

Did Roger Bacon Have a Telescope?

History of Science

By JAMES STOKLEY

Roger Bacon, the famous Franciscan monk who lived in England in the thirteenth century may have had a telescope, nearly four centuries before the generally accepted date of its invention in 1610. With it, possibly, he made a discovery of the nature of the spiral nebulae in the sky that anticipated one made less than a century ago, with one of the world's largest telescopes.

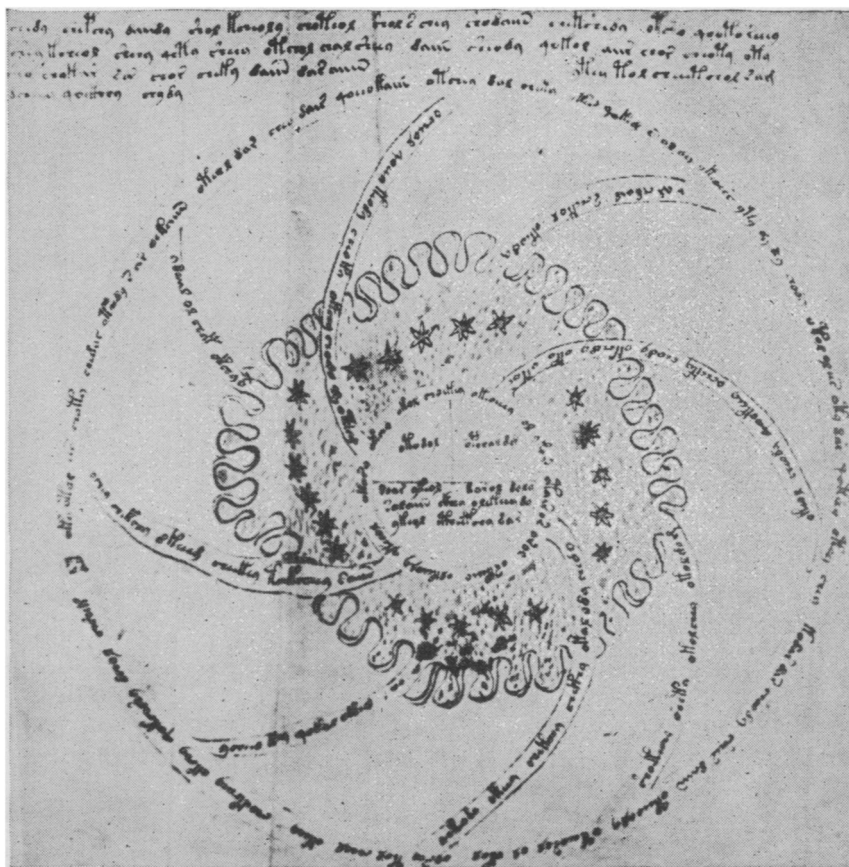
Perhaps, also, he had a microscope, and was able to observe the mechanism of reproduction, anticipating another discovery of later centuries.

Such are some of the startling conclusions that have been drawn from the study of a curious old manuscript written in cipher, that was found in an old Austrian castle in 1912. For many years before his death the late Prof. W. R. Newbold, of the University of Pennsylvania, labored over its decipherment, and the results of his studies have just been published by the university press. The title is "The Cipher of Roger Bacon", and it was edited by Dr. Newbold's colleague and friend, Prof. Roland G. Kent.

As thrilling as any mystery story is the tale of this manuscript, as pieced together by its owner and finder, Wilfrid M. Voynich of New York. After a few years of comparative freedom, Roger Bacon fell afoul of his superiors and was imprisoned in 1277. The place of his imprisonment is unknown, as is also the date of his release, but it was probably about 1290. But little good it did him, for in 1292 he died, and, according to the best authority, was buried at Oxford on June 11, 1292.

As might be expected of a man who had spent his lifetime gathering knowledge, in an age when any extraordinary learning was considered proof of communion with evil powers, Bacon evidently wanted to preserve his work. But he had to do it in a way to avoid attracting further suspicion. Another factor, pointed out by Dr. Newbold, is that, in common with the scholars of the day, Bacon considered that the man who had succeeded in penetrating one of nature's secrets had, so to speak, been taken into the confidence of God. Therefore it would be sacrilege to reveal the fruits of his labor to the vulgar.

Whatever the reason, Bacon pre-



THE CURIOUS SPIRAL STRUCTURE in the Bacon cipher, which Prof. Newbold believed to represent the Great Nebula in Andromeda, one of the closest of the spiral nebulae. The inscription at its center tells of viewing it "in a concave mirror."

pared this monumental work, written entirely in cipher, yet so closely was it done that to a superficial reader it would appear to be written in ordinary, though technical, Latin. Of course, at that time, as for centuries later, Latin was the universal language of scholars in all countries.

