest discomfort. A reasonably good operator can learn to send good quality International Morse on a straight key up to 20 - 25 wpm. Some can make 30-wpm, but 35-wpm seems to be about the absolute limit (equivalent to about 45-wpm for American Morse). On the other hand, don't assume that just because you can receive at say 25 wpm you can send well at that speed. What isn't intelligible isn't worth sending.

"Glass Arm"

Candler's description of Telegrapher's "Glass arm," or " telegrapher's paralysis," is:

A progressive and painful forearm condition where the arm gradually loses its former snap and responsiveness, and the dits become difficult to send correctly at one's customary speeds due to partial loss of control.

Fatigue sets in early and sending becomes "rotten", leading to discouragement or distressing irritation. It may or may not begin with a sensitiveness, which soon subsides, but true glass arm has neither inflammation nor soreness. This condition is caused by needless strain or tension or poor key handling, and is avoidable. Factors which may lead to it are:

- poor posture,
- holding the arm in an unnatural or uncomfortable position, so that blood circulation and nerve functioning are interfered with, making the hand uncomfortable, cold or clammy,
- undue pressure of the underarm on the table,
- unduly long periods of sending, confinement or lowered body tone which induce muscle strain and tension,
- conscious interference with normal automatic habitual control, or
- even the suggestion that by prolonged use the arm will ultimately fail.

All these may be prevented or relieved by proper mental and physical corrections. Some have found relief by rotating the key to use a sideways movement. Others cured it by going to a sideswiper, or more often by going to a "bug". Candler said that a false glass arm may occur when some infection is present which produces pain in the wrist, forearm, back and neck and/or headaches. Its cure is obvious.

Tests for Proper Operation of a Hand-Key

For the beginner everything will be easier if any serious faults are caught early, before they become habits. There are two general kinds of tests for an operator's sending ability. One concerns the quality of his sending, its readability, and the other concerns his endurance and comfort. Quality of sending may be evaluated in several ways. It is a good idea to record some of your own sending occasionally and let it sit a day or so and then to listen and see what it sounds like-- is it easily readable? A rougher way is to gage by the comments of receiving operators (or by the number of times a repeat is requested). This is strongly suggested also for bug operators.

There are several computer programs to evaluate one's sending against the ideal. One of the excellent ones is Gary Bold's diagnostic program, DK.BAS, designed for this purpose, which runs under QBASIC, a part of his Morse teaching software. (See Chapter 18) Looking at your own sending may be very humbling, but this program will show exactly what's wrong, and tell what you exactly what you need to do to improve it.

A typical comment of those using it is: -- "*My sending can't really be that badly, can it?*" But after taking DK.BAS's advice, the same operator said: "*Actually the whole episode was quite enlightening, as I found that after a number of attempts I had improved to the extent that I and the computer parted company on speaking terms at least*". If you are sure there's something wrong, but can't quite put your finger on it, let such a program find it for you. Your sending will really sound better if you concentrate on making the improvements indicated.

An excellent test for endurance and comfort is to sit down and send straight reading matter at a comfortable speed of from say 15 - 25 wpm for about an hour. It will take about ten minutes to get the fist limbered up, and if one has cultivated that clear, easy and correct style of sending that is so desirable, from then on one can send for a long period of time without experiencing the slightest discomfort. On the other hand, if the fundamental principles of correct key manipulation have not been learned, one may just 'blow up' after the first 15 minutes with a hand too jerky, and a wrist too sore to want to go on. That says, take a look for what you're doing wrong.

What Is It That Makes a Good Hand-Key?

Ease of operation and positive control are prime considerations for any hand operated key. The first Morse key (called "correspondent") was designed just to the minimum needed to do the job. Later designs took into account other factors as well, including ease of use and appearance. In the early days of high-powered wireless (spark) stations function again took over and these keys were awkward, massive things in order to handle the huge currents involved.

A good key lever should pivot freely without detectable friction, and at the knob or paddle there should be no perceptible movement in any direction except that for normal keying. The return

spring should be adjustable for best control (some recommend 250 - 400 grams pressure range for a straight key). This spring should not be so stiff that sending is choppy, or so weak that signals tend to run together, but always adequate to open the circuit by itself without assistance from the operator.

For a given rate of keying, the force required is a function of the spring, gap setting and the inertia of the moving parts. The key lever should be stiff enough to give a firm contact without noticeable vibration or bounce (no double contact). Bearings should be solid at all times. (Firm electrical contact is best made with a flexible wire rather than depending on the bearing points.) The return spring should have adequate adjustment range to satisfy operator preferences. Gap setting should give a firm feel and have a wide enough adjustment range for personal comfort. Is there a key design that is universally "ideal"? -- My impression is that well-accepted keys show a wide variety of design details to meet preferences.

Is this telling us that it isn't the design of a key per se that makes it "feel right", but rather that it is what we are familiar with and are used to? It feels comfortable partly due to national-historical and partly personal preferences. For some unknown reason, short or small keys have not been popular, although sometimes necessary. What a key is mounted upon -- a wooden table, one's leg, a concrete block, etc. -- and how it is mounted can make a great deal of difference in how it feels. It may feel "great" or "responsive" or "dead" or have disturbing vibrations. These are all factors that are partly hardware, partly psychological and quite personal.

Chapter 10

Other Keying Devices and Their Use

In Chapter 9 the regular "straight" keys were discussed at length. Here we look at all keying devices.

These may be classified as:

- KEYS (including "straight" keys, "side-swipers", and semi- automatic keys or "bugs"),
- KEYERS (keys and keyers may be called "handkeys"). and
- KEYBOARDS (including computers programmed to send like a keyboard).

All Kinds of Keys

Innumerable variations of simple mechanical switches may be devised. Almost any conceivable kind of motion may be used to operate the switch: up and down, sidewise, sliding, squeezing, twisting, etc. They may be actuated by: human action (finger, hand, arm, foot, lips, neck, breath pressure, etc.), mechanical or electromagnetic action (e.g., in a relay, to duplicate the keying patterns in a second circuit), etc.

For the handicapped several kinds of keys have been devised to be operated by breath pressure on a diaphragm or piston, etc. Some of the interesting recent designs take advantage of solid-state circuitry using such things as a) the interruption of a light beam by a finger tapping in front of a photo-sensitive cell, b) the change of capacitance or resistance produced by moving a finger to approach or lightly touch a fixed metal pad, c) the tone of a human voice humming in Morse code within the range of a tiny microphone, and other possible means to control the keying. How does one classify such devices?

Other Kinds of Manual Keys

The "Double Speed" Key - "Sideswiper"

Just when the first "sideswiper" came into existence does not seem to be known. It is based on the idea that sidewise hand movements should be easier and perhaps faster than up and down movements. According to records found and graciously supplied by Jerry L. Bartacheck, KD0CA, the J. H. Bunnell Co. patented their new "double-speed " key in 1888, and claimed that it was developed to overcome telegrapher's paralysis or "glass arm". Today this type of affliction is called "carpal tunnel syndrome". Those who used this new key did find its claims to be true - that sidewise movements are much more comfortable and natural, and that it did prevent or greatly reduce the risk of glass arm. This key for a time became popular and was often called a "sideswiper", and sometimes a "cootie key". However, Bunnell's key was rather expensive and easy to imitate.

To use it, the operator used his thumb and forefinger to move the paddle of the key lever alternately from one side to the other -- each direction closed the circuit, whether moved to the

right or to the left. In this way he formed the successive dits and dahs for each character. For example, If the operator made the first element of a character to the left (L), whether it was a dit or a dah, its next element was made to the right (R), and so on, alternately so that his pattern of movement was L-R-L-R-L-R .. . . or R-L-R-L-R-L . . .

This back and forth motion often tends to lead to a sort of peculiar rhythm of its own, betraying the use of a "sideswiper".

A few operators, troubled with "glass arm" found relief simply by turning their straight key around 90 degrees so it could be used with a one-way sidewise motion. (This use is easy to do with a bug or keyer, which already uses sidewise motion.)

Commercially made double-speed keys were relatively cheap compared to the Vibroplex, and it was quite easy to make a good homemade one. No wonder that it became popular in wireless operations, especially among hams, for some years. (It does not seem to have been used much by landline telegraphers.) Perhaps its novelty was as much an attraction as its claim for higher speeds and lowered fatigue.

The double-speed key may have led later to the idea of the semi-automatic key, whose first good commercial version, the "Vibroplex" was introduced in 1904, and soon began to be widely used by commercial telegraphers.

Of passing interest in 1926 was a similarly connected key having two pushbuttons, like typewriter keys or pushbuttons, to be used with two fingers, called the "Cricket" by its manufacturer. The keys were to be used alternately to form the characters, as with the "sideswiper". It never became popular.

The "BUG"

Historically the Martin semiautomatic key, introduced in 1906 as the "Auto" and later as the "Vibroplex" - commonly called a "bug" - is listed here second because of its greater mechanical complexity and difference in use. The patented Vibroplex, by making dots automatically (by the sidewise vibration of its elastically mounted arm), relieved much of the operator's effort (although he still had to form the dashes manually), and increased his speed potential, while reducing the risk of "glass arm" (by sidewise movement and division of labor between thumb and fingers).

In its various models it became very popular and has been widely used up to the present time. There have been many imitations, a few of which also produced automatic dashes. Normal (right-handed) models formed the dits automatically with a right-wise movement of the thumb and the dahs manually with a left-wise motion by one or two fingers against a paddle assembly. A few designs produced by a few manufacturers provided automatic dahs with by a second vibrating arm.

On the Australian landlines bug-keys were known as "jiggers". Those issued by the Sydney GPO Telegraph Office in 1946 had 3 knobs, two of them controlled separate swinging arms, one for automatically forming dits and one for automatic dahs and the third for manually controlled

dahs. The knobs could be positioned at either end of the base-plate for easy use by right or left handed people. I have no information as to how these were used.

Using A Bug

A "bug" should not slip on the table, and its paddles should be about 2-1/2 inches above the tabletop. Most teachers recommend a light touch, pivoting the hand on the knuckle of little finger and using as combination of finger action and rolling wrist-motion. (Long-time speed champion Ted McElroy, however, said the wrist and elbow should be off the table, and a full, free swing of the arm used.) We may suspect several different styles are equally satisfactory. (It has been suggested that by holding a pencil in the same hand while sending will help one learn to relax.)

Bug sending should duplicate good hand-key sending. Handle it easily. Do not grip its paddles, but only allow the fingers or thumb to touch the side you are pressing on -- not touching the other side. When a bug is used for radio work there is a tendency to make the dits relatively too light. As compared to telegraph landline sending, radio requires a heavier style to put the signal through static and interference, and a heavier key will help do this. So be sure to set heavy enough dits that they are not likely to be swallowed up by moderate static or interference.

Setting the Adjustments of a Bug

Like all keys, bug adjustments are a highly personal matter, varying from one operator to another. They are also sensitive to the range of speed. For example, a bug set for 35-wpm operation will do poorly at 18, and vice-versa. -- Remember the rule: NEVER readjust another operator's bug!

Hugh S. Pettis, K3EC, recommends the following as optimum bug settings:

- It is to be understood that operator's personal comfort and ease of operation govern the details of setting the adjustments.
- First, set the adjustments for paddle displacement so that it moves a comfortable and equal amount for dits and dahs.
- Set the spring tensions for comfort of paddle operation.
- Set the movable weight on vibrating arm for the speed desired.
- Dit weighting is determined by the distance of the stationary dit post from the contact on the vibrating arm.

He cites a common technique for setting correct dit duration (a dit equals unit space) is to clip an ohmmeter across the bug terminals. First, set it for full scale while holding the paddle against the dah contact. Then adjust the stationary dit post contact until it gives a mid-scale reading for a series of dits, and finally settles on a full scale reading - a closed circuit. His personal preference is for the dits to taper off to a closed circuit after about ten dits. More dits will give a lighter weighting, and if the series leaves the circuit open, it is too light. Fewer dits will produce a heavier weighting, and if it is fewer than eight, the nominal (8 dit) error signal cannot be made.

Robert R. Hall W9CRO recommends: (Some adjustments are interactive.)

- Adjust top and bottom pivot bearings so contacts are all on same level, just tight enough so that side play is barely perceptible.
- Set the armature (the movable part controlled by the key tabs) stops:--
    - Adjust the dah stop screw so the armature just touches the damper when held against this stop. (Damper contact should not be more than just enough to stop the swing.)
    - Adjust the dit stop screws so that end of the armature will oscillate when it is moved against this stop with a brisk paddle movement of about 1/8 inch.
- The tension of the armature return spring should not be heavy, but just enough to return the armature to the right hand stop screw without any bounce, and without any tendency to bounce off the damper.
- Set the "dit" action very carefully:
    - Set armature weight(s) about 3/4 of the way to the slowest speed. Then,
    - Push the armature paddle to the dit position and hold it there until motion stops, and continue holding it there while adjusting the contact screw so that it just makes firm contact (but not so light that it arcs or misses). Some previous adjustments may need correction now.
- Set the dah action:
    - Set the contact adjusting screw (which is also the stop) so the paddle moves about 1/8 inch.
    - Its spring should be set to give about the same paddle pressure as for dits.

Sending With A Bug

Key smoothly and easily with a minimum of effort. Let the bug do the work - you just control it, with the arm resting on the table, touching the paddles loosely (lightly) between thumb and forefinger. Control it without much motion of the hand or fingers. A slight twist or roll of the wrist will change from the dit to the dah side. Relax and enjoy it. Don't bat out the dits and dahs out with thumb and forefinger so widely separated and so hard that it tends to push bug around.

There is a marked tendency among some bug users to set the dits too fast relative to the hand-formed dahs and spaces. Hand-formed spaces tend to become too long in proportion. The result is often a choppy sounding code or to signals which are certainly readable, but tiring to listen to and read. Katashi Nose KH6IJ points out that "*at high speed one cannot put much force on the paddles.*" He also said that "*If you move your whole arm, the law of inertia prevents you from attaining high speeds.*"

Keyers

Keyers are electronic devices controlled by paddles similar to those on a "bug" for automatically making dits and dahs, and often incorporate other useful operating features, including buffers and memories. Many include "iambic" type of operation by a "squeezing" motion, which provides for alternate dits and dahs, which further automates sending and in this way reduces total effort. An iambic keyer will always produce perfect characters, even though they may not be used in our code.

Katashi Nose here says, "*If you have already mastered a bug, it will take about three weeks to convert to electronic-key sending. Once you are converted, you are hooked because now your*

bug fist is ruined [ed. for most people]; an entirely different technique is required." If your keyer has "forced character spacing" (FCS), use it! This may take several weeks practice, but your sending will be real armchair copy. It is worth the effort.

Keyboards

Finally, the keyboard (including the use of electronic computers with programs for using their keyboards) automatically makes all characters from a typewriter type of keyboard. Both keyers and keyboards often include teaching programs for learning the code and/or improving code abilities, as well as having memories for various purposes. This is about the ultimate in code production. (Machine sent CW is considered almost a "must" for good copy when signals are very faint, including QRP-- and for very high speed work (hand sending just won't hack that.)

Keyboards also have much to offer the beginner in learning the code initially and for improving one's skills. What may be possible hand-key speeds?

Psychological testing shows the average rates at which people can tap a fingers: -
On the High side: 9.7 per second, or 576/minute, (300 in 31 sec)
Average: 8.6 per second, or 516/min. (300 in 35 sec.)
On the Low side: 6.7 per second, or 402/min. (300 in 45 sec.)

If we assume that a dit is one "tap" and a dah is equal to two "taps" (two nerve pulses: one down and one up), then we may say:

Taps	Letters	Group Frequency	Taps x Frequency
1	E	0.130	0.130
2	T I	0.166	0.332
3	A N S	0.214	0.642
4	D H M R U	0.192	0.768
5	B F G K L V W	0.124	0.620
6	C O P X Z	0.139	0.834
7	J Q Y	0.024	0.168
Average per letter		1.000	3.494

Average for five-letter word = 17.47 taps.

At this rate, assuming the above rates can be maintained for periods of time needed to send messages, news, etc., the slowest keying rate would be 23 wpm, the average 30 and the highest 33 wpm.

An Interesting Bug

The Sydney Australia GPO Telegraph Office in 1946 produced a bug that had two separate swinging arms for dots and dashes. There were 3 knobs: one for dits, one for automatic dahs and one for manually controlled dashes. The knobs could be positioned at either end of the base-plate for easy use by right or left handed people.

Chapter 11

Further Development of Skills

Recognition of CW is a process of learning to perceive intermittent sounds as intelligible "speech."

Real skill begins when we no longer think of the code as code, but only of the content. A good operator is one who feels quite at home with code, fluent in it. He is able to copy accurately up from a low of about 15 up to about 25 wpm and can think and talk in telegraphic words, almost as if it were ordinary language at speeds sometimes up to 30-35 wpm ("conversational CW" as one teacher happily called "rag chewing").

This ought to be the minimum ambition of every operator, because it makes the game all the more enjoyable, a very comfortable working range. He enjoys it and feels no strain or pressure. He is competent. (Anybody can talk into a mike.) By omitting needless words and with the help of common abbreviations, Q signals, etc., his rate of communication is high enough to be comfortable, and he feels no particular drawbacks when he talks in Morse code. Sure, he may spell or sound out unusual or strange words or proper names, just as he would when he meets them in reading or writing, but mostly he hears words as words because he has become more proficient. Words are the "alphabet" of the skilled operator.

Higher Skills

As we talk about these highly proficient men and women, we must draw a distinction between reading code at these speeds and copying it. All through the history of telegraphy skilled operators have said they could "read a whole lot faster than they can copy the stuff down." Obviously no one can copy faster than he can write -- whether by hand or on a typewriter.

We have already discussed copying. In this chapter we address reading skills again. We're talking here primarily about amateurs who have achieved a still higher degree of skill, not for commercial or professional reasons, but simply because they want to. It may be for sheer enjoyment or to satisfy an inner drive, but whatever may be the reason, such an ability is as worthy an objective as any other skill, and even more so, for it is useful as well as enjoyable. We need incentive -- motivation -- to achieve, and that ought to be enough.

Doesn't our satisfaction over managing to get even one recognizable word out of a high speed code transmission trigger a desire to be able to read it all at that speed? "The joys of high speed CW are known only to those willing to put forth the time to learn what a unique world exists on our bands." This semi- pro is completely relaxed as he effortlessly reads or copies: he has no reason to doubt -- he knows he can read it even while doing something else. Regardless of what he may be doing, a skilled telegrapher hears what is being said in code within his hearing. He reads it like he hears the spoken word and may even be able to remember it later well enough to copy it down if he needs to.

The following is an interesting example: On a local SSB net of high speed operators the controller asked: "Gary, can you operate SSB as well?" After a short pause, somebody said: "Gary, He's talking to you on SSB!" "Ah" said Kirby, "So he is!" -- Morse is so much a second nature for those with real skill that they have to stop and think what mode they're actually using. It will surprise you when you first experience it.

Truly High-Speed Cw Awaited Electronics

High speed CW demands precision: it did not become a reality for most operators until digital communication in the form of microprocessor controlled keyboards became available. This made available at reasonable cost the two parameters which are paramount to enjoyable high-speed CW operation: -- accuracy, which is always the most important and never to be sacrificed for speed, and speed.

An operator cannot send accurately enough with a mechanical device at speeds much over 40 wpm for any length of time, but a keyboard makes that easy. In addition, its features of memory, etc. give further help, making CW communication better, with the result that operators can now converse instead of carrying on monologues. The human mind manifestly is better equipped than any computer to copy the Morse code, and the joy of operating comes from listening to accurate CW send by a skilled operator. No matter what sending device is used. The point is to send ACCURATELY. It is the mind that copies CW and it is in the head that pleasure is found.

Looking Backward and Forward

There are said to be four phases of skill:

- hustling for the letters,
- learning to hear words,
- taking in several words, a phrase or short sentence at a "earful", and finally
- the real expert who has the details of Morse code so well in mind that he gives them practically no attention at all, and only is conscious of the content.

Remember that in the earliest stage we learn to hear the letters as units of sound, rather than hearing the dits and dahs as such. Next, we advance to hearing many common words and parts of words as units, instead of strings of letters spelled out. At this point we are quite conscious that the dits and dahs are there, and this gives us a sort of inner confidence that the foundation is in place (our security blanket). Up to this point we feel comfortable.

The third step comes as we pass the point of being able to hear the dit and dah components any longer -- they seem to have vanished into a blur. (We should still be conscious that the letters are present, however.) At first one may feel somewhat helpless, as though the supports had somehow gotten lost. However, the automatic mind, which has been trained by enough of the right kind of practice (and has been active all the time, though we may have been unaware of how far its activity extends), seems to be able to hear those components and identify the letters with no strain. What we must now learn to do is to TRUST this mental ability although we are unaware of how it works.

"Conscious effort is fatal to speed" is a common observation with respect to any skill we have acquired. "The moment you let yourself think and cease to rely on 'instinct' you will fail in these special skills." If a code transmission is played at 20-wpm for the rank beginner, his probable reaction will be: "I will never be able to read or copy that!" However, after as few weeks of training he will be doing it. High-speed code may seem far too fast ever to read, but it is not nearly as fast as it sounds to the uneducated ear. A good share of the problem is overcoming the impression that it might not be possible to comprehend at such a speed. One stubborn fact faces us: others can do it, and surely I can, too. Therefore, take heart. We recognize that it is hard to understand recorded speech when it is played back at twice or at half speed because not only the pitches but the sounds become so distorted.

This is not true of code, where the important proportions are strictly maintained the patterns are still there. Skilled operators need to learn to read and copy over a fairly wide range of speeds. Ted McElroy once said: "*If you can pick out even one single character at a higher speed you are on your way*." So if you have ambition, take heart! When the mind is near its limit, struggling, concentrating on each individual letter as it is heard, there is no time to identify letters poorly sent, jammed together or missed, or words misspelled, etc. But if we have a comfortable margin of speed, this makes everything easier and much more enjoyable.

At slower speeds we can then reason out the words because we have time to think over each word as it comes in (we can't change the sending operator!). Early in the day we are likely to try too hard. Especially when we are fresh and alert the conscious, reasoning part of our mind wants to control our receiving ability, while the automatic part of our mind says "I can do it myself without your interference". We must stop this internal warfare, this conscious attempt to control reception. Make it let go let go, so the unconscious inner mind may function. Give yourself permission to let go of your conscious demand to recognize each letter. The better you succeed and the less you try, the better and faster you'll become at it.

As one student said: "*When I'm fresh and 100% alert, my code speed is really bad, but when I'm really tired I can keep up with best of them*." Does that give us a hint as to how to go about it? (This is not speaking of the beginning student, who needs to put his whole conscious attention on learning the sound-letters, but to the person aiming for very high-speed reception.)

The Skilled Operator

A long-time telegrapher was once given the code test at 13-wpm for a General Class ham examination, but laid down his pencil and said: "I can't copy that stuff." When asked why, he said: "Well, it's just too slow." Everybody laughed, then they speeded it up considerably and he made perfect copy. The dragged-out characters are harder to recognize -- patterning is lost much below about 12 wpm.

Faster...Faster...Faster?

The expert, who is a step up, races along effortlessly up to around 40-wpm or more, so fast that most of us can't make out much more than a letter or a word or two -- or maybe nothing at all. In the past these experts were mostly professionals, but now many are hams.

One old timer, now a silent key, who had begun as an amateur, then for an interim period of time was a commercial operator and could copy 40-45 wpm with no trouble, and could easily read up into the 50-wpm region, said that as a ham he always listened for ideas, for meaning, for sense, and was hardly conscious of the actual words sent. (This came out strongly when I asked him one day after a QSO: "What word was it that W8xxx used to express . . .? -- He didn't know. There was an expert.)

Above that speed is the super expert who lives in that upper atmosphere where 60-wpm is loafing, and some have been able to comprehend at 100-wpm to as high as 125-wpm (one of these was the well-known Bill Eitel of the Eitel-McCullough Co., tube designers and manufacturers). Some of these whizz-bangs tell us that they don't think there is any real upper limit in speed at all. Like most of us at such speeds, probably none of them consciously hears more than a buzz. (He wouldn't even think of trying to listen for the dits and dahs.) But all the while the automatic section of his mind is active and well, reading it easily and telling him what is being said.

What are these racetrack operators doing so differently from most of us? -- They are hearing in longer spans than we are. Their "groups" or units of comprehension are longer than ours, and they are not consciously thinking of code characters, letters or probably even in words as such. (See below and Chapter 26 Speed contests)

Somewhere above about 45-wpm speeds become too fast for us to be conscious of the difference between dits and dahs. The facts are that at these higher speeds -- unless we have actual hearing defects -- the interior workings of our brain are quite aware of these differences and can discern the patterns accurately, and so can convey to us the bigger picture of words and meaning, but for some reason will not allow us to be consciously aware of the details. The experiences of the operators described here are evidence of this.

Reading Versus Copying Skill

Many highly-skilled longtime landline and radio telegraph operators are said to have copied at steady rates between 50 and 60 wpm all day long for a 10 - 12 hour day. This was common on press circuits, as well as some others. (However, there are some questions -- we may suspect that they were typing 50 - 60 wpm in actual word counts, while receiving in Phillips code, an abbreviation system which typically shortens the number of letters by about 40% [See Chapter 27.] If so, this would be slower actual code speeds than in full normal English at the given speed.)

At high speeds, over about 45 - 50 wpm, many experts agree that copying -- but not reading -- quickly becomes very exhausting, and can be continued only for very short periods of time. For them as speeds go up, getting it from the ear to paper demands the utmost of concentration, shutting everything else out of mind. Some have described it as almost being hypnotized. (In great contrast to "comfortable" speeds of 20 to around 40-wpm, depending on one's degree of skill.) Tiny lapses of attention for them can be devastating. Since we have already discussed copying (Chapter 8), our attention here will be confined to reading the code.

The Sound Barrier
Sound Consciousness - From Details To Meaning

After an official amateur speed contest about sixty years ago, one of the judges, himself a former telegrapher, asked the young man who won at 56-wpm: "Listen, Kid, did you get it?" -- "Sure, why?" -- "Well, all I could hear was just one endless string of dits without even so much as a space anywhere." That judge had passed his limit.

"Sound consciousness" has been used to denote the limit beyond which a given person can no longer consciously distinguish the components of the code. At speeds somewhere around 50 wpm it becomes impossible to make out the separate dits and dahs any more - they become a blur. Conscious recognition of details ceases, and if one is to continue reading the code signals, there must be a distinct change in the consciousness of reception. Sound consciousness must shift gears from letters to words and phrases.

This ability is developed by allowing the automatic mental functions to completely take over the recognition of all details below word level, without any conscious interference whatever, so that from then on one is conscious only of words, phrases and meaning. One has to let go of any demand to be conscious of the details.

How Can Such Skill Be Developed?

One man did it this way: -- when he got so he could copy 14 wpm almost solid, he tried a 21 wpm tape speed and was surprised to be able to get about 60% right off. After three 15 minute sessions, one a day, he was getting 4 - 5 words or groups in a row without misses. He alternated back and forth between the two tapes, and found it helped both. Continuing with still higher speed tapes, he was able in about 5 months to copy at 35 wpm. (Many have gotten to that speed much sooner.) So, try listening at speeds 10 or more wpm above your present limit, and as you listen see if you can hear anything recognizable. WANT to understand what you hear.

A number of the very high-speed operators have said that if you can catch just one word in a high speed transmission, you are on your way to reading it. "If you start hearing short words, then you're on the right track, and are already moving forward." -- Listen, listen, listen and want to understand what you hear. Remember the rules for practicing -- work in short enough bursts of speed so as not to get tired, then drop back to a slower speed again and it will seem much easier. One of these experts says that he feels comfortable and does not sense any degree of tension or strain at all while reading or copying at these very high speeds. Nor does he sense any changes in mental action or approach as he listens at any speed. He says that at these high speeds he is not conscious of dits and dahs, and only sometimes is conscious of the letters, spelling, etc. ("You don't even need correct spelling at these levels.")

Unusual words, a proper name, call sign, abbreviation, etc., do not "throw" him and so he doesn't miss anything following it. He adds: "The faster the code speed, the better." (As for copying at very high speeds he says: "I usually listen for the first sentence and then start to copy.") In these comments he is joined by another expert. Both of them were initiated into the code before the age of six by expert close-relatives or friends. They feel entirely comfortable with code at any speed, and feel that there is no upper limit in speed. "The one thing that myself and others [find limiting] at high speed is the matter of putting QSO's on paper. Copying is the only limit." (Is

beginning at such an early age part of the reason they feel so "comfortable?" We need some more information on this point.)

Another of these experts describes this skill as something like this: - "You mention [hearing only] a 'blur of sound' at higher speeds. This happens to me too, where the code [at first] sounds like popcorn popping or chicken grease on a hot griddle, and I have to concentrate to 'break the sound barrier' before it starts making sense and I can read it. ... I have to make my mind break into this and begin concentrating on words and phrases.... [then suddenly] one word or phrase snaps me into gear and I go on from there. Then so long as I consciously maintain my concentration, I can continue to read it in my head ... without much sense of strain... [Then] so long as concentration is strictly maintained, 'drop-outs' [from this receptive state of mind] do not occur."
He admits that he misses occasionally - a hard or unusual word or a misspelling, etc., but he just continues on -- there is no time to ponder about it. This indicates that he senses the need for some kind of mental "shifting gears" in the way he is conscious of what is being received, and that once "in gear" he needs to keep deliberately concentrating on it, but without evident strain. He suggests the following thought: - If you are listening to a news broadcast on the radio while reading the daily paper, you have to give priority of attention to one or the other. If your attention is on the newspaper, you are usually be aware of the radio only as more or less gibberish, a noise. Then, if you want to listen to the radio you have to turn your attention to it, and what was gibberish now suddenly becomes intelligible. Snapping into high-speed code may be something like that.

Ted McElroy and Levon R. McDonald were men who before WW2 demonstrated copying in the 75 wpm range. A few years later Frank J. Elliott and James Ralph Graham demonstrated the same degree of expertise. There were others who were runners up. McElroy said there were many others who were as good as he was, or even better, who never entered the speed contests. George Hart said:" If you were born with a whistle and no voice box, you'd be able to send and receive 100 wpm or more. I guarantee it! It's all a matter of incentive." "Sit and listen, and keep listening and want to understand it." "Anyone who can type over 75 wpm can copy code over 75 wpm if he really wants to."

Factors Needed To Get There
In Addition to Practice

One vitally important point to remember while receiving is to KEEP COOL. Don't let yourself get flustered or distracted. If you miss something, keep going. At high speeds you can't copy characters, you must copy words and phrases. You will be surprised how much you can get and how much fun it will be to listen to high quality code at 40-45 wpm (as to the press in former years).

McElroy wrote: "I remember a contest where the word 'hospitalization' shot through around 57-wpm. How is a fellow gonna grasp at that speed? But half a minute or so later it came to me and I flipped back and filled it in. Try it for fun." Keep cool, don't let yourself get flustered or distracted. Keep the mind on the incoming stream of words. There is a limit to how fast we can consciously spell out words, but with the submind doing the work we don't know where that

limit is. Strong emotions seem to make the expert more fluent, but the less experienced tend to get rattled or upset.

Who Can Do It?

In England a blind and almost totally deaf young man of 23 could handle the code at 50-wpm. It was his only way of communicating at all. In 1959 Katashi Nose KH6IJ wrote, "Any DXer worth his salt is good for at least 60-wpm. He gears his speed to what comes back." As noted before, Bill Eitel was one of those able to communicate easily at 100-wpm. That means there must also have been some other hams with whom he communicated at that speed!

In looking over the years of contests and speed records made elsewhere it seems as though the capability to achieve ever higher speeds is something that has grown, either due to improved equipment or to better learning methods, or both. Higher speeds require more accurately formed code signals. Perhaps many superexperts were there all the time, but so busy they weren't officially recognized.

In 1845 telegraphers' speeds were about 5-wpm. By 1855-60 they averaged 20-25 wpm with 46 a maximum; by 1875 - they reached 52-wpm; by 1897 63.5 wpm. McElroy went from 51-wpm in 1920 to 56 in 1922, then to 69 in 1935 and to 75 in 1939. Other records were: 1937 - 4 hams at 55; 1938 two hams at 65; 1945 - 79 wpm.

In the mid 1970's a group of hams found that "their code reading ability had so far outstripped their sending skill that slow, frustration-filled 35-wpm QSO's grew increasingly unsatisfying." They then bought commercial keyboards simply to have more enjoyable chats with each other. Their standard conversational speed was about 65-wpm (reading, of course, in their heads), but on good nights some would go up to 80." One of their later participants said that he bought a keyboard and within three months his speed went from 35-wpm to 65-wpm. "They did not think they were doing anything particularly clever."

The observer felt that they were an exceptionally "Morse-talented" group who find code reading comes easily and have difficulty understanding why others can't do it. Why "can't" they? There are good reasons to suspect that these men, about whom we have no present details, while they may have had some special aptitude, either benefited from a wise teacher, or were so strongly motivated that somehow they all just stumbled onto ways to advance that did not penalize them. Somehow it doesn't sound like all of them just happened to have some special ability, does it? The fact that they didn't seem to consider they had done anything especially remarkable strongly suggests that they simply went up the speed ladder without any startling "jumps" in skill. This is something to think about.

Fellows, with this many engaged in using it, high-speed code must be really easy! Ted McElroy often demonstrated his skills in copying behind along with speed. He was noted for being able to listen rather casually for a number of seconds, then dash into the keyboard at high speed until he was up closer to the incoming signals. Not many others seem to have demonstrated this particular ability, but rather tend to copy close behind the incoming signals: often only a couple of syllables or words behind. (We see this in McDonald's statement regarding the 1939 contests (see Chapter 26).

Amateur High Speed Clubs

The European CW Association was founded in May 1961 to promote the use of CW. Member clubs have developed within it. Those of interest here are: - The High Speed Club, founded 1951, requiring a minimum speed of 25-wpm; the Very High Speed Club, founded l960 requiring a minimum of 40-wpm, with about 280 members; the Super High Speed Club, founded 1983, requiring minimum of 50-wpm, with about 200 members; the Extremely High Speed Club founded 1983 requires a minimum of 60-wpm, has about 75 members.

Similar high-speed clubs exist in America. CFO (Chicken Fat Operators) started out in the U.S. around 1980 as a loosely-knit bunch of hams with a deep love of CW, who enjoyed long ragchews with each other, sending lots and lots of beautiful CW on their keyboards from 40-45 wpm up to about 100. Almost immediately there were about 700 members worldwide and ten years later they numbered about 900. (Look for them on the air around 7033 kHz during the hours of US darkness, and on weekends.) Their identification is given at the end of a QSO by a chicken cluck in Morse, produced by an acoustical-mechanical device invented by Kirby, WS9D. They meet together for "Cluck-ins" at hamfests and conventions. Membership requires one to be able to operate at their speeds on a keyboard and to be nominated by a couple of members who deem the person worthy. There is also a "Five-Star Club", a group who are said to communicate regularly at about 80-wpm.

The truly skilled CW operator can accurately read and transcribe code that by amateur standards may sound very strange indeed. The operators on foreign ships, where CW is used because it is cheap and reliable, are often poorly trained and grossly underpaid. Their Morse sent by hand key and rarely faster than 18-wpm, can be very perplexing to read. A good commercial operator can learn nevertheless to copy them faultlessly, even while doing something else at the same time.

There is always some speed at which we all fall apart, so what? -- You will enjoy doing a bit faster. Listen to very fast code as if it were music and soon you can recognize character here and there you will hear some words pop out. High-speed code has a musicality and beauty, which musters respect and admiration for those who work it. Background music or other rhythmic sounds can be used to aid high-speed operators-- it does not distract, but rather relieves any tedium.

Chapter 12

How Long Will It Take To Learn?

Examples Of Effective Code Learning - Your Approach Is Vital

Here is a rather leisurely, easygoing approach that worked:
Thirty Hours, One-half Hour a Day For Sixty Days To a Solid Foundation In Morse Code.
That is what Marshall Ensor's famous course given over 160 meter amateur radio-phone offered for over ten years to any and all in the 1930's period. How did he teach?

Marshall H. Ensor's Code Course

Ensor was a High School Industrial Arts teacher who volunteered with ARRL to teach amateur radio classes. He designed and taught "The School of the Air", covering the fundamentals of Amateur radio over his Amateur radio station W9BSP on 160 meter phone by voice and oscillator. This was a basic course of 60 lessons given once a year each weekday over a two month period for over ten years. He used the basic methods taught here.

Thousands of amateurs were trained with almost 100% success. His students never thought of the code as being hard to learn. He continually stimulated the student's interest and attention by a variety of lesson content and by his manner of speaking. He encouraged students to write or visit him and let him know how they were doing. Every student was encouraged and he especially complimented those who persisted in their ongoing study, even though they might miss out now and then.

