n 1984, two small clay tablets of vaguely rectangular shape were found in Tell Brak, Syria, dating from the fourth millennium bc. I saw them, the year before the Gulf War, in an unostentatious display case in the Archeological Museum of Baghdad. They are simple, unimpressive objects, each bearing a few discreet markings: a small indentation near the top and some sort of stick-drawn animal in the centre. One of the animals may be a goat, in which case the other is probably a sheep. The indentation, archeologists say, represents the number ten. All our history begins with these two modest tablets.

They are — if the war spared them — among the oldest examples of writing we know.

There is something intensely moving in these tablets. Perhaps, when we stare at these pieces of clay carried by a river which no longer exists, observing the delicate incisions portraying animals turned to dust thousands and thousands of years ago, a voice is conjured up, a thought, a message that tells us, “Here were ten goats,” “Here were ten sheep,” something spoken by a careful farmer in the days when the deserts were green. By the mere fact of looking at these tablets we have prolonged a memory from the beginnings of our time, preserved a thought long after the thinker has stopped thinking, and made ourselves
participants in an act of creation that remains open for as long as the incised images are seen, deciphered, read.¹

Like my nebulous Sumerian ancestor reading the two small tablets on that inconceivably remote afternoon, I too am reading, here in my room, across centuries and seas. Sitting at my desk, elbows on the page, chin on my hands, abstracted for a moment from the changing light outside and the sounds that rise from the street, I am seeing, listening to, following (but these words don’t do justice to what is taking place within me) a story, a description, an argument. Nothing moves except my eyes and my hand occasionally turning a page, and yet something not exactly defined by the word “text” unfurls, progresses, grows and takes root as I read. But how does this process take place?

Reading begins with the eyes. “The keenest of our senses is the sense of sight,” wrote Cicero, noting that when we see a text we remember it better than when we merely hear it.² Saint Augustine praised (and then condemned) the eyes as the world’s point of entry;³ and Saint Thomas Aquinas called sight “the greatest of the senses through which we acquire knowledge”.⁴ This much is obvious to any reader: that letters are grasped through sight. But by what alchemy do these letters become intelligible words? What takes place inside us when we are faced with a text? How do the things seen, the “substances” that arrive through the eyes to our internal laboratory, the colours and shapes of objects and of letters, become readable? What, in fact, is the act we call reading?

Empedocles, in the fifth century BC, described the eye as born from the goddess Aphrodite, who “confined a fire in membranes and delicate cloths; these held back the deep water flowing around, but let through the inner flames to the outside.” More than a century later, Epicurus imagined these flames to be thin films of atoms that flowed from the surface of every object and entered our eyes and minds like a constant and ascending rain, drenching us in all the qualities of the object.⁵ Euclid, Epicurus’s contemporary, proposed the contrary theory that rays are sent out of the observer’s eyes to apprehend the object observed.⁶ Seemingly insurmountable problems riddled both theories. For instance, in the case of the first, the so-called “intromission” theory, how could the film of atoms emitted by a large object — an elephant or Mount Olympus — enter so small a space as the human eye? As to the second, the “extromission” theory, what ray could issue from the eyes and in a fraction of a second reach the distant stars we see every night?

A few decades earlier Aristotle had suggested another theory. Anticipating and correcting Epicurus, he had argued that the qualities of the thing observed — rather than a film of atoms — travelled through air (or some other medium) to the eye of the observer, so that what was apprehended was not the actual dimensions but the relative size and shape of a mountain. The human eye, according to Aristotle, was like a chameleon, taking in the form and colour of the observed object and passing this information, via the eye’s humours, on to the all-powerful inards (splanchna),⁷ a conglomerate of organs that included the heart, liver, lungs, gall-bladder and blood vessels, and held dominion over motion and senses.⁸

Six centuries later, the Greek physician Galen offered a fourth solution, contradicting Epicurus and following Euclid. Galen proposed that a “visual spirit”, born in the brain, crossed the eye through the optic nerve and flowed out into the air. The air itself then became capable of perception, apprehending the qualities of the objects perceived however far away they might happen to be. These qualities were retransmitted back through the eye to the brain, and down the spinal cord to the nerves of sense and motion. For Aristotle, the observer was a passive entity receiving through the air the thing observed, which was then communicated to the heart, seat of all sensations — including vision. For Galen, the observer, rendering the air sentient, held an active role, and the root from which vision stemmed lay deep in the brain.