Perhaps the cipher was based largely on a cipher manuscript which Bacon is known to have sent to Pope Clement IV, with whom he was friendly, in 1267, a year before the pope's death. This was sent in the hands of a youth named John, one of Bacon's trusted pupils. As he mentions in it a comet that appeared in 1273 and an eclipse of 1290, it is evident that it is not the identical manuscript that was sent to Clement. The original manuscript was long lost. Bacon's *Opus Majus*, or "Great Work," was sent to Clement about the same time. Within recent years the actual copy sent to the pope, with Bacon's autograph notes, has turned up in the Vatican

library in Rome. As a complete cataloging of the Vatican library, the first that it has ever had, is now under way, at the expense of the Rockefeller Foundation, it is not unlikely other lost works of Bacon may come to light in the future.

In any event, after his death Bacon presumably bequeathed the Voynich manuscript to one of his students, perhaps the same John, and then, after his death, it remained in some English monastery library. During the sixteenth century, when Henry VIII dissolved the monasteries, the manuscript, along with other spoils, passed to the Duke of Northumberland. A Dr. John Dee, the prototype of Prospero in Shakespeare's "Tempest," was one of the first of the later men of learning to recognize Bacon's achievements. At the age of 26 he began to collect Bacon's works and manuscripts, finally obtaining the cipher manuscript, along with other items, from the Duke (*Turn to next page*)

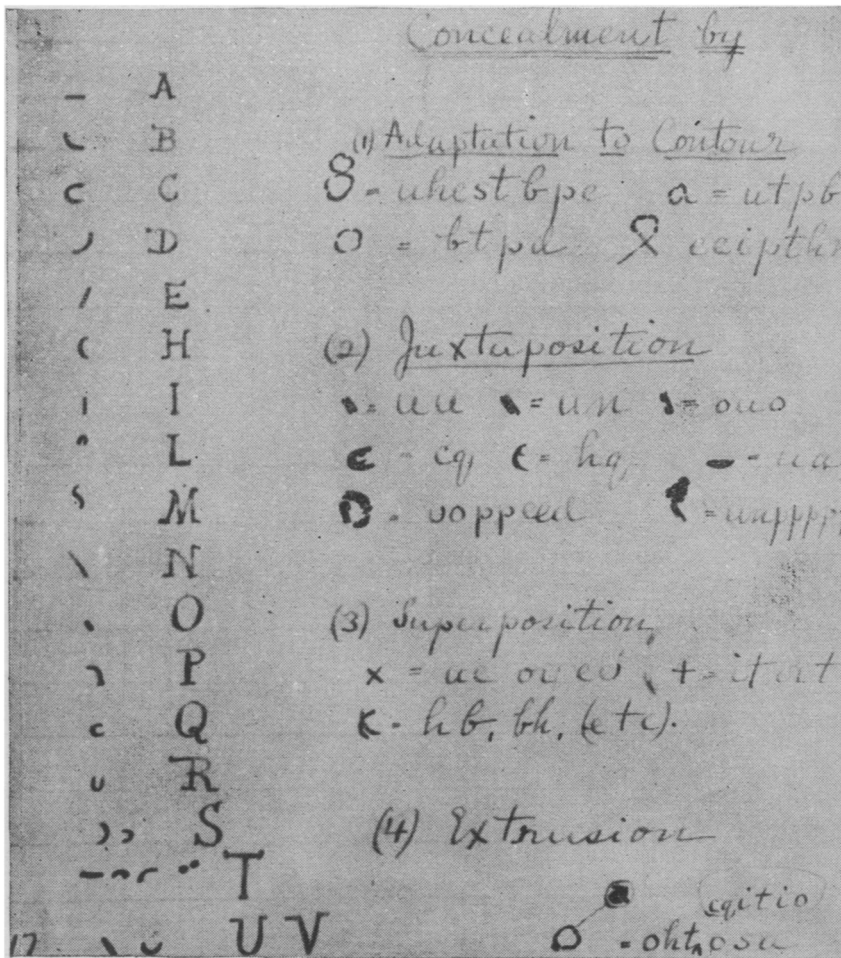
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of Northumberland. Dee made several visits to the Emperor Rudolph II, at Prague, between 1584 and 1588. At that time Rudolph was one of the most enlightened of monarchs, and chief patron of sciences. Apparently Dee presented the cipher to Rudolph, with whom he had discussed Bacon at length. Some time after 1608, probably about 1611, when Rudolph abdicated, it was acquired by a Jacobus de Tepenez, who was also interested in occult science. The next owner, who cannot be identified, probably obtained it at de Tepenez's death in 1622, and he bequeathed it, sometime around 1640, and after unsuccessful attempts to decipher it, to a famous scientist of his time, one Marcus Marci.

