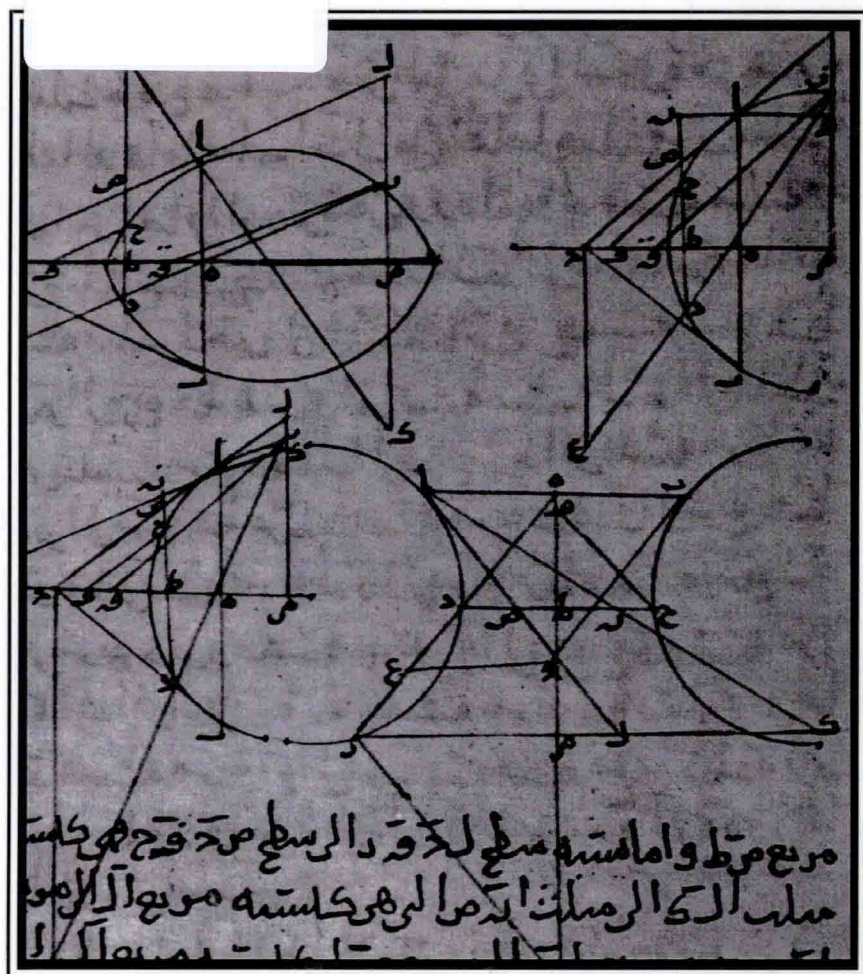


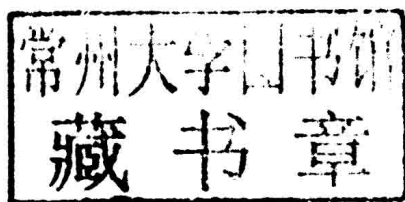
# HOW GREEK SCIENCE PASSED TO THE ARABS



DELACY O'LEARY

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De Lacy O'Leary



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## HOW GREEK SCIENCE PASSED TO THE ARABS

The history of science is one of knowledge being passed from community to community over thousands of years, and this is the classic account of the most influential of these movements – how Hellenistic science passed to the Arabs where it took on a new life and led to the development of Arab astronomy and medicine which flourished in the courts of the Muslim world, later passing on to medieval Europe. Starting with the rise of Hellenism in Asia in the wake of the campaigns of Alexander the Great, O'Leary deals with the Greek legacy of science, philosophy, mathematics and medicine and follows it as it travels across the Near East propelled by religion, trade and conquest. Dealing in depth with Christianity as a Hellenizing force, the influence of the Nestorians and the Monophysites; Indian influences by land and sea and the rise of Buddhism, O'Leary then focuses on the development of science during the Baghdad Khalifate, the translation of Greek scientific material into Arabic, and the effect for all those interested in the history of medicine and science, and of historical geography as well as the history of the Arab world.

The late **DELACY O'LEARY** was a well-known Arabist and published many works on the history of the Arab world.

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## CHAPTER I

### INTRODUCTION

THERE is a certain analogy between civilization and an infectious disease. Both pass from one community to another by contact, and whenever either breaks out, one of our first thoughts is, Where did the infection come from? In both alike there is the unanswered question, Where did it first originate?—do all outbreaks trace back to one primary source, or have there been several independent starting points?

