

"Electric Technology: The Key to 20th Century Exploration of Space," is the theme of a book to be published by AES in 1999, in time for ceremonies welcoming the 21st Century. Presented here for your review and enrichment is the first chapter of a section on "Aerospace Communication."

Another chapter, "Navigation: Ships to Space," by Myron Kayton, filled pages 521 to 574 in the September, 1988 *AES TRANSACTIONS*. It will be preceded in the book by Kayton's "Animal Navigation, the Ultimate Neural Network."

We welcome your reviews, suggestions, and even more important, your contributions!

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The History of Communications From Cave Drawings to Mail Messages

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In a special feature for the *Discover* magazine, Jared Diamond, Professor of Physiology and Ecology at UCLA and a noted science writer wrote, "after an evolutionary struggle lasting millions of years, our species emerged as the top hominid. And then, in one spectacular moment, we became human." After pondering the question extensively, he could think of only one plausible answer. 'The anatomical basis for the spoken complex language.'

An important characteristic of the human family is its need and ability to communicate intentions to one another. Whether expressing emotions, transmitting knowledge or simply providing entertainment, people express thoughts through some form of communication. With language it takes only a few seconds to communicate a message. But it took humans thousands of years to perfect the structure of language as we know it and to develop methods of communication to reach larger numbers of people, faster and unambiguously. This is rightly termed by Diamond as the "Great Leap Forward."

Civilization as we know it dates back to the time when people first settled down and began to grow their own food. No matter when they lived, where they lived, or how they lived, ancient people have communicated to us that their needs, hopes, and dreams were very much like those of people in today's world. Thus the history of communications is the story of human intercourse modified through the centuries by the changing standards of time and space. From another viewpoint it may also be regarded as the breakdown of isolation between peoples living in different parts of the world.

The important considerations that shaped human communication with time can broadly be categorized as follows:

1. The size of the audience;
2. Distance between the sender of the message and receiver;
3. The speed with which the message is sent;

4. Ease of duplication and degree of accessibility; (This criterion has become very vital in modern times with more and more people craving for information, which enables them to make decisions faster.)
5. Skill necessary for comprehending the communication;
6. Similarity between the received message and the primary source; and
7. Cost of implementing a communication system.

We will discuss the early history of communication in light of the above criteria. Each criterion helped shape various forms of communication. While inter-personal communication could always be done by language, we shall see how people tried to communicate to larger audiences and with greater speed.

Crude drawings on rock and cave walls are the earliest methods of communication which we know. Though it was cumbersome and slow it helped to convey ideas and past events to other people. With the coming of language humans invented methods of recording the complex system of sounds they had developed by means of drawings. But drawings had their weaknesses. Some words like 'how' 'are' and 'then' cannot be drawn. When humans stopped being nomadic and formed tribes and communities, a better system of communication had to prevail, to help the group or tribe sustain. So, 'letters' had to be invented. We shall take a closer look at the development of the written language in the next paper (Part 2). In this paper we shall see how messages were conveyed to larger audiences and over larger distances during the early history of mankind.

As early as 486 B.C., Xerxes, the emperor of Persia who ruled from 486-464 B.C, selected men whose voices carried a long way and whose hearing was good, to man a string of call posts across his empire, relaying messages from post to post. Over long distances this was quicker than sending a runner with the news or the rider. Homer tells us that the Greek Herald Stentor conveyed his messages at the sack of Troy with the voice of fifty ordinary men. Sometimes men also shouted from the top of a tower through a megaphone made from skins of animals. Though this method was fairly efficient and remained



Fig. 1. Men Whose Voices Carried a Long Way

in use for a long time, there were some serious disadvantages, for instance when there high winds or sand storms. Another slightly similar method in use at that time was to use posts and have runners go from one post to the next. Each runner would relay a message from one post to the next and it would be passed on. The Old Testament contains numerous references to this. Messengers were waiting at all times to bear important word from the palace and taking the King's command to the farthest corners of the land.

Runners often carried pigeons with them, so that if they were attacked or incapacitated due to some other reason they would open the cage and let the bird fly to the destination. The homing pigeon is one the best messengers used in the ancient times. Messages were put in tiny metal cases and fastened to a leg

under the wing. When fully trained these pigeons can fly about 700 miles a day at a speed of 40-50 miles an hour. There are tales that tell us that King Solomon and the Queen of Sheba exchanged notes through the carrier pigeons. Pigeons were also used to carry news successfully during the French Revolution of 1848. Interestingly, around this time they were also used to intercept ships coming to America through the Atlantic. This helped some newspaper publications in the East coast to receive news faster from across the Atlantic and be ahead of their competitors in terms of news delivery. But there was the problem that not too much weight could be suspended from the bird and the amount of information conveyed was necessarily limited. Very often these birds were also sent with horsemen, chariots or horse driven carts were used because they can travel faster than runners. These carts were the first mail cars.