Medieval scholars, for whom Galen and Aristotle were the fountainheads of scientific learning, generally believed that a hierarchical relation could be found between these two theories. It was not a question of one theory overriding the other; what mattered was to extract from each an understanding of how the different parts of the body related to perceptions of the outside world — and also how these parts related to one another. The fourteenth-century Italian doctor Gentile da Foligno decreed that such an understanding was “as essential a step in medicine as learning the alphabet is in reading.”⁹ and recalled that Saint Augustine, among other early Fathers of the Church, had already considered the question carefully. For Saint Augustine, both the brain and the heart functioned as shepherds of that which the senses stored in our memory, and he used the verb colligere (meaning
both “to collect” and “to summarize”), to describe how these impressions were gathered from memory’s separate compartments, and “shepherded out of their old lairs, because there is no other place where they could have gone”.¹¹

Memory was only one of the functions that benefited from this husbandry of the senses. It was commonly accepted by medieval scholars that (as Galen had suggested) sight, sound, smell, taste and touch fed into a general sensorial repository located in the brain, an area sometimes known as “common sense”, from which derived not only memory but also knowledge, fantasy and dreams. This area, in turn, was connected to Aristotle’s *splanchna*, now reduced by the medieval commentators to just the heart, the centre of all feeling. Thus the senses were ascribed a direct kinship with the brain while the heart was declared the body’s ultimate ruler.¹² A late-fifteenth-century manuscript in German, of Aristotle’s treatise on logic and natural philosophy, depicts the head of a man, eyes and mouth open, nostrils flaring, one ear carefully underlined. Inside the brain are five small connected circles representing, from left to right, the principal site of common sense, and then the sites of imagination, fantasy, cogitative power and memory. According to the accompanying gloss, the circle of common sense is related as well to the heart, also depicted in the drawing. This diagram is a fair example of how the process of perception was imagined in the late Middle Ages, with one small addendum: though it was not represented in this illustration, it was commonly supposed (going back to Galen) that at the base of the brain was a “marvellous net” — *rete mirabile* — of small vessels that acted as communication channels when whatever reached the brain was refined. This *rete mirabile* appears in a drawing of a brain that Leonardo da Vinci made around the year 1508, clearly marking the separate ventricles and attributing to different sections the various mental faculties. According to Leonardo, “the *sens comune* [common sense] is that which judges the impressions transmitted by the other senses . . . and its place is in the middle of the
head, between the impressiva [impression centre] and the memoria [centre of memory]. The surrounding objects transmit their images to the senses and the senses pass these on to the impressiva. The impressiva communicates them to the sensus commune and, from there, they are imprinted in the memory where they become more or less fixed, according to the importance and force of the object in question. The human mind, in Leonardo's time, was seen as a small laboratory where the material gathered in by the eyes, ears and other organs of perception became "impressions" in the brain that were channelled through the centre of common sense and then transformed into one or several faculties - such as memory - under the influence of the supervising heart. The sight of black letters (to use an alchemical image) became through this process the gold of knowledge.

But one fundamental question remained unsolved: did we, the readers, reach out and capture letters on a page, according to the theories of Euclid and Galen? Or did the letters reach out to our senses, as Epicurus and Aristotle had maintained? For Leonardo and his contemporaries, the answer (or hints towards an answer) could be found in a thirteenth-century translation of a book written two hundred years earlier (so long are sometimes the hesitancies of scholarship) in Egypt, by the Basra scholar al-Hasan ibn al-Haytham, known to the West as Alhazen.