In reading the autobiography of that distinguished orientalist Sir Denison Ross, there is a letter received from some inquirer which contains the sentence remarking what a good thing it would be if we could find out “how, and in what form, the Greek and Latin writers found their way to the ken of the Arab or Persian or Turkish student” (Sir Denison Ross, *Both Ends of the Candle*, n.d., p. 286). The author of the book makes no comment on this letter, but it may be noted that the way in which Greek literature passed to the Arabs and Persians, thence to the Turks, is not so unexplored as the letter suggests, and it may be traced with tolerable certainty, as it is hoped will appear in the following pages. No doubt it is a commonplace English convention which causes the writer to group Greek and Latin writers together: it does not appear that Latin writers ever did pass to the Arabs or other orientals, the transmission of ancient culture was concerned with Greek alone, and the Greek writers who influenced the oriental world were not the poets, historians, or orators, but exclusively the scientists who wrote on medicine, astronomy, mathematics, and philosophy, the type of scientific thought which does not always come foremost when we speak about classical literature. In the days when the Arabs inherited the culture of ancient Greece, Greek thought was chiefly interested in science, Athens was replaced by Alexandria, and Hellenism had an entirely “modern” outlook. This was an attitude with which Alexandria and its scholars were directly connected, but it was by no means confined to Alexandria. It was a logical outcome of the influence of Aristotle who before all else was a patient



observer of nature, and was in fact the founder of modern science. It had its germs in older thought, no doubt, in the speculations of quite early philosophers about the origin and world and its inhabitants, animals as well as men, but it was Aristotle who introduced what may be called the scientific method.

In entering upon this inquiry it may be premised that there are at least three threads very closely interwoven. In the first place there are Greek scientific writers whose books were translated into Arabic, studied by Arab scholars, and made the subject of commentaries and summaries : in such cases the line of transmission is clear. Then there are conclusions and scientific principles assumed and developed by Arabic writers who do not say whence they were derived, but which can only be explained by reference to a Greek (Alexandrian) source. Yet again, there are questions and problems raised which the Arabs dealt with in their own way, but which never would have occurred to them unless they had been suggested by earlier Greek thinkers who had tried to solve similar difficulties, but approached their solution in a different way.

Greek scientific thought had been in the world for a long time before it reached the Arabs, and during that period it had already spread abroad in various directions. So it is not surprising that it reached the Arabs by more than one route. It came first and in the plainest line through Christian Syriac writers, scholars, and scientists. Then the Arabs applied themselves directly to the original Greek sources and learned over again all they had already learned, correcting and verifying their earlier knowledge. Then there came a second channel of transmission indirectly through India, mathematical and astronomical work, all a good deal developed by Indian scholars, but certainly developed from material obtained from Alexandria in the first place. This material had passed to India by the sea route which connected Alexandria with north-west India. Then there was also another line of passage through India which seems to have had its beginning in the Greek kingdom of Bactria, one of the Asiatic states founded by Alexander the Great, and a land route long kept open between the Greek world and Central Asia, especially with the city of Marw, and this perhaps connects with a Buddhist medium which at one time promoted

intercourse between east and west, though Buddhism as a religion was withdrawing to the Far East when the Arabs reached Central Asia. Further, there were some scattered minor sources, unfortunately little known, such as the city of Harran, an obstinately pagan Greek colony planted in the middle of a Christian area, which probably made its contribution, though on a smaller scale.

The term "Arabs" must be taken in a broad sense. It is not here used strictly to denote those of Arab blood, but includes all those who were politically under Arab rule, who used the Arabic language and followed the religion of the Arabs. Some, like the Persians under the early 'Abbasids in the eighth century, were very definitely anti-Arab, but they lived under Arab rule, wrote in Arabic, and at least professed to follow the religion of Muhammad. Such being the case, they and their Arab rulers shared a common life which coloured their literature, education, and interests generally; even though Persian literature and religion diverged in its own direction, it moved from an Arabic starting-point. Neither culture nor language run on lines precisely identical with race. Conquest, superior civilization, economic needs have often caused communities to adopt new languages and new cultures. Yet there was sufficient coherence in the community gathered under the rule of the Khalif to justify its being treated as a unit, even though not all its members recognized the same khalif. The 'Umayyads in Andalus took their cue from the princes ruling in Baghdad. The schismatic Shi'ites agreed with the orthodox Sunnis that their leader on earth should be the heir of the Prophet Muhammad, though they differed as to the individual who was the lawful heir. The no less heretical Kharijites had a khalif of their own, freely elected on a democratic basis, but so elected because it was believed that this best followed Muhammad's precedent.