In 1665 Marcus Marci presented it to Athanasius Kircher, a Jesuit scholar who is still accorded a prominent place in scientific history. The letter of Marci to Kircher transmitting the work was still in it when found in 1912. He told Kircher in the letter that the manuscript was attributed to Roger Bacon. What happened to it after Kircher's death in 1680 is unknown—apparently it went to one of his friends, who took no particular interest in it, and from whom it went to the collection in which Mr. Voynich discovered it.

In this way there came to Dr. Newbold this most elaborate and deceptive of all ciphers. So difficult is it that several scholars failed to make any sense out of it at all. Dr. Newbold was sent a couple of photographic copies of certain pages, one of which happened to be the last. On this was a curious sentence in rather mutilated Latin: "Michiton oladabas multos te tccr cerc portas." Hidden in these words is "Michi dabas multas portas" or "To me thou gavest many gates." The words left out, that "ton ola" and "te tccr cerc," Dr. Newbold found, were cipher for "R. B." and "four," so that the whole thing meant, "To me, R. B. (i. e. Roger Bacon) thou gavest many gates."

This, to Dr. Newbold, was significant. "I found a clue in the word 'portas'—'gates,'" he wrote. "I had studied the Kabbalah, that curious gnostic philosophy of medieval Judaism, and I knew that Bacon had some acquaintance with the ideas best known to us as elements of the Kabbalah. Now, in the Kabbalah, the 'gates' are all the possible combinations of the letters of the Hebrew alphabet, taken two by two."



THE GREEK SHORTHAND SYSTEM which Bacon used in his cipher and the way he combined its letters so that they appeared to be other letters. This is one of Prof. Newbold's sheets of notes

"Bacon's primary aim," continues Dr. Newbold in his book, "was to construct a cipher which would give no indication of being a cipher at all, and which in consequence would arouse no curiosity and prompt no one to attempt its decipherment."

This is the way he did it.

Take an alphabet, a, b, c, d, e, f, g, etc., then combine it in turns with each of the other letters, so as to give a series of two-letter alphabets. These will be like this: aa, ab, ac, ad, ae, etc.; ba, bb, bc, bd, etc.; ca, cb, cc, etc.; and so on. Now these various alphabets, if continued to the end, will contain all the possible two letter combinations that occur in actual words.

Bacon's idea, which Dr. Newbold thought to be original and peculiar to him, was to assign to these two-letter symbols the values of single letters of the alphabet, and at the same time use the two-letter groups to build up other words. Dr. New-

bold gives the following example. If one wanted to cipher the latin word "tonus," with "fi" meaning "t"; "de" for "o"; "li" for "n"; "or" for "u" and "um" for "s", then the word "fideliorum" would be the cipher word for "tonus." The cipher was extremely complicated because the cipher equivalents of the actual letters must be constantly changed. Under such handicaps, Bacon wrote his secrets for posterity.

Even this did not satisfy Bacon, so he thought of still another way to make the puzzle harder for those who followed him. This was probably original with him, for he took a Greek shorthand system that was current in the Middle Ages. As in modern shorthand, short lines, straight and curved, were used, but each character represented a letter, instead of a syllable, like systems of the present day. Dr. Newbold found that certain characters in the manuscripts, when (Turn to page 133)

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examined under a magnifying glass, proved to be made up of a great number of short strokes of the pen. These short strokes were the short hand characters, and so, in what seemed to be a single letter, there might be concealed an entire sentence.

The "michiton olabadas" key at the end proved to be made up of such characters in part, and Dr. Newbold found that when fully deciphered, it gave a short Latin verse:

"Rogerus Bacon
Adiens coelum
Hilaris festum
Cum sanctis coenarit."

Or, in English:

"I, Roger Bacon,
Drawing nigh heaven,
Gladly would feast with
The saints at their banquet."

This might have been put there, Dr. Newbold suggested, as a mnemonic rhyme, to aid in remembering the key.

