

PARASITES AND  
PARASITIC INFECTIONS  
IN EARLY MEDICINE  
AND SCIENCE

*By*

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## FORWORD

THIS BOOK owes its existence to special circumstances. The writer who was a staff-member of the Peking Union Medical College<sup>1</sup> from 1930 to 1952 had gathered material dealing with parasitological subjects from the large collection of early Chinese medical books in the College library with the help of Mr. Ch'iang I-hung<sup>2</sup> who was then the secretary in the Division of Parasitology. In the course of years, he had published a number of historical studies in parasitology based on Chinese and European literature in collaboration with Mr. I. H. Ch'iang and further work had been published in conjunction with Prof. C. C. Tang<sup>3</sup> of Foochow. These studies appeared in China in the *Chinese Medical Journal*, *Monumenta Serica* and the *Peking Natural History Bulletin*<sup>4</sup> and, in Switzerland, in *Sinologica*. The translations from the Chinese original texts were made by Mr. I. H. Ch'iang and Prof. C. C. Tang respectively and were checked by a Chinese scholar.

In addition, three historical studies had been prepared under the writer's supervision: H. J. Chu and I. H. Ch'iang, 1931, *Extracts from some Old Chinese Medical Books on Worm Infections*; C. S. Chao, 1940, *Chinese Anthelmintic Prescriptions, Examples from the Han Period to the Present Time*, and H. F. Hsü, 1940, *Historical Development, Present Status and Future Prospect of Helminthology in China*.

Collections of early Chinese medical books exist in libraries outside China, but it is unlikely that these will be of use to parasitologists who are unable to understand classical Chinese or who cannot readily get the collaboration of Chinese scholars who possess such knowledge.

It, therefore, seemed to the writer desirable to bring together the material which had appeared in journals which are no longer readily obtainable outside China and additional Chinese material which had not yet been utilized for publication.

Old-style Chinese medicine and the information regarding parasites and parasitic infections up to the introduction of modern medicine correspond closely to what was known to European medicine in the first half of the seventeenth century, before the use of the newly invented microscope became more

<sup>1</sup> Renamed Chinese Union Medical College, after it had been taken over by the Peking Government. In 1957 it was absorbed by the Chinese Academy of Medical Sciences and is now officially regarded as part of the Chungkuo Yihsueh K'ohsueh Yuan.

<sup>2</sup> 强一宏

<sup>3</sup> 唐仲环

<sup>4</sup> The *Peking Natural History Bulletin* has ceased publication after volume 20, 1951-52 (vol. 20, last number 4 published 1952).

general. It was felt that a publication containing the combined Chinese material would be more useful and of greater interest if it also included material on similar subjects from various other countries and civilizations from ancient times to the middle of the seventeenth century.<sup>5</sup>

The present publication was, therefore, widened to include this.

It is not a history of parasitology, as it does not give its complete development in chronological order with subjects presented according to their respective importance. Instead, it is a series of loosely connected essays, each dealing in a comparative way with a special aspect of early parasitology. Some of the subjects are somewhat unusual and may be found interesting and even amusing. These chapters will compensate for sections of the book which include rather dry lists of medical prescriptions which, however, would be difficult to find elsewhere.

The writer wishes to emphasize that in reporting strange beliefs which appear ridiculous to-day and in describing treatments and remedies which appear repulsive to the modern generation, he has not the slightest intention to show the respective authors or people in an unfavourable light. The reader will moreover see that, unpleasant as they may have been, such beliefs and practices existed in widely separated countries all over the world.

It was the special aim of the writer to present the material as far as practicable in its original form. He has, therefore, given a considerable number of quotations from original texts and bibliographic references at the end of each chapter. All Chinese quotations have English translations.<sup>6</sup> The few Greek and numerous Latin texts are provided with English, and in a few cases with French, translations. The French translations from Greek and Latin texts were taken from French publications; a re-translation into English seemed unnecessary and could hardly have improved upon the clear, precise expressions of the French texts. In order to save space, some less important Latin quotations have not been translated into a modern language. Most German quotations, as well as texts in old French, and in Italian, are given with English translations. Texts in modern French have not as a rule been translated into English.

The book was prepared in Singapore where library facilities are limited. The writer had, in consequence, some difficulty in obtaining certain western literature, especially early publications. His own considerable collection of early medical and scientific books was not available and he frequently had to rely on

<sup>5</sup> The middle of the seventeenth century was in general taken as a time limit; occasionally however it was found desirable, in dealing with special subjects, to include publications which appeared as late as the first half of the nineteenth century.