The ancients realized that efficient communication must make use of some physical principle swifter than flight of foot. Both sound and light lent themselves for sending messages. Let us see some of the first ways in which sound and light were used for this purpose. The most far reaching, efficient and weather resistant of these early methods of communication was the drumbeat. Archaeologists say that it is likely that Stone Age tribes used drums made of animal skin stretched over a piece of hollow tree trunk. The first Europeans to arrive in South America and Central Africa found a system of sending messages by drumbeat which was superior to any signaling system possessed at that time by the white man. The sounds produced by the drum in the hands of an expert convey the message through the rhythm and strength of the beats. Deep drum beats can be heard clearly over a distance of up to six miles, and in valleys where sound waves meet with little resistance even up to twelve miles. Both in the Amazon and in Africa, some tribes had their drums partly buried in the ground. This had a dual effect. It helped the message travel better and faster and it was not deadened by foliage anymore. Someone at the receiving end would have their ears trained to the ground to interpret the vibration.

The horn and the whistle have also had limited use throughout human history as a means of sending messages. For example, it kept the followers of the hunt informed of the progress of the chase. The Alphorn, a wooden instrument has undoubtedly long been used by Alpine herdsmen, but is not recorded historically until the nineteenth century. The Zurich naturalist, Conrad Gessner, seeing an Alphorn for the first time in 1555 on Mount Pilatus near Lucerne, described it as being "made of two slightly curved hollowed-out pieces of wood thickly covered with willow." This simple design has changed very little until the modern day. The Alphorn was once a calling and signaling instrument of the mountain herdsman. A melodic air meant all was well, while single repeated notes were signals for men in the valley to come to the aid of the herdsman on the mountain. However it could not carry as much information as the drum. And it was not until man learned more about the use of metal and the physics of sound and could make musical instruments capable of a considerable range of notes that a refinement of the horn—the bugle—became an essential part of military communication. The whistle was mostly used by shepherds who skillfully developed them. The whistle had the



Fig. 2. Primitive African Broadcasting
This Signalling Drum of the Tucano Tribe was in use in 1923

advantage that its sound carries more clearly than the human voice in all weathers and does not call for so much physical effort.

When humans discovered fire, they had another means of communication. Fire could be seen a great distance away if it was lit on an exposed hilltop or on a great plain. This method was used by American Indians who became skilled in building smoking fires with damp wood, using a blanket to control the smoke. Each tribe had its own smoke code. Fire beacons were

also used before the birth of Christ to mark the entrance to harbors and then act as a guide to shipping. Fires from large oak logs, coal, candles, and later, oil lamps were used. The most famous of all harbor beacons was the one on the island of Pharos in the Bay of Alexandria. On top of a 400-foot square tower, a huge fire burned day and night shooting flames into the sky that could be seen 30 miles in clear weather. It's beacon fire was so well known that in time 'Pharos' became the word for a beacon or a lighthouse. England was warned of the Spanish



Fig. 3. Herdsmen in Central Switzerland today often take a smaller version of the Alphorn called a Büchel with them to the summer pastures. This use this trumpet-like instrument to play their traditional calls.



Fig. 4. The Pharos of Alexandria, built by Ptolemy Soter; the most famous of all lighthouses and one of the 7 Wonders of the World.

Armada by the chain of beacons set up in 1588. From the great Pharos of Alexandria stemmed the lighthouse now in use all over the world. Today's lighthouses are far more versatile and are equipped with brighter lights, horns and radio—beacons—all possible only because of the invention of electric power.

There are also records indicating that Greeks, Persians and Egyptians used polished metal as mirrors when they desired to send signals. Ships also began using flags to send messages to each other. This has developed into the International Flag Code of today where two ships can communicate to each other even if the people in it speak different languages. Semaphore is a method of visual signaling, usually by means of flags or lights. Before the invention of the telegraph, semaphore signaling from high towers was used to transmit messages between distant points. The first such system was developed by Claude Chappe in France in 1794, employing a set of arms that pivoted on a post. The arms were mounted on towers spaced 5-10 miles apart. Messages were read by telescopic sightings and passed on to the next tower. Semaphore signaling was extensively used for railroad trains and, to a lesser extent, ships. Switch mechanisms for railroad signals had semaphore targets that indicated to railroad engineers how switches were set. Signalling done by the use of light had its obvious advantages. Both by day and by night, messages could be sent over long distances with accuracy and great speed. No wind could blow the signal beam from its course. All that it required was a code of visual signs.

