# GILBERT

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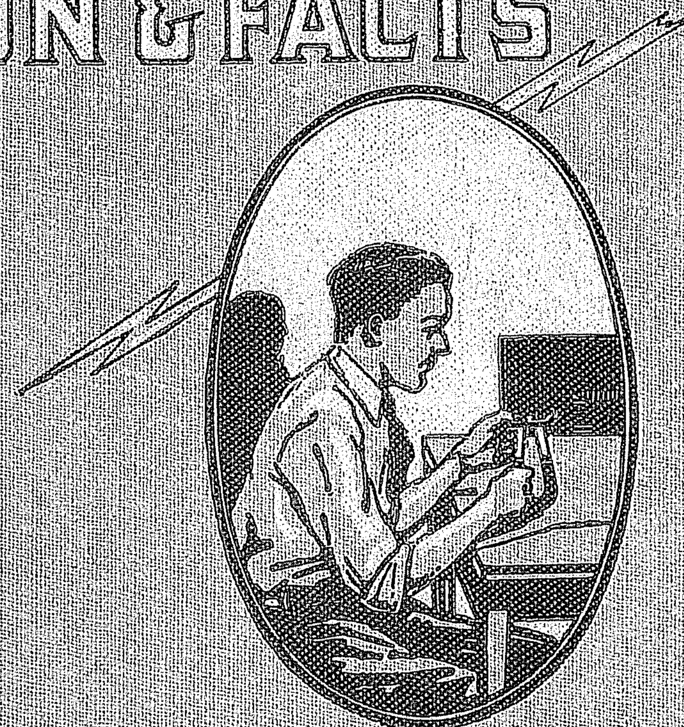
# MAGNETIC FUN & FACTS



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# MAGNETIC FUN AND FACTS


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# FOREWORD

Magnetism has always seemed to me to be such a fascinating subject, — it affects our everyday life so greatly that I thought those boys who are interested in Gilbert Toys would like to know more about it. So I have endeavored to compile information on magnetism in many of its forms that will be interesting for you to know. A thorough study of this book will, I am sure, give you a much better understanding of what magnetism means to all of us.

The boy who knows about different kinds of engineering —electrical, chemical, structural, etc.—the kinds that are covered by Gilbert Toys, is the type of a boy who will be a leader among his fellow boy friends. He is the boy whom the rest of the boys look up to, and they only do it because they appreciate that he has a knowledge of different things which they don't understand.

You can be a leader among your boy friends and you won't have to study and work hard to become one either. You don't have to do that at all. You can get all kinds of interesting information about sciences and other things right while you are playing. This book is only one of many of its kind that I have had compiled. Used in conjunction with the Gilbert Toys they describe, they offer you the best kind of an opportunity to have all kinds of fun and at the same time put you up among the leaders of boys.

Sincerely yours,

A. C. Gilbert

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# GILBERT MAGNETIC FUN AND FACTS

## Chapter I

### A SEA FOG

Have you ever been sailing in a boat way out at sea when the fog came down about you so that you could not see one end of the boat from the other? How did the captain guide the vessel toward port? He had one little thing to help him keep his course. That was the ship's compass.

Perhaps some of you have been hiking in the woods at night when the rain or clouds prevented the stars from shining. How did you find your way through the woods back to camp? If you had not the sense of direction, you probably used a compass to keep you from getting lost.

Did you know that this simple compass is one of the first magnets discovered? Men have found various other magnets after long years of search and have gradually learned how to use them. Today ships not only are guided through the fog, but are also lighted by electric lights, signals sent across the ocean, elevators run, bread baked and numberless other things done by the help of magnets.

Suppose we go back to the very beginning of these discoveries and, by making experiments, learn all we can about magnetism.

Sometime during the first hundred years A. D., wide-awake men and boys living around Magnesia, which is a town in Asia Minor, found pieces of hard, black stone which would pull or attract iron to them or would be pulled or attracted to the iron itself. Probably the first man to discover this found little pieces of this black stone clinging to the iron tip of his travelling staff which all the wayfarers used in those days. This peculiar black stone is found in several places in the world and is a kind of iron ore.

Perhaps you remember the story of the Arabian Nights about the wonderful iron mountain against which ships were pulled and dashed to pieces. Evidently the writer had heard of this wonderful iron stone and must have believed that the mountain was made of it.