<sup>6</sup> The writer apologizes for a certain inconsistency regarding the use of capital and small letters in the transcription of Chinese names and of titles of Chinese publications. These differences in the transcription have no bearing on the meaning of the Chinese text.

notes made in Peking some years ago. He also had to use editions which, in some instances, were not the best ones, and he had, furthermore, to rely on quotations and references given by other writers. It is hoped, however, that these shortcomings are counterbalanced by the numerous Chinese quotations with translations from original Chinese texts, many of which are difficult for most western scholars to obtain and to have them translated correctly.

From what has been stated earlier, it will be obvious that a number of chapters are based on previously published articles. In each case the reference of the respective former publication is given. It may be added that although the greatest part of the book is based on literature, the writer has also given some of his personal observations and experiences such as the result of experiments with Chinese remedies: 'tooth-worm' treatment in Peking; treatment of a malaria patient by a spirit doctor in Mukah, Sarawak; interviews with members of primitive races in British North Borneo, Brunei, Sarawak and studies carried out in the South Pacific on Fiji and Tahiti regarding parasitic infections.

The book is divided into three parts. The eleven chapters of Part I deal with important general subjects and fundamental problems of early parasitology. The twelve chapters of Part II, on the other hand, discuss more specialized subjects, six of them dealing with Chinese medicine. In some chapters, as for example in that on the doctrine of spontaneous generation and on the rôle of the moon in biology and medicine, parasites merely form a part of the material used to illustrate the main subject. Part III is added for the sake of completeness. It gives a very brief outline of the increase in knowledge of parasites and parasitic infections in the West from about 1650 to the middle of the nineteenth century, which period may be said to mark the beginning of modern parasitology.

Each chapter has, at its beginning, a résumé; at its end, as a rule, there is a varying number of notes, chiefly quotations followed by references. At the end of the book there is an Appendix containing brief remarks on the rôle of parasitic diseases in history, followed by a subject index, an index of names and a list of illustrations. Among the twenty-three plates there are six reproductions of photographs (Plates XVII-XXII) made in Sarawak by Mrs. Hedda Morrison. They show delousing and various kinds of indigenous medical treatment which cannot easily be witnessed by foreigners.

The book has no general bibliography. Instead, bibliographies, including very large ones, are given at the end of each chapter. This arrangement, although necessitating the repeated quotation of the same reference in different chapters, will probably be found convenient.

The author certainly cannot claim that this book meets a long-felt need. He hopes nevertheless that it will not be devoid of interest and usefulness. It gives a picture of early parasitology from different aspects including some rather unusual ones.

In the bibliographies the references of Chinese publications were in all cases prepared from the original editions. The references of western publications, on the other hand, are by force of circumstances in many cases second-hand, having been taken from bibliographies of other publications. Although the writer only used bibliographies which, in his opinion, were reliable, it is possible that errors or misprints have inadvertently been copied. However, a reader who has at his disposal the facilities of a good library in possession of early literature, will have little difficulty in checking and correcting such inaccuracies, should he wish to use some of the material appearing in this book for his own studies.

On account of the bibliographies and the very numerous quotations from original texts, the book may be considered to represent, not a historical study in itself, but a collection of material for a history of early parasitology.

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Should he have inadvertently quoted some sentences or brief translations for which an approval should have been obtained, he apologizes to the respective publishers for the omission. The source of the quotations is always given. He thanks Prof. T. W. M. Cameron, MacDonald College, Quebec, Canada, for permission to print part of a letter dealing with the Roman god Verminus. He is greatly indebted to Mrs. Hedda Morrison, Kuching, Sarawak, for her permission to reproduce six of her original photographs dealing with the indigenous population of Borneo in connection with medical practices.

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R. HOEPLI.

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## INTRODUCTION

A PARASITE, according to the usual textbook definition, is an organism which lives temporarily or permanently within or on the body of another organism from which it takes its food, both parasite and host being either an animal or a plant. While this simple definition is essentially correct, one has to realize that there are different, and often rather complicated, forms of parasitism. There are organisms which are parasitic only in certain stages of their development. We know facultative and obligatory parasites and animals such as leeches which may be predatory with regard to small animals and blood-sucking parasites on large animals. In addition, one has to consider certain cases of commensalism and symbiosis in which the borderline to parasitism is not sharp. For practical reasons plant-parasitic nematodes, parasitic fungi and spirochaetes are usually treated as special groups, separated from parasitology in the ordinary sense which comprises protozoology, helminthology and entomology with emphasis on their importance for man and domestic animals. If, furthermore, one considers the rôle in history of certain parasitic infections, such as malaria and syphilis, one will easily realize the extent of parasitology and its numerous connections with other fields.