More important than political, racial or religious unity is the fact that those here classed as Arabs shared the same cultural history and all participated in the scientific heritage derived from the Hellenistic world. At first the city of Baghdad was the distributing centre where Greek material was brought together from different parts, Syria, Bactria, India, Persia, and other, and from Baghdad this material spread out in an Arabic form to all those social groups which were held together

by the religion of Islam. Later on, when political and economic disturbances checked the cultural life of Baghdad and the empire of the khalifs began a process of devolution, or disintegration, very similar to that experienced by the empire of the Karlings in the west, the leadership passed from Baghdad to Aleppo, Damascus, Cairo, Cordova, and Samarcand. But before that happened Greek scientific literature had made itself at home amongst the Arabs and had begun a new and independent life in an Arabic atmosphere.

The Greek material received by the Arabs was not simply passed on by them to others who came after, it had a very real life and development in its Arabic surroundings. In astronomy and mathematics the work of Greek and Indian scientists was co-ordinated, and thence a very real advance was made. It may be stated that algebra and both plane and spherical trigonometry were Arab developments. The Arabs were diligent in making and recording astronomical observations, and these not only extended what they had received from the Greeks, but checked and corrected older records. The Arabs perceived the weakness in the Ptolemaic cosmology and the "new astronomy" of the thirteenth century tried to correct it, but in vain. It was not until Copernicus that the solution was found.

Not all Muslims approved of astrology. There were many who held that, as all events happen by the will of God, they could not be controlled by the stars. This was admitted, and by it came a modification of astrological theory in orthodox Islam: the stars were no longer regarded as "rulers" as in pagan astrology, but simply as "indicators" showing beforehand what God has decreed. Still some theological purists objected, and astrologers produced apologetical works to defend their science. But the Jews frankly recognized the stars as "rulers" on the ground of Genesis i, 14-16, which seems to teach that God set the lights of heaven to rule the earth, and in this were followed by the Christians.

In medicine the Arab physicians were careful observers, and their clinical records added much to what they learned from the Greeks. They invented some new instruments and in all branches, except surgery, advanced medical knowledge. Surgery was hindered by the uncleanness contracted by touching a dead body, though that impurity could be removed by

the greater ablution. But there was a prevalent belief that the soul did not immediately leave the body at death, but remained in it for a period, and this caused dissection to be regarded as inhuman and cruel. From Aristotle, however, the Arabs learned the similarity in human and animal physiology, and a certain degree of progress was made in comparative anatomy. But in medicine, as in astronomy, much of their work was made obsolete by discoveries which they never knew. Harvey's discovery of the circulation of the blood, and the knowledge obtained by the use of the microscope, opened a new range of thought which threw Arab achievements into the shade. Yet for several centuries the Arab physicians were in the forefront of medical work and, as scientific progress has been continuous, their live work made its contribution not only by passing on what others had done, but by a very real development which enabled them to give to succeeding generations more than they had themselves received.

Arabic science flourished most in the atmosphere of courts. Scientists usually depended upon wealthy and powerful patrons. They appealed little to the average man, and this chiefly because scientific and especially philosophical speculation was regarded as tending towards free-thinking in religion, and so "philosophers" were classed as a species of heretics. Ultimately the philosophers themselves partially acquiesced in this judgment, and adopted the view that the inspired Qur'an was well adapted for the spiritual life of the unlettered and simple, but the illuminated saw beneath the written word and grasped an inner truth which it was not expedient to disclose to the simple.

Meanwhile, Islam generally had its own wise men, men learned in jurisprudence, tradition, and Qur'an. These were universally respected with ungrudging esteem, such as was never rendered to the scientists who were only tolerated because they were under state protection. It very much tempers our estimate of Arabic learning to remember that scientific and philosophical scholarship was confined to one privileged coterie.