With such a complicated cipher, and with such juggling required to make it into plain language, it might be thought that any gibberish might be turned into something sensible, but that the result would be from the mind of the translator, and not in the original. Those who knew Dr. Newbold testify to his high moral character, so, of course, there is no suggestion of wilful deceit. But the subconscious mind of the translator might put meaning into it. There is evidence, however, that this is not the case, and that the

cipher methods as worked out by Dr. Newbold are actually correct.

In the French National Library, at Paris, there is a manuscript written by Bacon which is possibly the long-lost work that he sent to Pope Clement IV. It purports to be a medical treatise, but Dr. Newbold found that it was also in cipher and that, when deciphered, it contained some alchemical writings. The problems of alchemy, the art of changing baser metals into valuable ones, engaged the attention of many in the Middle Ages.

Part of the text which Dr. Newbold deciphered by the two-letter equivalent method that he had employed in the Voynich manuscript, proved to be a formula for preparing metallic copper. The method given is a most unusual one, one that modern chemists to whom he showed it had never heard. But Prof. Newbold's colleague in the chemistry department of the University of Pennsylvania, Prof. Hiram S. Lukens, tried it, and found that it actually worked. Since Prof. Newbold was not a chemist it is hardly possible that he could have thought, consciously or subconsciously, of this unusual method.

It is the illustrations that are most interesting, however for they together with the text accompanying them, when deciphered, may indicate that Bacon was possessed of optical aid in the form of powerful telescopes and microscopes, at least

three centuries before these instruments are supposed to have been invented.

One of these drawings is of a structure consisting of two concentric rings, and connected by spiral arms. In it are a number of stars, and a cipher inscription accompanies it.

The inscription was extremely difficult to translate, wrote Dr. Newbold, but his first attempts interpreted it as telling that the object was between "the navel of Pegasus, the girdle of Andromeda and the head of Cassiopeia," and that it was seen in a concave mirror. Of course, that was long before the days of modern methods of designating stars, and the usual way was like this, from parts of the imaginary constellation figures.

Now, it happens that in this part of the constellation of Andromeda there is a spiral nebula, one of the great group of celestial objects that have within the last few years been shown to be systems of stars. They are like the system of which the sun, the Milky Way, and all the stars that we can see are part, but far outside its confines. They all have a characteristically spiral structure, but in some it is much more evident than in others. The one in Andromeda is one of the largest and nearest of these. It can just be seen with the unaided eye on a dark night, and is the only one that can be seen without (*Turn to next page*)

Astronomical Meeting Here

Astronomy

The International Astronomical Union, at which astronomers from all parts of the world meet every three years, will be held in the United States in September, 1932. This decision was reached at the meeting in Holland. The meeting will be held in 1932 instead of 1931, when three years will have elapsed, in order to accommodate astronomers from other countries who wish to view the total eclipse of the sun that will be visible in New England and eastern Canada on the afternoon of August 31, 1932.

So far the place of meeting has not been determined. Sir Frank Dyson, British Astronomer Royal, who is in charge of the Greenwich Observatory, will preside over the American meeting.

Science News-Letter, September 1, 1928

Totems Showed Trades of Clan

Anthropology

An Indian belonged to the bear or beaver clan, not so much because of a mystic brotherly affinity with that particular wild creature, as because the animal was a simple symbol of the Indian's economic class. This new interpretation of the Indian clan system has won for Dr. E. A. Bates, of Cornell University, the award of the Tyler medal, which will be presented to him in London next April.

The beaver clan drew its name from the skillful carpenters of the animal world, because these Indians wished to be known as good home builders. The wolf was the group symbol of a hunting class of Indians. The bear was the farmer's symbol.

This explanation is further borne out by the return of the Berlin African Expedition. It has found that the elephant clan of the African tribes

originated similarly in the economic status of the people who dealt in transportation.

Dr. Bates will sail shortly for Europe, with the paradoxical aim of investigating there what the Indians contributed to American culture. In the attempts of scientists to reconstruct the dawn period of American history, it has been hard to distinguish what the Indians taught the white men, and what the white men taught the Indians.

Dr. Bates will trace the heritage of some of the oldest white families that came to this country, in the hope of finding out what customs of farming and housekeeping they would have brought to the new world. This will show more definitely what the typically Indian customs must have been.

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optical assistance. Unfortunately for Dr. Newbold's theory, however, though this nebula is so large and bright, its spiral structure is not at all obvious. Even with a large modern telescope it does not appear spiral, but as a rather elliptical area of light. Only with photographs made with the huge instruments of present day observatories, does the spiral structure become apparent, and it is only within the past half century that such photographs have been made. The first spiral nebula to be observed as really spiral was only discovered so about 1840.