Egypt flourished in the eleventh century under Fatimid rule, drawing its wealth from the Nile valley and from trade with its Mediterranean neighbours, while its sandy frontiers were protected by an army recruited from abroad - Berbers, Sudanese and Turks. This heterogenous arrangement of international trade and mercenary warfare gave Fatimid Egypt all the advantages and aims of a truly cosmopolitan state. In 1004 the caliph al-Hakim (who had become ruler at the age of twelve and disappeared mysteriously during a solitary walk twenty-five years later) founded a large academy in Cairo - the Dar al-Ilm or House of Science - modelled on pre-Islamic institutions, making a gift to the people of his own important collection of manuscripts and decreeing that "all and sundry might come here to read, transcribe and be instructed". Al-Hakim's eccentric decisions - he prohibited the game of chess and the sale of scaleless fish - and his notorious blood-thirstiness were tempered in the popular imagination by his administrative success. His purpose was to make Fatimid Cairo not only the symbolic centre of political power but also the capital of artistic pursuits and scientific research, and with this ambition he invited to court many celebrated astronomers and mathematicians, among them al-Haytham. Al-Haytham's official mission was to study a method of regulating the flow of the Nile. This he did, unsuccessfully, but he also spent his days preparing a refutation of Ptolemy's astronomical theories (which his enemies argued was "less a refutation than a new set of doubts") and his nights writing the bulky study of optics on which his fame was to rest.

According to al-Haytham, all perception from the outside world involves a certain deliberate inference that stems from our faculty of judgement. To develop this theory, al-Haytham followed the basic argument of Aristotle's intromission theory - that the qualities of what we see enter the eye by means of the air - and he supported his choice with accurate physical, mathematical and physiological explanations. But more radically, al-Haytham made a distinction between
"pure sensation" and "perception", the former being unconscious or voluntary — seeing the light outside my window and the changing shapes of the afternoon — the latter requiring a voluntary act of recognition — following a text on the page. 20 The importance of al-Haytham's argument was that it identified for the first time, in the act of perceiving, a gradation of conscious action that proceeds from "seeing" to "deciphering" or "reading".

20 Al-Haytham died in Cairo in 1038. Two centuries later, the English scholar Roger Bacon — attempting to justify the study of optics to Pope Clement IV at a time when certain factions within the Catholic Church were violently arguing that scientific research was contrary to Christian dogma — offered a revised summary of al-Haytham's theory.21 Following al-Haytham (while at the same time underplaying the importance of Islamic scholarship), Bacon explained to His Holiness the mechanics of the intromission theory. According to Bacon, when we look at an object (a tree or the letters sun) a visual pyramid is formed that has its base on the object itself and its apex at the centre of the curvature of the cornea. We "see" when the pyramid enters our eye and its rays are arranged on the surface of our eyeball, refracted in such a way that they do not intersect. Seeing, for Bacon, was the active process by which an image of the object entered the eye and was then grasped through the eye's "visual powers".

But how does this perception become reading? How does the act of apprehending letters relate to a process that involves not only sight and perception but inference, judgement, memory, recognition, knowledge, experience, practice? Al-Haytham knew (and Bacon no doubt agreed) that all these elements necessary to perform the act of reading lent it an astounding complexity, which required for its successful performance the co-ordination of a hundred different skills. And not only these skills but the time, place, and tablet, scroll, page or screen on which the act is performed affect the reading: for the anonymous Sumerian farmer, the village near where he tended his goats and sheep, and the rounded clay; for al-Haytham, the new white room of the Cairo academy; and the scornfully read Ptolemy manuscript; for Bacon, the prison cell to which he was condemned for his unorthodox teaching, and his precious scientific volumes; for Leonardo, the court of King François I, where he spent his last years, and the notebooks he kept in a secret code which can be read only if held up to a mirror. All these bewilderingly diverse elements come together in that one act.