Letters have carried news since humans first learned to write. The first mail consisted of messages scratched into clay tablets

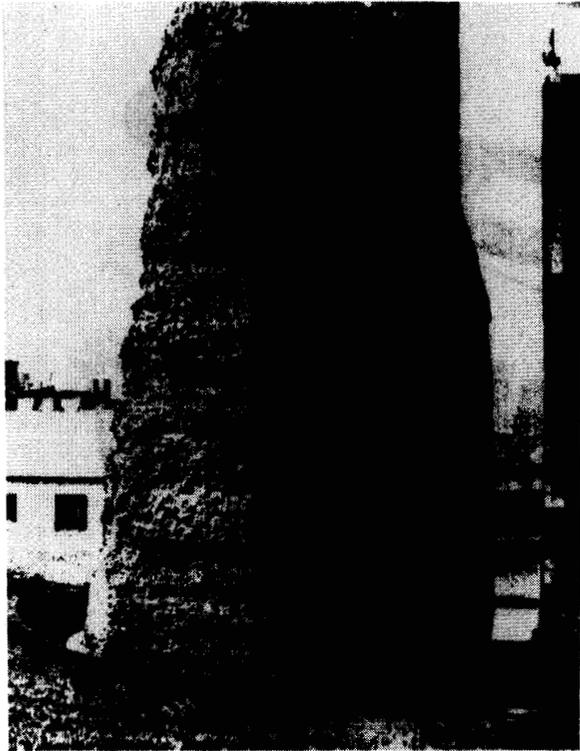


Fig. 5. The Remains of the Roman Lighthouse at Dover

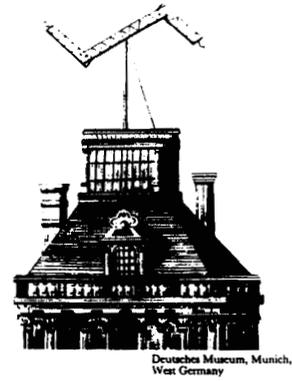


Fig. 7. The Chappe Telegraph consisted of a series of towers. An operator in each tower moved a crossbar and two large jointed arms to spell out messages in code.

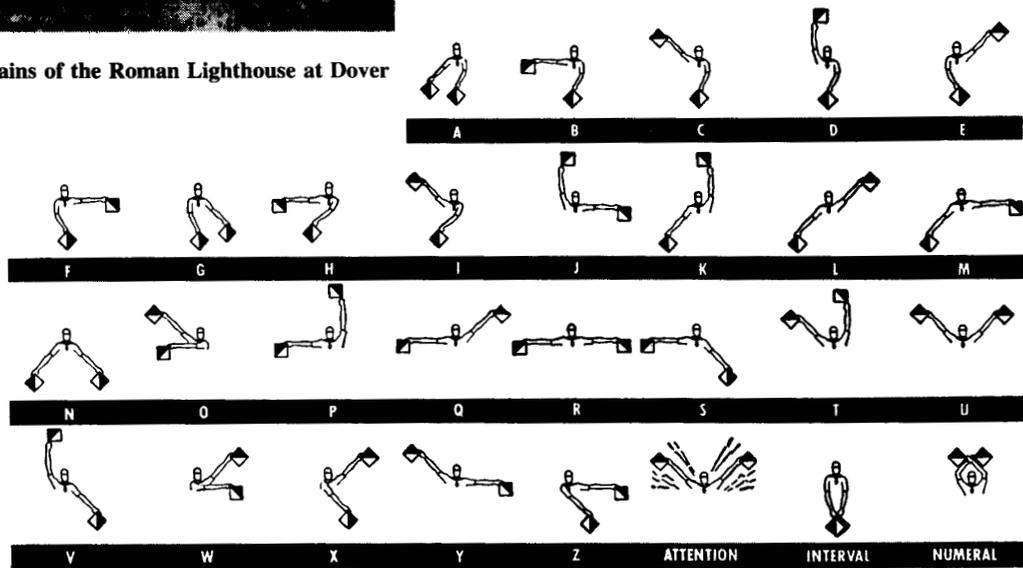


Fig. 6. The Semaphor Code Makes Use of Two Flags for Sending Messages. The sender holds the flags in various positions to represent the letters of the alphabet and other signals. The first 10 letters of the alphabet, preceded by the numerical signal, become the numbers 1 to 0. Punctuation marks must be spelled out.