A long time afterward, some unknown man discovered that if you hung one of these black stones on a thread or made a raft of cork or wood and laid the stone floating in a basin of water, a wonderful thing happened. The stone turned and pointed nearly north and south! The Chinese found this out perhaps sooner than the Europeans and put this peculiar quality to work as the earliest form of compasses on their sailing vessels. Before this time, men had to depend entirely upon the sun and stars, and if a fog came up or a night was cloudy, they lost their way and were often wrecked.

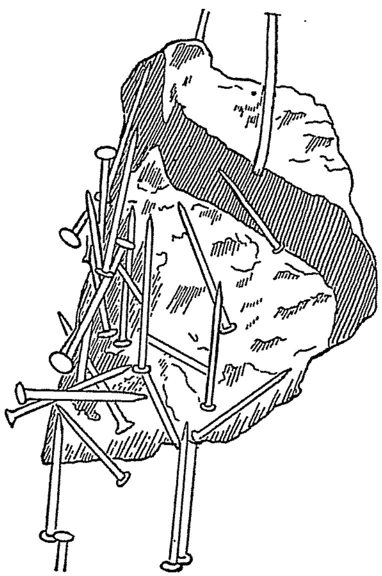

FIG. 1

Men familiar with minerals have given this iron ore the name of "magnetite" which you see sounds very much like "magnet". Sailors who used these stones for guidance over the seas called them "lodestones", which in those days meant the same as "leading



stone". Figure 1 shows a picture of one of these natural magnets or lodestones with iron nails clinging to it.

The next important discovery in this line was that hard iron or steel rubbed on these natural magnets became permanently magnetized and would draw other pieces of iron or steel to them.

The first reliable book on magnetism was written by Dr. Gilbert, an Englishman, in about 1600 A. D. Let us start with Dr. Gilbert's experiments and learn first about the compass.

## THE COMPASS

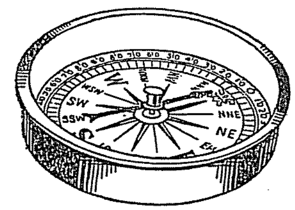

FIG. 2

Figure 2 is a picture of a compass. Notice first the black needle swinging on the pivot. Which way does the needle try to point? One end will try to point north and the other end turns toward the south. Around the bottom of the case is a paper with the different points of the compass marked. This paper is commonly called the wind-sail. See Figure 3.

BOY SCOUTS, in order to become second class scouts, learn the sixteen principal points of the compass, and, in reciting them, do what sailors call "boxing the compass". The list given below covers all points of the compass and the numbered points, those you are required to know to pass the SECOND CLASS SCOUT TEST.

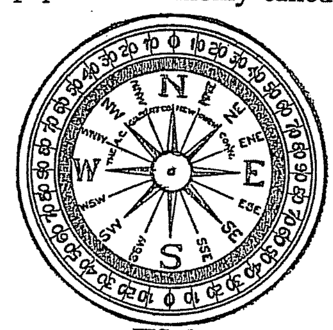


FIG. 3

(1) North
North by east

(2) North, north-east
North-east by north

(3) North-east
North-east by east

(4) East, north-east
East by north

(5) East
East by south
(6) East, south-east
South-east by east
(7) South-east
South-east by south
(8) South, south-east
South by east
(9) South
South by west
(10) South, south-west
South-west by south
(11) South-west
South-west by west
(12) West, south-west
West by south
(13) West
West by north
(14) West, north-west
North-west by west
(15) North-west
North-west by north
(16) North, north-west
North by west
North

Spin the needle around and notice that it comes back to rest always pointing in the same direction. Tie a little thread about the middle of a bar magnet and you will see that, when it comes to rest, it also points nearly north and south. Take a horseshoe magnet and hang it up by the top so that the shiny ends are toward the ground and the end with the mark on it will point nearly toward the north. Why do they all act this way?