## CHAPTER II

### HELLENISM IN ASIA

#### (1) HELLENIZATION OF SYRIA

HOW did Western Asia, what is now often called the Near East, come under Greek influence? The starting-point was Alexander's conquest of Persia in 331 B.C. The great oriental kingdom of Persia, which stretched from the Indus to the Mediterranean, went to pieces before the attack of this prince who was ruler of one of the comparatively petty states of Greece. It is one of the many instances in history showing that vast numbers count for little when faced by a small but thoroughly efficient force. The Greeks followed up this victory by an invasion of Persia which gradually brought the whole country under their control and at length penetrated as far as the Punjab, which was claimed as a Persian province. This political conquest did not result in the whole conquered territory becoming Greek, it remained Persian under Greek rule, Alexander planting colonies in the nature of Greek garrisons scattered here and there in the conquered land.

Alexander died, yet a young man, in June 323, leaving only an infant son as his heir. Immediately his generals began quarrelling over the heritage, and these civil wars lasted until 312 when the leading competitors consented to divide the spoils, and in this division Seleucus obtained the Asiatic share, practically the whole of the old kingdom of Persia. But Seleucus was jealous of another general, Ptolemy, who had obtained Egypt, and was much more concerned with his rivalry with this Egyptian monarch than with the internal affairs of Persia. About 300 B.C. he built a new capital Antioch in Western Syria and left the main part of his Asiatic territory in the hands of a deputy. Profiting by this a new independent kingdom of Parthia was formed by Arsaces in 248, much smaller than the old Persian kingdom but still a great power, and before long this began encroaching on the Seleucid heritage. Gradually it crept nearer and nearer to the Mediterranean until in 150 B.C. it absorbed Mesopotamia and the Seleucid state was reduced to little more than Syria. Thus Greek

control was permanent only in the area bordering on the Middle Sea.

How far did this country under Greek rule become Greek? This is best illustrated by parallel conditions in Egypt. In the dry clear air of Egypt documents of the Ptolemaic period have been preserved in large numbers, and from these we can learn a good deal about the Hellenization of the country, whilst in the humid climate of Syria such documentary material is comparatively rare. From Egypt we learn that all official business was conducted in Greek, and it was necessary for anyone aspiring to a post in the civil service to know Greek. Manuals still exist to help aspirants to acquire a knowledge of the Greek language and material survives to show how far they succeeded in doing so. Apparently the Egyptians found Greek a very difficult language and in most cases their mastery of it was very defective. It is quite clear that it never really became the language of the country. Egyptian was used in the home and in the markets, only those who wished for government employment tried to get a command of Greek. Even in Greek colonies like Alexandria and Coptos, where Greek was the language of the citizens, there was a large class, mostly occupying its own quarter of the city, which used only the native speech. In Greek cities the citizens formed only a privileged ruling class, often a minority. Outsiders (metics) who settled in the city and persons of the native subject population, as well as slaves, had no rights as citizens. Thus the Greek language, and with it Greek culture, customs, and religion were confined to the ruling class and had very little influence on the people of the villages, the tillers of the soil, and the subject community generally. Then again there often was intermarriage, and the home generally used the vernacular and inclined to sink back into native ways. This seems to have applied equally to Syria. The Greek language was used by the ruling class in the greater towns, it was used by officials throughout the country, but it produced only a Greek surface beneath which the native population remained, not unaffected by Greek influence but affected only slightly by it.

The usual language of Syria and Mesopotamia was Aramaic, a language akin to, but by no means identical with, Hebrew. The name 'Aram signifies highland, and Aramaic generally

was the language of the higher country in the north and in the hinterland, whilst Hebrew was used in the lowlands and came closer to the Phœnician language used on the littoral. But Aramaic had a good many dialects, as it spread over a very wide area. In later times one important dialect, or group of dialects, developed amongst the Christian population of Syria and Mesopotamia, with its centre at Edessa, came to be known as Syriac, and this Syriac-Aramaic<sup>1</sup> was the chief medium by which Greek culture was passed on to the peoples of the Near East. In oriental lands communities most often rest on a religious basis : nations are only temporary groups formed for political purposes, religions form social groups which share a common cultural life, economic structure, literature and art. As a rule the barrier between men of different religions is more definitely marked than that between members of different political states.

In the middle of the second century B.C., when the Parthians conquered Mesopotamia, the Seleucid state was decadent, worn out by a long and futile struggle to get control of Egypt. The Parthians did not follow up their conquest, because by that time they were being attacked in their eastern provinces by Mongolian tribes, and had no military resources to spare for the west. But there was a third power close at hand which was able to take advantage of the weakness of Syria, Armenia under an ambitious monarch Tigranes, and he conquered Syria in 83 B.C. But by this time a new power had appeared on the shores of the Mediterranean, the Roman Republic, not a conquering power like that of Alexander, but a rather narrow-minded democracy whose chief aims were to carry on trade successfully and make sure of safety at home. For safety the Romans gradually carried out the conquest of Italy, then they tried to exercise a kind of protectorate over all the other countries around the Mediterranean, and to check any one which tended to interfere with its safety or commerce. Conquest and expansion were forced on Rome by circumstances, and were undertaken by Rome only when foreign rivals threatened its security or its commerce by commercial rivalry like Carthage or by piracy on the seas over which Roman commerce passed, as was the case with Pontus.