There exists, so far, no detailed history of parasitology from ancient times to the present which considers the various aspects which have been mentioned before. Such a history will probably have to be written by a group of specialists as a single person would hardly be able to master the whole field.

Compared with an undertaking of this kind, the present study has only a modest goal. Its aim is to give a picture of early parasitology by showing the actual knowledge of parasites and parasitic infections of the time together with the prevailing ideas, common beliefs and errors formerly connected with parasites. Early parasitology as understood in the following is parasitology from ancient times to the middle of the seventeenth century when the use of the newly invented compound microscope became more general and opened a new era of investigation.

In limiting the scope of our study in the above-mentioned way, we cannot deal with many subjects which are of great importance in modern parasitology. On the other hand, it will be seen that even before the microscope was in wider use, there existed a not inconsiderable amount of knowledge concerning parasites in both the Orient and the West, and it is of interest to compare this knowledge as it was found among different people in different periods. Still more interesting is the fact that, in early medicine and science, parasites were connected with

## L. EXCHANGE OF KNOWLEDGE AND IDEAS REGARDING PARASITIC INFECTIONS

### RÉSUMÉ

The different ways by which an exchange of knowledge and ideas concerning parasitic infections may have taken place, are shown by discussion of the following subjects: a. important land and sea routes; b. the influence of conquests on the spread of knowledge; c. different kinds of travellers who may have contributed to the spread and exchange of knowledge and ideas; d. centres of learning, the favourable position of Islamic-Arabic countries.

In the final part some examples of beliefs and of real knowledge regarding parasitic infections spread by early communications are given. Among them are: the doctrine of spontaneous generation, the belief in a tooth-worm as the cause of tooth decay and toothache, the knowledge of the Guinea worm and of the clinical picture produced by this parasite, the knowledge of the sand flea, of elephantiasis, of *Loa loa*, first recorded from Cayenne and the West-Indies and, only a few years later, from Africa (Angola), whence it had been introduced by the slave trade to South and Central America.

Among the listed drugs the knowledge of which spread to far distant countries are the following: root and bark of the Pomegranate tree, Chaulmoogra oil, Semen contra, Betel nut, Kamala, Carica papaya, Kousso, Musenna, Cinchona bark, Chenopodium ambrosioides, Cucurbita pepo (pumpkin), Fucus helmintocorton, Schoenocaulon officinale (cevadilla).

Regarding the use of parasites for cosmetic purposes, leeches were used in a rather similar way as cosmetics in imperial Rome and in contemporary China. Their use may have developed independently in each country but one has to consider the possibility that early communications played a rôle.

Knowledge of certain parasitic infections, of specific drugs and also certain parasitological theories and beliefs evidently spread in consequence of early contact by people from different countries. At the same time similar knowledge, beliefs and practices apparently also developed independently in different parts of the world.  
22 References.

The foregoing chapters contain numerous cases in which similar beliefs and ideas, occasionally even of a rather strange kind, were held in different parts of the world by people who apparently could hardly have had contact with each other. Knowledge of a number of common parasites likewise existed to a similar degree in widely separated countries.

The question arises whether such knowledge and similar beliefs had developed independently due to the possibility that, under the same or similar circumstances, the human mind reacts to certain problems in the same or a similar way, or whether the observed similarities were due to early contacts and communications.

Nowadays we are so accustomed to modern ways of travelling that it is at first somewhat difficult to realize that people travelled very far even at times when travelling was comparatively slow, often beset with great dangers and in general full of hardships.\* The very fact that travelling was slow and that travellers occasionally had to stay in a place for a considerable time before they could continue their journey, may often have given an opportunity of exchanging knowledge and ideas.

We will show the different ways by which an exchange of knowledge and ideas concerning parasitic infections may have taken place in discussing very briefly the following subjects:†

- A. Important land- and sea-routes.
- B. The influence of conquests on the spread of knowledge.
- C. Different kinds of travellers who may have contributed to the spread and an exchange of knowledge and ideas.
- D. Centres of learning—the favourable position of Islamic-Arabic countries.
- E. Some examples of ideas and knowledge regarding parasitic infections spread by early communications.

### A. Important Land- and Sea-routes

#### PREHISTORIC AND EARLY HISTORIC TIMES

In Europe, roads extending from the Atlantic to the Black Sea and from Italy to the Scandinavian Peninsula existed in the Bronze Age and to some extent probably already in the later Stone Age. Their extensive use by traders is indicated by the finding of Etruscan objects far in the north and by the presence of

\* It is well to remember that in early times travelling was not always a hardship but occasionally to some extent even comfortable. This, for example, was the case at the height of the Roman Empire and, as seen from Ibn Battuta's *Rihla*, in the 14th century when large well furnished Chinese ships sailed to the West as far as the Persian Gulf.