Prof. Newbold realized this objection, and suggested that "the nebula must therefore have changed considerably in appearance in six hundred and fifty years." Astronomers, however, consider such vast changes as this in such a period to be entirely beyond the realms of possibility. If it were changing so fast, comparison of the photographs made of it about thirty years ago, with those made today, would reveal changes apparent to the trained eye of the astronomer. But no such marked changes are apparent. Astronomers who have been consulted are therefore of the opinion that the interpretation of the cipher inscription by Prof. Newbold is not correct. Certainly, the evidence that Bacon had a telescope is exceedingly weak.

Bacon made some other astronomical observations, but not to require the use of a telescope. One

inscription deciphered by Dr. Newbold related the appearance of a comet in 1273, and upon looking up the records he found that there was actually a prominent comet in that year. Another one described an annular eclipse of the sun, in which the sun is partly covered by the dark disc of the moon, so that a bright ring of light remains visible around it. This also checked with records of astronomical history.

When it comes to the possibility of Bacon having had a microscope, or at least some extremely powerful magnifying instrument, the evidence is a little more convincing than that for his telescope. Some of the drawings show curious elongated objects with long slender tails, that might be a representation of spermatozoa, the male generative cells. Other drawings associated with these show round structures with considerable detail. These Prof. Newbold thought, represented the ova, or egg cells of the female. The accompanying inscriptions, as deciphered, indicated that Bacon understood how the union of these two elements produces the individual. But the sperm cells are extremely small, so that even today powerful microscopes are needed to see them. They can be seen with rather primitive instruments, however, for the seventeenth century Dutch microscopist, Leeuwenhoek, did see them with an early form of the instrument.

"But," says Dr. Newbold, referring to Bacon's supposed discovery,

"whether the microscope with which he saw the spermatozoa and the cells which he has so clearly depicted in the drawings was of the simple or compound type will remain an open question until the manuscript has been deciphered. Some students are of the opinion that a simple lens of high power would have sufficed."

Regardless of whether or not Bacon had a telescope or microscope, there is little doubt that he was the great genius of his age, and that his talents were not appreciated by his contemporaries. On this account, thought Dr. Newbold, Bacon decided to preserve all his knowledge in the form of this cipher, which he had devised and used on previous occasions, "in the hope that in a more sympathetic age the fruits of his labors would come to light."

That age did not dawn as soon as Bacon had hoped, said Dr. Newbold, but now, at last, after more than six centuries, the manuscript has come to light.

"The secret of the cipher has been unraveled," he says. "Difficulties, formidable difficulties, still bar the way to the reading of Bacon's manuscript, but they are less formidable than those which have been overcome. These also must be overcome before the full story can be told. But even with the text unread, the drawings alone throw a flood of light upon the achievements of Roger Bacon."

Science News-Letter, September 1, 1928

Hordes of Squirrels

Zoology

E. C. MOSELEY, in *Our Wild Animals* (Appleton):

For a time after the pioneers began making clearings in the forest and raising crops, the squirrels increased because of more abundant food and fewer wild enemies. According to Dr. Kirtland, red squirrels first made their appearance on the Western Reserve in northern Ohio early in the nineteenth century. By the middle of the century they had become abundant there.

Gray squirrels, too, doubtless increased in numbers when food became plentiful. In northern Ohio a hunter is said to have killed 160 in a day; 21 gray and black squirrels were seen in one tree in 1855. In White River township, Johnson County, In-

diana, in 1821, gray squirrels were so numerous that on four farms not a single bushel of corn was saved from them. In one four-acre field, every ear was taken within two days after the corn had ripened. In Bartholomew County, Indiana, in 1834, there was a contest among the squirrel hunters in which one hundred persons participated. The champion killed 900 squirrels in three days; the second largest number killed was 783.

At various times and places gray squirrels have been observed to migrate. These migrations were seen in southern Wisconsin in 1842, 1847, 1852, and 1857, one each five years. Their cause is not well understood, but is thought to be due to a superabundance of the squirrels in the region from which they migrate. While

migrating "many are drowned in attempting to cross streams; not a few are destroyed by man; some die from utter exhaustion, and when forced to travel in an unnatural manner upon the ground they fall an easy prey to rapacious birds and mammals, all of which feast when the squirrels migrate. During one of these migrations innumerable squirrels swam across the Niagara near Buffalo, landing so exhausted as to be easily taken by hand or knocked down with sticks."

Referring to migrations of gray squirrels in the Ohio Valley in an early day, Col. James Barker speaks of their "coming in millions from the north to the south, destroying whole fields of corn in a single day."

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