Each lesson was an hour long and generally centered upon one theme, presented partly by voice and partly in code. Each lesson was about half devoted to teaching the Morse code and the other half to theory, fundamentals of radio, themes of interest and government regulations. There was enough variety to keep the student's interest peaked to know and use the code and go ahead to get a license. To avoid any tediousness or boredom, no adjacent lessons were identical in format or content, although many code "texts" were repeated over and over throughout the series of lessons. In addition, the student was urged from the very first to obtain a good key and make an oscillator so that he could practice sending accurate code between lessons.

The code portion of Lesson One began with a short explanation of how to "vocalize" the code, that is, using "dits" and "dahs" to get and keep the student thinking of the code letters as patterns of sound rather than as visual dots and dashes. It was illustrated by comments such as:
It is this sound-pattern of each letter that must be memorized.

These very important comments were restated in various ways in every lesson up to the tenth, and after that they were reinforced in almost every lesson in one way or another. This constant hammering of the importance of sound-only drove this key point home. They apparently all got it. Then in that very first lesson he sent the alphabet, numbers and punctuation marks for the student just to listen to, in order to give him an overall feel for the wholeness of the code as a system of sounds.

In the following lessons up to the tenth when the alphabet only (each letter repeated three times) was sent in ABC order just to be listened to without copying. But sometimes it was sent in character groups to be copied, writing down immediately each letter the student recognized. Even in Lesson One the alphabet was followed by three short sayings of 5 to 9 words each. Each saying was first read aloud -- once or twice -- then sent slowly, and finally read again. A few lessons later everyone was to try to copy them, although only those who were somewhat advanced were expected to be able to get it all.

He apparently never sent a character at less than about 12-wpm. In the earlier lessons the upper actual limit of word speed ranged from about 5 to 10 or more wpm. Later from time to time the upper limits were sometimes in the teens up to 25-wpm. The beginning speed was not a progressive advance, but rather was random -- sometimes starting at 6-wpm, at other times 10 or more -- to give exposure to how the code sounds at various speeds. 12 to 14 wpm were the commonest speeds. In the later lessons a wide variety of sentences was sent in this part of the lesson. In the earlier lessons they were familiar sayings, helpful remarks and encouragement, and later were usually taken from the text of the lesson theme. (After lesson 30 portions from the Radio Amateurs Handbook, and the Radio Amateurs License Manual, and finally all class B examination questions were included.)

Beginning in lesson 3 he encouraged the student to try to write them down as words separated by spaces. If they couldn't do that yet, to write the letters in a continuous string, without spaces. All copying to be done in ordinary handwriting not printed. Up to lesson 7 the average student was assumed to be able to copy the letters of the alphabet at word speeds of about 5-wpm. Beginning with lesson 8 the numbers and most common punctuation marks were added to the alphabet review and frequently also were vocalized up to lesson 27. This was done less often in later lessons. The first 26 lessons were dedicated primarily to establishing a firm foundation in recognizing and using the code characters. He used an automatic tape sender from about lesson 15 to send texts at various speeds for more practice.

The obvious goal was to make the student thoroughly familiar with the sound of each code letter, number and punctuation mark by repeatedly hearing them over and over and copying them down. Each lesson from about the twelfth also contained higher speed portions for those advancing more rapidly, and to tweak the interest of those not quite to skilled yet to try to copy. As the lessons progressed he used different speeds up to about 25-wpm. To avoid "ear" fatigue the code practice segments of each lesson were separated by a few minutes of spoken comments, reading of prepared text on the lesson theme or other items of general interest.

Code sections of a lesson rarely exceeded 5 to 10 minutes at a time. In later lessons these were sometimes an active part of the teaching of radio theory and practice. In some lessons he also gave general comments on how to go about studying and learning. Beginning in lesson 13 he encouraged the student to try to copy at least a letter or two behind. After lesson 30 most of the themes were taken directly from the ARRL Radio Amateurs Handbook and the ARRL Licensing Manual which each student was urged to obtain. These were to prepare the student for passing the radio amateur operator's test, which covered the elements of electricity and radio, the U.S.

rules and regulations concerning amateur transmitting, and amateur operating practices. His students easily passed the 10 and 13-wpm tests with flying colors.

Bruce Vaughan, now NR4Y, was one of his students. He started learning the code in the fall of 1938. Years later he wrote like this: "*I never understood why some find learning code difficult. I remember only vaguely, when I learned to read CW, [so] I suppose my Maker installed a code reader in my otherwise hollow skull at the time of my conception.*" He learned the code during that two-month radio class and then easily passed the government exam.

Another Example - Compounded By Handicaps

Steve Katz, WB2WIK, has taught hundreds of students in classes of 5 to 15 students over the years, and says "*CW surely isn't difficult.*" Most of his students in a typical class, he says, didn't know a dit from a dah, but after eight class sessions they all (except one or two) passed the 20-wpm CW element for Extra.

How did he do this? -- He tells them:" *The code is the world's easiest 'language'. It has only 26 words. Who here can't learn 26 new words in one night? When a person learns a new language, he doesn't think about how each word is spelled, or how many letters are in each word. He thinks about how the word sounds, and what it means, The same goes for learning Morse code. Each letter has a sound and a meaning. That's all one needs to know.*"

Then he begins with the simplest letters (E T I M A N S O) and progresses to the intermediate letters (U D V B W G) and then finally the last twelve. He teaches by rhythm and sound, not by "dits" and "dahs" or dots and dashes. He teaches by vocalization and demonstration -- no assigned homework or study of any kind. He uses his ham radio station along with an electronic keyer and key paddle to demonstrate and also uses on-the-air contacts.

His "proven CW teaching technique" after the ABC's, he describes as:
to make the student put away his pencil and paper and just listen to the code at very high speeds, while he, Steve, sends familiar text, including words like the names of sports teams, cities and so forth. He said: "*Don't write anything down. Just listen to the code, and if you get a little bit of it, that's fine*."

He taught his nine-year-old nephew Rob (who has cerebral palsy) when Rob got interested in ham radio from watching Steve communicating with distant stations. So Steve started teaching him the code and in about 3 weeks he passed the novice exam with flying colors at age 10. Rob hacked around in the Novice cw bands at 5 wpm for a while, when one day he tuned where high speed operators were working each other and was intrigued that they were going so fast. He tried to copy them but was disheartened to find he couldn't write as fast as they were sending. So Steve helped him out, and said: "*Don't write anything down. Just listen to the code, and if you get a little bit of it, that's fine.*"

So Rob just listened and soon was "copying" maybe 2%, and after a few more days of listening to high-speed operators, he could copy maybe 20%, which Steve said "*is more than enough to make a contact*". Steve encouraged him to do just that -- make contacts with operators going much too fast to "copy". He did that, even if he could only copy a call sign and name (Steve told

him: "*that's a complete contact*"). It didn't take long for Rob to copy in his head very solidly without pencil and paper (Steve said: "*I never use any either*"). When Rob had upgraded to General Class, Steve encouraged him to hang out near the Extra Class subbands and find the really great operators to contact. He did that, too, and within three weeks, he had increased his code speed from 5 to about 35-wpm without using tapes, computer programs or any other "artificial" means. He just did it by getting on the air and making contacts, which is how Steve says he did it, too.

When Rob was 12 he passed the Advanced exam, and also took the Extra Class exam where he passed the code element easily (100% solid), all answers correct, without writing anything down on paper, but he failed the theory parts of the exam because he hadn't had enough math yet in school. Just before his 13th birthday he did pass the full Extra Class exam. He now works CW contests where most QSO's are at 45-50 wpm and never writes anything down except the other station's call in his log.

This handicapped teen can "copy" at almost any speed with 100% accuracy, but he doesn't really know a dit from a dah. He didn't learn the code this way. Code was always the easy part for him. Rob is certain that anyone who can't pass the code exam must be an idiot, since it wasn't very hard for him and he has a learning disability, cerebral palsy which restricts his coordination. He had Steve's excellent example and was never told it might be "hard", so it was always easy for him. He had a good attitude and didn't know there was any problem. There seems to be no limit to his ability. He was learning it the right way from the very first exposure.

More Examples

The U.S. Navy during WW-2 code courses for the average person required about 3 weeks to achieve 12-14 wpm to meet the rigid Navy requirement of perfect accuracy (military operations and security at sea demanded letter-perfect accuracy). This time, they thought, could be shortened with better teaching methods.

Waldo T. Boyd K6DZY was a graduate of the Navy Radio Communications School. In 3 months time he was copying 35-wpm, and not long after that was copying 50 wpm easily. Dick Spenceley KV4AA known as "one of the world's best operators" taught Danny Weil so well that within one month Danny had earned his license and was working DX at 20 wpm. His was the result of a good teacher and an eager student.

Some Outstanding Examples Of Effectiveness

Conditioning Is Important

Katashi Nose, KH6IJ (Physics Department, University of Hawaii), who became a high speed expert, taught teenagers the code for 25 years. His students never heard that "this will be hard, you'll have to fight a plateau." They learned rapidly to good working speeds of 20 - 30 wpm in two to three weeks.

The fastest code learner we have ever heard of so far started code practice for the examination just one week before he took the test and passed it! You say: "Wait a minute. What goes on here?" You're right, there is a history behind this achievement. What was it, and what can we learn from it?

It was his conditioning, his background. That played a crucial part. His father was a skilled telegrapher at a country railroad station. His earliest childhood memories were of sitting, fascinated, on the floor in his father's telegraph office listening to the sounder clicking. Unconsciously he learned to recognize when his Dad's station was being called, and when he did, he would go to get his Dad. It was only after he was quite a bit older that he realized that not all adult men could automatically read Morse code in the same way that they could read and write English!

His mind had become so sensitized to the sound of Morse code from birth and so saturated with it that, when the time came to learn it properly, he had absolutely no hang-ups at all about "not being able to do it". He was totally conditioned and prepared. And in addition he may have felt, as almost every teenager does, that "whatever Dad can do, I can do better". Not many of us are so fortunate as to have this kind of background, but does his history suggest anything we could do? Is there some way I can condition my mind to make it easier? Isn't it the old story: what is familiar to us doesn't seem hard -- it is easy.

Gary Bold, ZL1AN, well-known teacher in New Zealand, related this story of a friend of his, and suggests one way to approach it that works, even though it may sound silly. This is by playing high quality code tapes in the background (like music) while you're driving to work, washing the dishes, cleaning the car, etc. You don't even have to listen to it consciously, he says. -- Will it work? It's certainly worth a try.

At the lowest skill levels: four-years-olds, barely able to write even block letters have been able to pass the code test. How many of us are willing to admit a four-year-old can outperform us? Then consider these higher skill levels:

Determination and Persistence

How long it should take depends on various factors. The first essential is how we approach -- this is vital. Am I prepared? Do I really want to learn? Will I stick to it? Am I determined to do it? All these are essential to rapid success.

By Contrast

Old American Morse operators, using the old visual, then widely practiced methods of teaching and experience, took about six months to reach about 15 wpm and about two years to reach an expert phase. Their code with its internal spaces does require more timing sense than International Morse.

During WW-I in America, the urgent need for wireless operators shoved most of them out the door into military service with only a bare code proficiency, no experience in operating either the equipment or the procedures.

WW-II American military radio training schools provided more rigorous code training, and some of them included, in their later phases, operational experience with wired QSO's and even included interference. These practical exercises sometimes introduced progressively worse QRM. Some courses introduced typing from the very first, but for advanced students typing was

the rule. Those receiving high-speed training also learned to copy high-speed press. It is easy, and need not take long to learn the Morse code if one goes at it prepared with the right attitudes and methods.

Chapter 13

The Role of Memory in Telegraphy

Why Learning Initially by Sight Doesn't Work Well

If you "memorized the code" (as I did) from a printed chart of dots and dashes, or from a clever printed diagram or picture which vividly impressed the mind, you felt you knew it. Maybe it only took you twenty minutes to "memorize" it, as some advertisers claimed - or perhaps it took a day or two. Then if you tried to send something in code with your key, it was easy: you had a vivid mental picture as to just how long to hold each element of a character, and this seemed to prove you knew the code.

But it was when you started to receive, to listen to the code, that the trouble began. The sounds you heard just didn't seem to match up with the dots and dashes you "knew" at all. Why should it be so hard to translate the code sounds into the dots and dashes and letters that you thought you knew so well? Those who have made a study of memory tell us that we have several separate memory banks: one for sight, one for sound, others for touch, taste and smell. (See, e.g., "Memory: Surprising New Insights Into How We Remember and Why We Forget" - Elizabeth Loftus, 1980)

Now we see why: the code sounds we heard couldn't make any direct connection at all with our vivid visual memory: they were two different kinds of sensations (sound and sight) -- they didn't relate. In order to cross that gap and relate them we had to give conscious thought to build a bridge between them: to convert the sound pattern into a pattern of visual dots and dashes so that our visual memory, where the "memory" was, could interpret them. That is why we stumbled and, under the pressure of time, often missed out or even failed completely. If we keep on this way we will have to form additional association links for each individual code character in order to connect them. This can be done, and has been done, but it takes a lot of time and also raises a new risk - the danger of interference between them (two possible pathways, one conscious, the other the new association formed) and possible hesitation as a result.

Our memories are complex mechanisms. To fill in the picture, experimental studies on memory have for many years shown that we have not only several kinds, but also several levels of memories. First are what may be called the "sensory registers", the very short times during which, after we see or hear something, its sight or sound persists in our consciousness as if we were still seeing or hearing it (persistence of vision or hearing) for a moment, then quickly vanishes. However, if we are paying attention and are conscious of a sight or sound, it will enter the appropriate "short-term memory" and stay there for maybe 15-20 seconds before it, too, fades out unless we deliberately try to remember it a bit longer, or make a real effort to put it into our "long-term memory" bank by intending to remember it (by reinforcing it).

Long term memory is what we usually think of as our "memory." Because for most of us it seems easier to remember things we have seen than things we have heard, the visual approach to learning seems more attractive. But obviously, since receiving the code is a matter of hearing, we

should begin the right way, by training our auditory memory banks. Now we can see why learning the code initially by eye is really the hard way, and actually creates a serious roadblock to advancement.

Some Further Questions and Thoughts

The intricate interworking of the various parts of our minds and brains raises questions as to what is going on as we consider receiving in the telegraphic codes. Memory studies are usually concerned with things we are fully conscious of and desire either to remember or to forget. With the higher skills in code, however, it is the operation of the unconscious parts of the mind and its relations with the consciousness that is of primary interest, and how these tie together with the memory.

As our telegraphic skill level increases, the ABC's of the mechanics of language become more and more the actions of the subconscious mind, which in turn may or may not bring them to the attention of our consciousness. In the process of copying, the consciousness of content may be zero: you just mechanically copy (dictation) what is received, while you may be conscious only of thinking of something quite irrelevant. However, in reading the code we are first conscious of the words, and later conscious more of the thoughts conveyed than being precisely aware of the words. In both these higher skill levels, the words and thoughts are generally collected together into at least the "short-term" memories, and often carried over into the "long-term memories," so that we "make sense" out of it all and follow what is being said as we do in conversation.

Perhaps the only thing we are conscious of, if we stop to think about it at all is that we want to understand and recall some of the things said to us. Perhaps there is an analogy with driving a car. Here our eyes are receiving impressions from traffic, traffic signals, certain sounds, and our physical responses on steering wheel, accelerator, brakes are so automatic that if we are asked later about some particular detail, we just can't reply. These habitual physical responses to stimuli from specific events are especially strongly retained over long periods of time. The complete response once started carries itself out automatically and fully.

Another, less frequent occurrence is this: over the years it has been found that people sometimes have retained mental "pictures" or "sound recordings" of things in earlier life to which they had paid no attention or had any interest in. Under certain conditions they were able to recall them -- even things that made no sense at the time or later. One aged lady was able to recall verbatim long speeches (in a language foreign to her) she had heard many years previously. Another sang a song in the native language of her mother, a language the singer never understood at all. The experts tell us that "long term memory" does not mean either permanent memory or accurate memory. All memories tend to weaken or fade out with time, and further, that they can and usually are altered in various ways so that the recall is distorted, or sometimes even reversed from the original.

One exception is those memories associated with physically-related skills, such as playing a musical instrument, driving a vehicle, stenography, telegraphy, etc. People who have not practiced such skills for many years will generally show surprising agility after decades of non-use. A little practice will usually put them back to nearly their best performance, barring physical disability. This has been demonstrated over and over. There is certainly room here for further

research into this fascinating subject as we look for specifically better ways to improve our telegraphic skills.

Those operators in commercial work who read the tapes by eye seldom if ever learned cw as we know it, but rather learned the visual appearance of words and letters on the tapes in groups. There is also another aspect to tape reading: it is more like reading print with each character in full context, not in sequential time. One operator accustomed to operating in the 35-40 wpm range was out of it for five years. When he sat down to listen he could copy only about 15 wpm: "I couldn't believe it!" By noon he was up to about 24-wpm and later in the afternoon was up to his old speeds again. Just a few hours of practice were needed. "One can indeed get awfully rusty," he said.

Chapter 14

The "Ear"

By "ear" we mean our total hearing and interpretive system, an intricate and ingenious complete system of perception and interpretation of what is heard: ears, nerves, and mind.

The ears themselves are sensitive over a very wide range of intensities, but have their maximum sensitivity and selectivity at low volume levels. Setting the sound volume level just high enough to be clearly readable, both protects the hearing and improves performance. The ear responds to what it hears first.

Pitch of CW Signal

The ear is sensitive to pitch. Few people can accurately remember pitch ("absolute pitch"), but most have no trouble detecting changes and differences in pitch. Not many seem actually to be "tone deaf." The usual pitch range used for CW is between 500 and 1000 Hz. Some find the best pitch for copying in interference is about 500 Hz.

Those with serious hearing losses -- who cannot hear certain pitches, or who cannot distinguish code signals in the usual pitch range because their ears "ring" where the spaces should be -- may find a lower pitch (e.g. 300 - 400 Hz) helps. Sometimes using a buzzer tone, or adding white noise to the tone may enable them to hear properly. (Note: Avoid the use of an actual buzzer in teaching as it has a delay in starting to sound. This distorts the timing.)

The usual narrow bandwidth of tone for CW is uncomfortable to some people and may become monotonous, uncomfortable or unpleasant. The narrower the pitch range the more frequent the complaint. They find a more complex tonal pattern far less tiring and even pleasant. However, when interference is present more complex tones become a hindrance.

Sensitivity to Duration of Sound

In the perception of rhythm the human ear will adapt itself within rather wide limits in the actual duration of sounds. Our judgment of the duration of a brief sound is poor, perhaps because of a persistence of sound (like persistence of vision), yet we can judge the relative length of brief silent intervals rather well. (This is probably why the telegraph sounder has worked so well for receiving American Morse, where rhythm patterns are complex.) Thus, "If we take care for the spaces, the 'marks' will take care of themselves." Some students may have difficulty distinguishing dits from dahs. (The normal ratio is 1:3.) For them it may help to overemphasize the length of the dahs at first by lengthening them from 3 units to 4. (It is interesting that in American Morse the dahs tended to become shorter than three units, to contrast with the longer dahs of L and zero. Again, it may be the nature of the sounder that led to this.)

There are good reasons for believing that we must distinguish between conscious perception of duration and what the brain actually is capable of perceiving at subconscious levels. Support for

this belief comes from the experiences of those operators who can receive code signals accurately at speeds, which far exceed the point where dits and dahs all sound alike. See Chapter 10.

The "Ear" Can Often Make Sense Out Of Poor Sending

The ear is remarkable in being able to make sense out of some pretty badly mangled code, such as is often heard on the air. It is a forgiving organ: by mental adjustment one can quickly learn to recognize and read quite poorly timed code-- code whose glaring defects would stand out prominently if traced out on paper. Within fairly wide limits the actual duration of the sound in a rhythmic pattern may vary and still be recognized. However, the spacings within and between characters and words is a highly significant factor.

Some distortions of proportion are less unintelligible than others. Better discrimination exists when the dits are too fast as compared to the dahs than when the dits and dahs begin to approach the same length (easily confused). The ear can often read this kind of stuff when "machinery" fails.

The Trained Ear Can Discriminate Between Signals

The normal ear can learn to separate between signals nearly, but not quite, identical in pitch. For many people the ear-brain filter can focus on a bandwidth as narrow as 50 - 100 Hz. If one can focus on a 50 Hz. bandwidth with a receiver having a 3 kHz noise bandwidth, a CW signal nearly 18 dB below the noise level can be heard. However, a bandwidth of about 500 Hz., rather than a very narrow one, makes the mechanics of tuning easier and gives freer rein to the ear-brain filter.

It is usually only when the going gets quite rough that we need an extremely narrow receiving filter -- and then there is the risk of losing the signal entirely if anything shifts just a little. It has been said that "The amateur ear, trained to dig out signals buried six layers deep in murderous QRM is the most prized ear in intercept work in all the world."

Headphones Are Superior To A Speaker

Headphones effectively double the power of received signals compared to a loudspeaker. The muffs on the phones keep out extraneous noises and keep the weak sound energy in. The signal-to-noise ratio can be increased by reversing the phasing of the phones: that is, the noise at one phone is 180 degrees out of phase with the other and the brain tends to cancel the noise. Noise type ear plugs can also help with phones and/or filters to reduce spurious noises.

Chapter 15

Timing

Timing Is the Heart of the Code

Timing is the heart of the code: there is no code without it. Clear intelligibility depends upon right proportions. However, it is true that some distortions are less unintelligible than others, and people can learn to read that sort of stuff -- but is it justifiable? Control of timing rests entirely with the sending operator.

For this reason, attention to careful timing is first needed when the student starts to practice with a manual key, especially a straight key, though also with most other types. This is one reason why some good teachers discourage the use of anything but a keyboard by a beginner. Most modern teachers agree that it is important not to specifically mention the subject of timing until the student has learned the alphabet and numbers so well by hearing them that he recognizes their patterns without hesitation.

Some teachers recommend that other than using "dits" and "dahs" to verbalize characters, they should not be time-analyzed at all in teaching, but that it all be done intuitively by sound. On the other hand, some excellent teachers of the past (before keyers and keyboards) have insisted on teaching precise timing, in terms of its elements, from the very first. Accurate timing is vital, but it must never distract the student from the basic recognition of characters by their essential unity of patterning: it must not lead to his breaking down the characteristic rhythm of the characters by analyzing them into components.

The Basic Units

The basic unit of code timing is the Baud, which is the duration of one dit (or "dot"), denoted here by 1 for the "on" signal, and by (the equal unit) 0 (zero) for silence, the "off" signal. The basic contrasting signal to the "dit" is the dah, which has duration of 3 units (111). It is obvious that each dit and each dah must be separated both before and after by at least one unit silence (0) in order to be distinguishable: this (one unit) is the normal spacing between parts of a character. Normal spacing between characters within a word (or group) is three units (000), and between words (or groups) is seven units (0000000).

Punctuation marks normally follow the last word with only one character space (000) between. It is these components of time, signal "on", short or long, and "off", which produce the patterns or rhythms which distinguish one character from another. We must learn to hear these patterns, sense them, feel them, and this is best done by hearing well-sent code. In actual practice, individual operators may and do deviate somewhat from the standards given above. This may be for emphasis or because of communication conditions, as well as unconscious individual variations.

Relative Duration and Spacing Are Very Important

In the perception of rhythm by the human ear the precise duration of sounds is, within fairly wide limits, unimportant. If the longer signals (i.e., dahs) are substantially longer than the shorter ones

(i.e., dits), the ear will be satisfied. While our judgment of the duration of brief sounds is poor, we can judge the relative length of brief silence intervals much more accurately.

It has been said: "If you take care of the spaces, the 'marks' will take care of themselves." Spacing, the periods of silence between parts of a character, between characters in a word or group, and between words, is critical to good receiving. Sloppy or hastily sent code can be a terror to receive and understand. (Beyond some speed the persistence-of-hearing effect tends to fill in the small spaces and make us unable to consciously recognize characters.) [In American Morse with its three different lengths of dashes, each successively longer one was taught as being twice as long as the next shorter one -- an amount which is clearly "hearable" under almost any conditions. In practice, however, because they used a telegraph sounder which marks the start of a signal by one kind of click, and its end by a different-sounding click, with silence in between, these durations were often shortened without confusion for reasons stated above. The same thing was true for its internally spaced characters.]

Code "translators", microcircuitry for converting code into print, break down when sending is poor or interference is severe. The human ear and mind, however, can copy rotten code far better than any machine. The "ear" is a forgiving organ: by mental compensation we can quickly recognize and read stuff as passable code, which if it were recorded on paper tape would show its glaring defects. In the presence of interfering signals and static, and to a large extent during fading, the "ear" can be trained to pick out a very weak signal and read it well. (Chapter 11)

Irregularities in Timing

From the very beginning of telegraphy as soon as the art began to spread, the individuality of operators became apparent. Little peculiarities in sending stood out to identify each one, just as voice quality and style do in speaking. Mostly these were subtle little things, which did not distract from easy intelligibility. But they did involve aspects of timing and rhythm. We hear them today on the CW bands among amateurs using hand keys just as they did among all operators in the past.

For many operators there was a certain pride in this. However, there is a danger here also, because some operators deliberately created peculiar styles of sending as a sort of trademark. When such distortion reaches a certain point and becomes habitual, intelligibility suffers. We hear some of these operators today on the air. They do not seem to realize, or perhaps even care about the difficulty they cause. With the advent of the "double speed key", also called the "sideswiper" or the "cootie key", a key, which is operated by sidewise movement, with one contact on each side, a new set of peculiar styles of sending arose. Sidewise instead of up and down motion helped relieve some forms of fatigue, but also the peculiar motion patterns developed a different timing pattern, one that is sometimes hard to copy.

The use of "bugs," semi-automatic keys (the best known being the "Vibroplex") which soon became very popular, also gave rise to various personal sending peculiarities unless the operator was careful. "SWINGS" One of the most interesting developments in disturbed timing of hand sending was the rise of so-called "swings." Swing has to do with a change in the normal rhythm of sending, sometimes described as a change in symmetry or lack of it: a peculiar way of forming the characters. Swings most commonly developed among marine operators within a close-knit

group having a large volume of specialized communications. Thus we have the names "Banana boat swing", "Lake Erie swing", "Cuban swing", etc.

The operators of the large United Fruit Co. were especially noted for this. Some have claimed that swings developed as a most effective way of copying the early day spark signals (which sounded so much like static) through heavy static. The basic principle of "sea-going swing" was to exaggerate the spacing between letters when a letter ending with a dah was followed by one beginning with a dah, and similarly for one ending in a dit when the next began with a dit. The spacing before and after an E within a word was often made a bit longer for clarity. Exaggerated dah lengths were common also in the attempt to improve readability: e.g., the first dah in C was generally dragged out slightly.

Other individual rhythmic disturbances were common also, such as drawing out the second dah in "Q" (which we often hear on the air today). In order to avoid confusion in the midst of typically heavy Gulf of Mexico static, sending the call signs of two main shore stations was modified: -- the P of WPA was made with long dahs, while the space between A and X of WAX was exaggerated and the dahs of X were lengthened. This stopped the confusion. In later years such swings were found necessary for intelligibility in low frequency marine work when signals were barely audible. Some said "Banana boat" swing developed from call letters KFUC, the general call for all United Fruit Co. ships. Others suggested the rolling motion of boats contributed to forming it. The name "Cuban swing" or "Latin swing" came from the way most Cuban and Mexican operators ran their words together. Sometimes it must have been quite deliberate -- just to try to be individualistic, such as a jerk in forming H P C S 4 5 Y Q; a lengthening of one of the dahs a bit in J, 1, etc.; any "funny" little stroke. But these things made them hard to copy by other operators.

Early in 1936 the Eastern Air Lines (EAL) communications supervisor decided to develop an EAL swing for its operators. He dreamed up the idea of modifying a "bug" by moving the stationary dot post a half inch forward. This produced a swing like none ever heard before. The operators did not like it and soon repositioned the post, but it unconsciously influenced the sending of many of them ever after. Recently operators in a foreign navy were found almost impossible to understand at first because of a peculiar rhythm taught by their telegraph instructors.

Over the years, peculiarities of this sort have often been observed in other parts of the world as well. These, too, would have to be called "swings". Swings. The earliest comment found so far about swing is from Radio News Dec. 1921 p.565: "The American Radio Operator" (commercial and shipboard): criticizes "*the cultivation of a fancy or eccentric style of sending, believed clever in originality, but causes the receiving operator to make more effort to copy than usual. He introduces a jerk in his H's, P's, C's, 3's, 4's, 5's, Y's, and Q's and makes one of the dashes of J and 1, etc., a trifle longer than the rest... A tricky swing he makes as an effort to acquire the 'funny' stroke as he goes on. -- Consider the other operator!*"

Chapter 16

Other Methods

Personal Computers And Keyboards For Self-Learning

For self-learning nothing is superior to a Personal Computer (PC) or a keyboard where the student can push a key and hear each character (and see it in print if there is a screen), as often as he wishes or needs to get the feel of its rhythm. The PC especially has become such a valuable tool that some teachers (as Gary Bold) consider it to be superior to private or classroom learning.

- It is consistent, always sending perfect code in exactly the same way.
- It is always available and ready to be used whenever the student wants to practice.
- Most computer teaching programs provide for easy tailoring to the exact needs of the individual student.
- A PC is impersonal and there is never any reason for the student to feel embarrassment, something which often is an emotional deterrent to efficient learning in the presence of a teacher or classmates.
- It can provide both an excellent introduction to the code and growth in skill to any desired degree.

Many Computer Programs Are Excellent

See also Chapter 18. Computer programs have been and some are still available for the Commodore and Apple computers, but most have been for the IBM-compatible PC's. They have been of all sizes and varieties, according to the skill, teaching experience and ingenuity of the programming writers. Many provide for connecting the computer with the transmitter and using the computer as a keyboard. Some provide an evaluation of the student's sending skills.

One of the important features for rapid learning is the degree of adaptability to the student and the amount of interaction with him that is provided. How flexible are they? Do they provide checks on skill and accuracy? One example of an interactive computer program (Gary Bold's) starts the new student out by having him hear the character, then keying in his identification of it. If his identification is correct, the character is then displayed on the screen. But if he is wrong, his answer is ignored, and the character is repeated until he correctly identifies it. The same character is then presented several more times for his correct response before taking up the next one. If he delays too long in responding, the character is repeated (and may be displayed simultaneously) until he gets it.

After a number (per student's request) of new characters have been introduced, they are repeated in random order, and if one is misidentified, it is repeated until the student correctly identifies it. This program then ingeniously ratios the next series of random characters in proportion to the number of times any of them have been misidentified, until the student reduces this ratio significantly. Many PC programs provide a considerable variety of practice material beyond the initial learning and recognition stage. Computer programs can be versatile tools for rapid advancement, tailored to individual needs. Keyboards may provide for some of these various

factors, depending on how they have been designed and programmed. There are some smaller pocket sized "computers" which are limited to hearing practice only.

Growing Up With Hearing It

Old timer **George Hart, W1NJM** is one who learned the code originally, as he says, by "osmosis" from an older brother who was a ham -- just by listening, with no intention of learning it or getting a license. This way he learned frequent letters and operating procedures until one day he discovered he could communicate by code. From then on he was hooked! He later wrote: "*[I was] practically born with a key in my hand, so cw [was] as natural to me as talking.*"

Learning By Listening To High Speed Code

A few hams in years gone by have said that they initially "learned the code" by listening to fast commercial press dispatches (probably 35 - 45 wpm), which were then available day and night. (Did they mean starting out, or advancing? Just how they actually began is not clear.) They claim that they found they could identify a letter here and there, then short words, and within a couple of months were reading it all. However, this approach may not have been very efficient -- for most of us it might prove discouraging -- and probably depended greatly upon the mental makeup of the learner as well as his enthusiasm. We mention it here only to show what can be done if one is determined enough.

Further Comments on Gaining Speed

With many modern computer code programs available, programmable keyboards and keyers, as well as tapes, etc., there are several attractive alternates available. With these, material can be better tailored for our individual needs. The Farnsworth method suggests itself here in the high speed range, too, to allow the mind time to digest and identify characters and words. Using this, some have found that to set up a character speed in the 50 - 60 wpm range and then widening the inter-letter and inter-word spaces initially, gradually reducing them as desired, can speed up the recognition process.

Sleep Learning (??)

A number of operators in the past who desperately wanted to increase their receiving skills deliberately tried sleeping beside their receivers or playback recording equipment (or their line telegraph sounders in the case of landline operators) with fast code signals coming through for several hours or all night. They claimed that within a surprisingly short time they had great increases in receiving speed. This procedure has been challenged, but apparently works for some people.

One ham, who says he can copy at 70-wpm and still wants to increase above that, has for years been listening this way every night. Maybe it works for some people, but I wonder if it is actually effective, and also whether they got any restful sleep that way. It is interesting that in the early 1920's a group of doctors were being trained to use Morse code. Their teachers tried sleep-learning with them, and found that if the word "doctor" was sent while they were sound asleep during the night, it would nearly always wake them immediately -- showing that there is some kind of unconscious receptivity and response.

Another Suggestion That Has Worked

When someone comes to me and asks how to make the 13-wpm requirement for General class, I give them the following plan of working:

"You need to listen every day to good sending, and I suggest the W1AW CW bulletins. They are at 18-wpm. Start out the first few days and just listen for no more than one minute. Then turn it off. As you listen, pick out the characters you recognize. Don't write anything down at all the first few days like this. After a few days, increase your listening time to two minutes and continue to pick out as many characters as you can in your head-- and don't write anything down yet. Then turn it off, as before. After eight to ten days of this practice, go back to the one minute period of listening, but this time write down everything you can recognize. Try to leave blank spaces where you miss out. Write down every letter you can catch for that one minute period, then turn it off. Repeat this practice for several days, then extend the time to two minutes, writing down everything you can recognize. After several days or a week or so this way you will find your comprehension coming up fairly rapidly because your concentration is improving and you will be surprised how much you can copy in just this short period of time. From here on gradually increase your listening time to 3, 4, 5, 6 or 7 minutes. When you can copy somewhere around 60% of the bulletin materials you will find that you can copy 13 wpm, the test speed, with flying colors. This scheme has worked well for a number of people who had reached speeds between 5 and 10 wpm, but had difficulty in advancing. This general pattern should prove of help to others aiming for the 20-wpm test or higher."

McElroy's Course and His Claims For It

Although this does not fall into the above categories, here is what was said: -

In the Nov. 1945 QST, p 115, was an ad in which Ted McElroy's Company offered to "send you this complete course of instruction (McElroy's 'Morse' Code Course) free so you can see for yourself what it'll do for you. It was said to contain "everything he has learned in 30-years of operating experience." "Assuming that the average person will practice several hours the first day, we can tell you ... that you'll be copying THAT VERY FIRST DAY, words and sentences at the rate of 20-wpm. The thing is that ingenious! Ted has taken one-half the alphabet, which appears on his chart No. 1, prepared a practice tape, which runs for at least one full hour without attention at the rate of 20-wpm. You won't copy 20 full words in one minute. But each letter you write will hit your ears at a full 20-wpm and the space between letters becomes progressively shorter as the rolls go along." Since Ted's receiving speed records were tops in almost every official speed contest, it would be very interesting to see this document. At present, the above is all that seems to be available.

Chapter 17

Common Errors and What to Do about Them

Both in sending and receiving errors are sometimes made.
Good operators make very few if any while sending, but "errors" do occur both during sending and especially while receiving under various adverse conditions. These make it necessary for us to keep in mind letters that may be mistakenly formed or because of poor conditions appear to sound alike:

- Dotting errors - too many or too few dits are made or thought to be heard:- H/5 S/H B/6 V/4 Z/7
- Initial or final dits or dahs missed or confused. (On the receiving end there is a tendency to hear signals as being shorter than they are):- J/1 C/Y P/J Z/Q W/J W/P
- Other characters which beginners may confuse, particularly:- F/L G/W Y/Q 6/5 Errors that the beginner or trainee experiences in his own work can be turned into advantages.

Specific errors that are often repeated show us where we need to give special practice. If we tend to confuse two characters, we can eliminate it by hearing them one after another until their differences in rhythm become obvious to us.

When we look over our copy and find non-sense or obvious missed out areas, the correction can often be made simply from examining the context. (This will generally not work for numbers, scrambled letters or call signs, where there is no repetition to help out.) Normal procedure when you catch yourself making an error while you are sending may be handled something like this:

- stop, indicate error by "?" (or by eight dits), then repeat the last correct word (especially if it is short), and then the one sent wrong and continue on, or
- in ragchewing unimportant matter, simply stop a moment and restart with the word mis-sent,
- similarly, if it is a long word and the first syllable or so has been correctly sent, and it is a word which the receiving operator surely will immediately understand, just pause a moment and then go on with the next word.

(The pause will indicate to him the problem.)

Chapter 18

Computer Programs and Tapes for Learning and Improving Skill in Code

It is always a bit risky to try to list currently available materials and books. These change with time, some for the better, a few for the worse, and some simply vanish from the scene. With that in mind, the following programs have been found representative, both adequate and good. It is quite impossible here to go into the many details of each program, so only the barest outline is given for information. They all provide a range of speeds and pitch of the tone. Some provide various options of screen or printing capabilities, etc., and/or allow the user to remodel it for his preferences, etc. Some provide various ways of increasing or decreasing speed while sending. All use the speaker in the computer for sound output. Helps are provided on screen in most of the programs. ("Freeware" means that there is no mandatory cost to the user other than that of providing the diskette. "Commercial" means the program is for sale on the market.) Unless otherwise noted all are IBM-compatible.