† Readers interested in the subject of early communications and travel are referred to the following publications: G. Sarton, *Introduction to the History of Science*, Vol. 1-3, 1927, 1931, 1947,<sup>1</sup> a monumental work in which the scholar and research worker will find a wealth of information and useful references; J. Needham, *Science and Civilisation in China*, Vol. 1, 1954,<sup>2</sup> very valuable and interesting, dealing especially with subjects and questions in connections with China; G. F. Hudson, *Europe and China; A Survey of their Relations from the Earliest Times to 1800*, 1931<sup>3</sup>; Sir Henry Yule, *Cathay and the Way Thither*, 1913-15<sup>4</sup>; J. Poujade, *La Route des Indes et ses Navires*, 1946<sup>5</sup>; A. Herrmann, *Die Verkehrswege zwischen China, Indien und Rom um 100 nach Chr. Geb.*, 1922,<sup>6</sup> dealing with the old silk roads; P. Herrmann, *Conquest by Man*, 1954,<sup>7</sup> a well written comprehensive publication which addresses itself in a popular form to a wider public. Additional literature on the subject will be found in the bibliographies of the mentioned publications.

objects made in Scandinavia, such as bronze swords in Egypt. A certain continuity in the Bronze Age between Europe and China can likewise be traced by the occurrence of similar forms of swords and other objects in Europe, China and occasionally in intermediate zones of the steppes, Needham, Vol. 1, p. 159, 1954.<sup>2</sup>

Prehistoric successive large scale migrations in Asia towards the South to regions which are nowadays in part represented by Malaya and Indonesia extended beyond Australia to the islands of the Pacific, Oliver, 1952.<sup>8</sup> How far Polynesia may also have received immigration from the American continent is still an open question. The voyage of Thor Heyerdahl's raft *Kon Tiki*<sup>9</sup> has given experimental proof that it was possible to cross vast stretches of the Pacific on a small raft.

Another early migration in successive waves, starting probably at about the beginning of the Christian era, took place from Malaya, Sumatra or Java to Madagascar. Considering that the Malays had probably only outrigger canoes or rafts and that they evidently travelled in large numbers with their women and children, one wonders how they succeeded in covering the enormous distance across the Indian Ocean.

As far as our subject, the spreading and exchange of parasitological knowledge and beliefs is concerned, the two migrations just mentioned will have had hardly any influence, as such knowledge will have been extremely small and beliefs and superstitions regarding parasites, in as far as they existed at all, will probably merely have formed a small part of the general beliefs of the migrating population concerning diseases which may be assumed as having been magico-religious, as is the rule among primitive races.

#### ANTIQUITY

Strabon (c. 68 B.C.-A.D. 20, II, 1, 15) mentions that Indian merchandise transported on the *Oxus* (Amur Darya) reached the region of the *Mare Hyrcanum* (Caspian Sea) without difficulty and Pliny, *Hist. nat.* VI. 19, gives details of the route which went from the *Indus* region to the *Bactrus*, a tributary of the *Oxus*, whence the goods were transported on the *Oxus* to the Caspian Sea\* and further by land and river to the *Pontus Euxinus* (Black Sea). This route which became especially known during the conquests of Alexander must have existed before his time, Filliozat, 1949, pp. 213-214.<sup>10</sup>

The end of the first and the beginning of the second century A.D. saw inter-continental communications and trade at their height in the antique world. The

\* The *Oxus* (Amur Darya) nowadays flows into the Aral Sea.

Roman Empire under Trajan, A.D. 98-117, had reached its greatest extent; Roman rule was established from the border of Scotland to the Sahara and the Red Sea, and from the Atlantic coast of Hispania to Syria, Mesopotamia and the Caspian Sea.\*