This much, al-Haytham had surmised. But how it all took place, what intricate and formidable connections these elements established among themselves, was a question that, for al-Haytham and for his readers, remained unanswered.

The modern study of neurolinguistics, the relationship between brain and language, begins almost eight and a half centuries after al-Haytham, in 1865. That year, two French scientists, Michel Dax and Paul Broca,22 suggested in simultaneous but separate studies that the vast majority of mankind, as a result of a genetic process which begins at conception, is born with a left cerebral hemisphere that will eventually become the dominant part of the brain for encoding and decoding language; a much smaller proportion, mostly left-handers or ambidextrous people, develop this function in the right cerebral hemisphere. In a few cases (in people genetically predisposed to a dominant left hemisphere), early damage to the left hemisphere results in a cerebral "reprogramming" and leads to development of the language function in the right hemisphere. But neither hemisphere will act as encoder and decoder until the person is actually exposed to language.

By the time the first scribe scratched and uttered the first letters, the human body was already capable of the acts of writing and reading that still lay in the future; that is to say, the body was able to store, recall and decipher all manner of sensations, including the arbitrary signs of written language yet to be invented.23 This notion, that we are capable of reading before we can actually read — in fact, before we have ever seen a page open in front of us — harks back to Platonic ideas of knowledge existing within us before the thing is perceived. Speech itself apparently evolves along the same pattern. We "discover" a word because the object or idea it represents is already in our mind, "ready to be linked up with the word".24 It is as if we are offered a gift from the outside world (by our elders, by those who first speak to us) but the ability to grasp the gift is our own. In that sense, the words spoken (and, later on, the words read) belong neither to us nor to our parents, to our authors; they occupy a space of shared meaning, a communal threshold which lies at the beginning of our relationship to the arts of conversation and reading.

According to Professor André Roch Lecours of Côte-des-Neiges Hospital in Montreal, exposure to oral language alone may not be
enough for either hemisphere to develop the language functions fully; it may be that, for our brains to allow this development, we must be taught to recognize a shared system of visual signs. In other words, we must learn to read.  

In the 1980s, while working in Brazil, Professor Lecours came to the conclusion that the genetic program leading to the more common left cerebral dominance was less implemented in the brains of those who had not learned to read than in those who had. This suggested to him that the process of reading could be explored through cases of patients in whom the reading faculty had become impaired. (Galen long ago argued that a disease not only indicates the failure of the body to perform but also sheds light on the absent performance itself.) A few years later, studying patients suffering from speech or reading impairments in Montreal, Professor Lecours was able to make a series of observations regarding the mechanisms of reading. In examples of aphasia, for instance — where the patient has partially or completely lost the power or understanding of the spoken word — he found that specific lesions to the brain caused particular speech handicaps that were curiously restricted: some patients became incapable of reading or writing only irregularly spelled words (such as “rough” or “though” in English); others could not read invented words (“tooflow” or “boojum”); yet others could see but not pronounce certain oddly assorted words, or words unevenly disposed on the page. Sometimes these patients could read whole words but not syllables; sometimes they read by replacing certain words with others. Lennuel Gulliver, describing the Struldbruggs of Laputa, noted that at age ninety these elderly worthies can no longer amuse themselves with reading, “because their Memory will not serve to carry them from the Beginning of a Sentence to the End; and by this Defect they are deprived of the only Entertainment whereof they might otherwise be capable.”  

Several of Professor Lecours’ patients suffered from just such a disorder. To complicate matters, in similar studies in China and Japan researchers observed that patients accustomed to reading ideograms as opposed to phonetic alphabets reacted differently to the investigations, as if these specific language functions were predominant in different areas of the brain.