Morse University

($50)- was an excellent Advanced Electronic Applications program for the Commodore C-64 computer, plugged into cartridge slot, with manual. It included:

- a learning program,
- a proficiency program to increase speed,
- a sending analysis (characters and spacings),
- a receiving game to recognize characters under pressure and a Morse keyboard to compose ones own code practice sessions.

1) Learning was at 20-wpm Farnsworth character speeds with a 3-second interval between characters. There were 54 basic lessons, plus 7 which teach the German, Spanish and Swedish characters, if desired. It was suggested that one spend two 20 minute sessions each day, and at the end of a month many would have achieved a solid 20-wpm receiving speed, and have enjoyed learning. Several options were available.
2) Proficiency sent a random sequence of characters with programmable starting and finishing speed. Speed was adjustable (5 - 99 wpm), length of practice (up to an hour), number of different characters (up to 45), size of groups, and length of intervals between characters.

Supermorse by Lee Murrah

A great deal of variety was built into this program, which is really a series of integrated programs. A learning phase introduced the student to the code characters, a Building speed phase provided variety in practice materials, an Enhance phase extended this to as fast as one might want, while a Measure phase provided for testing of skill with built-in or user-constructed tests, and finally an Operate phase. Interaction was provided in several aspects.

Morseman+ by Robin Gist NE4L/ZF2PM

had a Tutorial module teaching the characters, a Trainer module developing skill, another, "Testing" provided for various evaluations of skill, while an Interactive mode provided for certain user-response reactions. Several types of practice were provided in each of these modes or modules.

GTE Morse Tutor

version 2.1 for IBM PC, XT, AST and equivalents ($20). 11 lessons for basic learning. Each lesson reviewed previous characters as well as introducing new ones, up to lesson 12, which provided random QSO practice of infinite variety up to a length of 10 minutes per QSO. User specifies Farnsworth and all speeds as desired up to over 50 wpm. Character Excellent Non-Commercial Programs Presently Available

The Mill

MILL98a is the present status of long MILL developments by James S. Farrior, W4FOK. It is unique among the many freeware programs in providing for both old American Morse and International codes at user's selection. Jim has gone to great lengths in designing the character formation controls to incorporate the feature of old Morse environmental variability (see Chapter 20) to such a degree that it sounds "natural" to old time Morse operators, unlike the machine-regular International code, and has simulated sounders and output for regular telegraph sounders.

There is a basic learning section, a section for sending any file the user wishes to send, and another allows the user to create files he may wish to use. Another feature provides for using the computer as a control of the transmitter, using any of the other program aspects, which are appropriate. It is a carefully designed and elegant program, and Jim continues developing improvements. It was written in QBASIC. and is available from James S.Farrior W4FOK, 1332 Harrison Point Trail, Fernandina Beach FL, 32034, and any user, including Tony Smith G4FAI at: 13 Morley Road, Sheringham, Norfolk NR26 8JE England.

The MORSE TUTOR PROGRAM

is the result of another similar development for International Morse by Gary E. J. Bold ZL1AN, professor and long time code teacher in New Zealand. It is written for GW-BASIC and may be readily modified by the user. Like most other programs, it has several unique features. Each portion is a self-contained program. "Teach" interacts with the beginner, and regulates the instruction according to correctness and error in responses. "Random" practice programs are provided for code groups for any subset of characters or words from any source. A sending program sends any ASCII files for copying or reading practice. A keyboard program sends whatever is keyed in the keyboard. An interesting module is provided for key input to analyze the quality of the user's sending.

There are also other similar programs both freeware and commercial. Some PC programmers have been able to prepare their own programs tailored to their own particular needs. A number of interactive programs are available which give either immediate or delayed helps to the student -- these offer tremendous help in learning. Some may also allow the more advanced student to conduct QSO's with the computer program, just as if he was actually on the air. The potential here is great indeed. Finally, there are available computer programs and devices, which can read

received code transmissions. Because they are machines, they can only read code signals, which are reasonably accurate in timing. For the student who has access to one of these, it will give him a chance to test his own sending for accuracy. However, they are not recommended as substitutes for personal receiving by ear.

Code Tapes For Learning And For Other Purposes

The ARRL, several companies and some individuals which make or have made tapes for cassette recorders for learning up to the 20+ wpm seed range and higher, and some have prepared punched paper tapes for high speed transmission and reception. Some of these tapes are excellent, but some are of poor quality. The ARRL tapes are of high quality.

The Twin Oaks Associates (mental health professionals) offered code training programs. Three courses using cassettes and an instruction book emphasized learning by ear - mentally or verbally recognizing what is sent automatically. Course 1, alphabet took to over 5 wpm. "Practice listening through the first side, without writing anything down or rewinding to pick up anything. Side one first sounds each character and then the narrator immediately identified it. Then did the same thing on the second side, reviewing all previous material without the narrator. This is to train ear and brain to work together first without the complication of writing. After comfortably mastering the first tape, go to the second, etc, through all six tapes. The first tape presents the characters E T I A M N which have one or two elements. Each subsequent tape adds characters having one additional element, up to the fifth tape where numerals and punctuation are introduced." To be practiced 30 minutes a day. The Study Guide detailed the methods and theories used. -- The two other courses take the student up over 13 wpm, and up over 20 wpm.

In the past, as noted in Chapter 25, the Instructograph Co. and the Teleplex Co. were the best known makers of punched and inked paper tape machines for code instruction and training and used both by commercial operators and by amateurs. Commercially the Boehm inked tape and the Kleinschmidt perforated paper tape machines were the most commonly used. We mention these here because they were sometimes used for teaching or practicing the code, but much more often for commercial transmission of code at high speeds.

Similar systems were manufactured during WW-II by Ted McElroy's company. With these machines the operator would prepare the tape for transmission, either on a typewriter keyboard or with a special three-key device, for transmission. Transmission speeds of the tapes might go up to several hundreds of words per minute when conditions were good. At the receiving end the equipment would reproduce the incoming signals on a corresponding paper tape, inked or otherwise. The receiving operator was trained to read the tapes much as the good reader of ordinary print does, by words or phrases. He would read the tape as it was pulled past his eyes in a sort of track while he transcribed it on a typewriter at comfortable speeds. Typing speeds of 60 - 70 wpm seem to have been typical. McElroy prepared and promoted materials for building up these skills on his equipment.

Chapter 19

A Brief History of Morse Telegraphy - Part I

It would be very interesting to know the thinking behind the development of the original Morse code. It had to be tied in intimately with the limitations of the electro-magnetic mechanisms being designed to transmit and receive it. Records show that beginning as early as the B.C.'s reflected sunlight (heliography) by day, and lamps, lights or fires at night, were used for some kind of elementary signalling. By the A.D. 1700's (and well into the 1800's) several semaphore systems had been devised and were in rather extensive use in Europe and elsewhere. These used an alphabetic code formed by the configurations of two or more signal arms or shutters making block patterns (at night some used light configurations) for distance signaling within line of sight.

All these systems (often aided by the use of telescopes) were subject to weather and visibility limitations, and generally required at least two operators at the receiving end -- one to look and the other to write. Where considerable distances (a hundred miles or more) were involved relay stations were established. These signaling systems conveyed a symbolic message or spelled out words for visual reception. A few electric or electrochemical systems were developed using some method of spelling out words by transmitted letter symbols. Morse's system was not the first to use electricity. During the early 1800's several electrical and electro-chemical systems (which overcame the visibility problem, which was complicated by weather conditions) were invented and used. Some of them were quite ingenious, but tended to be cumbersome, rather slow and troublesome to maintain.

Morse's ingenuity was in combining a simple electro-mechanical system with some sort of "linear" coding. Samuel F. B. Morse ingeniously foresaw the newly discovered principle of electromagnetism in combination with some sort of "linear" coding as the key to developing a truly practical telegraphic system. It could provide the relative simplicity and ruggedness needed for the equipment. Like Marconi half a century later, his vision to combine these newly discovered principles and the entrepreneurial drive to bring them into use made telegraphy what it became in the field of communication for many decades. Two features were needed: equipment and a suitable code. As originally conceived it was to be a self-recording system, inscribing the code signals on a strip of paper tape to be read by eye. There was no thought given to "reading" it by ear alone.

The Original Morse Code

His coding system begun in 1832 was a translation system consisting of two essential parts:

- a two-way code book or dictionary in which each English word was assigned a number (and in order to spell out proper names, unusual words, initials, etc., when necessary, each letter of the alphabet was also assigned a number), and
- a code symbol for each digit from 0 - 9 to represent that number.

So, the sender would convert each word to a number, send that number and the receiver would then convert it back again to the English word with a reverse dictionary. In devising the symbols for the digits, Morse seems to have recognized that a receiving operator could easily read by eye up to five printed dots, but that a larger number of dots would be more difficult to read quickly and accurately, and would be more subject to error, as well as taking longer to transmit.

With such a system, the duration of the dots and spaces was not critical, but it was a tedious, slow and clumsy system (as well as being rather subject to errors which could only be found on deciphering). Not much ingenuity was required to develop the code symbols for the digits: he simply used from one to five dots to represented the numbers 1 -5, and extended this through 9 and zero by a longer short space following (here indicated by the symbol @).

Here is his code:- 1 2 3 4 5 6 7 8 9 0 . .. . @ .. @ ... @ .... @ ..... @

With such a system, the duration of the dots was not critical, but the relative spacings were important. What a tedious, slow and clumsy system it would have been (as well as being rather highly subject to errors, which could only be found on deciphering). The overall idea was ingenuous, and the actual code signals used for the digits were simplicity itself. But his coding system was the weak link in his whole system, and would hardly find wide acceptance. (Later, this code-translation-book method was applied in China where it made sense to convert the Chinese characters to numbers, using an already available standard Chinese dictionary in which each character had for other reasons been assigned a number.)

Who Invented What We Call "The Morse Code?"

Chapter 2 of George P. Oslin's book "The Story of Telecommunications" opens with these words: "Ask almost any American who invented the telegraph, and the answer will be 'Morse', but he did not create the dot-and-dash Morse code, the Morse key, or the stylus recorder." Who was Mr. Oslin, and where did he get this information?

He was a journalist who later became public relations director of Western Union. To prepare this book he exhaustively investigated newspaper articles, magazines, books and more than 100,000 letters and diaries of those involved and condensed it. (He was 93 years old when the book was published.) Pages 13 to 28 are devoted to a summary of the origins of Morse telegraphy, from which the following quotations come. Previous publications had only hinted at what Mr. Oslin has said so clearly. (The numbers in parentheses refer to pages in his book.)

In order to understand the confusion we need to realize first that "Morse's craving for fame was so strong that he postured, pontificated, tried to convince everyone he was great, and was zealous in defending his claims." (28, note 27) To blow up his importance, Morse on several occasions made some quite false statements and exaggerations. It is too bad that he refused to give credit where credit was due, for he would have showed himself a greater man by it. From the very first, Morse made strict contractual relationships whereby he alone was to be credited with all advancements and improvements: all credits for whatever anyone did for him would [publicly] belong to him alone. Yet in a letter Vail, his expert assistant, wrote on March 11, 1853 that "*his agreement with Morse provided 'that whatever Mr. Smith, Dr. Gale, or myself should invent or discover, going to simplify or improve Morse's telegraph would belong to all jointly*" (24).

However, Morse never shared any of this, and constantly cut Vail off from any public recognition for his work. Because of this, we know almost no details about the development history of the alphabetic versions of the code. We can be sure that if this code had been the work of Morse himself, he would most certainly have carefully elaborated every step of its development. (This is one clue previously published materials provide us.) A second factor was that they were physically separated during most of the first six or seven years: Morse was in New York City while Alfred Vail was working independently in Morristown NJ. This is only a distance of about 30 miles by air, but travel was difficult in those days.

See this in the following: "*On October 18, 1837 Morse wrote to Vail: 'I long to see the machine you have been making and the one you have been maturing in the studio of your brain.' Later Vail invited Morse to Morristown, where the artist realized his cumbersome picture-frame equipment [for recording the signals at the receiving end] was to be replaced by the practical and simple Vail instrument. Morse was so upset, Baxter said, that he became ill and was in bed for some weeks at the Vail home.*" (21) (Morse's feelings were badly hurt.) If Alfred Vail had not joined Morse as assistant in the latter part of 1837, Morse's telegraph system would no doubt have been a failure.

Vail was not only a skilled technician, but had a wider perspective, and must have quickly seen that Morse's complex translation-coding system and its equipment were not really practical: there must be a better way. "*It is evident that Henry showed how to telegraph, Morse planned a cumbersome system to do it, Gale made valuable contributions, and Vail developed the code and instruments necessary for successful operation.*" (25) On October 18, 1888, over 40 years later. Alfred Vail's widow wrote to H.C. Adams, president of Cornell University: 1888: "*... Prof. Morse ... sent for me, and on his dying bed [he died 2 April 1872, almost 81 years old], with the forefinger of his left hand raised and moving to give expression to his words, he said: 'The one thing I want to do now is justice to Alfred Vail.*" (27 note 18) As for his coding system, "*Morse's caveat of October 3, 1837, and his letter to Vail on October 24, 1837 announcing the completion of his dictionary of numbers for words did not mention a dot-and-dash alphabet.*" -- However, he kept working on it until 1843: "*Six years after Vail created the Morse code [1937-8], Morse wrote to [F.O.J.] Smith about the numbers-for-words dictionary he was preparing*." (23-24)

Vail, in a letter to his father and brother February 21, 1838, regarding a demonstration he had just given to the President and his Cabinet*:* "*... The President proposed the following sentence, 'The enemy nears . . . It was then put in numbers and written on the register.*" (27, note 16) On p. 39 the caption under picture 2.5: "*Alfred Vail who created the Morse telegraph key and sounder and telegraph code at Morristown N.J. while Morse was in New York devising a number for each word commonly used. Morse's idea was to transmit numbers instead of words to send messages.*" "*The Engineering News of April 14, 1886, stated that 'credit for the alphabet, ground circuit and other important features of the Morse system belongs not to Morse at all, but to Alfred Vail, a name that should ever be held in remembrance and honor*." (24) F. O. J. Smith wrote: "*It is evident that Henry showed how to telegraph, Morse planned a cumbersome system to do it, Gale made valuable contributions, and Vail developed the code and instruments necessary for successful operation.*" (24-25) "*Vail watched Morse gradually eliminate him from credit with mounting astonishment and anger, making no public outcry because Morse, involved in a multiplicity of court battles, required all possible support to preserve the patents. When Morse*

later referred to Vail and his father merely as 'furnishing the means to give the child a decent dress,' Vail supporters boiled, and telegraph journals contained many strong words." (24)
Vail's Thinking ? It would be very interesting to know the thinking behind the development of Vail's " Morse" code. It had to be tied in intimately with the limitations of the electro-magnetic mechanisms being designed to transmit and receive it. Factors which no doubt strongly dominated in Vail's thinking were: brevity, simplicity and accuracy.

Accuracy requires that the receiving operator be able to distinguish immediately between similar characters without confusion or hesitation. (We must remind ourselves that at this point in time Vail was thinking only of reading a record by eye on a strip of running paper tape, not about receiving by ear as was done later.) We must also realize that while "speed" was commercially important, it was by no means so pressingly demanding in the mid 19th century as it is today. Starting with Morse' simple off-on signaling system Vail developed this original idea into a truly practical alphabetic concept, one that does not require further translation. We may suspect that his key idea was to use more than one signal-on duration. (Did musical rhythms also suggest the internal character spaces?)

This was totally different from Morse' code-dictionary concept. Note: Although Morse, in writing out his code dictionary, is said to have written a dash in lieu of five dots, there seems never to have been any hint of his using such a signal element in his code itself. We cannot help wondering how he determined that the use of longer-than-normal internal spaces between elements would not cause the receiving operator confusion in distinguishing between characters.

Did Vail do some testing to try it out? These interesting aspects seem to have gone completely unreported in contrast to the attempt to associate the briefest code symbols with the most frequently used English letters, which is well reported (however, as if it were Morse's own work). "*In November and December 1837, when Vail built the instruments, he visited Louis Vogt, proprietor of a print shop at Morristown, and, over a case of type, learned which letters of the alphabet were used most frequently... He assigned the fewest dots and dashes to those letters.*" (23)

By January 1838, about three months after Vail had joined Morse, he had produced the first practical "Morse" code, a purely alphabetic code, which included the use of dashes as well as dots and internally spaced characters. [However, at this point not every letter had a separate code character; several (J = G, Y = I, V = L, and S = Z) were combined. This would be ambiguous for receiving by ear, but more easily handled reading by eye from the context of the inscribed tape record.] This alphabetic code would have made coding and decoding almost perfectly straightforward and let overall transmission speed jump up immediately to about ten wpm. However, he did not tell Morse about it: -- according to information now available, for six years later Morse was still working on his word-number and number-word dictionary. (Morse was so easily upset by some of Vail's excellent inventive developments.)

It is not clear whether any previous inventor had used more than one length of element in a linear code system. (The idea of "linear" is that of a simple signal running along a line in time, in contrast to simultaneous complexity of signals, such as a two-arm semaphore or a printed

alphabet.) Vail chose four kinds of linear elements (besides the necessary minimal spacing between the elements of a character) to form characters:

- dot, the shortest,
- dash, appreciably longer,
- longer dashes,
- longer internal space.

This gave four choices for the internal elements of a character and three choices for its initial and final elements (where internal longer spaces are obviously not applicable). These choices now allowed for a practical alphabetic code for linear transmission. (Additional spaces were of course needed between characters and words.)

By 1843, Vail had made such major changes to this early 1838 alphabet that the only letters which were not changed were E H K N P Q. These changes included assigning to each letter a single code character. -- It is not at all clear from a comparison of the alphabets and the relative frequencies of the letters why such extensive changes were made, as the same results could have been achieved by changing very few letters. (Were there other factors involved than mere brevity?) Since Morse knew nothing about this new code (he had many other concerns as well) and no one else would yet be using it, no confusion would result by whatever changes were made.

The average character length of the 1838 alphabet, calculated by the same methods used in Chapter 25 was 8.329. Thus the new 1844 code with average character length of 7.978 was actually about 4% shorter than in the 1838 alphabet. (If he had interchanged just two characters, L and T, in the original 1838 alphabet it would have averaged 7.950 units per letter or 4.5% shorter than it originally was, just a bit shorter than the new 1844 code!) Some other variations could have resulted in a still shorter system.

The 1844 code was thus not the "best" possible, but it proved to be very practical. Vail's final code was used successfully by many thousands of commercial operators, and was the standard for wire telegraphy in the United States, Canada and a few other places until nearly the mid-20th century. Relative timing is critically important to prevent confusion and misunderstanding by the receiving operator. The least bit of hesitation in the wrong place within the character, or holding the key down an instant too long would send the wrong character. If these very tiny differences in timing were disregarded, the following letters within a word would be confused: I, O and EE; C, R, S, IE and EI; Y, Z, II, SE, ES, H and the character &; similarly for "on" signals, T, L and Zero could be confused with one another.

Neither the final 1844 code nor its successor, the International Morse code, is perfect. Perhaps no code could be "perfect" for every application, but it proved practical, and together with the promotion of the telegraph instruments it came into wide and successful use. Its efficiency in other languages will vary, depending on the relative frequency of the letters.

Chapter 19

A Brief History of Morse Telegraphy - Part II

The Original Morse Code Modified in Europe

Morse telegraphy was introduced into Germany in 1847 by a Mr. William Robinson (without authorization by Morse). There the Marine Dispatch Service between Hamburg and Cuxhaven, a communication system for shipping, was using an optical system, useless under bad weather conditions. They became greatly interested in the potential of this electric all-weather system.

One of their officials who was also an engineer, Frederick Clemens Gerke, immediately translated Vail's book on the telegraph into German. This systematic German engineer saw how easy it was to confuse the receiving operator, so he modified the original code to eliminate the internally spaced characters and the various lengths of dashes. This left just two lengths: a dot and a dash. Even though this would make a transmission longer, it meant less skill was required to achieve the same level of proficiency and accuracy of communication. He retained A B D E G H I K M N P S T U V just as they were, used I for both I and J, and then formed new code characters for those deleted, and for the numbers, etc.

Other German and Austrian states soon adopted the Morse system, but each state modified the Morse code independently, making interstate communication difficult. In 1852 the German and Austrian state telegraphs convened to unify the codes in use (as well as the tariffs).
Their principles were:

- uniform dot and dash elements (and spacings),
- letters to be no more than four elements long,
- numbers to be five elements long, and
- punctuation six elements long.

They took Gerke's alphabet as the basis, but changed his O P X Y and Z to the present "International" forms, and developed the present systematic number system, etc. They made this code their official standard on 1 July 1852. -- The present form of J and other European language symbols were added in 1865 at the Paris International Telegraph Convention, and for a long time this form of code was called the "Continental" code, until wireless made it "International." Minor punctuation changes were made 1 September 1939.

Equipment

Morse's original receiving system was a clumsy recorder, which made marks on a paper strip pulled along by clockwork under a magnetically operated pencil, pen, or stylus. It presented an "on-off" record, which was then read by eye. Vail created a much superior recorder. There is plenty of evidence that even Morse and Vail had learned to distinguish most letters by ear during the first few months of their primitive sending.

As early as 1845 some other operators could identify most of the code letters by ear as they listened to the clicking of the recorder. By 1846 many regular operators were doing so, or could. However, there was great reluctance on the part of local office managers to accept this method of copying, and some strictly forbade it. The operators who read by ear had to keep the paper tapes as proof of their accuracy, and offered a means of correction. (In copying, operators often used abbreviations, which would be intelligible to the readers).

Morse's original sending device was a sort of typesetter's ruler with dots and spaces. Vail's first simple key, predecessor of later hand keys, was designed about 1840. It was a simple flat spring with a knob, which in time developed into the improved and sturdier designs we now know. Among several examples of receiving by ear only are: -- James F. Leonard in 1847. He had entered the service as a messenger boy at age 14. Within a year he became an operator at Frankfort KY, and was reading by sound. Not only so, but he had also taught himself to send and listen at the same time, writing down an incoming message while sending another.

Some other operators by that year were listening to a message or two, then writing them down later. On the first of May 1847 the Albany Evening Journal reported that a business man named W. C. Buell was sitting in the telegraph office listening to the incoming messages when the operator's tape printer fouled up. Buell was found to have correctly "read" and remembered what had been sent.

That same year a Louisville broker, who had been sitting in a telegraph office, was fined and jailed for listening to market reports coming in and not paying for them (because he had no operator's license)! That same year, a Mr. Books, operator at Pittsburgh, wrote out a long message by sound alone. Receiving by ear alone was proving to be not only possible, but practical (and time saving). Nevertheless, some offices were slow to accept receiving by ear alone and required all messages to be recorded even though the operator read by ear.

In 1852-3 an Erie RR conductor refused to accept train orders received by ear, and complained to his superintendent about the operator, Charles Douglas. When Douglas was reproved, he insisted on being tested, and demonstrated that not only did he copy accurately for short messages, but also for very long ones. Thereafter the Erie RR officially permitted copying by ear. The sounder was invented in 1856 and was used extensively and almost exclusively during and after the Civil War, though a few diehards persisted in requiring the old recorders to be used.

Early Day Operators Up Through The Civil War

Telegraphy grew up with the railroads, making train dispatching, etc., easier and safer. At first, most telegraph offices were in the RR stations. Each station, as well as many other important locations (such as switching points) was manned by an operator. There were many more "country" and small-town stations than "city" offices. Most operators came from the country and small towns where they remained, but some were attracted to the advantages of city offices.

Telegraphy was mostly a young man's occupation. The majority were boys whose ages ranged from nine upwards. Most of them ranged from 14 to 18. Some were in their 20's, but few above that. Many of them became superb operators, very accurate, fast and reliable. Almost all were completely trustworthy and loyal. They refused to divulge the contents of messages to other than

the addressees. Many of these young chaps who had served in railway and public telegraph offices became operators for the armies of both sides during the Civil War, frequently doing service far beyond the call of duty, and at great personal risk. (Although they were usually stationed right on the front lines, yet they never received military honors or pay.)
In the early days pencils were used to copy and an adequate supply of sharpened ones was kept at hand for each operator. Later, many telegraphers copied with pen and ink (in beautiful Spenserian script -- think of the risk of blots with the old steel pens!), at speeds that ranged up to 30-35 wpm: neat deliverable copy.

Operators after the Civil War

This was a period of growth, both in the number of RR offices, and especially the size of big-city offices. Women in large numbers began to become operators in the city offices because it was cleaner and more respectable work than domestic or factory labor. There were several categories of operators in the city offices: those handling slow traffic from country places, those handling higher speed material, financial report operators, and at the top, press (news).

The goal of most male operators was to advance and be able to handle high speeds accurately. These were honored men with the highest pay. In a city telegraph office it was common to "haze" a new operator. The others would arrange to have an unusual or garbled message sent to him, or more often a message sent at speeds too fast for him and watch him sweat and worry it out. If, when he looked around at their amusement and realized it was put on, he took it pleasantly, he was considered "initiated" and accepted into the telegraphic fraternity. But if he was infuriated or upset, he was considered still a freshman.

When typewriters became practical in the 1880's they began to be used in American telegraph offices. A superb operator was said to be able to copy 50 -60 wpm without trouble, and many of these were said to have copied regularly 5 - 6 words behind to do this.

The Introduction of Wireless

When Marconi entered the scene with his wireless, the "Continental" or "International" Morse code was in wide use everywhere except in America. Wireless was then primarily -- in fact, almost solely -- used where wire lines could not be strung. That meant that it was almost entirely ship to shore or ship to ship. American operators were American-Morse trained, and soon had to add "Continental" code to their repertoire, using both codes: American Morse among themselves and "Continental" with other operators. Many became highly proficient in both codes, using them interchangeably as needed, on a moment by moment basis.

For a period of time up to about WWI this became a requirement. However, using the somewhat faster and very "ditty" American Morse with the early spark transmitters made copying difficult whenever static was present. The static and the signals tended to sound too much alike, and at the low radio frequencies then in use, static was heavy during at least half the year. During this period the U.S. Navy developed an entirely different set of code symbols, probably for this reason, but they were abandoned in favor of the "Continental" code just before the U.S. entered World War I. It was about the same time that the "Continental" form of Morse code also became standard in the U.S. for commercial and among almost all radio amateurs.

When were the terms "dit" and "dah" introduced?

The March 1926 Wireless Magazine refers to the 1923 Transatlantic signals of (F)8AB as fluttery 25 cycle with "dahdahdahditdit didah dahditditdit". Were there earlier examples? With a sounder, instead of "dits" there are "iddies" and for "dahs" "umpties" to distinguish the two types of clicks. Another description was "klick, kalunk". In addition to this, of course, was the spacing between words. Good sending had to be relatively precise.

Accuracy was demanded of commercial operators: they were rated on the quality of their sending. A sender or receiver who had to repeat or to ask for repeats could be disqualified. It was not merely a matter of courtesy, but of economics: errors meant delays for customers and cost time and money to the telegraph companies. The good telegrapher adjusted his relative lengths according to the perceptive skill of the receiving operator, by making larger or smaller differences in the relative lengths.

One operator reports from his experience that careless Morse sounded worse on a sounder than on CW. Words with lots of Old Morse letters: joy jack jail Japan jelly jewel jiffy join jolly jungle jury quick quality queer equip quote ill long loss late labor loyal legal limit lip

The signal AR Comes from the American Morse fn = finished

Chapter 20

Learning the American Morse Code

Comparisons

Here we consider how to go about learning the other code. Since most of us know the International (formerly called "Continental") code, how do we go about learning the old ("American") Morse landline code? Do not use the following comparative lists in any way to learn the American Morse code. Their purpose is solely to show the differences between the two codes, and particularly the effects on the structure of certain characters due to the Morse internal spaces and the special lengthened dahs. They affect rhythms.

First, the old Morse differs from International in four aspects:

1) the following characters are the same in both codes:
   A B D E G H I K M N S T U V W 4 (2/3 of alphabet letters)
2) a number of International characters represent different
   letters or numbers or signs in old Morse:
   MORSE: F J Q P X 1 5 7 8 9 . ?
   INTN'L: R C F 5 L P o Z 6 X ? /
3) certain old Morse letters contain internal spaces
   which make them subject to possible misinterpretation as
   two letters: C O R Y Z might appear
   to be IE EE EI II SE
4) certain letters in old Morse are different from any
   International character for English:
   L = a longer dah , 0 (zero) = a still longer dah (see
   below). The following numbers are different in old Morse
   from any International English character sound: 2 3 6.

This does not include other punctuation, which differs and in old Morse landline circuits was used extensively. It must be heard to learn it.

Timing

There seem to have been no rigid "standard" timing relationships in American Morse as compared with International Morse. That is, the duration of a normal dah is stated variously as being two times or three times the duration of a dit. (My own impression is that it tended to be somewhat shorter than the corresponding dah in International code. This might have been done to save time and yet to keep the careful distinctions between a dit and the definitely longer dah for "L", which nominally was considered to be twice as long as the normal dah.) The important thing was to clearly distinguish between "E" and "L" and "T". Zero (0) would be intentionally longer than "L" when there would be a risk of its being misread, but otherwise would be about the same. (Some have described "L" as being as short as 4 or as long as 7 units, and zero as short as 5 or as long as 10 units. There seems to have been better agreement on the spaces.)

The important thing was "This is communication. Things should have to be sent only once. Having to repeat wastes time and money." Are the words and numbers being clearly understood by the receiving operator?" Commercial telegraphers were rated by their accuracy first and speed second.

In the same way, the space in the internally spaced characters (3 above) is usually stated to be the duration of two dits, but tended to be shortened just enough to be clear, so the receiving operator would not be confused. The spacing between letters in a word nominally appears to have been the duration of 3 - 4 dits, and between words about the length of 4 - 6 dits. Before and/or after the internally spaced characters a slightly longer than normal letter space was often felt necessary, depending on the code environment. Again, these values would tend to vary according to the skill of both operators. The object was, as always, perfect copy with minimum time to transmit, leaving considerable flexibility to the individual operators. Yet the demands of this code for accurate proportioning -- intolerance of the least bit of hesitation, key up or key down (e.g., the person who sent the word "telegraph" in such a way that it was copied as "jgraph") -- show how much more acute timing is in American Morse in contrast to International Morse.

No Need For Confusion

Three general features distinguish old Morse from International Morse code:

- Most obvious is the difference in basic rhythm: International has a distinctly "regular" sort of rhythm, while old Morse has a catchy sort of apocopated rhythm -- it marches in a striking sort of "go and halt" way, which, when sent by a skilled operator, is unmistakable.
- Along with this is a rather obvious "ditty" characteristic of old Morse by contrast with International.
- Not quite so obvious is that old Morse is about 10% faster than International when the same lengths of dashes and spaces are used in both codes (that is, it will take about 10% less time to send the same text). Interestingly, old Morse also requires about 15% less effort to send. It tends to be more of an art form, with considerably more variation in "fists," or sending styles.

At first sight, with some characters the same and others different, confusion between the codes might seem considerable in learning the other. - Take heart! In a personal letter in 1942 Mr. R. J. Miller, a skilled teacher with the old Teleplex Co., wrote: "*One who is expert in only one code, e.g. American Morse, can master Continental Morse in ten days to two weeks and be as expert at the new code as he was in the old code. This is because his mind is trained to recognize the quick sounds. This theory has been proved many a time*."

Notice his words carefully: "expert" and "his mind is trained to recognize the quick sounds." These are not trivial words. It is the operator who already can handle the one code like an expert, because his mind has been well trained to recognize the letter sounds instantly when they are sent at a good speed, who is going to learn so fast and well. Just how Mr. Miller defined "expert" is not pinned down, but we can assume that such an "expert" was better than the minimum requirement for a commercial radio operator of those early days. It is probably safe to say that a

person who can easily handle the code somewhere in the 25 - 35 wpm range will find Mr. Miller's words to be true, if he puts himself to it.

From this we may assume that those of us who are less skilled and want to learn old Morse may expect to take somewhat longer to get there. (Is it possible that in learning the second code in the proper way we may actually improve our skill in the code we already know, since immediate character recognition is the key point?)

Learning It

How should we go about learning old Morse? -- First of all, we have to hear it properly sent, because its rhythms are different. We should have little trouble with recognizing it on the air: its peculiar rhythms and "dittiness" will quickly identify it. But also we will find we can easily read many common words because they sound the same in both codes (e.g. "and, the, it, but, these, thing," and many others) -- that's an encouragement: we don't have to relearn their sounds. Listen to get the swing of it, then practice with your key, imitating the experts. This will help reinforce the sounds.

Consider the following suggestions:

1) Just ignore the idea of possible confusion: over the years many operators with various degrees of skill, from quite modest to expert, have managed to use either of both codes with no difficulty. In early "wireless" days a commercial operator was generally required to do this, and many of them were not very fast operators.

2) You already know two-thirds of the alphabet and one of ten digits: so you don't have to give these any special thought at all.

3) Think of all the characters that are different -- different in the one code from those in the other separately. Learn and think of each one of them as part of the code system to which it belongs. Don't mix or compare them -- keep each one separate and distinct from the other: (For example, don't under any condition let yourself start to think: that's "C" in International so it is "J". in Old Morse) There must be nothing standing in between the signal you hear and its immediate recognition as being the letter. (A person who knows German as well as English knows that the letters ch are pronounced differently in German than in English -- there is no confusion at all. We need to think the same way here.)

4) Remember that learning old Morse is going to be much easier and faster than learning International code because we already know how to go about it and that many, many others have succeeded well. This ought to give us great encouragement and confidence.

Some excellent suggestions come from those who have long known and used both codes. One of these is to use a Morse sounder instead of audio tones to provide a completely different sound environment to help distinguish Morse from International. (If this is done, one needs to get familiar with receiving by sounder. See below.) If one does not intend to use a sounder, there is no point in practicing with it. Some experienced operators see no benefit from it.

So there need be no confusion at all. We can simply go ahead and confidently learn the old, but new-to-us Morse code and enjoy it, using the principles already set forth here. Perhaps some of the old timers who have learned them both long ago may be pleased to give us some additional advice from their experience also.

[Expertly-sent Old Morse tapes may still be available from Cecil Langdoc, 201 Homan Ave. Elkhart IN 46516. They make for great listening.]

A Railroad telegrapher's story: -- a beginning operator was sending as fast as he could with a bug when the other operator cut in with what he copied as "REND STOW IMA GIRT". He asked for a repeat and got the same copy. He turned to his supervisor and asked: "What's wrong with that operator?" The reply: "Nothing, she's just saying 'Send slow I'm a girl.' You've gotta learn the difference between R and S and T and L. Didn't they teach you anything in that school?"

Here is an example of all-dot" sentence": Her Irish eyes cry cos she is so sorry.

Learning to Read by Sounder

Learning to read by sounder is no more difficult than by tone or buzz. It is just different. The sounder makes two different kinds of "clicks" which correspond to movements of the key. The down-stroke produces a sharp (high pitched) click to denote the beginning of the "on" signal. The up-stroke is a duller sound, indicating the end of signal ("off"). The length of the intervening silence between them corresponds to the duration of the code element, distinguishing a dit from a dah. Practice first with a string of dits and then of dahs till you get the hang of it, and then with some common words until you get familiar with this method of hearing the code signals. (Use letters, which are common to both codes -- see1 above.) You will probably find it interesting and a challenge at first.

American Morse was designed for operation over wires, where static and other interference are absent or minimal. Although the International form of the code was developed and adopted in Europe only 5 years later, in America the earlier code was first used for wireless. Two factors probably acted to effect the change-over: the predominantly "ditty" character of American Morse sounded more like static than the International form, and the world-wide nature of shipboard wireless operation urged a common code. This would have become more demanding, as international commercial and amateur operation became commonplace.

American Morse - An Art

American Morse telegraphy is considered by many of its practitioners as a thing of beauty, a work of art. The "tune sung out" by a local sounder "outranks the most precisely tuned aircraft engine in terms of sheer beauty", according to one old timer.

Some Further Comparisons

If the identical duration of the basic unit of time (the dit and unit space) is used for both codes while sending the same message, the skilled American Morse operators will have completed the message while the International operators are still sending and receiving. The message will in fact actually have been handled at a rate about 45% faster* on the Morse line than on the International channel.

*) Here the skilled old Morse operators will normally be using shorter dashes and spaces (as noted above) than their Inter-national peers. This, combined with the 73% shorter average letter and 65% shorter number in old Morse accounts for the apparent discrepancy between the previously cited 10% faster.

Therefore, when we read of the speeds achieved under American Morse operations we need to recognize that the sending operator is having an easier time than the corresponding International operator, but the receiving operator is under the same burden, but needs a more acute ability to discriminate small differences than his corresponding International operator.
In addition, when both have completed sending the message, the Morse operator will have used only about 91% as many keystrokes and about 85% of the total work or energy expended by the International operator.