\* An indication that transportation by Roman land- and sea-routes was very efficient and well organized may be seen in the great number of wild animals sent to Rome for entertaining the public by fighting in the arena. In 93 B.C., for example when Sulla had been elected praetor, he had 100 lions brought from Africa to Rome. Gordianus I, A.D. 238, used 1,000 bears which were killed in Rome during one festival. Besides wild animals used for fights, there were especially trained animals, for example elephants, which gave performances. Elephants dancing on a rope were for the first time shown to the Romans by Galba, the future emperor, (A.D. 68), during the games which he gave as praetor in A.D. 60 in the reign of Nero, A.D. 54-68 (Sueton, *Galba* VI, teste Gérard Walter, *Néron*, Paris, Hachette, 1955, p. 126). Certain animals were shown for their unusual appearance. An Indian rhinoceros came to Rome for the first time in 55 B.C., during the games given by Pompey the Great on his return to Italy, as reported by Pliny (*Hist. nat.* Lib. VIII, cap. XXIX). According to Suetonius, the emperor Augustus, 30 B.C.-A.D. 14, exhibited a rhinoceros in Rome at his triumph over Cleopatra, c. 26 B.C. In A.D. 5, a fight between a rhinoceros and an elephant took place in the arena in Rome (Dio Cass. LV. 27). From the time of Augustus the rhinoceros was apparently brought to Rome on special occasions, but never in larger numbers. In two epigrams Martial mentions a fight between a bear and an African rhinoceros (bicornis) and another fight between an Indian rhinoceros (unicornis) and a bull. An Ethiopian rhinoceros was sent to Rome in the reign of Domitian, A.D. 81-96. On that occasion two coins were minted showing a two-horned African rhinoceros; on one coin it faces right, on the other it faces left (see Plate XXIII, fig. 4). A rhinoceros was shown in Rome in the reign of Antoninus Pius, A.D. 138-161 (teste Cole, 1953)<sup>11</sup> and another one during the reign of Philippus Arabs, A.D. 244-249, when in A.D. 248, he ordered a great festival to celebrate the millennium of Rome. Many of these animals, among them, besides the rhinoceros, lions, tigers, hyenas, elephants, giraffes and hippopotamus' had been collected by Philippus' predecessor Gordianus III (assassinated in A.D. 244) for his intended triumphal return to Rome. Several coins were minted showing some of these animals. Other emperors besides those mentioned already who kept one or several rhinoceros' were Commodus, A.D. 180-193; Caracalla, A.D. 211-217, and Heliogabal, A.D. 218-222. A hippopotamus was brought for the first time to Rome in the reign of Augustus, 30 B.C.-A.D. 14, the same kind of animal was kept by Antoninus Pius, Commodus, Heliogabal and Gordianus III, A.D. 238-244 (teste Loisel, 1912, vol. 1, pp. 103-109).<sup>12</sup> It is significant of the decline in long distance transportation in Europe after the fall of the Roman Empire that no living rhinoceros was seen in Western Europe until 1515, when one arrived in Lisbon from India which is reproduced as Gomda in Dürer's famous woodcut (see Cole, 1953).<sup>13</sup>

Elephants (the Indian species) reached Italy for the first time according to Pliny (*Hist. nat.* Lib. VIII, cap. VI) with the armies of Pyrrhus, c. 280-272 B.C. whose victories at Heraclea in 280 B.C. and at Asculum in Apulia in 279 B.C. were in part due to the fact that the Roman soldiers were not accustomed at that time to warfare with elephants. Elephants (*Elephas africanus*) came to Italy again during the Punic Wars. The number of elephants (originally about fifty) which Hannibal brought to Italy (218 B.C.) was small as the majority had perished on the way. After the Romans had extended their rule to North Africa and the Middle East and had established trade connections with India and the Far East, elephants became well known in the Roman Empire and besides being used in war and in the arena appeared in various triumphal processions. They were also represented on coins, for example on a denarius of Julius Caesar (see Plate XXIII, fig. 3). An Indian elephant is shown on a coin (quincunx) minted to commemorate the victory of Curius Dentatus over Pyrrhus at Beneventum 275 B.C., and another one is shown on a coin of Antiochus I, Soter of Syria after his victory in 275 B.C. Indian elephants are also represented on coins of Bactria, for example on a drachm of Apollodotus. Coins of Juba and Bocchus show African elephants, likewise coins of the gens Caecilia. Hadrian's architect used twenty-four elephants to move the colossal statue of Nero which received a new head and was re-erected near the amphitheatre Flavianum (in consequence named colosseum) to represent the Sun god.

In Asia, especially in India and South East Asia, elephants were not only used for war, hunting and certain work, but especially also for official functions. They were associated with rulers and were carefully attended, as shown by Indian veterinary works dealing with diseases and the care of elephants. Elephants (and according to the records at least one rhinoceros, see A. Herrmann, 1922, p. 8)<sup>14</sup> were brought to the imperial court of Peking, where they were apparently kept chiefly as a curiosity. Chinese artists represented elephants in painting and sculpture (see Otto Keller, *Die Antike Tierwelt*. Wilhelm Engelmann, Leipzig, vol. 1, 1909, vol. 2, 1913).