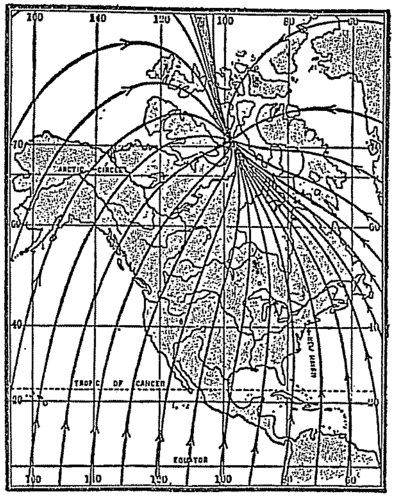

FIG. 4

Dr. Gilbert proved that this earth we live in is a great magnet. He found that this natural magnet had two ends or poles, one in the very northern part of North America and the other in the Antarctic regions. These draw the ends of all other magnets toward them. This is the reason why the magnet needle always tries to point north and south, but remember that the north and south poles spoken of in geography are at different locations from these. The compass really points not true north and south but rather to these magnetic places. The angle between the direct north and south line and the direction in which all compasses point is called the DECLINATION and varies at different places.



Figure 4 shows a map of the magnetic lines going toward the North Magnetic Pole. A compass placed in any one of these lines will point as shown by the arrows.

## MAKING A MAGNET

Suppose we take a sewing needle and a piece of soft iron wire. Touch the point of the needle to one end of the iron wire. What happens? Nothing happens, and the needle can be removed without trouble. Why? It is because the steel of the needle has not been magnetized. Rub the point of the needle on one end of the horseshoe magnet and again touch one of the iron wires. You will see that the wire sticks to the point of the needle and tries to hang on when you move the needle.

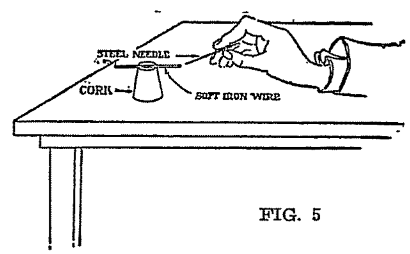

FIG. 5

In Figure 5 you will see another way to make this experiment by laying the soft iron wire on top of a cork and holding your needle against an end of the wire. The first time, before the steel is magnetized, nothing happens. The second time the iron wire seems to jump to the steel needle and clings so that you can pull it off the cork.

These experiments prove to us that a piece of steel or hard iron can be magnetized not only by rubbing it against a lodestone but also by rubbing it against the end of *any* magnet.

Take another needle and, before magnetizing it, suspend it by a thread so that it hangs level. Now touch one end with an end of a magnet. What happens? If you live north of the equator, the north-pointing end of the needle drops downward. If south of the equator, the south-pointing end of the needle points down. How can we explain this?

Dr. Gilbert found this to be caused by the pull of the earth's magnetism. It has been proven that, as we go further north, the pull of the North Magnetic Pole makes the needle point more and more downward until we have reached the very spot of the magnetic pole itself when the needle will point straight down. In the same way going south of the equator, we find the needle dipping more and more until the South Magnetic Pole is reached. See Figure 6.

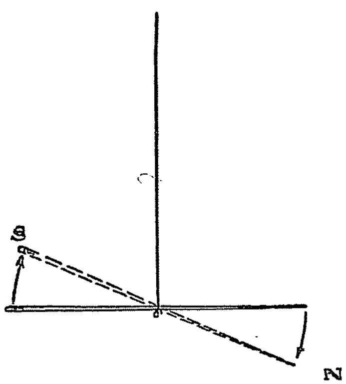


FIG. 6

**Inclination**—The needle hangs parallel with the floor before magnetized. After magnetization it dips. North of the equator the dip is shown by the dotted lines.

This curious thing is known as the Magnetic Inclination. For some reason yet unknown, both the magnetic inclination and declination vary from time to time. One variation is every eleven years; another every time there is an eclipse of the sun.



## POLARITY

Pour some iron filings on a paper and drop a bar magnet in them as shown in Figure 7. What happens?

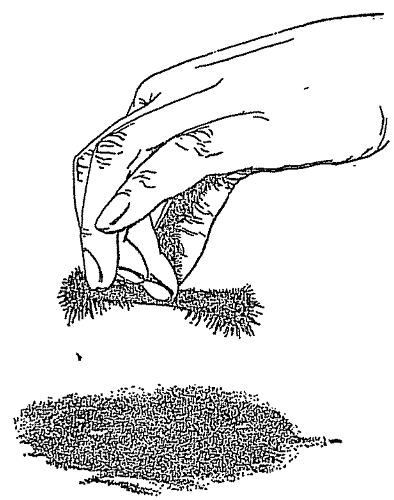

FIG. 7

You will see the little specks of iron form themselves together in little hairs or whiskers and jump and cling to the ends of the bar magnet, but in the middle part of the magnet there are practically no iron filings. This shows that the mysterious magnetic force is stronger at the ends or points of the magnet and apparently has little or no force in the middle. Dr. Gilbert called the ends of the magnet the Poles. The one turning toward the north he called the north pole; the one turning toward the south, the south pole.