These gains are achievable at a cost. First, the American Morse operator must learn to make some finer distinctions in sound than the International operator. He must readily recognize the internally spaced letters (C O R Y Z) and the lengthened dah characters (L and zero) as distinguished from what might be their equivalents, and he must generally live with closer spacing between characters and words. There is also the problem of the difference between reading by sounder in the telegraph office and reading signals over the air where static and interference can cause loss of signal components.

Ambiguities introduced by the spaced letters and the shorter dahs in American Morse under radio operation stand in sharp contrast to the standardized durations in International, making the latter easier to interpret under adverse conditions. I suspect that Old Morse operators under radio conditions tend to lengthen (or exaggerate) their time intervals (signal "on" and spaces) to aid in copying. If they do so, then the time gain is less.

Some Practice Materials for Learning

Words which contain only letters common to both codes: (a e i u b d g h k m n s t v w)

the and end man men view stew must mist missed kid king thing dig dumb sing sting stub hide side vast waste waist medium wide stab tug aim bug tame name magnet tube gust huge India ink sink had mad made human magnitude dean heat hum ham him sad dash dish shade gush bush hush mash smash biggest mug hug bag sag wag stage wages vague stag that tug heed head hasten skate hate date night might kite fight invite begin began behave behead aghast mane tame inane game wane hank bank stink wink

Words containing only the Letters Unique to American Morse:

Dits Only:

cheese choose coop cop cope copper copy core creep creepy crop cross cry echo eyes hoe hope horse hose ice ooze peer pie pieces pose precise press price prize prose recess repose rice ripe rope Roy seer seize series she sheer shoe shy size sore spice spree spy yippy zero zoo

Only Letters Unique to American Morse:

clop color crop off for joy fly lop offer plop roll jolly

Using Only the Letters Unique to American Morse plus the Rest of Its Vowels:

all aloe career clap clay clear cliff clip clique collar cruel equip expire explore fall fall fill fizzle flail flare fly for full fail jail jeer jello joy jury leap lily lop oil opera pear peel place play quail queer quip quiz rap reaper repair rill roll xray year zeal

From the MILL 72a opnotes of Jim Farrior who originally learned American Morse:

A considerable variation exists in the way American Morse is sent by different operators, and there is no rigid standard. Although it is not typically sent exactly that way, it is convenient for some purposes to assume that the Morse standard is the same as the CW standard, except that certain Morse characters contain a wider space between two of the dots, and the Morse word space is 1 unit shorter than the corresponding CW space. Also, Morse L is a dash approximately twice the length of the standard dash, and the Morse zero is a dash approximately three times the length of the standard dash. This results in the following Morse "standard": dot = 1 unit, normal space = 1, special Morse space = 2 units, dash = 3 units, Morse L = 6 units, Morse 0 = 9 units, character space = 3 units, word space = 6 units.

Although I haven't spent much practice time with learning American Morse, it isn't easy to for me to distinguish the different lengths of dahs and to perceive the spaced characters as units, rather than e's and i's, without paying close conscious attention to them.

My suspicion is that I have for so many years been trying to read poorly sent International Morse that my perception of these small differences in length and spacing has become badly desensitized. -- American Morse operators could never have lived with that kind of carelessness. They would have shuddered at such sending. -- Poorly formed International Morse, where the dits and dahs are often grossly distorted: on the one hand it is sometimes hard to tell the difference between dragging long dits and clipped dahs, and on the other where the dahs are far, far too long for the sending speed, with many simply irregularly sent. Add to that the careless spacings internally between letters within a word, and one has to do a lot of mental adjusting to understand such poor sending.

Chapter 21

Methods Not Recommended

In almost every subject we may study there are efficient and inefficient ways to go about learning it. It seems foolish to go about learning in a hard way, if we know of an easier, better one.

Doing It the Hard Old Way
Beginning somewhere back in the later 1800's, even the best schools for telegraphers started teaching the new student the Morse code by giving him a printed chart code to "memorize" visually. The implications were that learning the code is going to be hard and will take a long time to master. So the student expected it: that's why, if he could afford it, he went to a telegraph school. Without realizing it, he was thoroughly prepared to begin in the worst possible frame of mind and way.

This attitude carried over naturally into the early days of amateur radio and continued for a long time afterwards. The whole atmosphere was "it's hard". Isn't that still the attitude of most people today? We need to get rid of the idea that it is hard -- it isn't. Experience has shown that the best teachers have avoided that idea completely. Learning the code, as well as using it, ought to be an enjoyable experience, easy and even "fun". Such teachers also ignore a student's errors in order to avoid negative reinforcement.

The old way of learning by a visual memory or by counting dits and dahs analytically is almost guaranteed to produce that old and famous "plateau" at the fastest speed the mind can handle such a burden at a conscious level --usually around 7 - 10 wpm. Those who take each code character and put it through such a mental routine to get the letter for which it stands are on their way for trouble -- they soon get stuck on a plateau. Why should anyone bother to make the conscious mind go through that sort of thing at all, since it is so futile and is really working against us? The only obvious reason is that they don't know any better.

An analysis of that old way of learning is like this: The student

- first creates a mental table of the printed characters and the dot and dash patterns (how many and in what order) belonging to each one. Then he begins listening and copying practice and
- he then hears the sound of character as it is sent,
- mentally breaks it into so many dots and dashes, and
- may then say the dots and dashes to himself,
- which pattern he now looks up in mental table, finds it, and
- identifies it with the corresponding printed character, and finally
- writes it down.

How clumsy and awkward!
As late as 1975 George Hart in the August QST (p. 100) wrote "Most code learners start out by memorizing the alphabet in terms of "dots" and "dashes" or "dits" and "dahs". Even those who are cautioned by an enlightened instructor that A, for example, is not a dot followed by a dash. But a sound whose closest voice emulation is "didah" -- even those usually "memorize" that it is a short sound followed by a long sound… Thus, the initial stage of code learning with most people is a counting procedure, and no amount of emphasis on sound is going to change this." How discouraging and unnecessary! He pointed out that the way to learn the code is by first hearing the characters it at a speed too fast to count and learning them as rhythmic units of sound -- sound patterns. This is the way the ARRL code teaching programs now do it.

Other Discouraging Processes

Many, many people have managed to master the code by methods which we cannot recommend today, but they have done so at a heavy cost in time and effort, and often have experienced great discouragement along the way. They have managed by persistence to overcome the stumbling blocks and achieve success in spite of them. But countless others have gotten stuck and given up at some slow speed, generally less than 10 - 12 wpm.

Through the years all sorts of schemes have been devised for "memorizing" the code, and some of them quite ingenious. Most of them involve some kind of visualization: a pictorial or a systematic arrangement of printed coded characters, based on their structure, a "chain" of relationships of some sort, adding to or exchanging components of one character to obtain another. A few have devised words or phrases presumed to have a sort of "sound-alikeness" to the code character. Such methods probably would help a person who might sometime need to signal for help in a dire emergency, but they are worse than useless, of no value at all for regular telegraphic communication.

There is never any reason to see the code in written form. Never translate "dit plus dah means A" and then write it, or as another has said: "If you find yourself hearing 'dahdidahdit' and saying to yourself 'Aha, that's a 'C', and then writing it down, you're in trouble -- that's translating."

Most of these well-intentioned aids to learning have overlooked the fact that the code letters are an alphabet of SOUND. Their "aids" have interposed something else between the letter-sound and the letter. Most of these methods present their schemes to the eye, not the ear. Even those which purport to use sound (such as "sound-alikes") fail to provide the necessary unity of sound pattern (partly because they are too slow, but also because the "sound-alikes" are extraneous and distracting). Both kinds require one or more extra steps -- translation steps -- to get there. Those which require some sort of analysis (such as how many dits and dahs) of each character in order to identify it, or which run through a series of some sort, also have introduced needless steps which inevitably slow the learner down, and usually severely limit his achieving speeds over about five to ten wpm. Avoid them.

Very many of those who originally learned the code from a printed chart of dots and dashes began the bad habit of counting the number of dots and of dashes from a mental chart. Then they must decipher the longer characters by counting: for example, to separate B from 6 and 1 from J. Some of these hams were able by much practice, and perhaps realizing the nature of the problem,

to overcome their speed plateau. (I knew one experienced ham-ex-navy-commercial operator who could go right along at 20-wpm this way, but that was his ultimate limit. He loved the code, but could never advance a step further. That was as fast as he could analyze -- pretty fast at that!).

Those who have learned by the "sound-alike" methods, (e.g., they hear "didah", and it sounds like "alike", which they have been taught means "A") rarely reach even a ten wpm plateau.

One method extensively advertised for many years "taught" the beginner by the scheme "Eat Another Raw Lemon," which was supposed to remind him how each of the four letters E A R L was formed, each one adding one element to the previous one. This was illustrated by large printed dots and dashes. There must have been a good many who started out this way, and in spite of it, at least some of them finally managed to become proficient. I knew of one such amateur who got to around 20 wpm that way.

The expert teachers tell us that any kind of printed dots and dashes or any other such pictorial impressions will only impede the student's progress when he is beginning to learn the code. Chapter 13 explains why.

All such methods violate good pedagogy, because they do not teach the code the way it will be used, as actual sound patterns. They also require the student to learn something (which he must later forget in order to advance) in addition to the sound of the code itself. While these methods may seem to make it easier at first, they actually make it much harder, or even impossible, to advance. The wise teacher and student will avoid these approaches.

So:

- Never even LOOK at a written table of the Morse code before starting to learn, and certainly NEVER attempt to memorize one visually, or have anything to do with software that "shows you the Morse characters on the screen".
- Don't have anything to do with methods that ask you to listen initially to successions of dots and dashes, or parts of characters. Doing this will RETARD your progress. Listen ONLY to complete, correctly sent, characters.
- Never listen to Morse at a character speed of LESS than 12 wpm. Use 14 wpm or faster, if possible.
- Don't learn by memorizing opposites, such as `K' and `R'. This actually causes some people to confuse them ever after!
- Don't spend lots of time copying random code groups. Reading plain language is very different, and that's what the test requires. Random code groups are popular because computer programs can be easily designed to send them. They do have a place -- that is, for first identifying characters and then later practicing any "hang-up" characters, but that's all.

When a old timer, who had "learned" the code as it used to be taught from a printed chart, suddenly recognized that the sound pattern is the letter, it was like a light bulb flashing on. After that he began to progress rapidly.

The Futility Of Wrong Practice

Arnold Klein N6GAP said: "*For more years that I care to admit to myself, I have been trying to master a simple task: copy code at 20-wpm for the Extra class ticket."*

He practiced so much that there was no extended period of free time when he wasn't thinking code. He wore out a cassette player listening to tapes while driving, cutting the grass, sweeping, planting flowers, walking during lunch, using the tread mill at night and while washing the dinner dishes, while watching soft ball games he had the earphones on and copied in his head. He copied code while waiting in the doctor's office, while parked as his wife went shopping in the evening he copied CW on the rig -- a gray haired man wearing earphones and writing on a clipboard!

"*The results were frustrating. The speeds ranged from 20 to 24 wpm and always there was that sense of panic, that I can't keep up*" -- "tailgating" - that was exactly what he was experiencing. The problem was he didn't know what he was doing wrong. Asking those who passed the test resulted in the casual answer: practice. "*Well, my practice just wasn't doing it*". Magazine articles on copying behind did not relate how to learn the technique. The stock phrase seemed to be that the ability to copy behind will magically appear after enough practice.

He wrote like this after reading the principles presented here: "*Mastering the code has taken on a life of its own and I am determined to do it. . . I have now tried these during the week since getting them and they do work! I am losing the pressure to keep up. Keep calm is my newest admonition. They have given me the answer to the problem I've carried for years."*

The methods presented in this book are time-tested practical, working methods.

Chapter 22

Word Lists for Practice

The 100 Words Grouped By Function
(And adding the words "I" and "a")

(This will make it easier to construct sentences to use for practice.)

a an the this these that some all any every who which what such other;
I me my we us our you your he him his she her it its they them their;
man men people time work well May will can one two great little first;

at by on upon over before to from with in into out for of about up;
when then now how so like as well very only no not more there than;
and or if but;
be am is are was were been has have had may can could will
would shall should must say said like go come do made work.

Some sentences composed of these words alone are:

1. It is only there.
2. You will like your work.
3. Have you been out?
4. Was he with her?
5. I can go now.
6. We must say that.
7. Would the people come?
8. She has a great work.
9. There are more over there.
10. Such men may go in.
11. These men may come first.
12. All but you have been there.
13. It was as little as that.
14. You should not have said it.
15. How has he made up your work?
16. He has been very well.
17. No man said more than that.
18. He may not do any more.
19. We must like this.
20. Are they like them?

The Rest Of the 500 Most Common Words

did low see yet act die sea run age end new
set ago sun eye nor son air way far off ten
big arm few old too ask get own try add God
pay use boy got put war car law red sir yes
why cry let sat cut lie saw Mrs ill

also case even five head less just mile once seem talk
wall bank fill want tell seen open mind life keep hear
four ever city army back cost face full held kept line
miss part ship thus week lady many went told show pass
most live kind help gave fact dear best bill does fall
girl here king long move poor side took were whom town
soon read much look knew high give feet done body book
dont felt gone hold know lost name real sort tree wide
wind true step rest near love land home good till door
both call down find half hope last make need road stop
turn wish came drop fine hand hour late mark next room
sure wait word year walk take same note mean left idea
hard fire each care

young watch thing speak right paper least heard dress
bring above often water think stand river party leave
heart early built after carry again fight horse light
place round start those where alone cause force house
marry plant serve state three white still today whole
short point might human found child along began color
given large month price small story under world whose
tried stood since power money labor front close among
begin court green laugh night quite smile table until
write being cover happy learn order reach sound taken
voice wrong

chance across letter enough public twenty always change
family matter rather wonder answer coming father moment
reason result appear demand figure mother remain supply
around doctor follow myself return system became dollar
friend number school second office garden during become
better either happen person toward

hundred against brought produce company already husband
receive country America morning several another evening
nothing suppose because herself perhaps through believe
himself picture whether between however present without

National continue question consider increase American interest possible anything children remember business together
important themselves Washington government something condition president

Some Common Prefixes and Suffixes
Prefixes which are not frequent words:

un ex re de dis mis con com for per sub pur pro post anti para fore coun susp extr trans

Suffixes which are not frequent words:

ly ing ify ally tial ful ure sume sult jure logy gram hood graph ment pose pute tain ture cient spect quire ulate ject ther

Some Common Phrases For Practice

we are in the he is and the will be we will that the
it is do not I am to the for the of this to them
it was and he of a from me that was on the they were
she is I will in a there is he was I will that was

Some Long Words For Practicing

somewhere newspaper wonderful exchange household
grandfather overlooked depending movement handsome
contained amounting homestead workmanship production
discovered preventing misplaced requested breakfast
department investment throughout furnishing regulation
forwarded friendship herewith foundation deportment
geography important lemonade graduation federated
educational handkerchief conversation arrangement nightgown
commercial exceptional prosperity subscription visionary
federation heretofore ingredients certificate pneumonia
interview knowledge stockholders property chaperone
permanently demonstrated immediately responsible Chautauqua
candidacy supervisor independent strawberry epidemics
specification agricultural catalogues phosphorus schedules
rheumatism temperature circumstances convenience Pullman
trigonometry bourgeoisie slenderize camouflage broadcast
defamatory ramshackle bimonthly predetermined clemency
beleaguered voluptuous intoxicating depository pseudonym

indescribable hieroglyphics morphologist Yugoslavia cynosure
parallelogram pleasurable toxicology bassoonist influenza

Practicing words such as these may help you get used to reading long words without missing parts of them.

Chapter 23

Making Sure You're Understood

From The Originator's Standpoint

Communication fails unless our message gets across and is understood. Weak signals and poor conditions during transmission (static, interference, fading) all contribute to partial failure to get through. In all of these conditions, telegraphic communication is vastly superior to voice because almost all its energy is effectively concentrated within a very narrow band. Yet it pays a cost for this by taking more time to communicate the same words. In addition, it too can suffer partial loss due to transmission conditions as well as from just plain accidental misunderstanding. How can we reduce these losses to a minimum? Let's focus on the originator's use of the words themselves (by "words" we include the use of abbreviations and Q-signals).

Feedback and Redundancy

We rarely think much about how we speak when we are conversing. When we speak face to face we can generally tell whether we are being understood or not by feedback through the reactions and responses of the listener. But when our communication is remote, by voice over a wire or the radio, the visual clues to the hearer's understanding are missing. When the telegraph code is the link, auditory clues (tone of voice of a comment or reply, "uh-huh", "yeah", etc.) are also missing. Relatively awkward break-in is the only possible direct feedback while transmitting in code, and it is an ambiguous interruption, until the receiving operator explains his problem.

It is when we speak, whether face to face or by remote means, that most of us tend to use more words than the bare minimum necessary to be understood: this is called redundancy. The degree of redundancy varies from person to person and from situation to situation. Redundancy increases the context from which the listener may understand.

When we write we generally are much more careful of how we say things that are important than when we speak. We give more thought to the choice of words and the way we write them: we becomes more circumspect and precise in order to minimize the reader's possible misunderstanding of what we mean. Since we have no feedback at all, we generally tend to use more words than the minimum necessary in order to make up for that lack.

In telegraphic communication the tendency, largely because of the time required to transmit, is to eliminate every word which does not seem to be absolutely necessary. We abbreviate in various ways-- generally down to bare bones: the minimum required to express the thought. First we leave out words, and then we tend to abbreviate what is left as much as we think we dare to omit and still have it understandable. (This is especially true when paying on a per-word basis for transmission.)

What we have been saying is this: redundancy helps to insure adequate and more accurate communication. That is, we normally use more words and expressions than the bare minimum required to get our meaning across. Time, however, is a factor working against telegraphic

communication. It is not as rapid as speech in terms of words per unit time. In order to balance the time factor against the intelligibility factor, the originator of a telegraphic message generally weighs more carefully exactly what words to use and how to put them together. If he is wise he will also consider the effect of possible mistakes or distortion during sending and receiving which might produce ambiguity.

Repeating and Counting Words

What can we amateurs do to minimize misunderstanding or complete failure of our communications? One of the commonest things is simply to repeat each word or words, or the whole message. We may repeat only the most critical words or numbers two or three times. (Numbers are almost impossible to correct because there is no significant context to help out.)

Another form of repetition is to ask the receiving station to repeat the message back to the sender word by word. This nearly assures perfection. But this, like repeating each word as it is sent, requires at least twice the original time on the air.

Counting the words in a transmission has long been a common commercial practice, but is not generally used except for message type traffic. It does not assure complete accuracy (exact words and spelling).

Using Redundancy Intelligently

We can often prevent misunderstanding by adding a word or two to a short communication. For example, to confirm a scheduled QSO later in the day, to say "CUL this afternoon," or "CUL in pm" instead of just "CUL" helps insure that the other operator knows that you mean today, and that you are not canceling it (as he might assume otherwise due to some interference, etc.). When conditions are rapidly deteriorating this may be our only hope to get across before further communication becomes impossible.

A little forethought along these lines on the originator's part may help avoid unfortunate misunderstandings. Especially when we simply must get through, and conditions are very poor, we should choose our words and expressions carefully.

At The Receiving End

Here we ask "Will I be able to copy (or read) it?" and if I can't, "What is the problem?" -- "What can be done to improve the quality of this material I am receiving," or "What can be done to make sense out of this somewhat garbled transmission which is all I have?" -- "What is the nature of the problem?"

During the communication, speed of transmission is an important factor, one directly controlled by the sender. Both too fast and too slow sending can cause trouble in receiving -- here the receiving operator must tell the sender to slow down or speed up to meet the receiver's needs. Quite naturally, speed of transmission must set be within the receiving operator's capability.

It may be that the weighting of the dits is too light and I'm missing some of them. If so, can the sender make them a bit longer (heavier)? Maybe the sharpness of the pulses has been rounded off too much to remove "clicks" and the signals sound mushy. At higher speeds, perhaps the dits are

too heavy and confusing the ear. These are things, which the sender may be able to modify on the spot, but he must be told.

In Chapter 14 "The Ear" we have discussed some of the things which can be done to help, especially the use of filters. Here we look at the filter requirements for an audio filter. We want a filter which will separate the desired signal and still keep it intelligible. At this point we are not concerned with any of the radio frequencies of the signal as it passes through the receiver, but only with the audio beat signal, which is output.

That audio signal consists of

- an audio frequency (the beat frequency -- analogous to the carrier frequency of an AM signal), and
- the off-and-on modulation of its envelope (corresponding to the audio modulation of an AM signal) produced by the keying device at the transmitter.

The audio frequency is expressed in Hertz or cycles per second, while the corresponding telegraphic signaling "frequency" is usually expressed in bauds. One baud equals one telegraphic element (called "unit" in Chapter 28) per second. Since the baud may be unfamiliar, let us examine it.

The minimum basic telegraphic element is the "dit, an "on" signal lasting a given length of time in seconds. For example, a 10 baud rate of signaling means that there are ten basic telegraphic elements per second (or 5 cps or Hertz) and each element lasts 1/10 of a second, the reciprocal of the baud rate. Obviously, to perceive a dit or a dah requires silence both before and after it. The minimum element of silence (space) is also equal to one dit. One dit followed by one element of space constitutes a square wave two telegraphic elements long and may be called one "cycle," by analogy with a cycle of sinusoidal wave. (This is expressed symbolically in Chapter 28 by "10".) A continuous series of dits would then for a given length of time have twice as many bauds as cycles per second. A sequence of 25 such dits and spaces (10101010..., 50 elements) in one second would thus correspond to a frequency of 25 Hertz, 50 bauds. It is in this sense that we compare these two frequencies (audio frequency and telegraphic keying frequency).

For a filter the two predominant factors for intelligibility are passband width and center frequency of the beat note. (The actual shape of the filter's frequency-amplitude response curve is also of importance but for other reasons: see Chapter 24 and engineering manuals.)

There must be enough audio cycles to fill in the keying pulse shape of the smallest code element, the dit, in such a way that all code elements begin and end clearly and are therefore properly timed. That means that the audio center frequency (pitch of the beat note) must be high enough to preserve the square wave shape closely. A mathematical (Fourier) analysis shows that the center audio frequency needs to be about 7 times the telegraphic cycle rate to give the best shape of telegraphic pulses.

A square wave frequency related to words-per-minute, and the duration of one telegraphic unit can be worked out for English using the data in Chapter 28 as follows:

For standard English text, there are 49.38 elements per word. This is only 1% less than the standard 50 elements used as today's standard word, so we shall use the 50 element standard here.

If this 50-element word is, for example, assumed to be sent in one second, it will be at the rate of 50 bauds, or 25 Hertz, (cps square wave equivalent). For this example there will then be 60 words in one minute – 60 wpm, a high speed. Using this to convert wpm to bauds we multiply (wpm) by 60/50, that is by 1.2. Since the duration of one basic telegraphic element is the reciprocal of the baud rate, in this case it will be 1/50 second.

Now to determine the minimum audio frequency needed to fill in the telegraphic square wave shape well and give really high quality audio code signals, the following factors must be taken into account:

- at least two samples per cycle of audio frequency are needed to identify a frequency, (this factor of 2 for samples per cycle is cancelled out by the cps = 1/2 baud rate). and
- up to the 7th harmonic is needed for high quality.

So, we merely multiply the baud rate by 7, the highest harmonic number.

For our 60-wpm example above, this means an audio frequency of 50 x 7 = 350 Hertz for best quality of code pulses. Thus it can be seen that, except for extremely high-speed transmissions, there will be no problem, since the typical values of beat frequency are in the 400 - 1000 Hz. range.

The minimum bandwidth will be concerned with signal stability and intelligibility limits. If the bandwidth is too narrow the signal may drift out and be hard to find again. If it is too wide the risk of random noise and interfering signals increases. The rise-fall time of a filter to square wave input should not exceed about half a dit length. Working through the arithmetic for 6 dB down shows that the minimum bandwidth for Standard English should not be less than about 1.33 x (wpm). This is well below the bandwidth needed for signal stability, so there is no problem here for normal CW use.

Finally, if your copy doesn't seem to make good sense, and there is no way to verify it, see the end of Chapter 8 "Copying" for suggestions.

Signal required for CW with 5% character errors is 20 dB below that of double-sideband a.m. A good operator with CW at 15-wpm in presence of thermal noise, a signal to noise ratio (in one kHz bandwidth) of -1 dB is required for 10% character errors and +1 dB for 1% character errors. This latter is 22 dB below double sideband order-wire quality. However, 17 dB below double-sideband a.m. for CW was chosen to account for differences between operators.

Thus: CW	needs at 0 dB
compare with SSB	needs at +14 dB (room for improvement)
DSB	needs at +17 dB (5 dB Difference in operators!)

Reference: Power relationships and operator factor: (QST Fe 1967 p 46, US Army Rept).

Chapter 24

Bandwidths and Key Clicks

As discussed in Chapter 23, keying speed is usually expressed in bauds rather than in Hertz, or cycles per second. One Baud is one keying element per second, so one square wave keying cycle per second equals two Bauds. Using the standard word as 50 units, then (wpm) / 1.2 = Bauds. (Since 60 seconds divided by 50 units = 1.2)

Harmonic analysis of the on-off keying wave shows that strong odd-numbered harmonics and weak even-numbered harmonics are present. It has been found that under good conditions, adequate readability results when the 3rd harmonic is present, but under poor conditions we need up through the 5th harmonic. (Really good quality, however, will include up through the 7th harmonic.) International regulations have specified accordingly that minimum acceptable bandwidths should be at least three times the keying speed in bauds for good conditions and five times for poor conditions.

Thus, working from standard wpm, convert to Bauds by dividing by 1.2, then multiply by the highest harmonic (3, 5, or 7) desired. (Since this modulates the carrier frequency, the transmitted bandwidth will be twice this value because of sum and difference frequencies.) Accordingly, e.g., for 20 wpm, covering the 3rd harmonic requires a 50 Hz. bandwidth filter; for the 5th harmonic coverage a 83.3 Hz. bandwidth filter.

A perfect square wave will generate strong transient overtravel, both initially and at the end of each pulse. These spikes are especially objectionable, as they generate a host of harmonics, which will interfere with other transmissions. For the receiving operator they produce an unpleasantly harsh quality. Shaping to round off these sharp corners of the wave by making a 5 - 7 millisecond delay gives satisfactory reception, but if it is lengthened too much it tends to blur the signals and make them hard to read. This situation can be taken care of only at the transmitter, of course. It can be seen that there is a delicate balance between "good quality" and troublesome harmonics. Refer to the handbooks for corrective measures.

Chapter 25

Code Courses and Devices Advertised in the Older Days

(Dates show what I have been able to find)
These items are in partial supplement to chapter 25.

Morse's first "sender" used tooth-like raised characters on a straight edge "ruler," over which a follower-contactor was pulled along in order to send. No doubt derived from this idea Morse (in 1844) is thought to have built a "transmitting plate," a board of insulating material having the code characters composed of metal bits imbedded in it. They were arranged so as to produce the code character (whose name was marked beside it) when a metal stylus was dragged across the surface at a constant speed. (Such a plate was independently designed in Germany about 1850.)

Telegraph teachers realized early in the game that the student needs a lot of practice hearing good quality sending. The transmitting plate may have become the earliest self-teaching device. (Such boards were advertised as late as 1960!)

The Omnigraph

The Omnigraph, which first came out in 1901, was an obvious derivative of original Morse "sender" with its raised "teeth." It was a mechanical device consisting of a hand-crank, clockwork or electric motor to drive an assembly of thin interchangeable metal disks bearing the code characters past a follower-keying device. Several disks were stacked up together on a spindle-carrier, which was driven by the "motor." The whole assembly of disks looked like a cylinder with little "bumps" on it. A wide range of speeds from about 5 to over 60 wpm was provided for by adjustment of the brake on a flyball governor which held the speed constant after it was set.

Each disk had five groups of code characters cut like gear teeth around its periphery, and each group was composed of five characters plus a separating space. A spring-loaded "follower" rode along the edges of the disks, opening and closing the keying contacts. A clever adjustable sequencing mechanism actuated by the rotating disk carrier caused the follower to move up or down at user-selected points during each revolution. Various models provided for from five to ten or more disks. By changing the stacking of the disks and by adjusting the sequencing mechanism the five character groups could be sent in many different sequences. There was, however, no way to alter the order of characters within a group, and all keyer-follower movements occurred between groups.

These machines were to be used with a sounder for American Morse or a buzzer or oscillator for International Morse. They seem to have had a very wide usage for basic learning and developing speed among would-be operators, including amateurs. (Advertising often claimed that a month of serious study could qualify an operator.) The government licensing authorities also used Omnigraphs to administer the code tests for operator's licenses for many years, at least until 1930, when I was tested.

The Omnigraph Manufacturing Co., New York City. A 1922 ad read: "Learn Telegraphy (Wireless or Morse) at Home in Half the Usual Time... Just Listen - the Omnigraph will do the teaching." You will be surprised how quickly you will attain speed. Even if you are already an operator the Omnigraph will help you. It will make you more proficient, more accurate and more confident..." In 1918 the Electro Importing Co., NY, advertised them starting at $16.00 for a five disk machine, and $23.00 for a 15 disk model. Additional disks were available at five for $1.00. In 1902 Thomas A. Edison's book "Telegraphy Self-Taught" was published by Frederick J. Drake & Co. in Chicago. It was written with the philosophy that "it is not the speed at which the letter is sounded that perplexes the learner, but the rapid succession in which they follow each other." (This is identical with the so-called Farnsworth method today.) The book was accompanied with a small hand-crank-driven tape puller and a set of paper tapes with the code characters punched in them. The tapes were designed to start out with very wide spacing between characters, and as the student progressed these spaces were reduced to normal. The goal was a practical working speed of 25-wpm. The actual speeds, of course, would depend on how fast the student turned the crank on the machine.

In 1917 the Marconi-Victor set of six double-sided phonograph records, described in. the first sound-only course for International Morse for a phonograph seems to have come out. It consisted of 12 lessons recorded on six 78 rpm records produced by a "code expert," approved by the Marconi Wireless Telegraph Co. and put out by the Victor Phonograph Co. Lessons 1 and 2 gave the code and conventional signs. Lessons 3 and 4 contained easy sentences, etc. Lessons 5 & 6 had Marconi Press and then messages with static interference. Lessons 7 & 8 were press with static, and messages with errors and corrections. Lesson 9 was press with interference from another station. Lessons 10 through 12 were groups of figures, ten-letter words and ten-letter code groups. It was an ambitious program, which included realistic, typical, practical problems of reception. Playing time was short. In 1921 the Wireless Press, New York City. advertised: "Study the Code Anywhere" appeared. The ad said: "*This New Way - The Sound Method for Memorizing the Code. For success in telegraphing the letters must be learned by the sound. Each letter has a distinctive cadence or rhythm, which is easily memorized by a few hours' practice. The charts attached give the key to the rhythm of each letter of the telegraph alphabets. It forms no picture in the student's mind, but instead a sound is memorized like a bar of music. An hour a day devoted to memorizing the distinctive rhythm of each letter will enable the student to send or receive a message in a few weeks. The beginner is strongly advised not to practice with charts or books, which show the actual dots and dashes. Once a picture of each letter is formed in memory it will be found difficult to send or receive by sound. Don't try to teach the ears though the eyes.*" [It would be very interesting to see a copy of their course method.]

National Radio Institute. Washington DC. Radio News Se. 1921.
"*Wonderful Natrometer Gives You Code-Speed in Half Usual Time. ... 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. ...A beginner can quickly learn the alphabet from our A dial*." Picture shows a mechanism similar to Omnigraph, but about half the total size, using ten disks which were exchangeable. Price not stated.

The first ad for the Dodge Radio Shortcut (Later "Shortkut") called "BKMA YRLSBUG", by C. K. Dodge, Mamaroneck NY. was seen in Radio News Dec. 1921: The ad said: -"Memorize Continental Code Almost Instantly. Two hundred beginners in 44 states have reported mastered [sic.] code in 20 minutes, in one hour, one evening, etc., etc...." It was a large 5/8 column ad. The usual later ad was about one inch in one column, though sometimes larger. Price at first was $3.00 for small booklet. These ads appeared for many years afterward. (This is the worthless "Eat Another Raw Lemon" method mentioned in Chapter 21.)

Memo Code, H. C. Fairchild, Newark NJ. Radio News Aug. 1922.
"*Boys and grown-ups. Makes you a real radio operator. By my System and Chart, you will know the code in 30 minutes... Complete system $1.00...*" A buzzer-blinker key practice set available with course for $5.00.

In 1922 a Radio News ad of Oct.1922 read: "*The fastest way to learn the radio code*." The American Code Co. of New York City put out a phonograph course recorded by the famous hero operator Jack Binns, whose bravery and skill saved almost every life aboard the liner Republic after it was struck in 1909. "*Two phonograph records made by Jack Binns and text-book $2.00*." This course claimed to be able to teach the code in one evening! Pretty Ambitious!

Teleplex Co., New York City. First ad in QST seen Apr. 1927:
"*The Easy Way to Learn the Code Cuts Learning Time in Half. The famous Teleplex for self-instruction at home. The quickest, easiest and most economical way of learning Morse or Continental... Faithfully reproduces actual sending of expert operators.*" Next month's ad: "*At last! The Famous Teleplex ... with only a screw to turn.... 5 to 80 words per minute*." Third month: "*Learn the Code at Home This Easy Way with Teleplex. Complete course ...*" They provided a code instruction manual and help and advice personally by correspondence. It was initially a spring-driven punched paper tape machine. Later models were electric-motor driven. In 1942 they produced a paper tape model which could record one's own sending (using electro-chemical means) as well as send user-prepared tapes. In 1956 they reverted to punched tape again, and in 1959 they went to a machine resembling the Omnigraph. Prices never published in ads. The Teleplex Company later brought out an inked paper tape type of mechanical keyer, which was available for several years. It used the sidewise motion of a pen with a conducting ink (apparently made from a silver compound), and was followed by a similar mechanical design using a chemically treated paper tape. The user could make his own recordings with a key or from a receiver. Playback was by a pair of spring-loaded fingers, which contacted the conducting ink to close the circuit. Later designs used a photocell instead of direct electrical contact for reading the tapes. This permitted the use of non-conducting inks. These differed only in degree from Morse's original "recorder." McElroy's company also manufactured this type of recording system. These types of systems were generally far beyond the average ham's pocketbook.

The Candler System, Chicago. First ad seen in QST dated Sep. 1928 (probably advertised earlier in other magazines), last ad seen in QST Feb. 1959. Emphasis on high speed and "scientific" nature of course. Large ads from time to time, but usually about one inch in a column. Price not advertised. See Chapter 30.

The Instructograph Co., Chicago. Must have been in use before first ad seen in QST of Jan. 1934. "*(Code teacher) The scientific, easy and quick way to learn the code. Machines, tapes and complete instruction for sale or rent.*" Similar to the Teleplex punched paper tape machine, speeds from 3 to 40-wpm. Last ads seen in 1970 ARRL Handbook.
0ther devices included machines for producing code practice using punched paper tapes. The tapes were wound on reels and pulled by a clockwork-type spring motor or electric motor having adjustable speeds. The tape perforations actuated a spring-loaded contactor to open and close the circuit. Commercial machines were in use long before they entered the amateur field. There, Teleplex and Instructograph were the earliest and best known; other later imitators were Automatic Telegraph Keyer Corp., Gardiner & Co., etc. A few provided for punching one's own tapes. Ted McElroy, the long-time code speed champion began making a series of similar high-quality equipment primarily for commercial and Military use during the WWII period and continued for some time afterwards.

Some of these units could be rented as well as purchased outright. In either case, it involved a substantial amount of money, which most amateurs could not afford. In addition, the variety and amount of practice material they provided was often rather limited.

McElroy's "free code course" offered in 1945 and again in 195- appears to have been associated with the use of one of his code machines. For its use the claim was "*Assuming that the average person will practice several hours the first day, we can tell you... that you'll be copying that very first day, words and sentences at the character rate of 20 wpm. Ted has taken one-half the alphabet and prepared a practice tape, which runs for a full hour without attention at 20 wpm. You won't copy 20 full words in one minute, but each letter you write will hit your ears at a full 20 wpm rate, and the space between the letters becomes progressively shorter as the rolls go along.*"

An odd little unit offered in 1970 was called the "Cotutor." It was just a simple whistle with a set of disks, which contained the alphabet and numbers. Each disk had six characters, punched through so that the characters would sound when one blew into the mouthpiece while at the same time turning the disk by hand.

Recorders And Computers

The real turning point in availability and variety arrived with the advent first of the wire recorder and then of the tape recorders. Here, like the phonograph, the "machine" was probably something already owned and could be used for other things besides code-learning. This kept the cost down. Many prepared code tapes became commercially available, or could be self-recorded from the radio or other sources and played over and over as desired. Many good courses became available and more are available today.

Some electronic keyboards and keyers offer a wide variety of pre-programmed practice materials for practice. One of their main advantages is that they always produce perfectly formed characters -- something that greatly expedites initial learning.