American Antiquarian Society,
Worcester, Mass.

Fig. 8. Postal Service was Established in Many Nations during the 1700's. This postrider carried mail between Boston and other cities in the American Colonies.

which were entrusted to runners or men on horseback. An interesting story tells us of how in 54 B.C., Caesar's letter from Britain reached Cicero, in 29 days. In 1834, Sir Robert Peel, hurrying from Rome to London required 30 days. Regular postal service began in Europe toward the end of the fifteenth century, but the cost of sending a letter was so high that patrons were mostly people of wealth.

When the first colonists came to America from England, they received mail unofficially from ship captains and it was not until 1639 that the first official postal system was established in the United States. As the American frontier moved farther and farther West, the delivery of mail to the pioneer towns was slow. After gold was discovered in California in 1849, post offices were set up in towns and cities, but mail from the East might take months to reach the West coast. With miners and others in California clamoring for faster mail service, the ancient method of horseback riders was called upon to carry mail. This was to become the Pony Express. Each rider changed horses every ten miles and rode for a hundred, where it was given to the next rider.

It is an important fact that until the very beginning of the nineteenth century, the speed of carrying the messages almost remained the same. While light and sound were used for the sending and receiving of messages, the communication had a very limited audience or was not two-way. Often the limit was the endurance of human or animal muscles. It was not until the invention of electricity that communication was to acquire a new meaning. And it may also be said that this communication revolution which began with the advent of electric power is one of the foundations of the modern world.

REFERENCE

- [1] UNESCO Courier,
February 1987, pp. 29-31.

Foundation of the German Association for EMC-Technology (DEMVT)

**Parliamentary Secretary of State, Dr. Erich Riedl,
wishes the newly-founded DEMVT great success for their future activities.**

On Thursday, November 7, 1991, the "German Society for EMC-Technology" was founded in Munich. More than 60 experts for the field of "Electromagnetic Compatibility" from Germany, Austria and Switzerland attended the event which was launched in the Penta Hotel in Munich at 15.00h.

In his speech the Parliamentary Secretary of State of the Ministry of Economics, Dr. Erich Riedl, wished all participants good luck and success for the newly-founded society and emphasized the urgent necessity for such an initiative, especially at the present time.

Electromagnetic compatibility is the ability of an electronic or electric device to work interference-free in its electromagnetic environment, especially with the introduction of integrated circuits over the last few years and the ever-growing application of electronic components in all spheres of modern life. This feature has become a major task for technicians and development engineers.

Presently the subject "EMC" has again started many discussions, since on 1 January 1992 the German EMC regulations will become valid. With these regulations a multitude of national and international recommendations, which have been in existence for many years, will become law.

"I would like to emphasize that the EMC is not only a theme for experts but also has a growing importance in the political field," Dr. Riedl started his speech during the foundation festivity and thus emphasized the acute sensitivity of the EMC-technology and the extensive consequences in political and economic decisions.

For many companies the new EMC law creates considerable problems. The EMC often still has a "Black Box" character, since the EMC know-how in the company was not appropriately promoted so that the staff today does not have sufficient knowledge in this field.

Dr. Riedl: "The public has to be informed first what electromagnetic

compatibility actually is and which fatal consequences the neglect of EMC problems has for the functioning of equipment and installations in the fields of telecommunication, traffic technology, medicine and vehicle electronics, etc. . . ."

The aim and task of the DEMVT is, on the one hand, the demonstration and representation of EMC technology in political, economic and public spheres. On the other hand, the society would like to create the possibility of allowing an exchange of know-how by establishing committees for specified fields.

The extensive EMV field resulting from the two roots, high frequency and high-power engineering, affects, in almost all spheres, modern mankind in his environment that is greatly oriented toward electric energy technology and communication and data transmission and processing. Affected are human safety and the availability of modern technical equipment and systems as well as the reliability of communication/data transmission.

Just as important are the biological factors acting on the human physique and psyche, surely a theme that in the future will create many discussions. In order to accomplish competent and successful work the DEMVT will establish four committees which will work on the aforementioned themes.

The highlight of the foundation festivity was the ratification of the foundation document through 22 of the present representatives of smaller and larger firms in the EMC field. Joseph Schmitz, manager of ELNIC GmbH in Rosenheim, was voted president; Kilian Müller, publisher of the magazine EMV Journal, became vice-president; Monika Neufingerl, of EMV GmbH took over the post of secretary; and Jakob Mooser, manager of Mooser Consultant GmbH, takes the post of cashier. The nominations for the committees will be dealt with during the first regular general meeting.