In connection with fights of wild animals in the arena, it may be added as a curiosity that the eccentric emperor Heliogabal, A.D. 218-222, Elagabal, real name Varius Avitus, a Syrian from Emesa, ordered a fight between ten thousand mice, one thousand sorices (possibly screwmice, probably rats) and one thousand weasels (Keller, vol. 1, p. 17, 1909).

The reader interested in the various kinds of rare animals brought from foreign countries to Rome for fights in the arena or other purposes, will find information in Gustave Loisel, *Histoire des Ménageries de l'Antiquité à nos jours* (three volumes). Paris, 1912, vol. 1, pp. 135-139.

Simultaneously the Chinese Empire under the Later Han, A.D. 25–220, had greatly extended its power. Chinese administration was introduced into eastern Turkestan. In the South, the Chinese Empire reached to the neighbourhood of India after Yunnan and Tongking had been conquered and incorporated. India was then in part under different successive foreign dynasties some of which, for example the Kushan, who from the early first century A.D. controlled north-west India, Bactria and Sogdiana, favoured trade between India and neighbouring countries.

The Parthians, who controlled the roads and the trade from the Oxus to the Euphrates, and the Arabs, especially those of the southern part of Arabia Felix, whose ships sailed the Red Sea and the Indian Ocean, were the chief intermediaries who controlled transportation of goods from China and India to the eastern parts of the Roman Empire.

The silk-roads which connected China with India and the Roman Empire left the extreme north-west of China from the Gate Yu-men (Jade Gate) of the Great Wall west of Tun-huang. At about A.D. 100, there existed the northern, the central and the southern silk-roads by which the highly valued Chinese silk reached Kashgar, whence it was transported by different roads to the eastern parts of the Roman Empire (see A. Herrmann, 1922).<sup>6</sup>

Goods and travellers destined for India either went southward from Khotan or from Bactra over the western passes of the Hindu-Kush and the Kabul valley to Purusapura near present-day Peshawar. From there various roads went to the interior of India and to the seaports of Barygaza (Broach) and of Barbaricon in the lower Indus region. In addition there existed a trade route between Szechuan and India via Yunnan and Burma, as shown by the travels of Chang Ch'ien (see below).

The caravan traffic on the silk-roads obviously depended on the political conditions of the regions which had to be passed. During periods of war, for example during the invasions of the Hsiung Nu (Huns), the silk-roads were temporarily abandoned for long distance travel and were to some extent replaced by sea-routes used by Arabic and Roman ships, the latter actually being Graeco-Egyptian vessels.

Attempts to link the Mediterranean and the Red Sea by a canal go back to the time of Ramses II, 1292–1225 B.C. The Wadi Tumilat, east of the Nile valley, afforded a good opportunity for the construction of a canal which made use of the Nile. Necho II, 609–593 B.C., began to build a canal which started near Bubastis (Tel Basta). About 120,000 Egyptians perished in the work which Necho suspended in consequence of a prophecy (Herodotus II, 158).

After Cambyses had conquered Egypt in 525 B.C., Darius I, in about 520 B.C. had the canal completed and enlarged. Ptolemy Philadelphus (ruled 285–247 B.C.) improved the outlet of the canal into the Red Sea.

At the time of imperial Rome the canal, referred to as *Amnis Trajanus*, was apparently in a bad condition; it was reconstructed towards the middle of the seventh century A.D. by 'Amr-ibn-el-Ass, the conqueror of Egypt, and was used for about 100 years, chiefly by Arabic ships. In A.D. 770, large parts of the canal were filled in for military reasons by order of Abu Ja'far (al-Mansur), the second Abbasid Caliph, and traffic through the canal ceased.

Arabic and Roman ships, making use of the monsoons,\* went regularly from Egypt to India and back, as mentioned by Strabon.

In the first century A.D. it was found that one might use the monsoons for a rapid direct passage from the Straits of Bab al-Mandab to Barygaza and other more southern Indian ports. In the third century A.D. some Graeco-Egyptian ships went as far as Cattigara, a city possibly in Indo-China or in South China. Coins of Antoninus Pius have been found at Go-Oc-Eo in Indo-China, Coedès, 1947,<sup>11</sup> and Roman beads in Johore, Malaya; Tweedie, 1955.<sup>12</sup>

A contemporary book which describes the routes, the ports and the goods carried by the ships in the first century A.D. is the *Periplus of the Erythraean Sea* (i.e. the Indian Ocean) written at about A.D. 70, by a Graeco-Egyptian merchant-captain whose home was at Berenice on the western shore of the Red Sea.<sup>†</sup>

#### MEDIEVAL PERIOD

With the establishment of the T'ang Dynasty, A.D. 618–907, communications and trade by land between Europe and China revived, while at the same time Chinese rule spread far beyond the borders of China. For China the T'ang period was one of international contact and exchange, not only of goods but also of ideas and knowledge.