But personal computers, which entered the scene actively in the early 1980's, offer the widest range for basic code learning and for advancing in skill. A wide variety of freeware programs for

learning and for practice are available, as well as programs commercially produced. Not a few PC programmers have been able to prepare their own programs tailored to their own particular needs. A number of interactive programs are available which give either immediate or delayed helps to the student -- these offer tremendous help in learning. Some may also allow the more advanced student to conduct QSO's with the computer program, just as if he was actually on the air. The potential here is great indeed. (See Chapter 16)

Finally, there are available computer programs and devices which can read receive code transmissions. Because they are machines, they can only read code signals, which are reasonably accurate in timing. For the student who has access to one of these, it will give him a chance to test his own sending for accuracy. However, they are not recommended as substitutes for personal receiving by ear.

Chapter 26

Speed Contests

Speed contests -- officially and unofficially -- have been held over almost the whole history of telegraphy in America. Both the professionals and the amateurs have had a pride of accomplishment, which begged competition to display and reward. Speed contests provided that.

After WWI speed contests among amateurs, but open to others also, began under the sponsorship of the ARRL and also local hamfests and amateur clubs. Ted McElroy, who was not an amateur, stood out as the world's speed champion for decades beginning in 1922. (In 1933 he lost out to Joseph W. Chaplin, but regained the title again in 1935.) There were others who demonstrated almost equal ability, and McElroy himself said on occasion that there were probably many others who were as good or better than he. Several unofficial records have been established in this country, and lately the European clubs have reported some astounding high-speed champions.

At first, in the latter 1800's, contests seem to have been concerned only about sending ability. This implies that receiving ability exceeded their ability to send -- which is borne out as we read history: operators were then limited by their sending ability only. Only later, as "speed keys" and then machine sending entered so that truly high sending speeds could be achieved, do receiving contests seem to have become important. That means until about the turn of the century. We have already looked into sending abilities in Chapter 9, so we turn here to receiving contests.

We have little detail about most of these receiving contests. However for the one conducted at the ARRL Convention in Chicago, in August, l933, where former World champion Ted R. McElroy was defeated by Joseph W. Chaplin, we have extensive information provided by Ivan S. Coggeshall, one of the four judges. Mr.Coggeshall was a telegraph operator himself, and later a vice president of Western Union. He was the only non-amateur judge. (QST November 1933 p 3., personal correspondence with Mr. Coggeshall and comments from McElroy, etc.) From these materials the contest may be described as follows:

It was an "open" championship for the world's speed title and cup. More than 250 contestants showed up, both amateurs and professionals. Silver trophies were to be awarded in eight classes, beginning at 8-wpm. The contest was run in two sections, the first a preliminary classification test on August 4, eliminating most contestants, and the final run-off the next day. The first section of test began at 8-wpm, then 10, and at 5-wpm increments up to 55-wpm. At each change of speed the contestants first listened to some familiar taped material, followed immediately by the fresh test tape. The test tape material was in plain English taken from Chicago newspapers and carefully edited so as to contain no difficult or unusual words or figures, and only the simplest of punctuation. Each section of test tape ran for five minutes at each speed.

The set-up provided 200 pairs of headphones to listen to the 1000 cycle tone of the oscillator as it was controlled by a Wheatstone automatic keyer. The available test room was small and not many visitors could watch the proceedings. Because there were so many contestants the first test series had to be run in two heats.

Mr. Coggeshall's personal reactions to the tests are interesting:
"*At 8-wpm you sit back and twiddle your thumbs, you yawn... At 15 you take up your pencil and leisurely jot the stuff down... At 20 you see the first signs of life. For a minute or two you sit back and copy, and then, on second thought, you hitch your chair forward a bit and straighten the paper. At 25 you quit 'laying behind; you decide to close the gap until you read about a word behind the sender. Not so bad, now. At 30 the fun begins. You can read it all right, but the pencil seems to be getting a little sluggish -- better make a grab for a 'mill' [typewriter]. At 35 you begin for the first time to think about errors: 'How many am I allowed on a 5-minute test run of this?' At 40 it gets hotter and very suddenly, too. The last 5 wpm have more mustard on them, it seems, than the first 30. You are holding your own with many a crack commercial radio or telegraph operator now. You quit worrying about single wrong letters and start hoping you can put a typewritten line down without leaving a word out. At 45 the jig is up. You quit, but half a dozen of the champs go on.... At 50 wpm the dots and dashes get blurred and jumbled. ... at 53 it is just a lot of static - no sense now in trying to hear anything. At 55 there is no change. Just as easy to read the QRN [static]...*"

As each group reached its limit, the contestants left the test room. Finally, eight passed the test thus far. Between this test section and the final run-off a WU cable operator, J. C. Smyth, copied 5-letter solid cipher code correctly at 45-wpm, making all the other contestants look like amateurs, and thus putting their attitudes on a more nearly equal footing for the speed grind to follow.

The test tape for the final run-off had been prepared and sealed in New York in the presence of Inspector Manning of the Federal Radio Commission, and was opened by Inspector Hayes of the Chicago office at the scene of the contest.

The final run began at 40-wpm - then 45 - then 50, 53, 54.1, 57.3 and 6l.6 wpm. (The machine apparently could not be accurately preset at these speeds, and speed was determined afterward by word count and time elapsed.)

Rules of the contest allowed a maximum of 1% error for each 5-minute run. At 61.6 wpm all made more than 15 errors. At 57.3 (1432 characters or 286.7 5-letter words) Chaplin had 11 errors out of an allowable of 14, while at 54.1 wpm he had but 5 errors, and McElroy made 8 at this lower speed. Chaplin was declared the winner at 57.3, breaking McElroy's 11-year old record (1922) of 56.5 with one error on a 3-minute run.

From this we can see that the 5-letter word had been standard for some time, and is in fact representative of regular English. It is not difficult to compare this with the present 50-unit standard word (as in "Paris") by using letter-frequency tables (such as used in crypto analysis. See Chapter 25). From this it can be shown that a word count based on standard written English may be expected to come within about one percent of the present standard of 50 units per word.

Regarding speed contests in general, Lavon R. McDonald wrote in 1940: "*About the speed tests, government count is used, that is five units to the word. Only plain newspaper English is used, everything having clear meaning, no trick stuff.*"

As for the well known 1939 speed contest, where McElroy was credited with winning at a speed of 75.2 wpm, McDonald wrote: "*In the Asheville tournament, the speed was practically the same for McElroy and myself. We both copied solid (press matter prepared by the FCC), but they sent some stuff at 77 wpm and I didn't get a good start on it. McElroy made something that looked like copy, but pretty ragged looking, so they gave him 75.2, I guess it was. If only first class copy had been counted, it would have ended a tie. McElroy and I have had about the same telegraph experience*."

At the present time the Europeans appear to have exceeded our recorded contest speeds. In the 1991 International Amateur Radio Union high speed telegraphic championship contest Oleg Buzubov UA4FBP copied 530 figures (numbers) per minute with only one error: that is 106 wpm, 8.83 figures per second! Amazing! (See *Morsum Magnificat* 22-4) However, the duration of these tests is stated to be one minute. This seems rather too short in itself or to be in any way directly comparable with the contests run in America. It seems doubtful that these speeds could be maintained for three to five minutes.

Some of the others who have achieved very high speed have been:
Eugene A. Hubbell (W9ERU, later W7DI), Wayland M. Groves, J. W.Champlin, J. B. Donnelly, V. S. Kearney, J. S. Carter, Carl G. Schaal (W4PEI), Frank E.Connolly, Wells E. Burton.

Chapter 27

Abbreviations

Some of the More Common Abbreviations in CW Work

ABT about
AGN again
ANT antenna
BCI broadcast interference
BCL broadcast listener
BK break
C yes
CUD could
CUL see you later
CUZ because
CW continuous wave (telegraphic code)
DX distance
FB fine business; excellent
GA go ahead; good afternoon
GE good evening
GM good morning
GN good night
GND ground
GUD good
HI high; laugh
HR here
HV have
HW how
LID poor operator
MSG message
N no
NW now
OB old boy
OM old man
OP operator
OT old timer
PSE please
PWR power
R received as transmitted
RCD received
RCVR receiver
RFI radio freq. interference
RIG station equipment
RPT repeat; I repeat
S and
SED said
SIG signal; signature
SKED schedule
SRI sorry
TMW tomorrow
TNX thanks
TT that
TU thank you
TVI television interference
UR your
VY very
WKD-WKG worked - working
WL well
WUD would
WX weather NR number
XMTR transmitter
XTAL crystal
XYL wife
YL young lady

Abbreviations Used in Traffic Handling

AA all after
AB all before you
ADR address
BN all between
CFM confirm
CK check
DLD delivered
GBA give better address
MSG prefix to radiogram
NIL nothing; I have nothing for
PBL preamble
REF refer to
SINE opr's personal initials
TXT text
VC prefix to service message
WA word after
WB word before
WD word

Examples Of The Phillips Code

The Phillips code was developed to bring the sending operator's skill up toward that of the receiving operator, who typically could receive much faster than anyone could send by hand. Phillips code is a systematic, rigid system of abbreviations used along with normal spelling of all other words, and cuts total transmission time about in half. There were about 6000 abbreviations under this long-used system. It was used in commercial press (news) transmissions. A skilled operator could easily keep up, typing out the words in full as fast as the sender could hand send, but he didn't dare let his mind wander.

Words were cut to their "backbone", leaving only the letters that carry the brunt of their pronunciation. See the list below for how this was done. Abbreviated words were modified by, e.g., adding "d" for the past tense of verbs and "g" for -ing; "s" was added to nouns for their plural; some words added "b" forable. A couple of simple examples of text are given here.

Example of 188 letters reduced to 116 (?) 61.7%:
"T DCN CD MEAN T END F UNPRECEDENTED TWO Y CDY BTL, T FS D US X A SURROGATE MOTHER WS TKN TO TRL FO BACKING OUT O AN AGM TO TURN OV A CHILD SHE BORE UND CAK." Translated into normal text, it says:

"The decision could mean the end of the unprecedented two year custody battle, the first in the United States in which a surrogate mother was taken to trial for backing out of an agreement to turn over a child she bore under contract."

AB about	AJ adjust	AYG anything
ABV above	ANR another	AYM any more
ADZ advise	AR answer	B be
AF after	AX ask	BC because with
AG again	AY any	BD board

BF before
BH both
BK break
BN been
BTN between
BTR better
C see
CCN conclusion
CD could
CK check
CKT circuit
CL call
CLO close
CLR clear
CMB combine
CNG change
CT connect
CU current
CY copy
D in the
DD did
DT do not
DUX duplex
EMGY emergency
EQ equip
EQPT equipment
F of the
FD find
FJ found
FM from
FR for
FT for the
FYI for your information
G from the
GD good

In addition to these there were a large number of very short special abbreviations for phrases common in news releases, such as for "President of the United States," etc. Usually these consisted of 3 - 5 letters, very brief.

GG going
GM gentleman
GTG getting
GV give
H has
HD had
HM him
HR here, hear
HS his
HV have
HW how
ICW in connection
IM immediately
INVG investigate
IX it is
KW know
LV leave
M more
MK make
MSG missing
MSJ message
MSR measure
N not
NA name
NF notify
NI night
NR near
NTG nothing
NUM number
NV never
NW now
NX next
OD order
OFS office
OP operate
OTR other
OV over
PGH paragraph
PLS please
Q on the
QK quick
S send

SAF soon as feasible
SAP soon as possible
SD should
SED said
SES says
SM some
SM somehere
SMG something
SN soon
SNC since
SPL special
STN station
SVL several
T the
TGH telegraph
TGR together
TI time
TK take
TM them
TNK think
TRU through
TS this
TT that
TTT that the
TW tomorrow
TY they
U you
UN until
UR your
VY very
W with
WD would
WG wrong
WH which
WI will
WIN within
WIT witness
WK week
WN when
WO who
WR were
WS was
WT what
WY why
YA yesterday

A Few Useful Z- Signals

The Z-signals were developed and used for a time by some commercial operators. A few of them which might be useful to amateurs are:

ZCG local receiving conditions good
ZCP local receiving conditions poor
ZLS we are suffering from a lightning storm
ZSH static is heavy here
ZOK we are receiving OK
ZSR your sigs strong readable
ZGS your signals are getting stronger
ZWR your sigs weak but readable
ZFS your signals are fading slightly
ZVS signals varying in intensity
ZFB your signals are fading badly
ZGW your signals are getting weaker
ZSU your sigs are unreadable
ZAN we can receive absolutely nothing
ZUB we are unable to break you
ZVF your signals are varying in frequency
ZDH your dits are too heavy (long), please adjust
ZDL your dits are too light(short), please adjust
ZMO stand by a moment
ZMQ stand by for...
ZLB give long breaks
ZWO send words once
ZWT send words twice
ZSF send faster

ZSS send slower

ZTH send by hand

ZCS cease sending

ZAP acknowledge please

ZHC how are your receiving conditions?

ZRO are you receiving OK?

You will notice that these signals are much easier to remember than the Q-signals. The two letters following Z- are suggestive. (QST 1943 No p. 63)

In 1910 some wireless abbreviations were:
GA= go ahead, 4= please start me, where..., 13= understand,
25= am busy now, 30= no more, 77= message for you, 99= keep out!

Chapter 28

Letter Frequency Counts
-International Morse-

The letter frequency counts (left-most column) are taken from one of the common books on cryptanalysis, based on number of occurrences per thousand of normal English text material. Each character is analyzed ("structure") into units, 1 for minimum signal duration (one dit), 111 (three units duration) for a dah, and each equal unit of silence denoted by 0 (zero). The required three units of silence separating each character is added (000) to each one below.

Freq.	Letter	Structure	Units	Total
130	E	1000	4	520
92	T	111000	6	552
79	N	11101000	8	632
76	R	1011101000	10	760
75	O	11101110111000	14	1050
74	A	10111000	8	592
74	I	101000	6	444
61	S	10101000	8	488
42	D	1110101000	10	420
36	L	101110101000	12	432
34	H	1010101000	10	340
31	C	11101011101000	14	434
28	F	101011101000	12	336
27	P	10111011101000	14	378
26	U	1010111000	10	260
25	M	1110111000	10	250
19	Y	1110101110111000	16	304
16	G	111011101000	12	192
16	W	101110111000	12	192
15	V	101010111000	12	180
10	B	111010101000	12	120
5	X	11101010111000	14	70
3	Q	1110111010111000	16	48
3	K	111010111000	12	36
2	J	1011101110111000	16	32
1	Z	11101110101000	14	14

1000 Ave. Structure length 11.23 Ave. 9.07 9076

From the above, if we take five times the above average letter length and add the space required for word spacing (seven total or 0000000) we arrive at the normal English word length as 5 x

9.076 + 4 = 49.38. This is just a bit less than 1% shorter than 50 units per standard word. (By contrast, a random five-letter group averages 60.15 units. This is 20.3% longer than normal English word length.) A similar analysis of numbers will show that the average length of a number is 17 units (minimum 12, maximum 22) or a group of five numbers takes about 1.78 times as long to transmit as a five letter word.

Comparing these calculations will show some of the reasons why receiving speeds vary with the kind of material being sent.

As a matter of interest, we list here the letters from the shortest to the longest by the number of units (less letter space) -- notice that all lengths are odd numbers: 1 - E; 3 - I, T; 5 - A, N, S; 7 - D, H, M, R, U; 9 - B, F, G, K, L, V, W; 11 - C, O, P, X, Z; 13 - J, Q, Y.

Foreign Adaptations Of The International Morse Code:

If the same kind of calculations are carried out for several foreign languages, the following results are obtained for the average character length: (Frequency data from Secret and Urgent, Fletcher Pratt l942 Tables II to IV, p. 253 ff.) German 8.640, French 8.694, Spanish 8.286 . These range on the average from 5 - 9% shorter per character than in English. There seems little doubt that if the code were somewhat redesigned and adjusted to optimize it for English a reduction of about 5% could be made.

For the Original American Morse code:

Mr. Ivan Coggeshall made an analysis of American Morse comparatively, using the same normal dah lengths and word spacings one unit shorter, and arrived at an average letter (frequency) length of 7.978 (as compared with 9.076) and average number length of l4. As noted in Chapter 16, American Morse timing is open to considerable variation.

Chapter 29

The Koch Researches

The obviously extensive researches of Ludwig Koch, psychologist at Die technische Hochschule, Braunschweig, Germany, reported in Jan-Feb. 1936 (see Sources), seem to be virtually unknown outside of Germany. His goal was to discover the most efficient way to teach the Morse code to prospective radiotelegraph operators to meet the International requirements for commercial radio operators. These requirements were:

- send 100 words in five minutes,
- copy a 100 word telegram in five minutes, and
- copy 125 words of ordinary text in five minutes, one word being reckoned as five letters

Koch's researches involved: determining what competent operators are doing, examining teaching methods in current use, then devising better methods, and testing them in actual classes. His conclusions and recommendations seem to be the earliest real research into how best to teach the Morse code. They agree on the whole with the best methods of today, and may offer some further ideas of value to us. They are summarized here.

Tests to Determine What Competent Operators Are Doing

He ran three series of tests to determine how the code is comprehended and for this purpose used four competent, actively-practicing radio telegraphers. Three of these operators had learned the code solely by sound, while the fourth was self-taught from printed code charts.

Sending Tests

For the first test each operator was to send by regular handkey the series of ten letters b c v q f l h y z x at various speeds while monitoring his sending with a pair of headphones to satisfy himself as to its quality. Out of his sight and hearing a recording system made an accurate timed graphical record of his sending, so that the actual timing of signal and space durations could be examined in detail. He was instructed to send, using standard International Morse timing, at each of six different speeds ranging from about 20 to 80 characters per minute. Standard International Morse timing, as described in Chapter 12, was then used to compare their sending at all speeds.

Below about 10 wpm the only operator who closely conformed to standard timing was the one who had visually learned the code. The three others deviated considerably from "standard" timing. At 5 wpm these deviations were appreciable:

- the dits were too short,
- the dahs tended to be longer than 3 times dit length, and
- the spaces between characters were too long.

However, spacing between the components of a letter was almost perfectly equal to their dit lengths.

At successively higher speeds this situation changed slowly and somewhat irregularly until by about 10-wpm character rate all four operators were forming fairly accurate patterns of sound (nearly to the International Standard), except that the letters themselves were somewhat faster and the spaces between letters were somewhat longer than standard. By about 12-wpm all sending had become quite consistent with the standard. (Only the well-known individual peculiarities of sending by hand were obvious. At 10-wpm and above these deviations were always very small.)

The three operators who had learned by sound obviously showed no real sense of sound patterning (Gestalt) at these very low speeds: no sense of unity, but rather just a series of separate elements strung together. Only by about 10 wpm were the code characters now felt to be entities of sound in themselves, patterns which were clear-cut in each operator's mind, no longer shattered elements, disjointed parts.

Receiving Tests

Test number One: - Each operator was to copy the 30 German Morse characters sent by a machine in perfect "standard" timing at each of four different speeds over the same speed range as before.

At about 5-wpm these experienced operators hardly recognized a single character correctly! At 7-wpm only 40% to 60% of the letters were correctly identified. At 10-wpm all operators were getting about 95% correct. By 12 wpm all of them correctly identified every character.
Test number Two: - Here the length of the spaces between the letters was doubled. This time the operators recognized almost all letters correctly at all speeds. That is interesting.

From these tests it was concluded that experienced operators recognize a code character by its overall acoustic pattern (Gestalt), and that this pattern stands out clearly only when sent at a minimum character speed of about 50 characters per minute. At lower speeds it is heard simply as a disjointed series of signals. -- Koch concluded that these operators could recognize the too-slowly sent letters only when letter spacing was doubled, because this increased interval gave them time to integrate the sound and mentally speed it up to where they could recognize it. (A beginner would not have the skill to do this.)

The operator who had learned from a printed code chart apparently formed better-proportioned characters at very low speeds because his visual mental picture was so strong. However, the price paid for this was that it limited his maximum speed of copying: he could barely meet the minimum requirements - a marginal operator. (See below.)

Analysis And Criticism Of Previous Teaching Methods

The "Analytic" Method introduces the student to the code using some sort of systematic arrangement, or chart, where the code characters are arranged by number and type of related elements, etc., in a visual form. The student is required to memorize this as a mental picture before going any further. After that, the characters are sent to him in standard timing, at first

very, very slowly. This means they are sent with long drawn out dits, dahs and spaces. The speed is then very gradually increased in tiny steps.

The faults with this system are:

- To begin by learning visual symbols creates a useless detour
- Slow sending destroys any unity, or coherent sound-patterning
- The disjointed signal doesn't meet our need for a sense of unity
- Learner can hardly help counting the dits and dahs
- the long spaces between letters distract his attention from listening by:
    - encouraging him to think and try to put the shattered parts together to make sense of them, a shaped unity, (Gestalt), or
    - guessing what may come next
- at each increase in speed everything sounds different, and he virtually has to start over again.

In short, the student is sidetracked and severely penalized all the way along: needlessly translating from bits and pieces of sound to try to put it together into a meaningful whole, then converting that to visual form and then finally to the letter.

The "Sound-Pattern" Method first introduces the Morse characters to the student at a character speed fast enough for them to be perceived as an acoustic unity (Gestalt), but with wide spaces between the characters. However, the student has usually already visually mastered a code table or is encouraged to do so as he learns.

Unfortunately, visual mental pictures are usually very much stronger and easier to recall than auditory sound patterns. Thus the student tends to convert the signal pattern he hears into the corresponding visual representation, break it into its component parts, and then finally into the letter. This complex action tends at least partially destroys the wholeness of the acoustic impression.

This series of actions is encouraged by the long pauses between characters, giving adequate time for thinking, speculation and the cumbersome translation processes. With increasing speeds the pause time becomes too short to go through all this, and so the student gets stuck below or around 10 wpm, just as with the analytic method.

So this method tends to suffer about the same faults as the analytical method. Both generally lead directly to that troublesome plateau at around 10 wpm, where the distinct change in perception from bits and pieces to coherent unity of each signal occurs.

Analyzing these methods, two classes of errors can be seen:

- Errors which hinder the building of a sense of acoustic unity
    - Detour through an optical symbol.
    - Disintegration of the acoustic form of the character.
- Errors which prevent going directly from acoustic impression to the letter:
    - Thinking about the signal during long pauses.
    - Guessing what may come next.

- Converting or translating from sound to visual and from visual to the letter
- Converting or integrating into a total rhythm pattern.

The remedy is obviously to eliminate all visual references and associate the sound directly with the letter, to send fast enough from the very beginning so that coherent sound patterns are immediately sensed, and to eliminate non-normal spacing between letters.

Tests To Establish A Better Teaching Method

Character Speed for Initial Learning?

The obvious goal was to meet the International requirements. The question is how best to get there. Would it be better to begin from the first using a 100 character rate per minute, or some lesser speed? This experiment was tried. For the average student it was found that the demands on his concentration were significantly greater at 100 letters per minute than at 12 letters per minute, especially as more and more new characters were introduced. (Above average students did well, however, at the higher initial speed.) But, of course, if one learns initially at some lower speed, speed is going to have to be increased to meet the requirements.

Various tests showed that about 12-wpm was an optimal speed for most people to begin learning. It is far enough above the 10 wpm plateau to avoid it. Further tests showed that once the student had mastered all the code characters at 12 wpm, it was relatively easy for him to advance to 70 letters per minute, and by continuing to practice using the same principles, to advance fairly rapidly, step by step, to the required speeds. Thus a 12-wpm beginning speed seemed well justified.

Can the Rhythm Patterns Be Enhanced?

Koch observed that in the early stages of learning, the beginner has to concentrate intensely to catch the letter rhythm-patterns. Is there anything which could be done make this easier for him?

He observed that some teachers were speaking, or even almost singing, the sound patterns of code characters using the syllables "dit" and "dah", whose vowel qualities and lengths make sound patterns stand out somewhat like little melodies. This helps accentuate the differences between sound patterns and simultaneously promotes an immediate sense of meaningful unity of the acoustic patterns.

Could the use of two different pitches, one for dits and the other for dahs, make it easier for the new student to recognize the wholeness of the rhythmic pattern ("melody") of a code character, and make it easier to learn? Could it help reduce the stress caused by the intensity of his concentration in the early learning stages, while he is being introduced to the rhythms and trying to get accustomed to them? It looked worth a try.

He conducted two classes simultaneously to evaluate the merits of the two-tone approach. After the first lesson, at each stage the two-tone group averaged two lesson periods ahead of the monotone group. (For the two-tone class the pitches were gradually merged into one by about mid-course.) Results: - the two-tone class in 24 sessions reached what took the monotone class 28 lessons to achieve. Total teaching time was 12 (two-tone) to 14 (monotone) hours. (With both

groups there were the usual, occasional short plateaus, each lasting generally no more than one lesson period.) Conclusion: - this is a worthwhile improvement to help the beginner.

What Letters Should Be Taught First?

1) Distinguishing Between Similar-Sounding Patterns.

What characters should first be presented to the student? Although tests had shown that students can, in their first lesson, readily learn to distinguish similar patterns such as the series e-i-s-h, the degree of concentration required had a negative effect on them. Experience has shown that many sound patterns, as speeds rise, can be mistaken for similar sounding patterns, especially in regard to the number of dits which become pretty short at higher speeds: e.g., S and H, or U and V. The dah characters do not run this risk so much: e.g., W and J. In addition some beginners do experience temporary confusion between mirror image characters, such as B and V, D and U. Thus it seems best to begin with sound patterns which are distinctly and obviously different. In this way the student can learn more gradually to discriminate between smaller differences.

2) Letters that Tend to be Troublesome

Koch says these (for German students) are generally x y p q. (Z is very frequent in German.) If these are introduced during the first third of the program, there is more opportunity to give them adequate practice, and this generally results in shortening the total program.

When To Introduce A New Character

His tests showed that it is safe to introduce a new character into the list only after the student knows thoroughly all the characters he has already studied. He set his working standard at a minimum of 90%: that is, not to introduce a new character until the students were getting at least 90% correct copy at any stage. This provided a good measure for comparison, and at the same time let the student evaluate his own progress. It is indeed interesting that the test classes showed that students learned new characters almost in exact proportion to the number of lesson periods (total hours). The experiments also showed that three to four new characters were about optimum for any one lesson period.

Should Practice Be By Groups of Letters?

The question he asked is this: should the student practice one group of characters until he knows them well, then work on a second group separately in the same way, and after that combine the groups?

He began this teaching test with characters composed of dahs only: t m o ch (German single character ch). After enough practice (a couple of class sessions) to "master" this group of letters, he began teaching the dit group e i s h by itself in the same way. Next he combined these two groups together, and found that somehow during the intensive study of the second group, the students had forgotten the first group almost completely, and their confidence was badly shaken. He had to begin all over again teaching these eight letters together until they were mastered together.

After this, when these eight letters had been practiced to the point where they were correctly and consistently identified two new groups were studied separately in the same way as the first two groups. First the group d b g, then after that the group u v w. Next, when these two new groups

were mixed together, it was found that the d b g group had been forgotten. But worse, after these two groups had been re-learned together (d b g u v w) to the point of correct identification, and then combined with the first 8 letters, alas, the (combined) first two groups of 8 letters had been virtually forgotten!

It appears that the student's intense concentration upon a new group of characters by itself causes that group to override and replace what had been previously "learned". He sensibly concluded that teaching by groups is wrong-headed. Therefore, the most efficient way is to introduce one new letter at a time and then immediately integrate it into the group of letters already learned, until finally the whole alphabet is complete. In this way all the previously learned characters are under constant review and repeated frequently without lapses.

Troublesome Characters

Experience has shown that quite a few students have some trouble identifying one or more individual characters, tending to miss or confuse them. They show up as little plateaus on his record of advancement. What letters these are varies greatly from student to student. The five-column copying forms described below serve to help identify which these troublesome ones are -- needing more practice.

How Long Should Lessons Be And How Distributed In Time?

He cited B. Jost's researches which found that people learn more quickly and retain it longer for a given total learning time, when the lesson periods are shorter and widely separated in time. E.g., for a total of 24 lesson periods (which always include reviews): - to schedule four lesson periods a day for six days is four times more effective than to schedule eight lesson periods a day for 3 days, and that to schedule two lesson periods a day for 12 days is eight times more effective. That is, spread out the lessons in time.

What is the ideal length of a lesson period? -- Koch found by testing that to have a long morning lesson, and then after corresponding length of rest period to continue in the afternoon, demanded too much intense concentration. The students got tired too quickly and the repetition practice was not as effective as it should be. By trial he determined that a half-hour lesson period was about optimum. (Even a 45 minute period began to show diminishing returns.) He finally recommended two half-hour periods, one in morning and one in the afternoon as optimum.

Several courses using various of these principles were conducted. However, at the time of this report, he had not had classes where he could combine all the optimum test conditions. The students savable were people who were interested, but not primarily, at least, for professional purposes. Furthermore, they were employed at full-time work during the day, and were often tired by class time, which had to be scheduled in the evenings. Also, he could schedule only two or three half-hour lesson periods per week. Hardly ideal.

In spite of this progress was good, and no difficulties were encountered. Three to five characters were presented and learned in the first half-hour period. He aimed for many repetitions during each lesson, never less than ten repetitions of each character during a given lesson period, even after the entire alphabet had been introduced. Each successive period began with a lively review of what had been learned up to that point.

New Philosophy for Teaching

- It is a mistake to let the student see a code character in any kind of visual form, because a visual impression is so strong that it will almost invariably lead to analyzing it into dits and dahs, and thus shatter its unity.
- Each Morse code character must retain its unitary nature, its acoustic wholeness at all times. This is facilitated by:
    - Sending at a speed of at least 12 wpm (60 letters/minute) from the very first. This will promote the sense of acoustic unity and bypass the discouraging 10 wpm plateau (transition) region completely.
    - Emphasizing the melodic nature of the code patterns initially, like a little tune, by the use one pitch for the dits and a slightly different pitch for the dahs. These pitches are then gradually to be brought closer together so that by about the mid-point of the program they are identical and continue from there on as a single pitch.
- From the very first all practice is to be in five-letter groups, with normal spacing between the letters, as in ciphered texts, but with distinctly longer pauses between groups. This has a dual purpose:
    - to leave no time for conscious thinking or translation between letters, and thus to require direct passage from sound pattern to the letter itself, and
    - so that the student will immediately become used to hearing letters in groupings as in normal communication, and not as isolated letters.

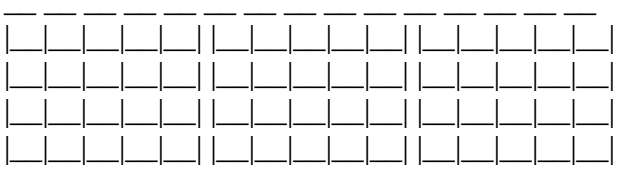
Designing an Efficient Teaching Program

1) The first exercise is to teach the student to hear and begin to become accustomed to hearing the different overall rhythms of sound and silence: -

a) Character rhythm: Character - space - character - space ...

b) Group rhythm: Letter-group - space - Letter-group - space ...

From the very first, to get the student accustomed to overall rhythms, he is supplied with "copying" sheets having several sets of five-column groups of little squares like graph paper, as shown below. They will also be used for all subsequent regular copying practice.



Five letter random groups are then to be sent. At first these will all be unknown letters. As he hears each acoustic pattern of a letter in a five-letter group, he is to place a dot in the square, which corresponds to the position of that sound pattern within its group.

Thus he works along across the five-space line, becoming used to hearing each letter-rhythm pattern and then writing a dot for it in the appropriate square. (At this stage he only recognizes the sound patterns as entities, nothing more.) He continues to work line by line down the column as each new group is heard. In this way he begins the practice of focusing:

a) on the coherent acoustic forms and
b) on the associated rhythm, letter by letter, of the writing hand, and
c) on recognizing the pause after each group.
A relatively short initial session (10 minutes or so) of this will begin to accustom him to these overall and detail patterns of sound as entities.

2) The second exercise is to start him on the way
a) to recognize the differences in rhythm-pattern between two quite different-sounding letters, and b) become familiar with the sound patterns of each character, and to become accustomed to them. (All sending to be machine precise.)

A) This begins by introducing the two first characters just as sound patterns - without identifying what letters they are. They are to be sent separately and at random until the student definitely recognizes and distinguishes their individual patterns (pattern one and pattern two, or whatever). At this time they are not yet to be identified with their printed letters: they are simply recognized as different patterns of sound.

B) Only after he has become accustomed to distinguishing the first two letter patterns from each other, and to the rhythm groups as they are, and writing dots in the little squares, is he to be told the names of these first two characters. He should from then on have no difficulty in writing their letters down in the little squares whenever and as he hears them.

This is to train him during these early stages and later on that he is to recognize and react to the presence of each and every acoustic pattern, either by identifying it or by a dot in the square, and of the larger groupings of letters identified by the longer space.

Is is obvious that, especially in the learning stages, there are going to be acoustic patterns passing by which he may or will not be able to recognize immediately and automatically. He must get accustomed to giving such signals no thought at all (except to put down a dot), so that he can give his undistracted attention to the next incoming sound pattern.

Otherwise, during the all-too-short pause after each signal which he does not immediately identify and before the next one is heard, he is going to try to think about what signal it was. But while he is thinking about it the next signal arrives, tending to upset him and cause him to lose the flow of the rhythm. This interruption must from the very first be stopped. His teacher must insist that whenever the student does not immediately and automatically recognize a sound pattern, just to put a dot in the corresponding square, then immediately let it go, and continue on with the rhythm. This action must become habitual, and this technique has been devised to develop it from the very first.

Now as he identifies the acoustic patterns he will write their corresponding letters in the little squares. If the teacher chooses to mix into the 5-letter groups code characters which the student has not been taught, there should be dots to correspond with them.

After one or two short (about 10 min.) practice periods this way, the relationships between the acoustic impression and the letters they represent should have become so closely knit together that there is an immediate transition from the acoustic sound pattern to the letter (or a dot). Only when this point is reached is a third letter to be added to the first two.

3) Only one new letter at a time is to be introduced and added to those already known. The criterion for adding a new letter is: when at least 90% of the letters already well known are correctly identified. Each new letter is added to the group of recognized sound patterns in the same way as the first two were:

first by simple recognition of the pattern without knowing what letter it is, and in contrast with the previously known ones, and only when he readily recognizes it its individual sound pattern is he to be told what letter it is.

As an example of the introduction of characters and the five-letter groups used, if the sequence of letters taught were h - f - a - g - etc.: for the initial two-character lesson, groups were like:

l) hfhhf fhfhfh ....
2) Next character: aahfh fahfh ...
3) Next: ggbaf ghfah ...
4) Next: ccgaf gcafh ..., etc. (In this example he did not begin with the more frequently "troublesome" letters.)

Chapter 30

The Candler System

No treatise on learning the code would be complete without a summary and discussion of this famous and formerly long-advertised course.

Background

By 1904 Walter H. Candler had learned the American Morse code and worked for two years as a telegrapher. He had practiced diligently and felt qualified to apply for a job as commercial relay operator in the Western Union office at Atlanta GA. But he didn't last out there even one day, and had to take a night shift job as telegraph operator at a small town R.R. station. He was deeply hurt and puzzled. What was the matter? What mysterious ingredient was missing?

As was the custom at the best telegraph schools, he had visually memorized the Morse code from a printed table of dots and dashes, and then practiced and practiced. (This "standard" procedure was confirmed by a former teacher at the well-known Dodge's Institute -- no connection to the later C. K. Dodge "Radio Shortkut".) One night on the job, quite by accident, he discovered that when once in a while he dozed off at the operating table, he could read the fastest code coming over the lines to his sounder. Yet when he was awake and alert he could catch only a word here and there.

It was then that he began to realize that telegraphy is primarily a mental process, and that the so-called "sub-conscious mind" must play a vital part in it. (At that time here was quite a bit of popular writing about the "sub-conscious mind," which no doubt helped him put it all together.) He began experimenting until he had solved his own problem and mastered the code himself, and in time he became qualified to teach others how to do it, too. By 1911 he had established his own "school" in Chicago to teach "The Candler System," later moving it to Asheville, NC.

Although he died on 23 April 1040, his wife, who was already an experienced telegrapher herself when they were married in 1924, and had worked with him since, continued to handle the course for a number of years. (It was last advertised in QST in 1959.)

The Course

Originally his "High Speed" course was designed for operators who already "knew" American Morse, but were stuck at some too low speed. Later he added the International code to it, covering both codes. Still later a new course, called "The Scientific Code Course," designed to be successfully used by beginners working alone, was created from the regular "High Speed" course by modifying it to add helps to get the beginner started. (Thus it contained all that the "High Speed" course contained.) That new course was later renamed "The Junior Code Course," and was the one I obtained in October 1939, and made extensive notes on.

There is evidence that although the essentials stood out strongly and firmly, over the years the details varied in minor ways. His basic philosophy may be stated as: - "This system trains you to use your MIND" to develop "scientifically your coordination, concentration and confidence" --

your responsiveness. The course consisted of ten lessons plus considerable valuable supplementary material, mostly as letters. It is summarized below.