Agreeing with al-Haytham, Professor Lecours concluded that the process of reading entailed at least two stages: “seeing” the word, and “considering” it according to learned information. Like the Sumerian scribe thousands of years ago, I face the words. I look at the words, I see the words, and what I see organizes itself according to a code or system which I have learned and which I share with other readers of my time and place — a code that has settled in specific sections of my brain. “It is,” Professor Lecours argues, “as if the information received from the page by the eyes travels through the brain through a series of conglomerates of specialized neurons, each conglomerate occupying a certain section of the brain and effecting a specific function. We don’t yet know what exactly each of these functions is, but in certain cases of brain lesions one or several of these conglomerates become, so to speak, disconnected from the chain and the patient becomes incapable of reading certain words, or a certain type of language, or of reading out loud, or replaces one set of words with another. The possible disconnections seem endless.”

Neither is the primary act of scanning the page with our eyes a continuous, systematic process. It is usually assumed that, when we are reading, our eyes travel smoothly, without interruptions, along the lines of a page, and that, when we are reading Western writing, for instance, our eyes go from left to right. This isn’t so. A century ago, the French ophthalmologist Émile Javal discovered that our eyes actually jump about the page; these jumps or saccades take place three or four times per second, at a speed of about 200 degrees per second. The speed of the eye’s motion across the page — but not the motion itself — interferes with perception, and it is only during the brief pause between movements that we actually “read”. Why our sense of reading is related to the continuity of the text on the page or to the scrolling of the text on the screen, assimilating entire sentences or thoughts, and not to the actual saccadic movement of the eyes, is a question which scientists have not yet been able to answer.

Analysing the cases of two clinical patients — one an aphasic who could make eloquent speeches in a language that was gibberish, and the other an agnostic who could use ordinary language but was incapable of infusing it with tone or emotion — Dr. Oliver Sacks argued that “speech — natural speech — does not consist of words alone. . . . It consists of utterance — an uttering-forth of one’s whole meaning with one’s whole being — the understanding of which involves infinitely more than mere word-recognition.” Much the same can be said of reading: following the text, the reader utters its meaning through a vastly entangled method of learned significances, social conventions, previous readings, personal experience and private taste. Reading in
The language-sense divided according to its functions, as recorded in photographs of the human brain taken at the Washington University School of Medicine.

Hearing Words

Seeing Words

Reading Words

Generating Verbs

In the nominal sense of the word, we construct a meaning for it. In this complex process, "readers attend to the text. They create images and verbal transformations to represent its meaning. Most impressively, they generate meaning as they read by constructing relations between their knowledge, their memories of experience, and the written sentences, paragraphs and passages."

Reading, then, is not an automatic process of capturing a text in the way photosensitive paper captures light, but a bewildering, labyrinthine, common and yet personal process of reconstruction. Whether reading is independent from, for instance, listening, whether it is a single distinctive set of psychological processes or consists of a great variety of such processes, researchers don't yet know, but many believe that its complexity may be as great as that of thinking itself. Reading, according to Dr. Wittrock, "is not an idiosyncratic, anarchic phenomenon. But neither is it a monolithic, unitary process where only one meaning is correct. Instead, it is a generative process that reflects the reader's disciplined attempt to construct one or more meanings within the rules of language."

"To completely analyse what we do when we read," the American researcher E.B. Huey admitted at the turn of our century, "would almost be the acme of the psychologist's achievements, for it would be to describe very many of the most intricate workings of the human mind." We are still far from an answer. Mysteriously, we continue to read without a satisfactory definition of what it is we are doing. We know that reading is not a process that can be explained through a mechanical model; we know that it takes place in certain defined areas of the brain but we also know that these areas are not the only ones to participate; we know that the process of reading, like that of thinking, depends on our ability to decipher and make use of language, the stuff of words which makes up text and thought. The fear that researchers seem to express is that their conclusion will question the very language in which they express it; that language may be in itself an arbitrary absurdity, that it may communicate nothing except in its stuttering essence, that it may depend almost entirely not on its enuncitators but on its interpreters for its existence, and that the role of readers is to render visible — in al-Haytham's fine phrase — "that which writing suggests in hints and shadows."