By experimenting with little soft iron wires, you will find that Non-Magnetized Iron or Steel Will Attract Either Pole of a Magnet.

Look at a bar magnet. You will notice one end is usually marked with an "N" or with a "+" sign. Hold one end toward the suspended needle as in Figure 8. What happens? One end of your sewing needle turns toward the bar magnet and tries to stick to it. Hold the same end of your bar magnet toward the other end of your needle. What happens? It doesn't attract, does it? It seems to try to get away. What does this mean? Turn the bar magnet around in your hand and hold the other end of it toward the ends of the needle. What happens now? You will find the end that was

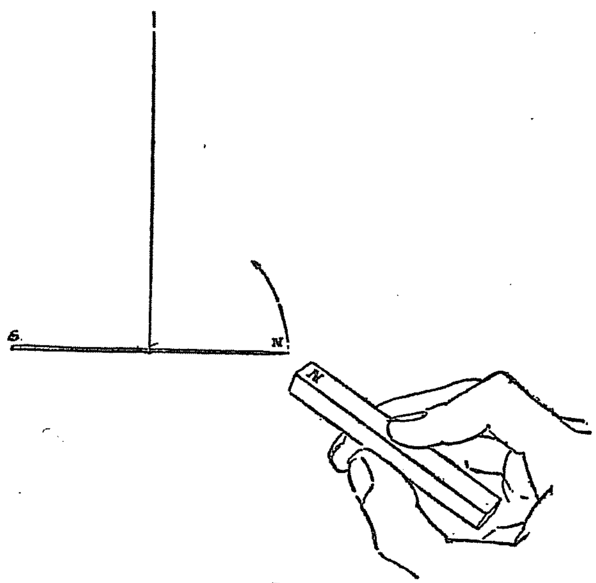


FIG. 8

pulled toward the bar magnet before now turns away while the other end comes rushing around to grab the other end of the bar.

Hang up one bar magnet in the same way and hold another bar magnet toward it. See Figure 9. You will find the two act toward each other just as the needle and magnet did, and, if you will look closely, you will find that the ends marked "N" push each other away and if you hold an "N" end toward the plain end of the other bar magnet, they pull toward each other.



Another interesting way to try this experiment is to lay one bar magnet on the table, as in Figure 10, balance another on top of it, giving the top one a little push, and you will see that it will swing so that the marked end of it is at the opposite end from the marked end of the bottom one.

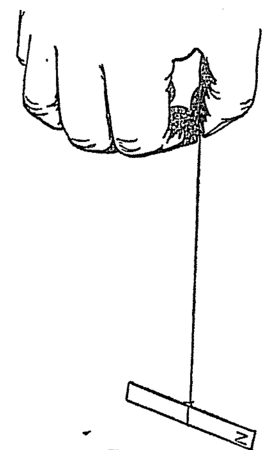


FIG. 9

All these experiments prove to us that magnets not only attract each other, but repel and further than this, the NORTH-SEEKING ENDS REPEL EACH OTHER AND THE SOUTH-SEEKING ENDS REPEL EACH OTHER, but a SOUTH END WILL ATTRACT A NORTH END and likewise a NORTH END, A SOUTH END. The ENDS of the magnet are called POLES and the discovery above is made into a statement or law which says "LIKE POLES REPEL EACH OTHER; UNLIKE POLES ATTRACT."

Now we must ask ourselves, what is magnetism? That is yet to be found out. No one knows just what it is, neither do they know what electricity is. Currents of electricity and magnetism always seem to be found together and the men of electrical science have put this pair of giants to work as their servants in a great many different ways, sometimes making magnetism work to increase the power of electricity, other times making electric currents work to increase the magnetic forces.

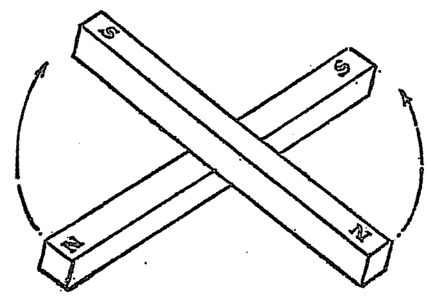


FIG. 10