The Essential Principles

Since Candler was concerned with those training to become commercial operators, he first emphasized the importance of healthy living: eating, exercise, breathing, etc. This emphasis was needed in those days because the typical city operator worked long hours in unhealthy smoke-filled, darkish, crowded and poorly ventilated offices.

1) Develop "SOUND CONSCIOUSNESS." -- In Lesson 7 he wrote: "*In learning code it is necessary to consciously count the dits and dahs of the various signals, both in sending and receiving. By repetition, the sub-conscious mind gradually assumes this burden of counting them. As long as you must consciously count them, work will be slow, but as the sub-mind takes them, they go faster and faster.*" "*As you progress,*" he wrote elsewhere, "*Begin to respond more readily to the sound patterns than to visual ones: learn to shift from what you mentally see to what you hear. So long as you must consciously remind yourself that so many dits and dahs 'stand' for certain letters, you are not learning code.*" So, "*when you hear didah, no longer say to yourself: 'didah stands for A.' Instead, when you hear didah, hear A. Do not translate.*" "*In learning code you do not have to relearn words, but you do have to change the approach...from visual to auditory... Once you have mastered this consciously, your sub-mind will handle that detail, and do a faster, better job than your conscious mind possibly can.*"

Critique: We must remember that he and most of his students had already "learned" visually, and now this must be REPLACED by direct auditory recognition. Here was the real reason they all had gotten stuck at some slow speed. This traditional approach must have blinded his thinking so that it did not occur to him to START THE BEGINNER WITH SOUND ALONE, and so save the beginner from having to cross that annoying hurdle with its discouragement.

2) Your sub-mind will only do what you have consciously trained it to do. Therefore, teach it the RIGHT WAY and the SAME WAY consistently from the beginning. Think and act POSITIVELY: (The "I can do it" attitude). If you maintain a positive attitude as you think and consistently practice, the sub-mind will take over the task more quickly, and it will become easier each time you do it. Conscious effort is needed until it becomes automatic. First you learn by consciously employing the principles in your regular daily practice. Then gradually, if you practice as directed, your sub-mind will take over the job with less and less conscious effort, and you will make good progress.

3) Learning to READ CODE, to RECEIVE, is the important thing. That is, to understand without having to write it down. Reading means listening and understanding what is being said, just as in reading ordinary print or when listening to someone speak. Reading code must never depend on copying. As soon as you have learned all the letters, start listening to good code on your receiver (or nowadays, practice tapes, etc.) for 5, 10, 15 minutes at a time, or until you become tired -- even if you cannot put together enough consecutive signals to form words. Keep on, and soon you will be catching small words and then larger ones. But do not practice too long at one time - never when fatigued.

"*I am acquiring the ability to read words subconsciously now. When reading code, I know, as soon as a word is sent, what the word is, although I didn't consciously spell it out to myself as it was coming in*," wrote a student.

4) YOU CANNOT WRITE DOWN WHAT YOU CANNOT READ (RECEIVE). This is step two after learning to receive. Writing down what you receive is a routine matter that will take care of itself if you are properly trained. Of course, in the initial stages of learning the alphabet and numbers, etc., you must copy letter by letter, slowly, just as you had to learn to read that way. After this stage, stop until: When you get so you can listen to code and read it at 15 to 25-wpm without copying, you must begin copying some at each practice period. Commence this way: each day copy for 10 - 15 minutes, striving to copy one or more signals behind, then spend a similar period just listening to good code without writing.

5) When you do copy, learn to COPY BEHIND. If you have been copying letter by letter you must begin systematically to overcome it, and the best way is to listen to good code and form the habit of reading it without copying. As you acquire the independent code reading habit, by daily practice, you will find it easier to drop behind a few signals without confusion or fear of losing out when you are copying. You must break the bad habit of copying letter by letter. Get in the habit of carrying the letters in your mind, forming them subconsciously into words and sentences, without writing them down. "*When I found I could begin to read small words as easily by sound as by sight, I was delighted. I soon learned to read words 'in my head. After that, copying them by pencil was easy. Previously, I had been writing words down letter-by- letter: that was wrong*!" wrote a student.

6) Practice intelligently: in the RIGHT way, daily, regularly, in short and well spaced periods, purposefully. Never practice error. Practicing when tired is not efficient use of time. A good schedule is 30-minutes daily, 15-minutes in the morning and 15-minutes in the afternoon or evening. The time between practice periods is important - use it to prepare yourself to be receptive by cultivating a positive attitude toward yourself and what you are trying to do. THE TEN LESSONS With these statements of basic principles in mind, let us look at the lessons for the beginner. Note that each new group of code letters was presented in the old visual dots and dashes manner, but the student was told to THINK of the letters in terms of dits and dahs as they sound. He seems to have anticipated that a typical student would take a week or two to complete each lesson.

LESSON ONE: Emphasis on sound units. The first group was E I S H, to be sent smoothly and in accurate, regular timing by the student with his key, saying the dits as he pounded them out. Candler recommended that two or more beginners work together so each could send to and receive from the other. As soon as he can recognize them easily and send them smoothly, he was to form words, such as "he, is, see, his, she." Next to take the letters T M O, and do the same way, saying the dahs as he sends them, and then to make small words using both sets of letters, as before. Lastly the letters: A N W G. Then practice small words, including as many of the 100 most common words as can be formed from these eleven letters. At one period Candler either supplied or recommended the use of mechanical senders, such as the Teleplex, with his course for the student studying alone. This would provide an accurate timing sense as well as good

hearing practice. With a machine or companion, he would be able to listen and, during this initial period, copy letter by letter as he heard each character.

LESSON TWO: Emphasis again on thinking of the letters in terms of dits and dahs as they sound, not as they appear in dots and dashes. Groups of new letters to be learned the same way: D U V J B; R K L F; P X Z C Y Q. Words to be practiced included the rest of the shorter 100 most common words. Emphasis on accuracy of timing, and that repetition builds habit (whether good or bad).

LESSON THREE: Emphasis on knowing you are right, then going ahead and making it a habit by repetitive practice. Analysis of the letters in code, accuracy of signal, spacing and speed: precision. Get in the habit of instantly recognizing each and every letter when you hear it, without having to stop and think: automatic association of each signal with its letter. Also now learn the numbers and commonest punctuation. When you have learned the letters so that you do not have to "stop and think" of what character any combination of dits and dahs represents, begin listening to good code every day regularly without copying, even if only for 5 minutes at a time. (The radio was his favorite source of good code: commercial press and government stations were on 24 hours a day. Now we have ARRL code practice, tapes, etc.) Catch everything you can as you listen. You may not get much at first, but keep trying and you will soon begin to hear letters and words.

LESSON FOUR: Think of the code as being easy to learn. Trust your sub-mind to do its work. Review and practice, especially any characters you tend to miss or confuse, until they are automatic. Every character must stand on its own feet. Keep drilling on the 100 most common words, both receiving and sending. Begin using the "two-column drill" where you set up two parallel columns of three or four letter words, each having the same number of letters; then go down the columns spelling the word in the first column out loud while simultaneously writing down the other. Then do the same, reversing the columns. (See Chapter 8, "Conquering Our Fears of Losing Out," " third paragraph.) These are the first easy drills on learning to copy a word or two behind.

LESSON FIVE: practice each letter and character until you know them all so well - whether receiving or sending - that you don't have to stop and think about them at all. Do the same with the 100 most common words. Keep up the practice of the two-column exercise started in Lesson 4, going on to words with a few more letters as you find it easier. This is to HELP DISENGAGE CONSCIOUS ATTENTION from the proper functioning of the sub-conscious mind so that it can do its work unhindered. Learn to trust it by continuing this kind of practice until it becomes easy. This is a highly successful method of training to shift the effort from conscious to automatic, that is, subconscious, making it a useful habit.

LESSON SIX: Development of skill is developing coordination, where everything runs smoothly. It begins by constant practice listening to and sending consistently and perfectly formed code characters, learning to recognize each code signal instantly, learning to read it all easily, and when copying, to write it down in a uniform, simple style of handwriting. Watch for any step along the line where there is any hesitation or question, and practice to overcome that block. Give this your attention, and allow time for it to develop until it becomes automatic,

habitual. This is the scientific way. Do some practice copying mixed five-letter groups, but do not write down any letters of a group until the whole group has been sent. Have wide enough spaces left between groups to allow you to write it down before the next group starts. (His emphasis throughout the course is on receiving and copying normal English, not ciphered groups.)

LESSON SEVEN: Emphasis on proper timing while sending. Start by sending a series of letter E's with wide spaces between them, first with six counts between letters, then gradually reducing the space to normal one letter space. Then do the same way with S, T, H, O, etc. (Here he discussed "counting" as given above under "1 - Sound Consciousness, Critique.")

LESSON EIGHT: A discussion of "glass arm," or telegrapher's paralysis, and its prevention by certain exercises, relaxation and proper warm-up. Continuing practice of fundamentals.

LESSON NINE: Obstacles to progress listed as:

- lack of practice,
- thinking visually rather than by sound,
- hesitation over poorly learned signals, causing loss of the following ones,
- looking back over one's copy while copying,
- negative attitudes. One must force oneself to copy behind by degrees, gradually.

LESSON TEN: Learning to carry words in your mind by continuing the copying behind practice. Learning to write rapidly and legibly as an aid to receiving. Learning to copy on the typewriter. (He had a separate course specifically for this.) Learning by doing until it become second nature.

Chapter 31

The So-Called "Farnsworth" or Spacing Method

This method (in which the spacing between letters and words is lengthened to facilitate recognition of character patterns and words in the early learning stages) is obviously excellent.

This is actually an old procedure used by many teachers long before Farnsworth, who popularized it. It appears that the first clear mention of this approach is by Thomas Edison, a highly skilled telegrapher himself in 1902. He hit the nail on the head when he wrote as follows about his punched tape course called "Audio Alphabets" (by Frederick J. Drake & Co.) for teaching the American Morse code:- "*It is not the speed at which a letter is sounded that perplexes the learner, but the rapid succession in which they follow each other.*"

A few students have felt temporary rhythm recognition problems with the way this method was used by some teachers as the speeds were increased by shortening the spaces, making the characters seem to run together. They may feel a bit frustrated, but this is easily avoidable.

This effect seems to be most noticeable when using a character speed of around 13 wpm, and is one of the reasons why it is recommended from the very beginning to use character speeds of 18 - 25 wpm. These higher character speeds also make it easier to concentrate on the character as a unity of sound, without the risk of counting or analyzing it as a collection of shorts and longs. (Of course, after learning the code, we need to get used to hearing it at various speeds, including those slower than our initial learning speed. One reason: operator's tests for license will be slow speed.)

This method starts out by having the beginner hear each character from the very first at a high enough speed for it to be perceived as a unit of sound (which means at least at a rate of 12 or more wpm), rather than as composed of dits and dahs. It accentuates this perception by separating the letters and words at first by wide spaces, giving the student time to recognize each one clearly and associate it with its printed letter, or number, etc., and then as the student progresses, gradually shortens the spaces to normal length. It has been confirmed by experiments in psychology, which have proved that if a stimulus can be grasped as a single unit, a wholeness or "Gestalt", learning will take place at a rapid rate. And with respect to how this course handled it, he added: "*The principal feature of the Audio Alphabets is the graduation in the intervals between the letters. By beginning with a record in which the characters are widely separated and then changing to others with less and less intervals, the student gradually reaches the one having normal telegraph spacing.*"

This spacing method is perhaps the most obvious and effective way of focusing a beginner's conscious attention on the Gestalt, or form, of each individual code form of letter. It makes the letter- patterns stand out prominently and allows him time to associate it with its equivalent printed letter with a minimum of interference and distraction from all other characters.

So this is actually an old procedure based upon the experience of many teachers long before Russ Farnsworth (W6TTB), whose name apparently became attached to it because of his Epsilon Records Code Course consisting of 3 LP phonograph records in an album put out in 1959. In that course the characters were from the very first sent at 13-wpm, widely spaced, and the time between them gradually reduced as the student became more proficient. Next of record we find two bulletins published in 1917 and 1918 by the Federal Board of Education which recommended sending each character at a rate of 20-wpm with rather lengthy pauses between them.

In Chapter 11 of "RADIO SIMPLIFIED", a popular book of 1922-3, authors Kendall and Koehler, instructor and director respectively at the YMCA Radio and Technical Schools in Philadelphia wrote about learning the Code: -- "*To begin with, the novice should not set out by committing [to memory] the number and order of the dots and dashes in the various letters and figures in the code, as for example, that "dash-dot-dash-dot" equals "C". Much of the energy so spent will be wasted. The radio operator does not recognize letters as so many dots and so many dashes nor does he translate signals in that fashion. The operator hears and learns to recognize each letter as a combination of sounds "dah-de-dah-de" [sic.] as the letter "C", "de-dah-de" as "R" , "dah-de-dah" as "K", etc., in much the same manner as children in the primary school learn to read words by sounds instead of by learning to spell them.*"

Although they do not mention the spacing method directly, they imply it by comparing it to how children learned to read in those days, by recognizing letter forms and spelling out words at first. This involved one at a time learning with spaces as a natural part of learning, without calling any special attention to it. In 1940, in his Master's Thesis "Teaching Radio by Radio" Marshall Ensor summarized his highly successful code teaching methods (which began about 1929 from Olathe KS). He clearly used this spaced-learning method to teach hundreds of students during his one-hour lessons daily on 160-meter phone "broadcasts". Each lesson alternated teaching code, theory and regulations. (See Chapter 12)

In 1945 Ted McElroy offered printed copies of his free "Morse" Code Course said to contain "everything he has learned in 30 years of operating experience." He claimed that, "*Assuming that the average person will practice several hours the first day, we can tell you ... that you'll be copying THAT VERY FIRST DAY, words and sentences at the rate of 20-wpm. ... You won't copy 20 full words in one minute. But each letter you write will hit your ears at a full 20-wpm and the space between letters becomes progressively shorter as the rolls go along.*"

Chapter 32

Other Alphabets

This would be incomplete without some mention of non-English alphabets.

Other languages require certain diacritical marks, or additional letters, or symbols for common digraphs (single sounds represented by two letters in writing, like our th). Here we shall include the Germanic group, French, Spanish, and Polish, Hungarian, Turkish, all of which use the Latin alphabet, and Greek, Russian, Hebrew and Arabic, which use different alphabets. Japanese does not have an alphabet, but uses a syllabary (spelling by syllables instead of single sounds), and requires 73 - 78 characters In general, letters which represent sounds more or less identical to those in English are represented by the same code signals as in English. For example, B, D, F, G (hard)*, K, L, M, N, P, R, S*, T. "A" represents the letter "A" in European languages, including Russian, and Alpha in Greek, Aleph in Hebrew and Alif in Arabic. "C" represents written "C" in European languages and Polish, but é in Greek, thƒ in Arabic, samech in Hebrew, and tseh in Russian. "E" represents "E" in European languages, Greek and both yeh and eh Russian, but vav in Hebrew, and hamza in Arabic. "G" represents ghain in Arabic, not jŒm. "H" represents "H" in European languages, "H" in Greek (a vowel), "X" in Russian, HeT in Hebrew and guttural Hƒ in Arabic. "I" represents the same letter in European languages and Greek, i and i-kratkoyi in Russian, yod in Hebrew and yƒ in Arabic. "J" represents this letter in European languages, the diphthong "Yi" in Greek, ayin in Hebrew and jŒm in Arabic. "O" represents this letter in European languages, but He in Hebrew and khƒ in Arabic. "Q" represents this letter in most European languages, but Psi in Greek, shcha in Russian, qof in Hebrew and qƒf in Arabic. "S" also represents shŒn in Hebrew as well as sŒn. "U" represents this letter in European languages, "Y" in Russian, the digraph "OY" in Greek, Tet in Hebrew and Tƒ in Arabic. "V" represents this letter in most European languages, dotted z in Polish, zheh in Russian, the diphthong "HY" in Greek, and Dƒd in Arabic. "W" represents this letter in European languages, "B" in Russian, ê in Greek, tsade in Hebrew and waw in Arabic. "X" represents this letter in most European languages, "hard" L in Polish, Xi in Greek, both tvyordy znak and myakhky znak in Russian and Sƒd in Arabic. "Y" represents this letter in European languages, "Y" in Greek, yerih in Russian and Zƒ in Arabic. "Z" represents Z everywhere except Arabic dhƒl. "8" also serves to represent the diphthong "Oi" in Greek. Additional code characters are needed or used for the transmission of other languages. Such characters are: - didahdidah: „, Polish nasal a, Greek diphthong Ai, Russian ya, Arabic 3ayin. didahdahdidah: , † dididahdidit: ,, Polish nasal e, Arabic final hƒ. dahdahdahdit: ", Polish digraph cz, Greek diphthong "îY", Russian cheh, Arabic zƒi. dididahdah: , Polish ziet, Greek diphthong "AY", Russian yu. dahdahdahdah: digraph ch, Greek X, Russian sha, Arabic shŒn, Turkish sh-sound. dahdahdidahdah: ¤, and Hungarian ny. didahdidahdit: Polish ¢. dahdidahdidah: Polish digraph sz. didahdahdidah: Polish cie. dahdidahdidit: Turkish ‡. The Hungarian vowels marked with double quotation mark-like accents have the same Morse characters as those with double dots.

Chapter 33

A Brief History of United States Operator Licensing Requirements and Military Training

In the Beginning

Prior to 1912 no licenses of any kind were required, either for stations or for amateur operators. An amateur, however, might apply to the Navy Department, which would issue a "Certificate of Skill." This merely stated that the successful applicant was "proficient" in code. It had no legal value or necessity.

The First Laws 1912 to 1927

In 1912 Congress passed the first laws requiring licenses for wireless operators and stations whose signals would:

a) interfere with government or bonafide commercial stations (those open to public use) or b) cross state lines.

b) This meant that very, very many "little" stations and their operators did not need licenses. "Little" often included even those up to one kilowatt, the maximum allowed for any licensed station. This was because the "passive" (mostly crystal detector) receivers in those early days were so insensitive that reception over land masses beyond a hundred miles or so was exceptional. The word "amateur" does not appear in these regulations, but is covered by the term "experimental". [In England, by contrast, a license was required even for owning receiving equipment.]

From 1912 until 1933 operator and station licenses were separately issued and were impressive diploma-like documents about 8 by 11 inches. They had to be posted at the station location and were usually framed by the operator. Initially there were two classes of license, with identical qualifications. Amateur First Grade was by examination by a government examiner covering: radio laws, regulations, proper adjustment and operation of equipment, along with sending and receiving tests at 5 wpm in International Morse code. For those living too far away to come in for personal examination, there was an Amateur Second Grade whose applicant had to certify by mail that he could meet these identical requirements. In Aug. 1919 the required speed was raised to 10 wpm.

When the U.S. entered WW-I all radio activity, receiving as well as transmitting, except for that specifically authorized by the Military, was prohibited. All equipment (including all antennas) had to be either dismantled or sealed. This began on 17 April 1917 and continued until 12 April 1919 when receiving was once again permitted, and finally when amateur transmitting was again allowed on 1 October 1919. 1923: a new Extra First Grade was created requiring at least two years experience as a licensed operator.

A new written examination included requiring the applicant to diagram a transmitter and receiver and to explain the principles of their operation, plus a code speed test at 20 wpm (the speed required of a Commercial First Class operator). The license was printed on pink paper! Such operators were qualified for "Special" station licenses, which conveyed CW privileges on certain wavelengths longer that 200 meters and also gave them distinctive call signs. As shorter wavelengths came to be used this grade of license lost popularity. In the early 1920's licensed amateurs began to get skittish about working unlicensed stations (with their self-assigned calls), including the "little boys with spark coils." (They were often a big annoyance and source of interference.) The Department of Commerce, however, seems to have taken little notice of them unless they caused serious interference

The Radio Act Of 1927

Most of these unlicensed stations had already vanished from the air when the Radio Act of 1927 replaced the Radio Act of 1912 and brought all radio transmissions under regulation for the first time. (Legal doctrine had by then come to hold that Congress had power to regulate intrastate activity where its total effect reacted upon interstate activity.) The days of the "little unlicensed station" were over. 1927: "Special" station licenses. Amateur First Grade renamed "Amateur class". Amateur Second Grade renamed Temporary Amateur Grade and valid for one year only, and renewable. 1928: - "Special" licenses reinstated on somewhat different terms, and called "Extra First Class" operator. 1929: - the 20-meter band was opened to phone, and Extra First Class licenses were extended by an endorsement "for unlimited radio-telephone privileges" on that band. 1932: Extra First Class renamed Class A, Amateur Class renamed Class B, and Temporary Class renamed Class C. Ten (10) wpm speed required of all classes.

Operator and station licenses combined on wallet sized card. The special endorsement (of 1929) became available for all amateurs with at least one year of experience, upon passing a special test on radiotelephone subjects. This endorsement was now extended to include use of phone on 75 meters also.

1933 And After

In 1933, after the creation of the Federal Radio Commission, amateur regulations were completely revised and operator and station licenses were combined on a single, wallet-sized card, good for three years. Extra First Class licenses would no longer be issued. A minimum code speed of 10 wpm was required of all three classes of license: A, B and C. Class A (advanced) required one year of experience, a written examination on both phone and telegraph theory and regulations, and conveyed exclusive phone use on 20 and 75 meters, and was renewable by application. The Class B (general) examination covered less on phone operation, and gave all privileges not reserved for Class A, but required re-examination for renewal. Class C, a temporary license for those living 125 or more miles from an FRC examining point (administered by class A or B amateur), differed from Class B only in being taken by mail. 1936 the code speed for all classes was raised from 10 to 13 wpm.

1951 And After

1951:- the whole structure was revised for Amateur licenses: Extra Class (new, available 1 Ja. 1952), 20 wpm, no exclusive privileges, two years Advanced Class (previously Class A), 13 wpm General Class (Previously Class B) 13 wpm Conditional Class (previously Class C, by

mail, 125 miles or more), 13 wpm Technician Class (new, available 1 July 1951), 5-wpm, 5 years Novice Class (new), 5-wpm, one year, non-renewable
1952:- hams licensed before May 1917 eligible for Extra class without examination.
1953: - no new Advanced Class to be issued.
1954: - Novice and Technician available by mail only after 10 Jan., if over 75 miles from examination point.
1964: - on 17 Mar. filling fee $4.00 assessed for new or renewal of license, except no fee for novice.
1967: - incentive licensing was adopted. Advanced class was reactivated and given more spectrum than General class, but less than Extra class. Novice class licenses were extended to two years.
1968: - Advanced and Extra were made available for shut-ins and Technician class eligible for Novice.
1970: - fees increased to $9.00, five years license duration.
1976: required new Technician class to be tested by FCC examiner.

Volunteer Examiners

1983 Volunteer Examiner (VE) system set up to conduct Technician and General class by December.

Various Military Training Requirements

At the outbreak of WW-I the U.S. Military forces desperately needed wireless operators and equipment. Many amateurs volunteered as operators and as teachers. Training in all phases was minimal, and "operators" were usually graduated without having had any hands-on experience with the actual equipment or operating procedures. (Absolute radio silence was the rule in general - except for the most extreme emergencies on the high seas.)

For operators in the WW-II period Signal Corps graduation requirements were: 25 wpm plain language, 20 wpm code groups with pencil or mill, receiving, and 25 wpm sending. Qualifications for field operators - 20 wpm pencil printing copy and perfect sending copy at 15 wpm; for fixed base operators - 35 wpm straight copy on mill.

For Marine Corps graduation they were: 20-23 wpm plain text, 15-18 wpm coded groups, 17 wpm perfect sending of plain text. WWII training varied widely between various schools, but included actual operating procedures though wired QSO's among themselves to overcome the beginners' initial "buck fever" and to set them up as operators.

Real radio interference -- learning to copy through QRM and noise -- was added, and it became louder as the student progressed. Advanced students also practiced on the "mill" (typewriter). For high speed training, there was a room where high speed press was copied for practice.

In 1988 a U.S. Special Forces radio operator's test required 18 5-character groups (e.g., QY9/Z 6G.J4 X5,B7, etc.) a minute.

Chapter 34

Examples which Illustrate the Nature of Real Skills

The following are samples taken from the literature to show various skills some operators have achieved.

They illustrate clearly the automatic, subconscious nature of real skill in telegraphy that it is a habitual form of behavior, done without conscious intervention or effort. They also show what can be done by what has been done. People who do things well do not struggle with them: they enjoy doing them. It can be seen that there is a hierarchy of skill habits, ranging from lower degrees to very high degrees of skill, each step leading to greater freedom of action than before.

Receiving Code While Doing Something Else

Both in the past and in the present there are very many examples of sending or receiving while speaking or doing other things at the same time. Old landline operators typically could do this at speeds up to 35 to 40-wpm. Some hams today can and often do the same things.

Sending and writing at the same time:

Almost all old Morse operators developed this kind of skill to some degree, and usually were able to send with one hand while writing on the message blank the number, time, date, etc., with the other hand. Pressure of work almost demanded it in a busy office.

Sending and receiving simultaneously:

A regular RR agent-operator at a small town near Salina, KS, was observed to be sending a bunch of RR manifests (lists of freight cargo, giving details) when he was called on another wire. Without pausing, he opened his key with the other hand, sent an acknowledgement, closed the key switch, picked up a message blank and slipped it into the typewriter, rolled it into position and proceeded to copy the message with one finger of his left hand while continuing to send the manifests with his right hand. This was not at all unusual for regular operators: there are many examples. A slightly different example is with the many old RR operators who regularly would copy down an incoming message with one hand and simultaneously send it on down the line with the other hand.

Receiving two or more messages at same time:

One ship operator offshore of California had the amusing experience of simultaneously receiving the identical message for him from two different shore stations, KPH and KPJ. Both called him at the same time and he told the one to go ahead, but instead, both began at once to transmit. He tried to copy them both. This became very easy when he discovered they were both sending the same message. The climax came later when both of them billed him for the same message! In 1924 in the Boston Postal Telegraph office a wire chief claimed he could simultaneously copy one message in French with one hand and another in English with the other hand. His chief operator took the challenge, promptly went out and picked up one message in each language, provided pencils and pads to the wire chief, and had the two messages sent to him

simultaneously at the usual keying speeds. The wire chief made good on his word in the presence of all the other operators in the office, and made perfect copy on both.

A former Navy operator claimed that while copying one message, he often could mentally note other messages which were interfering with the reception of the one he was copying, and do so accurately enough to write them out later. He said that, especially when he was copying some particularly dull and uninteresting material, he was always fully conscious of the content of messages heard at the same time on adjacent frequencies concerning shore leave, pay or other interesting aspects of these transmissions.

One expert operator in San Francisco is credited with having received three separate dispatches at the same time, writing each of them out correctly by memory afterward. That looks a little hard! Using both American Morse and Morse International codes simultaneously: - Robert (Dick) Johnstone of old KPH was a phenomenal operator, said to be one of the best of his day. He could send one message in International Morse while simultaneously sending another with his other hand in American Morse. Similar claims have been made by others also.

Comparison with other mental functions and discussion

Can't we compare this to a certain extent with other habitual activities, such as driving a car while thinking of something quite different? (Later wondering, e.g., "Did I stop at. . . , or did I drive on?") Or like the stenographer who looked at her notes after taking dictation and was startled to see she had written a joke being told in the same office while she was taking dictation?

Doing two things at once, one subconscious or automatic and the other conscious is relatively commonplace. For example, I can read aloud from printed matter while consciously thinking about something quite different, and still read so that it sounds meaningful -- yet afterwards have little or no recollection of what I had read aloud (and sometimes wondering if I had included anything of what I had been thinking at any point along the line.

As for the operators who could copy two messages simultaneously, is it possible that both actions were automatic? Were they hearing one with the right ear and writing it down with the left hand, while hearing the other effectively with the left ear and writing it with the right hand, or what? Or, was the one automatic and the other conscious, although done at fairly high speed? If both were automatic, were they free to think of or hear something still different at the same time? This seems possible from the experience of a few who have said that they were attending to two messages and yet hearing salient points of still a third, or voices in their environment. Or, is this something like the "sandwich" operation of a large computer where each of several different people seems to be doing his job as the only one in control, yet the computer is apparently handling them simultaneously. Actually the computer does this by dividing the jobs into parts which are scheduled and processed in an interwoven manner by a schema for optimum usage of computer functions, time-slicing and controlling to keep each one separate, and only seeming to give each operator sole control. For a human example, how does the traffic control officer of an airport keep alert to the arrival and departure of many aircraft all at the same time, seeming to give each "simultaneous" attention? Very interesting, isn't it?

Speeds

By 1933 it was written that a good commercial operator can and does average about 40 wpm over an 8-hour stretch, handling everything from straight news to tabular matter. Hand sending was absolutely steady, rhythmic and even, intelligently coded and spaced - a joy to listen to. On the main traffic arteries of the Associated Press, speeds up into the 60-70- wpm range were said not to be uncommon. In 1937 WCK had two press schedules, one at about 45 wpm to be copied by ear and another very much faster for automatic recording and visual tape transcription. Yet Pete Pettit and Paul Magarris, Navy operators, could copy the higher speed press solid, and others were runners up. Ralph Graham, W8KPE, a landline telegrapher, demonstrated at Smithsonian during AWA conference before ten witnesses, copying a 79.4 wpm. -- George Batterson W2GB (first AWA president) at age 94 could still copy 50 wpm, but complained that his sending speed had slowed down to only 35. Mike Popella KA3HIE could copy 45 wpm by hand on paper.

Jim Farrior W4FOK wrote this way: - "*When I was a boy of 13 I lived in a small town in AL. The RR telegraph office was one of the few things in town that interested me. One of the three agent telegraphers gave me his sounder and telegraph key. The night agent usually had little work to do and often helped me by sending to me and telling me about operating procedures, etc. The sounder there was nearly always active, and I gradually became able to copy directly from the wire. I guess I learned it pretty much like one learns to speak, because I don't remember trying to learn. I was told that it was really very easy, and I guess I believed it. I was just having fun, and dreamed that some day I might become a telegrapher*."

Some Interesting Examples Of Young Skilled Operators Of The Past

In 1856 seven year-old John O'Brian delivered telegrams for his brother Richard, who at age 15 was the telegrapher for the local RR office. After two years of this John prevailed upon his brother to teach him how to operate. So, while still only nine years of age John became a good operator and was eager to have a job of his own. The RR offered him the position at a nearby town, and he snapped it up. People in those days were used to seeing young telegraphers, but not this young! Very soon, however, they became so pleased with his work that no more questions were asked.

Those youngsters were motivated and quick to learn. When the Civil War began he volunteered along with many others, became their youngest operator, and by early 1862 was already the assistant operator at the important military station of Ft. Monroe, VA, and considered an expert. When the Commander, General Wool, first saw him he was astounded. On a subsequent military assignment at Norfolk, VA, on one occasion John scrawled down two incoming messages while he was actually asleep, writing them down in a book he had been reading. (Civil War operators often worked impossibly long hours under difficult or dangerous battlefront conditions, and when things let up a bit, easily dropped off for a few winks of sleep.)

James H. Bunnell became an operator at age 13. He was so short that he had to sit on a stool to reach the telegraph instruments. At age 16 he was one of the best operators in the country, noted for his speed of 38 wpm (by actual word count). These are just two examples of the many, many boys who quickly became skilled telegraphers in the mid-1800's.

EXAMPLES OF EFFECTIVE CODE LEARNING

At the lowest skill levels: Four-years-olds, barely able to write even block letters have been able to pass the code test. How many of us are willing to admit a four-year-old can outperform us? Then consider these higher skill levels: In 1909-1910 Don C. Wallace learned the code with a friend, John Cook, and the help of the operators of Commercial station PJ in San Pedro CA. In 1910 he set up his first station. In 1915 he passed the test for a first class commercial operator's license, said to have required demonstrating ability to handle 25 wpm in Continental code and 30 wpm in American Morse code. Later with Tony Gerhardt he played a game they called "burnout." One would send as fast as he could with speed key (bug) while the other copied on a typewriter, the idea being to see who could go the faster. This continued wherever they were until Don could send in excess of 45 wpm and receive about 55 wpm

Later he needed a staff of 35 assistant operators of about his own speed capabilities. Within a short time he found them among Navy personnel where he was stationed, and did it this way: by sending his requests at these speeds and seeing who responded to what he sent. Here were at least three dozen men with high-speed skills before 1920. They were men who enjoyed the code so much they achieved high goals. Moral: If you want to do it, you probably can.

Arnie's Father was chief telegraph operator at a RR station and had once won a 60-wpm award in a contest for RR operators. His son, age 8, Arnie hung around the station all his spare time. He didn't say how, but he learned Morse on his own and soon had learned to send and receive at about 25 wpm. When dad was out he copied down the train orders for him. He wanted a job as operator. After much pleading, his dad said he could operate the station all by himself when he reached his 9th birthday. So he did, all day, while his dad looked over his shoulder and smiled a time or two. Arnie begged the RR to let him be a second shift operator after school and weekends for 50 cents an hour as second shift operator. He was required to pass the cooked-up special qualifying test: of sending a train order at 25 wpm using one key with his left hand for the dashes and a second key with his right hand for the dots. He succeeded in doing it some months later, and finally was given a job as sole operator on second shift all summer.

Appendix

Sources of Material

The following are the major sources for the concepts expressed here.

Very few of them have been quoted verbatim, but when they have, they have normally been enclosed within quotation marks. (References in general are to the first page of the article only.)

QST: 1923 Jl p52; 1925 Mr p45; 1929 De pI, 1933 Fe p76, No p39 -- 1935 My p68 -- 1937 Au p7, No p26 -- 1939 Ap 6 -- 1940 Oc p9, 73, De p90 -- 1941 Ja p45, Fe p48, Jn p66, Jl p44, Au p51, Se p35, Oc p44 1942 My p66, Se p23 (Au p40, Oc p28 -- 1943 Ja p17, Fe p13, Ap p13, My p14, Jn p40, p50, Jl p9, Au-p9 -- These items concern military schools) -- 1944(?) Ja p34, Mr p19, Oc p30 -- 1949 Oc p100 -- 1951 Fe p54; 1952 Ja p49 -- 1972 My p101, Au p58 -- 1975 Au p100-- 1976 Se p53 -- 1978 Jn p48 -- 1979 Jn p51, Au p58 -- 1982 De p55 -- 1983 Ja p76, p77Au p45, Oc p30; 1985, Au p49; -- 1989 Ja p9 -- 1991 Oc p60, p66; 1992 Mr p 51

HAM RADIO: 1988 Ja p10, p35, p36

73 MAGAZINE: 1971 De p83; 1972 Fe p , Jl p120; 1978 Ja p8 CQ: 1959 Fe p63; 1963 Ja p47; 1970 De p35; 1972 Mr p45; 1973 Mr p28; 1987 Oc p106; De p56

WORLDRADIO 1987 No p24; 1989 Fe p7,42; 1991 Au p56

"BREAK-IN" Official Journal of the NZART, "Morseman" column (by Gary Bold), various issues.

RADIO 1935: How Telegraph Operators are Made, 3 parts -- McElroy Ja, Fe, My (Related article in Radio News No 1939)

KEYNOTE CW Fists Club - various issues.

DOTS AND DASHES, (Morse Telegraph Society) various issues.

LEARNING THE RADIOTELEGRAPH CODE. John Huntoon, ARRL 1942

YOUR INTRODUCTION TO MORSE CODE ARRL 19 ARRL National Educational Workshop: #1, #2, #3

"CONQUER THE CODE WITH RHYTHM", article, source unknown pp. 17-21

OLD WIRES AND NEW WAVES, Alvin Harlow 1936.

ARMY TECHNICAL MANUAL TM-11-459, TO 31-3-16

SPARKS JOURNAL, various issues

MORSUM MAGNIFICAT, English Edition, various issues

RADIO HANDBOOK, Bill Orr 21st Ed.

RADIO SIMPLIFIED - What It Is - How To Build and Operate The Apparatus, by Lewis F Kendall and Robert P. Koehler, John C Windston Co. 1922

PSYCHOLOGICAL REVIEW Vol. IV (1897) p27-53, Vol. VI (1899) p345-375.

JOURNAL OF EXPERIMENTAL PSYCHOLOGY XXXIII (1943) "The Relative Difficulty of Morse Code Alphabet Characters Learned by the Whole Method" S.D. S. Spragg p108-114.

JOURNAL OF APPLIED PSYCHOLOGY 1943 "New Method of Teaching Code Reception at Columbia U. p407-415; "Errors Made in Telegraphy" p504-509; 1944 "Errors, History p254-266; 1945 "Second Level Training in Reception" p161-3; 1946 "Effect of Phonetic Equivalents" p265-270.

MEMORY: SURPRISING NEW INSIGHTS INTO HOW WE REMEMBER AND WHY WE FORGET - Elizabeth Loftus, 1980 Zeitschrift f r angewandte Psychologie und Charakterkunde. Feb. 1936, pp. 1 - 70, Ludwig Koch "Arbeitspsychologische Untersuchung der T„tigkeit...f r Funker"

THE CANDLER SYSTEM, Junior Course. Walter Candler 1939 edition.