Throughout the centuries there must have been thousands of people of various professions who travelled in both directions along the old roads between Europe and China, but with very few exceptions they left no trace (see below).

After the fall of the Southern Sung, the Yüan (Mongolian) Dynasty, 1279–1367, once more unified China and the Mongols extended their power over the

\* The monsoons are regular winds which blow in the Indian Ocean in opposite directions, the south-west monsoon lasts from April to October, the north-east monsoon from November to March.

† *Periplus Maris Erythraei*. The author travelled along the East coast of Africa to Zanzibar and then driven by the monsoon crossed the open sea to India, where he reached the Ganges region. See: W. H. Schoff, *The Periplus of the Erythraean Sea. Travel and Trade in the Indian Ocean by a merchant of the First Century*, London, 1912; and R. Hennig, *Terra Incognitae, Bd. I, Alterum bis Ptolemaeus*. Leiden, 1944, p. 388. Quoted from C. E. Dubler, *Der Afro-Indo-Malaji-sche Raum bei Idrisi*. *Asiatische Studien, Études Asiatiques*, X, 1956. Bern, p. 22.

greater part of Asia to eastern Europe. Communications and long distance travel in various directions were re-established and reached a high degree of perfection. The well kept roads with rest-houses and the State Post by which those who travelled with government privileges could cover very long distances in a comparatively short time, aroused the admiration of foreign travellers.\*

The reign of Kublai Khan, born A.D. 1216, as Shih Tsu 世祖, the first Yüan emperor, died 1294, saw the peak of such travel in the Mongolian empire which however was short-lived. The Yüan dynasty ended with Toghan Timur (Shun Ti 順帝) in 1367. Under the Chinese Ming Dynasty, 1368–1644, Chinese navigation became very active for a brief period but, on the other hand, long distance communications by land greatly declined as compared with the Yüan period.

Chinese navigation by ocean-going junks began in the third century A.D. Chinese ships sailed to Malaya at about A.D. 350; about 50 years later they went to Ceylon. In the fifth century they apparently already called at Aden and went to the mouth of the Euphrates. In the thirteenth century Chinese long distance navigation had reached its full development and extended to the Pacific.†

Japan received western goods and ideas chiefly by way of China especially during the T'ang period with its cosmopolitan character. This influence, transformed on Japanese soil, led to the flowering of the Nara period.

Examples of objects reflecting old western cultures are kept in the famous *Todaiji Shosoin*, the treasure house of the Todaiji temple in Nara. The nucleus of this famous collection is represented by the offerings made on the death of Emperor Shomu in A.D. 756, by the Empress Dowager and consists of precious objects and medicines. The cosmopolitan character of the Shosoin treasures is shown for example by a lute of Assyrian origin, by the method of glass overlaying reminiscent of Byzantine technique, by a lacquer ewer in Sassanian-Persian style and by a picture of fighting animals with Scythian motives.

Japan therefore received objects and ideas from the cultures of the Sassanian and Byzantine empires which in their turn had been influenced by the earlier cultures of Egypt, Assyria, Greece, Rome and India.

\* They did not know that very rapid travel similar to that by the State Post of the Mongols had already existed in Egypt, in Persia and in Rome, even before the establishment of the empire and in India. A remarkably quick messenger service also existed in some South American countries, for example in Peru, before the Spanish conquest.

† Jordan Catala de Séverac (died after 1330) a French Dominican missionary who travelled in Persia and India and became Bishop of Columbum (Quilon in Travancore, south-west India) in 1329, wrote *Mirabilia descripta*. In this work he mentions Chinese ships which had more than 100 cabins sailing between India and China.

Ibn Battuta, 1304–1377, in his *Rihla*, 1355, states that the large Chinese junks at his time had up to twelve sails and carried a crew of about 1,000 men consisting of 600 sailors and 400 men-at-arms. In addition they had between 200 to 300 passengers. These ships had large oars besides their sails. They were very heavily-built, had four decks, many cabins and even suites with private lavatories (for more details see P. Herrmann, p. 305, 1954).<sup>7</sup>

Japan was likewise in communication with Korea, North-West Asia, and Southern Russia, while at the same time numerous products of South-East Asia reached Japan by way of China (see *The Shosoin Medicinals, Report on Scientific Researches*, edited by Yasuhiko Asahina. With an English abstract by Shigeyoshi Obata, 1955, Osaka. Shokubutsu Bunken Kanko-Kai. Botanical Literature Publishing Society).