Italy, a long narrow peninsula with a protracted coast line

<sup>1</sup> See note 1 on p. 182.

necessarily depended on sea power for its own security as well as for international trade, though that received only a tardy and grudging recognition in Rome. Gradually it was perceived that the freedom and prosperity of Italy, which included that of Rome, depended on control of the Middle Sea, and necessitated a check on the formation of any great power along its shores which could intercept sea communications. An attempt at founding such a power was made in 168 B.C., when the Seleucid Antiochus Epiphanes made an attempt to conquer Egypt. He was camped before the walls of Alexandria when an envoy arrived from Rome warning him to retire, and that he reluctantly did. Rome was already a formidable power, and the Seleucid considered it wiser not to challenge it. Next, Mithridates VI of Pontus formed imperial ambitions. He occupied Asia Minor, massacred a number of Roman citizens, and then invaded Greece, whilst Pontic pirates ranged over the eastern Mediterranean. The Romans had no wish to interfere in eastern politics, but this forced them to do so, and the Mithridatic War followed, which the Romans under Pompey brought to a successful conclusion in 83 B.C. These events forced Rome into the tangled political strife of what we now call the Levant, and in 81 B.C. they were still further drawn in when Alexander II of Egypt died and left his kingdom by will to the Roman people.

Syria had by then long ceased to be a danger. Parthian control had passed away from Mesopotamia and Syria, as the Parthians had to deal with threatening pressure on their own eastern borders. Under the degenerate Seleucids Syria was near a state of anarchy. The real masters of the country were the Arab tribes, many of them roaming the country as brigands, others settling down in lands they conquered and forming native states.

Pompey had just completed the Mithridatic War when the last Seleucid monarch Antiochus Asiaticus came to the throne, and thought it expedient to obtain formal recognition from Rome. To his request Pompey replied that Rome would not recognize any monarch who could not keep his country in order, and by now it was obvious that the Seleucids could not do this. So in 65 B.C. Syria was annexed and made a Roman province under a *legatus* whose first duty was to defend the frontier against the Parthians, Pompey determining that the



River Euphrates should be recognized as the frontier. But the Arab states formed along the eastern borders of Syria were left alone, and so the larger state known as Nabataea, though in 63 Pompey led an expedition against the Nabataean capital Petra. Thus Syria passed out of Greek Seleucid control and became part of the Roman Empire. Politically it was a change, but culturally there was no change, the influence of Rome was as definitely Greek as that of the Seleucids had been. The cultural life of Syria and Mesopotamia went on unaffected by the political change and from that time forward it was the Romans who brought Greek influence to bear on the Near East.

## (2) THE FRONTIER PROVINCES

When Syria became a Roman province it was secured against the immediate menace of its two oriental neighbours, Parthia and Armenia. Roman arms protected the border and sometimes crossed victoriously into enemy territory. But with this began a long series of wars lasting for some seven centuries, in which the frontier frequently shifted according to the fortunes of war. There was a debatable territory between the Tigris river and the Libanus mountains, which was sometimes Græco-Roman, sometimes Parthian or Persian, and these political vicissitudes had their effect on the cultural life of the area involved.

The Emperor Augustus recognized the Euphrates frontier and allowed the Arab states to remain without interference, and so matters continued until the accession of Trajan, though the trade route through Mesopotamia was practically closed because the Parthians were unable to control the tribesmen along the border. Trajan decided to carry Roman authority farther east and to bring the disordered border lands into a more satisfactory condition, and to effect this in A.D. 115 conquered Mesopotamia and made it a Roman province. The following year he invaded Parthia, advanced to the Tigris, occupied Adiabene in northern Mesopotamia and made it a province under the name of Assyria, took Seleucia the chief Greek colony on the Tigris and the Parthian capital Ctesiphon close by, and went on as far as the mouth of the Tigris, but was called back by the news that Mesopotamia in his rear had revolted. That revolt he put down, burning Seleucia and