BOOK OF FACTS ABOUT THE CANDLER SYSTEM. 1939 ed.

THE AMERICAN TELEGRAPHER - A Social History 1860- 1900. Edwin Gabler 1988. BRASS POUNDERS Young Telegraphers of the Civil War. Alvin F. Harlow 1962.

THE MILITARY TELEGRAPH DURING THE CIVIL WAR, 2 vol. William R. Plum. 1882.

PEAK PERFORMANCE. David R. Krauss. 1984

THE PSYCHOLOGY OF SKILL. William Frederick Book.
YOUR FIRST YEAR OF TEACHING SHORTHAND AND TRANSCRIPTION. Marion M. Lamb.

GESCHICHTE DER TELEGRAPHIE, Th. Karasss, Brauschweig. 1909 p.347-350

GESCHICHTE DER NACHRICHTENTECHNIK, V. Aschoff. Band 2 p. 198-208

THE STORY OF TELECOMMUNICATIONS by George P. Oslin, 1992 Mercer University Press. Chapter 2.

THE AMERICAN LEONARDO, Carlton Mabee 1943, New York

SAMUEL F. B. MORSE, LETTERS AND JOURNALS

STUDENTS' MANUAL for the Practical Instruction of Learners of Telegraphy, J. H. Bunnell & Co. 1884, reprint by L. A. Bailey

THE EDISON ALBUM, Lawrence A. Frost 1969, Seattle

CYCLOPEDIA OF TELEPHONY AND TELEGRAPHY Vol. IV American A Technical Society, 1911 & 1919

Personal Correspondence from: R. J. Miller, Teleplex Co. 22 Oc. 1942 Raymond K. White, Dodge Telegraph School L. R. McDonald, high speed contestant Ivan S. Coggeshall, Western Union, contests and misc. John F. Rhilinger, KC1MI, high speed code Donald K. deNeuf, WA1SPM, various aspects old and new George Hart, W1NJM, high speed code Tony Smith, G4FAI, general and historical L. A. Bailey, American Morse operator William K. Dunbar, K9IMV, AD9E, American Morse operator Verle D. Francis, W0SZF, American Morse operator Charles Bender, W1WPR, former chief operator W1AW ARRL Station Cecil Langdoc, Elkhart, IN, American Morse tapes James S. Farrior, W4FOK, computer programs both codes, Warren L. Hart, AA5YI, general Steven D. Katz WB2WIK, general Tom Perera K2DCY, general Louise Moreau, W3WRE, general Loraine McCarthy, N6CIO, general Carl Chaplain, W7QO, general Gary E. J. Bold, ZL1AN, and probably several others.

Personal discussions with a number of CW operators: George Marshall, amateur 9AER, 9CX, commercial first class from 1915-6, and Navy to about 1945; Quido Schultise, amateur 9NX and commercial from 1919, K6TK, K5OJ; Alvin B. Unruh, 9BIO from 1923, (W)9AWP, commercial, and W0AWP; and others later, including Clarence Wallace (W)9ABJ, my brother P. Kenneth Pierpont, KF4OW volunteer instructor; all of whom contributed something of value (including some materials). Since these materials have been assembled over a period beginning about 1930, some few sources may have been misplaced or lost.

With the Psalmist we may well say: "I will praise Thee; for I am fearfully and wonderfully made. Marvelous are Thy works, and that my soul knoweth right well."

High-Speed Appendix

I strongly recommend that all those who are starting, or thinking of starting to learn the Morse code, read at least Chapters A and B of this appendix to see how valuable this new approach is. For those who just want to know today's thinking on this subject it should surely be of interest

For those who want realistic help to increase their receiving and sending speeds, especially above 45 to 50-wpm to bring them closer to normal speech rates. (even up to 80 to 100-wpm) it provides useful information and practical guide lines Those who have done this tell us that communicating at these speeds is so much more enjoyable, and that it is now really so easy that there is no good excuse for not at least trying. Not everyone perhaps is physically and mentally able to reach the highest speed. But do enjoy whatever speed you do achieve.

The Chapters Here are:

a) A New Way to Talk?

b) Recommendations for How Best To Achieve It

c) Keyboards - - Code-Sending Typewriters

d) The Experiences of a Number of QRQ Operators Who Have Achieved It

e) Further Thinking

- The 'High-Speed' Circuits of Commercial Telegraphy
- No Challenge in Older Times

Chapter A

A New Way to Talk?

It was in 1925 in eastern Pennsylvania that Ed Hart at age 15 became a ham with his first operator's license and call 3NF (two licenses were required in those days). His 3-1/2 year old younger brother George got curious. What was this Ed was doing and having so much fun with? Was it some sort of new language he was using? -- George said:

"I admired my big brother Ed. He was my ideal. He was 15 and I was 11. I began to learn the Morse code like a baby learns to talk – by listening to my big brother operate and I picked up the 'code' by 'osmosis'-- recognizing and imitating the more frequent sounds I heard.

I wasn't aware of any such thing as "dots" and "dashes", but only of symbols with meaning.

I quickly learned the sounds of his frequent CQ's, his call 3NF and special procedure signals such as "AR, K", "DE" and "R" (all still used), and "U" (for US calls to foreigners before the prefixes W and K were issued), and absorbed other sounds, as sounds with meaning. I just sort of drifted into it by listening. It was easy for me.

"I didn't start out with any determination to learn the code, or to get a ticket, or get on the air. But one day -- it was 14 Sept. 1926 – using my brother's station, when I was 12, that I made my first QSO with W9CRJ in Lexington, KY. I was pretty shaky on that first contact and Ed had to finish it for me.

"When I was 14, I clocked myself at 34-wpm, plain language. I discovered that I had mastered the Morse code and was able to carry on a conversation just like Ed did.

"So my advice is to acquire proficiency in code, sit and listen, and keep listening and want to understand it. Anybody who's learned to talk [and can hear] can learn CW. It's that easy. Just live with it and it will come to you. Morse code is just another way of talking."
[Youngsters and adults will no doubt begin to learn in somewhat different ways.]

Learning conversational CW is more like learning to talk than it is to learning another language. It is far easier -- you don't need to learn how to pronounce or hear strange new kinds of sounds, to learn a new vocabulary or a new grammar. It is just recognizing the simple monotone sounds and imitating them. Learning it is "all a matter of incentive."

"In my opinion achieving high-speed CW is a natural progression, if you learn it right in the beginning and continue to practice it the right ways." For receiving, George has for many years been able to read code up to 60-wpm, almost to 70, but now he can only send at about 40, and so his QSO's today are rarely over that speed.

Most of us talk so fluently and so easily that we scarcely give a thought to how very different we are from each and every animal. From birth we are well on our way to learning to express our needs -- for water, for food, to get rid of some discomfort, and for companionship, to be cared for and loved. To be part of the family and society around us -- communicating first in body language and simple cries, and soon in the spoken language of family, friends and neighbors.

Behind "language", communication is this growing overall sense of our ability to think. Human thinking is a God-like, God-given activity. At first we tend to think of concrete things: things seen, felt, tasted, smelled and heard. But soon we begin to have thoughts of things not having physical existence, things we remember or imagine. We learn to think and express our thoughts about these "things' in words, too. And people around the world do this in over six thousand recognized and different languages and dialects.

Writing and learning to read are other skills, not "natural" or inherent or innate, but by practice they become almost automatic, as talking is. Learning to write and to read takes conscious effort on each one's part, and lots of active practice.

Written records of what was once just spoken have been kept for at least some 6000 to 7000 years. Strings of spoken sounds or syllables (as in Japanese, etc.), and sometimes whole words (e. g., Chinese) have been given arbitrary, but conventional symbols "characters"). One such set of symbols has been generally agreed upon within each language group.

Now, what about Morse and other telegraphic codes? Where do they fit in? What are they? They are more like writing than they are of speaking. They are more like a different alphabet or set of symbols than like a language itself. The same set of symbols may "write' in almost any language.

Many of us today are so literate that we read as easily and readily as we talk. We hardly see the one as being any different from the other. We can think, and express what we are thinking and communicate with those around us, by using our native language, or some other.
Let us here in this appendix think about our views and our attitude toward the Morse code in the above light.

This year, 2001 A. D., the so-called Morse telegraph code reached its 163rd year of age.

Like printing, it can talk in any language. Using simple stop-start, on-off type signals or motions, we can communicate using touch, sound, light, electricity, radio waves, any medium of exchange.

It has no dialectical peculiarities, no lisps, no strange or difficult-to-hear or pronounce sounds, or "speech defects", nothing to make it hard to understand. Paralyzed persons can use it to "talk" by blinking the eye or wiggling a finger, even controlled breathing.

More normal people can use it by radio to talk to those on the other side of the world or in space. With practice and the help of modern sending equipment it can be transmitted and "read" by ear at speeds almost as fast as ordinary conversation. It may be sent and received automatically at speeds many times faster, but this is not of interest to us here.

Edward Vail, one of Samuel Morse's hired and most valuable co-workers, did not realize what a wonderful communication tool he invented in 1838.

Let's keep these words in mind: it is a communication tool.

In the early days of telegraphy it was thought of as "writing at a distance", which is what the word "telegraphy" means. (See Ch.19.) But very soon the early operators found they could understand the letters and words from the noises the printing machine made. Then they discovered they could also just converse together without having to write anything down. This all occurred within 10 - 15 years of the start of commercial telegraphy. Talking by Morse code is not something new at all.

How then did we radio amateurs get started thinking of it as something to have to learn to write down? It is because writing it down exactly as it is heard is the only positive proof that we have correctly received it. This is called "copying". And to obtain a government amateur operator's license we had to be able to copy it at a specified speed. (This is still true, but at a speed that is hardly practical -- 5 words per minute.) But do we copy down everything we hear on the telephone? Even to think of that would seem silly. We understand speech because it is spoken as strings of sounds one sound shifting. or blending into the next, to form words and sentences. We learn to understand code the same way, but with a different form of characters, spelled out as words.

This is something that has to be acquired by practice. In this way it resembles reading, because we need to know how to spell. This is an added (hopefully small) difficulty for English speakers Spelling is hardly a problem for speakers of Italian or Spanish, which are spelled almost exactly as they are pronounced.

These are clues to help us speed up our listening to near talking speeds. Now in the next chapter let's see how to go about it.

Chapter B

Recommendations for How Best To Achieve It

Normal Speech

Experts tell us that the range of normal speech is between 100 and 300 wpm, The faster we speak the shorter the time the articulating members (lips, tongue, jaw, throat and chest-abdomen) have to move and the less precisely they articulate and the less time they may hold a changed position.

To speak slow normal English we must articulate about 2 -1/3 syllables a second. (The average English word is approximately 1.4 syllables long.)

What Can We Learn From Comparing the Examples in Ch. D later in this appendix?

Some few have begun the right way, the "normal" way, learning the Morse characters as individual sounds from their very first exposure, and just continued practicing that way from there on, from letters to words from words to phrases and sentences on to their top speed.

Here is how one of them described it:

"When you reach a solid reading speed, then you must have the desire to want to go up to the next level of reading speed. You can do it with tapes, but the best way is to communicate with a friend (on the air or otherwise) who can push you to the next level, and who will send to you on a regular basis.

"My friend taught me this way: "When I got to one solid reading speed, he would increase his sending speed. When I could not read solid at the increased speed, he would then send to me at a still higher speed. I was not able to get too much of it, but when he dropped back to the one I could not read solid before, it would then sound slow and I could read it easily.

"In other words, he would not slow down when I wasn't getting it solid, but would go still faster and let me listen to that for a while, even if I could only get a word or two. Then, when he dropped back to the lower speed, it would then seem slower and I could read it."

If you don't want to practice this way, then don't. But if you enjoy challenging yourself and want to go faster -- go ahead. If you "love" the code you may want to advance.

Some of us have natural limitations and some of us just assume or imagine that we are limited. Be honest with yourself - be realistic. Accept natural limitations, such as paralysis, severe pain, etc., or work around them, but don't add imaginary ones.

1. The most important factor to promote learning true high-speed telegraphy is to WANT to learn it faster. This may be just because you want to excel and are interested in improving your own skill. It may be a desire to challenge yourself to improve your speed of understanding, or it may be competitive with others, for the sake of winning.

2. The next important factor is the WILLINGNESS TO USE WHATEVER METHODS OR TECHNOLOGY will help me advance. Keyboards allow us to send faster. We can hardly learn to receive faster if no one can send faster. That's just common sense.

Then comes a willingness to learn and to ENJOY the learning process.
Other suggestions offered are:

a) If you are more or less "normal," forget that anybody ever said it might be "hard." Think of it as being "EASY" and FUN, an ENJOYABLE thing to do. Enjoy every bit of the learning process, as well as using it.

b) Start THE RIGHT WAY - and keep going. Learn to "talk" this way.

c) Set whatever speed goal you feel comfortable and satisfied with - the sky may be the limit.

d) Remember that HUNDREDS HAVE tried and SUCCEEDED - you're not alone.

e) When once we learn NOT TO WORRY about reading each and every word absolutely perfectly, it seems that we begin to RELAX. This is especially true when we get over about 65-wpm, and we can concentrate on the FLOW of general conversation and enjoy it.

There are some other features, which may help. Here is an additional suggestion from Fred Ryan:

Raising Your Typing Speed

"Here is how I improved my sending and reduced the number of errors at speeds over 70-wpm on the keyboard. I experimented and found that it took about ten days of practice to exceed 100 wpm." He began his experimenting and practice at his then present 70-wpm. Successful things he tried were:

1) He turned off the side-tone completely, and

2) He stopped looking at the screen, except maybe a glance when his fingers tell him he has made a mistake and

3) He did not look at the keyboard either. These three changes eliminated the distractions, so he could concentrate on his fingers;

4) While he does not look at the keyboard, he "visualizes" it. Then he can mentally concentrate and direct where his fingers are going to go next. He just "wills" his fingers to go there, and they do.

This is not an easy process to describe. He compared it to this:

"When I was seriously into playing the piano, although I was aware of the presence of the piano keyboard, I never looked at where my fingers were going to go. Even if I was jumping several octaves quickly, I could hit the proper note(s) exactly without ever turning my head. Looking to the keyboard to see where the fingers were supposed to land would have made good piano playing impossible."

Within a couple of weeks of experimenting and practicing, he found he could send as easily at 100-wpm as he had before at 70. But what surprised him the most was that now he could chat just as easily at 100-wpm as he could before at 70.

He said "I can get the thoughts organized in time to keep the fingers busy at these higher speeds. When I had mastered this technique, I found to my surprise that getting the thought-flow going at 100-wpm became very easy."

5) One further thing—he needed to improve the CADENCE of his sending -- sending each letter at exactly the same rate. He said: "Errors that I make, such as sending "Dan" for "and", are due to hitting the "d" finger out of cadence, too quickly to allow the "n" finger to type. Now I concentrate on keeping the cadence constant, something that I have never done over my past 50 years. I had thought that would be the really hard thing to master. But it wasn't."

How observant and thoughtful he was. Are these suggestions I need to follow?

Others have mentioned regular exercise, a healthful diet and way of life. This is just common sense.

Chapter C

Keyboards – Code-Sending Typewriters

Perforated or inked Code tapes were used commercially - prepared at slower speeds and sent at speeds up into the hundreds of wpm by a tape reader. The expense and time delay made the use by amateurs impractical and costly, except for functions like ARRL code practice or bulletins.

The first machines were mechanical devices. Some were developed before 1900 and most of them used other types of codes than Morse. Yeoman was a Morse keyboard used to some extent. Some both sent and received as letters and punctuation. One was a real mechanical marvel and won a world prize award. It was:

"A Telegraph Key With a MEMORY" described such a mechanical marvel, designed by Edwin H. Persian of the Persian Telegraph Company of Topeka KS which manufactured them in 1910. It had a four-row keyboard and a large drum on which the characters are embossed deeply. It was about the size of a regular typewriter. (Described in QST July 1963 p. 70f.)

It had a hand-cranked spring drive motor like the old phonographs, but was enclosed within a long cylindrical drum under torque from the driving spring. Through a gear drive this drum controlled, when acted upon by an ingenious escape mechanism, one line of a second and larger drum called the memory drum.

The rotatable character memory drum was complicated. It had a total of 3240 deeply embossed code characters, corresponding to the 45 letter, number and punctuation keys, and an equal number of escapement tabs.

Each horizontal line of 45 embossed characters was identical, with total of 72 of them around the drum. If one looked at one character in any row and then went around the drum at that position in the line, he would find the same letter at that identical position in each line.

The operator typed into the memory character by character. As he pressed each key the trip device would remember that character and move to the next line until a total of 72 characters (the length of memory) had been used up. As soon as he started typing the drive would begin sending perfect code characters and spaces in order.

It would continue sending, and a dial on the front of the keyboard would show how many characters were still to be sent. The operator could keep on sending as long as the meter showed space to list, and the mechanism would continue sending until nothing more remained in memory. He could send continuously -- very long continuous messages. The operator thus constantly knew how far the machine was sending behind his keying until it would stop, allowing opportunity to rewind the motor, if necessary.

As he continued typing, the dial would update its information. This was a very clever and practical device. .

All characters and their spaces, word and sentence spaces were correctly and perfectly formed.
.
My suspicion is that most of the mechanical keyboards, like this one, sent relatively slowly, with a maximum on the order of 30 -35 wpm.

Only one such machine is known to exist -- it is in the Topeka State Museum.

QST in May 1961 described the "Codamite", Model MG-100, developed and being manufactured by the Ling-Temco Electronics, Inc., with the technical help of the R. W. Johnson Co. It must have been developed, built, and then used by W6MUR and then demonstrated extensively. Its circuit diagram and method of operation are described during 1960. It was primarily intended for commercial use, but was of great interest to
amateurs.

It was installed in a small suitcase-like carrying case with hinged lid, measuring about 6.5 inches wide, 4.5inches front-to-back and about 3.5 inches thick. The character-keys on a drum stretched all the way from side to side in four "vertical" rows, and the time and level controls were at the top of the keyboard. It was self-powered by an inboard 9 v. battery. Its output was monitored by a self-contained oscillator and speaker.

It operated like a typewriter - touch a key and let it go, and the desired character was automatically produced, one letter at a time. All spacing between letters and between words was manual, made space by space by the operator.

In later keyboard designs, the code characters were defined by the spaces between the elements of each character, using digital logic, not by the start and stop elements of the tone. These used solid state devices (AND/OR, FLIP-FLOP, and transistors) with a Magnetic Core Shift Register for storage memory. Continuing new developments (chips, etc.) greatly simplified to ease of operation and sending quality.

Several designs were promoted developed and promoted by amateurs. Some few of these and some commercial designs are in QST's of July 1965 pp. 11 - 20, QST July 1969 p. 11ff, Aug. 1970, p. 47, QST 1973 Nov. p. 56ff. . All these were before PC type computers came out in 1980-81. John Ricks W9TO was a major developer and high-speed operator.

Keyers made it easier to send faster, and there must have been an overall general speed increase with their arrival in the 1960’s but it was the keyboard that really started the great step upward in speed.

Among the early keyboards were: in 1961 the “Codamite”, in 1967 one designed by John Ricks W9TO -- these and others had no memory. They had no space bar. (Others had no more than the automatic individual letter spacing after each character). Spaces were made by the operator.

In 1974 the “Curtis KB-4200 Morse Keyboard” was one of the first units with a space bar to provide normal controlled word spacing It also had a mini-memory which allowed typing 64 characters ahead of sending. A meter showing how many character spaces there were between typing and sending allowed a form of “continuous” typing.

Somewhere in this period the addition of a buffer-mini-memory made the Keyboards far more useful and faster. The following QST's -- Oc.1974 p.40ff. (allowed a 64 character mini-memory); Jul.1975 p. 11; Se.1976 p.11; Ja.1978 p. 24; Oc.1979 p. 22ff. (This article is perhaps worth reading for information on design problems, but falls far short of some of the others in utility and flexibility.); Ja.1980 P. 44ff (should be interest for designers.)

Chapter D

The Experiences of a Number of QRQ Operators Who Have Achieved It

(I have brought together in this appendix a number of the super-high-speed operators' experiences in learning and using high code speeds. All, except for Gary Bold, are from the US. It is as accurate as I can make it. It has been coordinated with those named, insofar as they are still alive and able to respond. You can see that there is not just one single way to reach high speeds, but people have done it in several ways.)

This file is roughly in historical sequence.

In the contest stages, the highest key-sent code speeds were in the range of 45-55 wpm using a bug. Test speeds above this were achieved by commercial high-speed punched-tape sending machines. The evidence for winners in those days was the ability to COPY. Ability to READ did not count.

#1 Perhaps the best known and most famous operator at high-speeds is **Ted McElroy** who from 1922 on, almost permanently held the high-speed record. He was a commercial telegrapher, not a ham.

On 6 May 1922, he learned of an Exposition in Boston, which would include a code speed contest. His boss allowed him the evening off to try, and he easily wound up using International Morse code, which by then he hadn't used for about a year, at 51 wpm. It was great fun for him. Later in 1922 at Chicago he won the trophy at 55-1/2 wpm with perfect copy for the World's Championship.

In Sep. 1935 in a contest at Brockton MA he lost it to his friend Joe W. Chaplin at 55.3-wpm, by making 11 errors. Then again at the World's Fair he scored 69 wpm with only two errors, while Joe Chaplin made three. What many may not know is that in July 1939 he and Lavon McDonald of Chicago tied at 75 wpm. But when the speed increased to 77-wpm, McDonald fumbled worse than Ted did (he made some bad errors, too), so the judges credited him with 75.2 wpm, the winner. He has not been challenged since and has 75.2-wpm remained as the official world's record.

Ted acknowledged that there were many other operators who had abilities as good or better than his, but they did not enter the contest. What most people do not know is that Lavon N. McDonald was equal with him, and but for a slip in the increase to 77-wpm trial, might have been the technical winner.

Ted was born 1 Sep. 1901 and died suddenly in Nov. 1963. He was one of four brothers who were telegraphers. He left school in 1916 and went to work for Western Union as a messenger boy. As he passed by the telegraphers, he saw how many of them could nonchalantly turn out 50 - 60 messages per hour. He managed to get some of them to teach him Morse code during their 15-minute rest periods. After a few weeks he imagined that he was himself to be a good operator. He got a try-out. It was tough, but it gave him a start. He found piecemeal telegrapher's jobs here and there and finally wound up at Fort Devons, near Ayer MA, where he continued until the end of the war in 1918.

Back in Boston he got a job using International Morse code at station RCA, Chatham MA. It was rough getting used to the new (International Morse) code during the first two weeks. In 1920 the station moved to New York City, but the move didn't work out well for him so he moved back to Boston and got a job with Western Union again.

In a telegram to Frank Borsody dated 14 Sep. 1933 he wrote "to my old pal Frank Barsody, in grateful recognition of the valuable coaching and assistance he gave me, to which I owe my ability to gain the world's championship as Radio Operator." And again in a letter dated 4 Sep. 1935 to Frank Borsody Ted wrote "You have been the best friend to me on this code racket that I've got. I cannot understand how I can fail to win it this year. As I sit in this chair I am copying solid (?) without a single error for five or ten minutes at a time, at 70 wpm, and I cannot understand how any (blankety) living man can do the same, because I know that the signals I am copying can't be read [copied?] by anyone else, that is, without error.

In a telegram from Dorchester MA dated in 1935 to Borsody, McElroy wrote: "I want to tell you that I very deeply appreciate the help you give me in winning the title. Your equipment and advice really won the title. I will never forget the debt I owe you." [Notice that this totally refutes the rubbish he wrote as to how much Candler's method had helped him.]

Borsody, in letter marked in ink "received April 1975", wrote to Bill Eitel that at the exhibit he had invited Ted to sit down and take a little workout in receiving some high- speed code at an "informal run."

Borsody's station sending operator had punched up a tape, and his receiving operator got up and let McElroy sit down in his chair and type down the copy. In another place Borsody says that Ted made an accurate copy at 79-wpm for 75 lines without a single error. Elsewhere Borsody says that he and Taylor verified McElroy's [later] contest speed as 76-wpm. It contained technical material with which Ted could not have been familiar. That is phenomenal. Ted said that he could READ the code much faster than that. He also said that he knew many others also could. It was typing that limited him and them.

#2 Lavon McDonald equal with McElroy. He definitely tied with Ted McElroy in the 1939 contest. No further information on him.

#3 James B. (Jim) RICKS, W9TO, b: 1914-12-23, d: 2001-10-20. Promoted and developed the keyboard system. He first designed a keyer using vacuum tubes, (Gary Bold used one of these for 15 years beginning in 1966, when he then went to the Curtis Keyer.) Jim was a co-founder of the CFO club and must have been a high-speed man himself. No information on his background.

#4 William (Bill) Eitel b. 1908, d. 1989. And perhaps his wife LaNeil. "On High-Speed Code." Taken from a file of some of his letters and replies from friends and others beginning in1974.

His early radio and code learning history does not seem to be known in any detail by any correspondent now living. He was active in radio in the early 1920's, and was familiar with the arguments between spark and CW enthusiasts in those days. He was a genius in the development of high-powered vacuum tubes and other electronics aspects, and was best known as a co-founder of the well-known Eimac Co. in 1934. He was a deep thinker. Most of the following materials are in his own words.

"The potential of Morse code for communication, using the benefits of modern equipment, expands our past ability in a manner never thought possible. Some amateurs have been and are talking together with Morse code at speeds of 80 to 100 wpm or more. These new high-speed operators accept new equipment as a means of improving their operating ability (a tool) and not as a threat to their status. It is interesting to note that the members of the 5-Star club attained their speeds using keyboards having no memory, such as we have today.

Because with our older tools we could only send so fast, is this really the upper limit of our receiving ability? Let us not resist using either better operating methods or equipment that will allow better use of the code, simply because we have some vague "romantic" thoughts about things of the past.

Have we forgotten the history of keys? Stop and think of the gains we have made in ease and speed when we went from a straight (up and down motion) key to a sideswiper, to a bug, then to a keyer! Is a keyboard something evil? Is the true measure of one's receiving proficiency one's ability to COPY, to "put it down" on paper? -- Copying was very important when messages were paid for and the coded message had to be recorded so the message could be given to the recipient in a form he could read and know that it was accurate.

Official government messages, diplomatic and military required accuracy. But when we see the Morse code as a means of communication between individuals, not as a means of handling business or official messages, we have a new set of circumstances and benefits, and it is no more desirable to "put it down" than it is to write down a telephone conversation word by word.

This use of the code can become a challenge both to master the code and to use the associated modern equipment available at speeds above and below 80-wpm. (e.g. in a roundtable discussion one can transmit a thought while waiting for an SSB transmitter to actuate VOX). Yes, there may be some whose physical or mental limitations prevent these speeds, but the biggest deterrent is the lack of a real interest.

Once you determine to master the Morse code, I believe it will be found that practice can be as much fun as operating. The most important and final ingredient is the determination to use the keyboard, and any other useful equipment. GOOD code becomes easy at high speeds. Good spacing tends to be a problem, but one that practice can overcome.

The 5-STAR club originally required 70-wpm, but soon raised it to 80-wpm. There were four original members, but by 1974 the total had increased to ten. There must have been others also who were qualified.

(See QST November 1974 page 155 for a good photo of Bill and his wife LaNeil in an ad promoting the Ten-Tec Triton as working well with high-speed code keying input. The letterhead gives the Butro Ranch and Laboratory at Dayton, NV 89403, and was dated August 24, 1974.)

#5 Tom Alderman, W4BQF. First-person story:
"As a boy of 8 or 9 I was wondering what my Dad found so entertaining about sitting at a desk copying all those dits and dahs; but I could tell that it was something he greatly enjoyed as a CW traffic net operator.

Therefore, I didn't start hamming with the slightest negative attitude about code and so I never generated the attitude that "I'll never be able to do that". In fact, copying CW is one of the great enjoyments that I get out of this hobby. It is fun.

Before I had finished my year as a Novice ham, I too was into CW traffic nets and enjoying it tremendously. So for the past 49 years (since 1951) I've been enjoying CW and still think of it as "fun".

I'm still l enjoying high speeds at near 80-wpm as W3NJZ, K3TF, KB9XE and I 'harass' each other on Wednesday night for about an hour on 3.533 MHz. My real high-speed pal, Ira-NU2C, used to 'challenge' me to determine how fast I actually could read code. We found the maximum speed that I could understand and correctly respond to his questions was 144-wpm. (I am not a 'freak', hi, hi).

I suspect the starting key to being able to copy high speed code is one's initial learning attitude. It may be the strongest factor. I believe that learning code has forever been talked about just like

we talked about that ‘awful’ mathematics stuff in high school; therefore most potential hams start off with a ‘bad’ impression of code.

I’m pretty much convinced that there is a ‘speed hump’ that most hams (myself included) seem to have a problem exceeding. I think that speed hump range is between 45 and 60-wpm. Almost everyone I have helped get into the 60+ wpm area, has had an extremely difficult time debunking that mythical ‘negative attitude’ and actually reading faster than at that hump. I can imagine what most of them thought when I would tell them to try not to think of reading 60-wpm as something they can’t do.

Think of it as just learning a different way of talking. Because I’m convinced that QRQ CW is one, just like conversing in a second language.

How does one read CW at 80-wpm or more? -- I can honestly tell you that I have no clue! Around 50-60 wpm one no longer reads dots and dashes, they literally begin (or continue) reading words. As the speed increases, don’t think you even just read words any more, you get into the flow of the conversation and literally begin reading phrases or complete sentences.

Interestingly enough, I find that when reading over 80-wpm, I don’t even realize I’m reading code, UNLESS a major word is either badly misspelled or was really hacked up on the keyboard. I don’t concentrate on the code; I concentrate on what is being said. There is no difference in doing that, as having a Native American converse fluently in French.

CODE READERS -- It certainly bugs me that most hams think that if you’re using a keyboard and/or your running CW over 30-wpm, that you MUST be using a code reader! (I think that’s another part of the universal negative attitude about code.) Sometime around 1968-69 I began trying to copy the QSO of a guy in New York and a guy in Florida, who almost nightly held a 100-wpm one-hour-long chat. My wife (I still don’t know how she found out about them) bought me an Info-Tech Morse code reader for my birthday. At that time, I sneered at it. But when I used it, I found that when I was trying to copy the ’hump’ speeds around 55 wpm, if I missed a letter or a word, my brain would freeze up and try concentrating on deciding what word I had just missed. Therefore I was losing total concentration. But by glancing up at that code reader, I would see the missed word, my brain be quickly satisfied, and I would continue with the reading!

At the time I didn’t realize this was actually happening. However, after about a year of this, it suddenly dawned on me that I was not looking at the reader any longer and I was reading in excess of 60-wpm.

In a sense, we are pretty lucky with code readers - they copy extremely well in the speed ranges we need them to help us get over the ’speed hump’- but with the QRN on 40/80 meters, once you try to get them to consistently decode CW over about 70-wpm, they just can’t do it because of the normal band noise!”

He added, “There is a lot more to be said on this subject.”

#6 Bill Pletting KB9XE.
He was about age 35 and was enjoying personal radio communication with CB. It was real fun. His CB buddies were having weekly get-togethers just to socialize. Then he discovered that one of them was also a ham, whom he visited in his home. Bill was astonished to hear Morse code and, like many others, apparently had never heard communications in Morse code before. It fascinated and intrigued him.

Then and here he became so enthusiastic to learn it that he immediately bought a set of learning cassette tapes from Amateur Electronics Supply, a reputable and well-known company in Milwaukee, which advertised in QST. He became so "obsessed" with those dit and dah characters, that he quickly learned the sounds of the alphabet, numbers and punctuation, and within a couple of weeks he had begun to practice wherever he was when it would not disturb others. He would tap out all kinds of stuff with his finger as if using a key…. or saying them in "dits and dahs" (At home it was so bad that his wife was getting irritated!)

He was determined to do it. Apparently he did not question whether it would be either "hard" or "easy"… he just did it. So it was "easy", because he never thought of it being "hard". He eagerly wanted to do it and learning was enjoyable fun.

Because he started learning it as it is used, hearing it and sending it as sound patterns, he did not have to do any relearning. He was learning it in the perfect way. He was practicing it almost constantly and enjoying every minute of it. It was "easy" because it wasn't "hard" in any way. It was something to be enjoyed and done -- that was it.

About this time he bought a ham band receiver just to be able to listen to amateur signals. Meanwhile he also prepared for the technical questions and regulations in the US license examination. So, within a month he took and easily passed the 5-wpm code text and then the written test, and soon received his first license - as a Novice.

Now Bill got a transceiver and went on the air using code actively in all QSO's. But also when he was away from the radio, he just tapped out the code with his finger as he had been doing before. He knew he needed to build up his code speed to be able to read most signals. He did this so well that within a year of getting his Novice license, he took and successfully passed the Extra Class license (20-wpm) exam.

Now with total access to all the ham bands he tried RTTY and some other digital transmission methods, but absolutely nothing could hold his fancy like Morse code did. He was also discovering that the more you practice doing a thing the right way, the better you get at it.

Higher speeds were a constant challenge. He still kept hearing stations that were too fast to understand, and he wanted to understand everything he heard. These were like a horseman's spur jabbed into his side. He kept telling himself, "I've just gotta read that." This was the incentive that drove him onward.

During this period, a number of new build-it-yourself kits came out, including some Heathkits.

One was the Heathkit Ultra-Pro CW Keyboard, which came out in 1983, and he built several of these -- he also made several for his friends.

Along the way a number of high-speed operators helped him -- W4BQF Tom Alderman, W0GHX Ray Larson, W9TO Jim Ricks, K9AMC Christ C. Kovacheff, KU2D Daniel E. Silsona (deceased), K0PFX Melvin L. Whitten, and others. So in only about 4 years from when he got his first ticket, he reached the 80 wpm speed range, and has pursued it ever since. In short, he " took off and flew."

Since that time, like Tom Alderman and others, he welcomes any newcomer and tries to help him get into the higher speed ranges.

#7 Harry W. Lewis W7JWJ (b.: 1923-02-02) is another highly skilled old timer. (The material here was gleaned from WorldRadio Aug. 1991 p. 56, and March 1993 pp. 31,32. and a number of personal letters. Sometimes things are paraphrased to bring out the basics.)

He got interested in ham radio in High School when a friend's transmitter penetrated the school movie sound system. It "hooked" him. He found the two Morse codes [American and International] printed in a physics book and learned both of them all by himself. He does not seem to particularly "love" the code, but it constituted a challenge to him. As long as he has felt a challenge, he has been driven to it.

He was having a health problem, and he saw learning the code as a way, which could to help him recover his health. Learning the code to this degree of skill was not easy for him. Along with this he decided to become a part of the magic world of radio, so when he finished high school (about 1940) he entered a radio and telegraph school to learn the code really well, because it seemed to be a prerequisite to progress.

At this school the better students competed one against another to become head of the class. An attractive young lady student paralleled his speed at 45 wpm. With this challenge he pushed himself still harder by long (up to as much as six) hours of daily practice.

After finishing school he spent some years in the military service as a flying radio operator and instructor. Then he entered the commercial world of radio broadcasting and TV. Over the years he worked at nine different radio stations, three TV stations, a telephone company, a computer center and several other places. This gave him a broad range of experience.

Since 1946, while doing his various regular jobs, he found time to teach beginning amateur radio classes, teaching the code, technical matters and the regulations. He helped a total of some 3,500 students to obtain their amateur licenses. He readily admits that he loves teaching Ham radio.

But he observed that over this long period the average age of applicants gradually increased by 15 years and it was taking longer and longer to teach them the code. To attract high-speed code operators and learn the secrets of how they gained that skill, he started giving code contests at various hamfests.

This wasn't just for the fun of it -- he wanted to learn more and better teaching methods. He applied what he was learning to his own practice and he began to approach the 100-wpm rate for copying. He anticipated that the same things that helped him would also help the students. But he was disappointed to discover that it did NOT help them to improve very much.

He researched books on the psychology of learning, etc., and found there are five fundamental factors involved if one expects to have success in teaching. Presumably they would also apply to learning to copy code:

1) First and foremost, the student must be strongly self-motivated. But the students did not seem to be convinced of this.
2) Diet. The over-consumption of sugar, pre-processed food and meat products seemed always to impede the learning process. [Note that Candler had said much the same thing many years before.].
3) Exercise (such as push-ups, running, etc.) before and after practice periods [Candler also agreed here, but in his day the cramped telegraphers' working area, with little sunlight and little or no fresh air circulation, plus long hours, were then common problems.]
4) Correct methods of practice. Successful code learning results in the individual copying totally by subconscious mental activity. That does not occur until the mind has been properly trained. [Lewis was aiming at copying ability, not just reading understanding.] Other factors involved the shape of the code pulses, the rise and decay times of the code signal envelopes (the dits and dahs), the frequency (pitch) of the tone and its timbre, the adjacent vowel and consonant combinations, etc., to optimize the impression to our ears.

When asked in 1991 what it is like to copy at very high speeds he replied "at 75 to 85-wpm there is absolute concentration, almost to a state of hypnosis." When asked if he could start copying immediately at 75-wpm, he said: "NO! I would have to prepare myself psychologically first, and that takes from a few minutes to as much as 45." He then was asked if he thought there is an upper limit to receiving speed, he said:
"It is definitely above 120-wpm, because his friend Jerry Ferrell had been clocked at 90% complete reading at 125-wpm."

Harry was certified in 1988 by the ARRL when he copied at 76-wpm. Now with advancing age (70) he feels he is slowing down somewhat.

#8 Edward (Ed) Hart, Jr. b. 1909, and George Hart, 3-1/2 years younger.
In the early 1920's their father Edward Hart, Sr., was a professor of chemistry at Lafayette College in Easton PA. The family lived in a house on the campus, which was owned by the College. When their father died in 1931 they had to move. They moved to a farm about five miles south of Easton near the little unincorporated village of Raubsville. The farm had 400 acres of woods and meadows in two valleys near the river. Ed first got his two required licenses - his amateur operator's license and separate station license 3NF. - when he was 15 in 1925.

When their Father died he was operating the family printing business in Easton and continued with that for some years. Much later he moved to Philipsburg NJ as W2ZVW and served as

SCM of Northern NJ in 1958 - 1959. Later he moved to Albuquerque NM as W5RE and served as SCM there in 1973-1976, and finally in 1978 moved to near Bonita Springs FL as N4KB, where his ”little” brother George and family often visited him in the summer. Ed must have been a quite fast operator. He died in 1988.

George Hart, Ed’s younger brother, was born 1 Nov. 1913. Now W1NJM, George tells his history with Morse code as a first-person story. It has been rearranged and sometimes paraphrased.
It was in 1925, after Ed got his first Amateur license, that his little brother George got curious. What was this that Ed was doing and having so much fun with? Was it some sort of new language he was using?

George says “I admired my big brother Ed. He was my ideal. He was 15, 3-1/2 years older than me - I was then 11. I began to learn the code like a baby learns to talk, by listening to my brother operate and picking up the ‘code’ by ‘osmosis’, recognizing and imitating the more frequent sounds I heard. I just sort of drifted into it by listening.

“I wasn’t aware of any such thing as “dots” and “dashes”, but only of sound symbols with meaning. I quickly learned the sounds of his frequent CQ’s, his call 3NF and special procedural signals such as AR K, DE and R (all still used), and the now-obsolete U (used for foreign calls before US calls were given prefixes W or K). I also absorbed other sounds, as sounds with meaning. I must have been born with a key my mouth.

“I didn’t start out with any determination to learn the code, or to get a ticket, or get on the air. But one day it was 14 Sept. 1926 -- using my brother’s station, when I was 12, that I made my first QSO with W9CRJ in Lexington, KY. I was pretty shaky on that first contact and Ed had to finish it for me.

“It was when I was 14 in 1928 that I clocked myself at 34 wpm, plain language. I paid for that quite some time later because of the strain in mis-using a straight key and got a “glass arm” (a painful form of paralysis). But I had discovered I had mastered the Morse code and was able to carry on a conversation, communicating just like Ed did.

“Finally my brother Ed bullied me into getting a temporary license (obtained by mail) in 1930. The code was not a problem, but I barely passed the written theory test with a grade of 70. I wasn’t even capable of building my own station yet. . Ed took me to Philadelphia in 1931 and I obtained my first Amateur Class license W3AMR (good for three years, renewable subject to proof of use).

“In 1932 I attended Penn State U and graduated in 1936. “We never used the call W3AMR until after Father died and we had moved out of the College property to ‘the farm’ (‘ole 66’). W3AMR had a great CW ‘swing’ to it, and I learned to love it. But on the farm we had no A.C. power, so we used batteries. Ed set up his station at the printing plant we owned in Easton. In 1932, Ed got a second-hand generator for the farm and set it up in an outbuilding. Unfortunately it caught fire one day and destroyed several outbuildings and almost burned the house, too.

"My advice is to acquire proficiency in code sit and listen, and keep listening and want to understand it. Anybody who's learned to talk can learn CW. It's that easy. Just live with it and it will come to you. Morse code is just another way of talking." [Youngsters and adults may learn in different ways.] Learning conversational CW is more like learning to talk than it is to learning another language. It is far easier if you don't need to learn how to pronounce strange new kinds of sounds, learn a new vocabulary or a new grammar. It is just recognizing the simple monotone sounds and imitating them. Learning it is "all a matter of incentive."

"I was given a Vibroplex key in 1929 and in my late teens and early 20's I could send almost like a machine at 45-wpm." But first with a straight key and later with a bug he developed that painful "glass arm." When keyboards came out he found he could send quite comfortably with two fingers.

"I never learned touch-typing, so this is a handicap for me with a keyboard. With two-fingers I can type up to 55-wpm. That is also my best speed of copying a printed text, because I must keep shifting my eyes back and forth from text to keyboard quite rapidly. This back and forth eye movement also promotes more errors, as I grow older. I did copy at 55-wpm for one minute out of five in an AARS contest. I can read, but not copy, at 60-wpm, but get only some words at 70-wpm or more.

"In my opinion achieving high-speed CW is a natural progression, if you learn it right in the beginning and continue to practice it." For receiving, George has for many years been able to read code up to 60-wpm, but now he can only send at about 40, and so his QSO's today are rarely over that speed.

George worked at ARRL Headquarters for 40-years, starting as second control operator at the new W1AW station on 22 Aug. 1938, and ending as Communications Manager in charge of all on-the-air activities sponsored by the ARRL and its affiliated clubs on 1 Nov. 1978. After retirement he moved back to "the farm."

Most of the time since 1957 he has actively promoted high-speed reception by putting weekly speed-practice periods and occasional qualifying test sessions on the air, and awarding certificates of proficiency. First he did this from a small club he formed, with practice and testing sessions advertised in the QST.

ARRL had no part in it other than some notices.

The club fell apart later and some members of the Society of Wireless Pioneers (SOWP) gave their name support to it, but otherwise did nothing.

His transmissions were originally made using a tape puller at speeds ranging from 20 wpm to 70 wpm. Some of his transmissions in later years were made from his brother's station in Florida. Only recently has he dropped back to one session a week and he no longer issues certificates. Now he rarely sends over 30 - 35 wpm. He feels he could maybe copy at 40-wpm.

He feels that "personal aggrandizement" is one of the basic motivations of the Amateur radio

pursuits, especially DX-ing and contesting. We do what we do "because we enjoy it", and some people do it purely for itself.

"I came into contact with William C. Smith, K6DYX, Monterey CA, professor of electronics at the US Navy Graduate School in Monterey. That was in the days of home computers. He urged me to "go computer" with my code practice sessions, much against my inclinations. Not only that but he insisted on giving me his older Apple II in 1988, and a set of personally spelled-out instructions for using it. He also visited me in person several times after that. I was a rotten pupil, but he was an excellent instructor and very patient. I still am using it."

#9 John F. Rhilinger, KC1MI, is able to read at 80-wpm, and to copy at 70. In 1992 I asked him 22 questions, each of which he answered, plus several nice letters. Here is the essence of what he says was his experience.

His father W1QQS was a close friend of Ted McElroy, the long-time world Speed Champion record-holder, who frequently visited them. John knew him as Uncle Ted. By age 6 John became interested in Morse code and from them at that time he learned the code up to a rate of 10 – 15 wpm, but did not get a license.

In his later years when he had become a ham and reached a speed of 30-wpm, he began to practice sleep-learning. (Sleep-learning was a method successfully tried by some Germans in the early 1920's.) Generally he practiced it up to four hours each night. He used a tape recorder to send continuous code materials which he had previously heard and recorded at various speeds, and then speeded up ultimately to record the 60-wpm range or higher by the recorder's play-back speed. This seems to have been the main way he reached the higher speeds. He was also actively hamming six hours a day and probably aiming at the higher speeds he heard.

He has not sensed any loss of rest during the sleep-learning at night. He does not need any prepping-up to start reading at high speeds. He just starts. Typical misspellings and other such errors cause him no problems in reading. He does not lose out.

#10 Katashi Nose, KH6IJ, was a long-time ham, a well-known DX man and code teacher. What his top speed was is apparently not recorded, but he worked up into the 60-wpm range in DX, and his students advanced rapidly from zero to 30 - 35 wpm in a few weeks with no problems. In 1959 he wrote, "Any DX-er worth his salt is good for at least 60-wpm. He gears his speed to what comes back."

#11 Jerry A. Ferrell WB7VKI (CFO # 760) is another very high-speed operator. (over 100-wpm with whom I had extensive correspondence in 1992, and later).

He was born in 1927. In 1945 at age 18 he joined the US Coast Guard. His aptitude tests showed he should make a good radio operator. He was assigned to the six-month radio course at Atlantic City, where the goal was 20 wpm of ciphered 5-letter groups. Very little standard English text was practiced toward the end. He was not too good at that. Otherwise he was at the top of the class.

The course plan at the CG school was to start out at 5-wpm (apparently using very slow code characters - far below our being able to recognize them as patterns of sound (which occurs in the range of 10-13 wpm). The class progressed faster by a stepwise increment each week until reaching 20-wpm.

After that school he started out on US Coast Guard ships. He left the Coast Guard for a part of 1948 and 1949 and went into Rail Road telegraphy. He spent one month at their telegraph school to learn the American Morse code and then went on temporary assignments. Later in 1949 he returned to the US CG and stayed there until his retirement in 1966.

During various assignment in the CG he copied normal English messages at 20-25 wpm, and press broadcasts for the ship's newspaper at 35-40 wpm. He was so good that sometimes the shore station operators would punch tapes to send to him at 50-60 wpm to try to trip him up -- but he did not miss anything, and they wondered what was going on.

Then for a period of 12-years, 1966 to 1978, he worked at different occupations away from radio or telegraph activity. In early 1978 he got a ham license. In May that year he visited the Vancouver Ham Fair. On entering the building he heard code signals and located their source. It was a code speed demonstration for a crowd of spectators being given by Harry Lewis who was using a keyboard, a TV monitor and a meter showing sending speed.

Jerry asked for a try, starting at 30-wpm and increasing by 5-wpm increments. He copied perfectly up through 50-wpm. At that time he became friends with Harry Lewis, who from then on lent him equipment and help, and encouraged him to increase his speed capability. So he bought a reel to reel tape recorder and a keyboard and made 50-large reels of 1/4 inch tape at speeds ranging from 50 to 75, 60 to 80 and 70 to 90-wpm for practice. Later he made more tapes with 5-wpm speed increments between 50 & 80, etc. He also has a 75-wpm & 100-wpm "warm-up" tape that makes the others seem rather slow.

I sent him a list of questions, which he answered, in considerable detail. His answers are:

1) He rightly suspects that the main reason for the increase in the number of high-speed operators is the widespread use of keyboards for sending.

2a) He is quite correct that reading code and copying code are two different kinds of operations - copying takes far more time to learn. This is because you must receive the code with your ears, process it through your brain, then it goes on down to your fingers to the paper or typewriter.

2b) He says he feels no strain while reading, but high speed copying is stressful for him. It is because of this that he feels that he must practice at least an hour each day for five months before a contest. He must also get psyched up immediately before the contest. He feels that it would be so stressful for an operator to copy continuously at 60-wpm for 10 - 12 hours every day, that it would be almost impossible.

2c) He says he is sure that the secret of learning to copy at higher speeds is to start out listening to and trying to copy 10-wpm - or more -, faster than you are comfortable with, and then dropping back to a slower speed. It is like driving a car at 90-mph and then slowing down to 80-mph seems slow.

3) He says that to him International Morse code at 75-wpm or more sounds like "chicken fat frying in a hot griddle." To start reading it he has to make up his mind to break into it and begin concentrating on words and phrases.

4) Then so long as he consciously maintains his concentration, he can continue to read. What does he concentrate on, and how does he do it? -- He visualizes it as something like this: "If I am listening to a news broadcast on the radio while reading the daily paper, one or the other will have my attention. While I focus on one, I am conscious of the presence of the other, but I am not fully aware of its contents - in fact it may be more or less gibberish to me." This is an inexact parallel, but it is this snapping of attention to the one or to the other that makes the difference between reading and treating it as "noise."

Hard or unusual words, etc., are sometimes difficult, but generally do not cause dropouts by destroying overall concentration. He may be conscious of missing something (due to misspelling or a sending error, etc.) and he may be momentarily puzzled, but not for long, as he continues on. His attention is on understanding - that keeps him going. Long words do not cause any problems.

5) He does not know whether there is a limitation on the speed of understanding, but thinks there surely must be.

6) He has always been able to listen to the code or send it while doing other things -typing at moderate speeds, conversing with others, re-tuning, etc. While he was a shipboard operator and returning with others from shore leave after being still somewhat inebriated, they would sometimes try to trip him up by sending words spelled backwards, etc. to him. But he did not trip up.

7) Although he can read and copy American Morse up to around 30-40 wpm it does not sound right to him with a CW tone. He does enjoy reading it occasionally from taped sounders, however. He never practiced it at higher speeds.

#12 Frederick M. Ryan W3NIZ (b. 1932-01-20)

In 1942 when he was 10, as a Christmas gift, Fred's father gave him a toy telegraph set which could be used to send between two stations. It used a buzzer, a clicker (simulating a sounder) or a lamp. There is no doubt as to why he was given that. His Father was a telegrapher on the Pittsburgh and Lake Erie RR, his Grandfather was a telegrapher on the Pennsylvania RR, and an uncle on the Baltimore and Ohio RR. He taught himself the letters and numbers by memorizing them at a very low speed.

After WW-II when ham radio was again allowed, he decided to improve his code ability and take the exam. He practiced on his telegraph set and also mentally put advertisements in the

newspapers or posted in the trolley cars into code (while he rode into town). His Father was not much help here because he knew only the old American Morse.

He took the 13-wpm exam in 1946 and failed. At that time one had to wait six months before trying again. So, during that interim he practiced more, as he had done previously, and remembers that his sending speed got up to 18 – 20 wpm. Early the next year he took the exam again and just barely passed it -- barely, not highly successfully.

Since he expresses himself in terms of “dots” and “dashes”, he probably followed his father’s approach in copying and thinking, and practiced with “dots” and “dashes”, rather than in terms of sound, as ”dits” and “dahs”. Whether he learned it by sound or visually, he says he was sort of “stuck” at the test speed of 13-wpm for a while. At that time he had little opportunity for speed building because he was busy with high school studies. Also since that was as fast as most of his contacts, he felt no interest or incentive to go any faster.

In the early 1950’s when he was in the Army he worked with a straight key up into the 15 – 17 wpm range

Sometime in the 1960’s his first real improvement began when he started listening to the ARRL code practice transmissions in preparation for taking the Extra class exam. He knew from experience that a person tends to do worse under test conditions, so he waited until he could copy at 30-wpm before being tested at 20. Of course he passed.

On into the 1970’s his comprehension and sending speeds increased slowly to about 40-wpm, when he used a keyer for sending and was no longer copying it all down. In the mid 1970’s, when good keyboards became available, he heard some fellows sending over 80-wpm, but he could understand very little of what they were saying. He did think that it would be fun to do. But he thought, “They are really in a different league than I am and what they are doing is way above my ability. I am now busy with my job, so I had little time to try it.

“When I retired in 1992 I finally had leisure to spend on CW, so I bought a keyboard and started sending at 45 wpm.” Then he heard some guys holding QSO's at over 60-wpm, and “I decided I would see if I could improve to that level.

“It took a lot of desire and practice, but over the past three years (from 1997 to the end of 2000) I have gone from 45-wpm to over 70-wpm. I intend to keep it up and improve more. It has been a lot of fun, and I have met some great people also who acted as mentors to me.”

In his own experience he says he finds the way his brain functions is like this: “Below about 55-wpm I construct the words from letters, and so comprehension is cumbersome. Especially below about 25-wpm I find that my attention span in remembering the slowly incoming letters and constructing words from them is really tedious. But above 55-wpm my brain starts paying little attention to the letters, and the words just ”pop” into my head. Even at 90-wpm I am still getting some words as words and putting them together to form thoughts. 90-wpm seems to be about my limit to do that, and I believe that to comprehend over 90-wpm I will have to change the way in

which my brain operates." Further practice and time has raised his comprehension speed to over 100-wpm.

Raising Your Typing Speed

Fred tells how he improved his sending and reduced the number of errors at speeds over 70-wpm on the keyboard. He experimented and found that it took about ten days of practice to exceed 100-wpm. He began his experimenting and practice at his then present 70-wpm. Successful changes were:

He turned the side-tone off completely, and.

1) Stopped looking at the screen, except maybe a glance when his fingers tell him he has made a mistake.

2) He did not look at the keyboard either.

These three changes eliminated the distractions, so he could concentrate on his gingers; Although he does not look at the keyboard, he "visualizes" it, so he can mentally concentrate on it and direct where his fingers are going to go next. He just "wills" his fingers to go there and they do. It is rather hard to describe.

He compared it to this: "When I was seriously into playing the piano, although I was aware of the presence of the piano keyboard, I never looked at where the fingers were going to go. Even if I was jumping several octaves quickly, I could hit the proper note(s) exactly without ever turning my head. Looking to the keyboard to see where the fingers were supposed to land would have made good piano playing impossible."

Within a couple of weeks of experimenting and practicing, he found he could send as easily at 100-wpm as he had before at 70. But what most surprised him was that now he could chat just as easily at 100-wpm as he could before at 70. He said "I can get the thoughts organized in time to keep the fingers busy at these higher speeds. When I had mastered this technique, I found to my surprise that getting the thought-flow going at 100-wpm became very easy."

One further thing -- he needed to improve the cadence of his sending -- sending each letter at exactly the same rate. He said: "Errors that I make, such as sending "adn" for "and", are due to hitting the "d" finger out of cadence too quickly to allow the "n" finger to type. I concentrate on keeping the cadence constant, something that I have never done over the past 50 years. I had thought that would be the really hard thing to master. But it wasn't."

How observant and thoughtful he was. Are these suggestions I need to follow?
He has noted that in his 53 years of hamming he has not operated a great deal—typically less than an hour or two a week. Even now he is fortunate to find one week in a month when he can communicate with a truly high-speed operator. High-speed operators in the US are rare today.

#13 Ted J. Newport (b. 1919-09-11) First person account.
"I learned code when I was in flying school l during WW-2. We had to send and receive 12-

wpm before we could start our flying training. After the war I bought my son a short wave receiver. I heard CW on it, and relearned the letters I had forgotten. I taught myself code with tapes and with friends helping me on the air. I owe what speed I have to the help of two friends, both now deceased, who worked with me on the air for years, helping get my speed up. They were Jimmy Moss W5GRJ and Gene W4JKT who kept pushing me.

"First you must have the desire to learn CW, and to like/love CW, and have the desire to increase your speed, instead of staying at a plateau.

"Next, practice, practice, practice. When you can read solid at one speed, then you must have the desire to want to go up to the next level of speed. Tapes are fine, but the best practice is to get on the air with friend who will push you to the next level, and who will send to you on a regular basis.

"Gene taught me how to increase speed. 1) When I got to one solid reading speed, he would increase his sending speed. 2) When I could not read solid at the increased speed, 3) He would then send to me at a still higher speed. I was not able to get too much of that, but 4) when he dropped back to the one I could not read solid before, it would then sound slow and I could read it solid.

In other words, he would not slow down when I wasn't getting it solid, but would go to a still higher speed and let me listen to it, even, if I could only get a word or two. And then, when he dropped down to the lower speed, it would seem slower then and I could read it.

"I cannot read, copy and send as well as Tom Alderman and the others do I don't get on the air much any more and my reading (not copying) speed is in the range of 60 to 70-wpm.

#14 Rodney L. Whitten W4BI (b. 1912-04-22) is one of our oldest available examples of very high-speed operators. His interest began in 1924 when he was 12.

Spark was beginning to lose its rough, noisy thrill and sense of power (like a motorcycle), and was going out of use, displaced by the tiny vacuum tube with its peeping CW signals. And the rapid increase of DX occurred, as "short waves" became shorter and shorter - into the "useless" range.

He was interested and wanted to learn.

He joined the US Navy and was selected to be a CW operator. He was trained as one of that special "crypto over the roof gang" operators, an elite group of guys trained to learn various codes (he learned to copy 8 different national codes) before and during WW-II. Altogether that group included about 178 men who were so trained. Their work included QRQ copying.

He spent most of his time in the South Pacific and was at Pearl Harbor when it was bombed.

#15 Melvin L. Whitten K0PFX (b. 1946- 03-05).
He learned the Morse code from his Father, W4BI, and (see above) who started teaching him when he was about 9 or 10 years old.

Since his Father-teacher was a QRQ expert, Mel was never troubled by first "memorizing" the code visually as printed dots and dashes, but rather heard it as it is, as patterns of sound. Furthermore, he must have had no concerns as to whether it was "hard" or "easy" to learn. It was just to be learned like anything else. If there were any difficulties along the way, his Father encouraged him to keep on, with something like: "Look how much you have learned and can do already."

Then, because the FCC office was 150-miles away at the time, he used his Father's call sign for a couple of years until he finally managed to get to the FCC office for the test and to get his own license and call in 1958.

He was able to copy 40-wpm up until somewhat more than 20 years ago when both he and his Father got electronic keyboards. His sending speed began to go up and along with it his copying speed rose to 45 then 50 and finally reached 55, where going to higher speeds seemed like work -- above that he must sweat up to his absolute limit of 60-wpm. His comfortable range is 45 - 50 wpm.

He says he owes his "QRQ" to 35-years of QSO's with his Father who has long been able to copy over 60-wpm.

He feels that if he would work at it, he is sure he could increase it even more. "It just takes a lot of practice."

#16 Ira I. Silverman, No data other than that he is a very fast operator, can type into the 140-wpm range and receive at least to 100.

#17 OSCAR (Ozzie) Levin W5RK. (b. 1918-12-4)
This is one of the most interesting cases, for it illustrates "normal" learning.
He "got interested in Ham radio back in the mid-thirties after visiting a Boy Scout friend that had a ham station." -- He was more than just "'interested."

1) He wanted to learn the code and had no preconceived ideas about it. We may say he loved it already.
2) He started from the concept of the code presented as sound – "spoken" dits and dahs - not printed dots and dashes. He had no visual roadblocks. What did he do? -- He "learned the code on his own" because he "had no mentor or anybody to send code to him." He learned it by looking at a newspaper and saying the dits and dahs to himself for all the letters and numerals in the story he was reading He took the examination in 1937 and passed both the 10 words a minute code test and the theory test.
3) He had no initial mental blocks—that it might be "hard" -- but rather just "that's the way it is", something, like everything else that he wanted to learn. He enjoyed learning it. It was fun.
   Without the excess misdirected baggage so many unwittingly carry, he reached a 50-wpm

copying ability within three years. His evidence joins the rest of that relatively small group who did it right from the very beginning and had nothing to have to relearn. That is why it seemed ”natural” to him.

4) He “entered the Coast Guard in 1941, just before we got into WW-2, and was assigned as an apprentice Seaman operating the high-speed circuits along with veteran operators. After another assignment, he left the service in 1946.
   For ten years he was inactive, though he continued his license. In the late 60’s he ran into the Chicken Fat Operator’s Club [CFO’s} where one of the operators observed he had been copying the high-speed and asked him if he wanted to join them. He did, but soon found he could not keep up his sending speed with just a paddle, so he built an electronic keyboard.
5) The use of a keyboard, which is only a tool, is the almost universal newer hardware, a key which gives that boost to pass the frequent “plateau”, the speed “barrier” around 50 - 60 wpm.

Some kind of internal change in mental approach seems generally needed (is it a change that is hidden from our conscious understanding?). He could now practice well-sent code at home or during QSO’s with others using keyboards. (Bug or keyer sending is a special skill that not many achieve at those speeds).

This change resulted in a noticeable increase of his receiving speed and he was soon sending 70-wpm. “It was a wonderful experience.” Today he finds few hams using these high speeds.

#18 Florence C. Majeras W7QYA, b. 21-10-1915.
Bill Eitel said, “She is a very talented and practical woman. Her accomplishments are many and unknown to most people, because she is a modest and sincere person. She is a pilot, musician, schoolteacher and a top CW operator.

She does not have to take a back seat to any one when operating CW. She can send it, read it in her head, or copy it down on a manner, which people do not realize because she is no show-off. She is the kind of person I formed the 5-Star Club to recognize.” I have no information as to how she learned or when she started into ham radio.

#19 Gary Bold ZL1AN is the only known New Zealander who belonged to the CFO club.
He says: “In this area 40 - 45 wpm is as fast as we ever go. Keyboards are not in general use. He was quite astonished to learn that some hams in America were conversing in Morse code at 100 wpm. Gary had himself written computer programs to read code at fair speeds, and using them, managed to reach his present limit at 55 wpm.

#20 Jesse W. Caravello, Jr. W8MCP b. 1936-06-07
The following comments are from Gary Bold ZL1AN.
In 1985 I visited Ann Arbor on Sabbatical leave and encountered him on the packet system. He invited me to visit his home. He told me he was also a CFO Club member. I thought it was defunct. Learning that I was without a rig, Jess lent me a SWAN transceiver, power supply, tuner and filter which at our rented house, put me in regular contact with other CFO members and nets whenever possible. He also connected us home to our teenage children through the ZL packet system. When I went back to ZL, we kept schedules on 40 when conditions were right.

Later when I returned to Ann Arbor several times, each time I enjoyed his and his wife Brenda's hospitality. They became very dear friends to me.

I know virtually nothing of his early Morse experiences. I am sure that he would have told me everything. A couple of years ago Jess passed away, I think due to a massive heart attack.

Jess was, indeed, a first class CW man. I know he had spent time as a sea-going operator. I don't know how fast he could receive, and I never saw him use a keyboard, but he could read anything. He could copy noisy, weak signals covered in static and QRN from which I was gleaning mere letters and occasional words. Strange fists were no problem to him.

Nor do I have any information on the following names who are supposed to be very high-speed operators:

David H Freese Jr. W1HKJ wrote software for 99-wpm and on Bill Eitel's request revised it to run at 160-wpm.

FRED C. CLARKE W9AMC, CHRIST C. KOVACHEFF K9AMC, David H Freese Jr, W1HKJ, CHARLES F. VAUGHN, III, AA0HW, b: 1958-01-18, J PHILEMON ANDERSON W9TP b: 1929-05-31, RAYMOND H. LARSON, W0GHX, b: 1936-08-01, CHARLES F. VAUGHN, III, AA0HW b: 1958-01-18, J PHILEMON ANDERSON, W9TP b: 1929-05-31, WILLIAM SEPULVEDA, K5LN b: 1944-08-01 , CARLOS DALE HAMM, W5LN, MELVIN J. LADISKY W6FDR, CHARLES H. BROWN, JR, W4AFQ, b: 1928-05-28, WELLS E. BURTON, N4EE b: 1919-07-14

Other older operators for whom we have no data on their leaning methods: Frank J. Elliott, Cpl. James Ralph Graham, at 60-wpm or more:--A.J Burkart (1913), E. Proctor, W5FDR Earnest L. Sitkes (W4AFQ), W5GET,W9RUM, William L. Gardiner, Wells E. Durham (N4EE), Cpl G. Schaal, others in Europe, who used these speeds daily

There were nearly one thousand listed members of the Chicken Fat Operators club, which required at least 45-wpm for entry, before it faded out as a club a few years ago.

I suspect that the number of highly skilled commercial operators and hams around the world who can or could receive at over 45-wpm would add up to many thousands, with a large number of them capable of well above 60-wpm.

Appendix E

Further Thinking

Telegraphy Was a Highly Respected Profession for Almost a Century

In 1845 the first short telegraph line was built between Washington DC and Baltimore MD and opened. From then on, many a young man and some young women chose it as a thrilling and honorable and greatly respected profession. It was an opportunity to do something worthwhile in the world.

For the first fifty years telegraph lines were built over longer and longer distances, installed along railroad (RR) lines for communication, to facilitate scheduling, control, and safety in the operation of the railroads.

For many years the arrival of trains had been the local source of news from other communities along the RR line. With the telegraph the RR telegrapher's desk brought much nation-wide news. It soon began to connect newspapers with sources of news, which formerly were delayed for days or weeks by lack of rapid communication. In addition, important personal messages now began to travel widely. (Even the youngest telegraphers were scrupulously careful not to divulge any personal or business message contents to outsiders.)

Some home electrical experimenters made or bought their telegraph equipment and strung up wires to friend's homes in their neighborhoods. Throughout the American Civil War, the telegraph was used extensively by both the Northern and the Southern armies to coordinate their troops and overall and local attacks, to obtain supplies, etc.

From ancient times when a ship left harbor it had no communication with its home port until it returned (if it did return). In the 1860's undersea cables began to connect many seaports and sometimes a ship's arrival could be verified from port to port through cable telegraphy. That was a huge improvement. It also made possible rapid two-way diplomatic and business communications to and from distant places around the world, as well as news.

Beginning with Marconi's development of the first practical wireless telegraphic transmitters and receivers, ships were now usually able to communicate while in transit. Long distance communication opened up independently of the expensive long wires and cables. It was not quite as reliable as wire telegraphy because static and man-made interference often prevented or garbled it.

Invention of the telephone in the latter 1800's partially replaced telegraphy. In time continuing developments in electronics began to replace the need for professional telegraphers—by the end of WW-II.

The airplane as it became a useful means of commercial and military transportation introduced another new need for wireless. Some few early aircraft in the WW-I period began to be equipped with radios. The pilot needed weather and other information related to scheduling, routing and safety. This was met first by the use of radiotelegraphy and later by radiotelephone.

Shipboard radio-telegraphers continued on until the invention of the almost automatic communication systems now predominantly in use. Skilled radio and telegraph operators are said to be no longer needed. However, these automated systems are very expensive and are not perfect, often making erroneous emergency trouble reports (false alarms), and sometimes cannot handle a severe emergency at all.

The ships operated by many small nations cannot afford these new systems and still have their older radios and telegraphers aboard. A recent article (in Morsum Magnificat #74) listed 55 such transmissions within two or three day's time from 22 different ships in just one northern European location.

Manual telegraphy is still very useful and may sometimes be imperative for safety.

Today in our modern European-Western culture telegraphy is almost altogether a hobby confined to the amateur radio world. It is an honorable and useful hobby in times of emergency when nothing else can be made to function. It should never be allowed to die.

The 'High-Speed' Circuits of Commercial Telegraphy

Written by James S. Farrior, W4FOK CFO #431

Commercial telegraph operators used to have two types of CW circuits. One was a "high speed" circuit, up to 400-wpm, which used punched transmitting tape and printed inked receiving tape (called "slip"). The other was the familiar operator with his bug and "mill", with its speed set as that which the operators could send and receive for long hours.

The receiving operator never had a chance to hear code being sent much over 45-wpm. Some news services could send at slightly higher seeds, but since such broadcasts were copied simultaneously by many operators, it was not worth while to send it at a speed above that at which all of the operators could produce clean copy. What I'm saying is that there was no practical reason, and usually no available means, for typical telegraph operators to learn to copy or read code at very high speeds.

The old "high-speed" circuits produced inked slip at a rate that would keep several transcribing operators busy. The slip, after inking, was run across a sort of "bridge" just above the keys of the mill (typewriter) keyboard, and the operator had a floor pedal that allowed him to adjust its speed. The speed limit of the moving slip was the operator's typing speed.

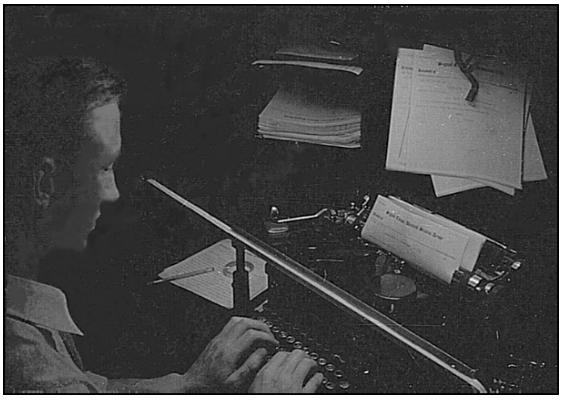
A trained operator could read the slip faster than his sustained typing speed. For instance, I remember that while typing as fast as possible, I could scan ahead to see what was coming, so as not to get surprised by some unfamiliar word, name, or number. I would have them figured out by the time they came across the bridge and were typed. The operator did all of this without a high degree of conscious concentration, and meanwhile could think of other things while doing it.

When I first began copying slip, it was below my fastest typing speed, because I observed the dots and dashes that made up each character. However, after some experience, I began to recognize the characters by their appearance without being consciously aware of the underlying code. After some additional time, entire words and groups of words were read at a glance. It was much the same as reading print, except that the characters were written in a different way. My output was limited by my maximum sustained typing speed.

There is some similarity in copying slip and in copying the code: the eye reads the slip and the ear "reads" the audible code. Some people can learn to read slip at a very high speed, just as some people can learn to read printed text much more rapidly than others. One limit on the speed of reading slip is the fact that the length of the word on the slip is longer than a word in normal print. To minimize this problem, the speed of the slip as it was being inked was adjusted to make the characters as short as practical so as to make the words shorter and more readable. Just like we learn to read print, we could have learned the "appearance" of the characters, without being concerned about dots and dashes.

Also from Jim Farrior, some additional comments:

In early 1941, while working at WVR, the Army's 4th Corps Area Net Control Station in Ft. McPherson, Ga., I snapped a photo of Jack Ivy transcribing slip. Jack was perhaps our fastest manual and "high speed" operator. He could transcribe slip for hours at about 80-wpm and he seldom made an error.



The "high speed" circuit was between WVR and WAR, the national Net Control Station in Washington, D.C. Message handling within the Corps Area was done by conventional radiotelegraphy.

The "bridge" over the mill, across which the slip was drawn, can be seen in the photo. A motor driven reel, not seen because of insufficient light, was located at the left. The slip, which is visible in the photo, was pulled across the bridge at a speed that was controlled by a foot switch, and was wound on the reel as it was transcribed.

As the inked slip came from the recording head, it was not wound on a reel, but was allowed to "spill" onto the floor. A transcribing operator would go to the recording head, grab the free end of the recorded slip and quickly wind a "figure 8" ball of slip around his thumb and little finger of his left hand. He would tear off the ball at a point between messages and take the ball of slip to his transcribing position, where he would thread the inside end across the bridge at the top of his mill. The ball of slip, which held a number of messages, would be placed upon the floor.

Several transcribing positions, such as the one shown in the photo, were kept busy. Typically, to provide variety, the operators would rotate between punching transmitting tape on a Kleinsmidt perforator, operating the sending head, operating the recording head, transcribing slip, and operating a normal manual telegraphy position.

When the transcribing operator would reach the end of a message form, he would drop a blank form in the mill's platen so that when the message was pulled out, the blank form would be rolled into place automatically. Thus, with one quick motion, the operator would remove the completed message form from the mill, place it in the clamp holder that can be seen just over the typewriter, and roll the new form into place for beginning the next message. A similar thing was done at the manual operating positions, and an office worker would continuously collect the messages from

all of the clamp holders, so that they could be delivered or given to another operator for forwarding.

No Challenge in Older Times

For Amateurs to Use High Speed Morse code

Sending speeds for us amateurs are limited by the kind of keys we use and by our personal skills. With a straight key 25 – 30 wpm is the usual limit, although some reach 35. A bug raises this to 40 - 45 wpm. Keyers raise this further, perhaps to 55.

But it required a keyboard, a typewriter-like device, to raise it to typing speeds, which may reach or exceed 100-wpm. Now the challenge comes. How fast can I read, not copy, this stuff? Nobody even suspected such speeds as 120 to 140-wpm could be reached, until recent decades.

If you don't want to do this, then don't. But if you enjoy challenging yourself and want to go faster - go ahead and try. If you "love" the code you may want to.

Some of us have natural limitations and some of us assume or imagine that we have limitations. Be honest with yourself; be realistic. Accept natural limitations, such as paralysis, severe pain, etc., or work around them, but don't add imaginary ones.

People have learned to recognize the Morse code characters correctly from an age before they could read print, and up to any age where their minds are still active. Age is no problem.

If our hearing is adequate for ordinary conversation, with or without artificial aids, we should be able to reach almost a talking speed. We may have physical limits on sending, however, because of limited finger movement.

Let's settle the question of how fast for now. The purpose of using Morse code is to communicate. Can I and the ham I am communicating with reach some certain speed? There is no point in sending faster to him than he can receive comfortably. That is just common sense.

Surely you can enjoy communicating at 20-wpm even though you can receive at 80-wpm or more. Do you really want to be able to read at 60, 80 or 100-wpm? If no one you know uses these speeds, there is not much purpose to it, other than some pleasure in doing it. The problem today is that fewer hams use CW because they haven't learned to enjoy it or don't want to spend the effort to gain useful speeds. So set your goal for now. You may change it later if you want to. There are many enjoyable in-between speeds.

Tom says that high-speed is a "fun thing" for him and he does not like to talk about challenging or contesting to see who is best.

Fred says: "I find it much easier to comprehend CW over 60-wpm than below. You begin to listen to the flow of thought, without any attention to the individual words".