The spread of Islam and the establishment of Arabic rule in Southern Europe, in the Middle East, North Africa and Egypt, and furthermore, along the shores of the Red Sea and on the west coast of India, greatly facilitated travelling, especially for Muslims. In the eighth century Islamic-Arab navigation became more and more important. Arabic ships controlled parts of the Mediterranean and took an active part in the traffic from Red Sea ports to Taprobane (Ceylon), India, Malaya, Indonesia, the Philippines and China. In China the Arabs established factories, for example in Canton (Khanfu), Hangchow (Khanzai) and Ch'üan-chou, the Zayton of Marco Polo. In the latter city in 1927, the writer saw the ruins of a great mosque which had been built in Arabic style.

The Arabs also knew of the existence of innumerable Pacific islands.\* Arab navigation in the Pacific declined in the twelfth century and was replaced by Chinese shipping.

Indian ships also participated in the trade with Red Sea and Far Eastern ports.

Persian crews likewise went as far as China; Persians from pirated ships settled in Hainan where their settlements were seen and described in A.D. 749, Needham, 1954, vol. 1, p. 215.<sup>2</sup>

Malaya, by its geographical situation, was linked from early times with transhipment to and from Arabia, India, Java, Sumatra, the Philippines, Annam, Tongking and China. A number of objects of very different origin have been found in Malaya which prove the contact of Malaya with various countries and civilizations. Among these finds are two bronze bells from the beginning of the earlier Han dynasty (c. 200 B.C.) and two kettledrums dating from the end of the earlier Han. Objects which came from Hindu settlements and were found in the State of Kedah, date from about the fourth to the twelfth centuries A.D. and offer evidence of an early colonization by people from southern India.† Furthermore, fragments of Chinese T'ang pottery, probably dating from the eighth

\* The famous Arab traveller, geographer and historian Ali al-Masudi, born in Baghdad before 912, died in Cairo c. 957, mentions the island world of the Pacific in his *Meadows of Gold and Mines of Precious Stones* (Muruj al-dhahab wa-ma'adin al-jawahir) written c. A.D. 947.

† South of Gunong Jerai (Kedah Peak) there existed a great city called 'Kadaram' or 'Kidaram' in the ancient Tamil poem 'Pattinappalai'; in a Sanscrit inscription of the eleventh century its name is given as 'Kataha' (the modern Kedah). It had been founded by Hindu traders and colonists in the second or third century A.D. This

and ninth centuries, and fragments of Sung and Yüan pottery of the tenth to the fourteenth century were unearthed. Chinese trade porcelain of the sixteenth and seventeenth century Ming type was found at Kota Tinggi and Johore Lama at the sites where formerly apparently important trading stations had been built.

A stone with Arabic writing dating from the fourteenth century A.D. was discovered near Kuala Berang in Trengganu.

Of particular interest are about 600 beads found at Kota Tinggi, 20% of which are supposed to be Roman of the first two or three centuries. In addition two Phoenician beads were found. This discovery suggests the presence of settlements along the Johore river at a very early date (see M. W. F. Tweedie, 1955).<sup>12</sup> Phoenician beads were also discovered in necklaces of Sea Dayaks in Sarawak.

Ethiopia, which was temporarily united with Egypt, had good communications and trade with Egypt of the Pharaohs and with that country after it had become a Roman province. Furthermore Ethiopia also traded with India. It became isolated and practically inaccessible for Europeans after the Arabs had conquered Egypt in the middle of the seventh century A.D. Notwithstanding great difficulties and obstacles throughout the centuries there were nevertheless some occasional visitors from Europe. It is interesting, although somewhat surprising, that in spite of their trade with Ethiopia, the ancient Egyptians apparently did not use some effective Ethiopian drugs, such as the anthelmintic 'Kousso.'

In Europe, beginning from the end of the eleventh century, the Crusades opened new roads and outlooks towards the Orient, although they did not reach countries which had not already been known to the Romans. The importance of the Crusades, in as far as exchange of knowledge is concerned, rests in the fact that they brought people of different races in closer contact and that they stimulated interest in the works of physicians and scientists of the Islamic world.

#### RENAISSANCE

During the Ming period, 1368-1644, large sea-going Chinese junks made long voyages. In 1405, the Moslim eunuch admiral Cheng Ho 鄭和 went with 63 ships to the Indian Ocean. Cheng Ho undertook altogether seven expeditions into the South Seas and across the Indian Ocean.\* Following his expeditions, other large Chinese ships made long voyages to the South, and visited Borneo,

once flourishing city declined with the coming of Islam and at present its site is covered by scattered Kampongs and rubber plantations. Along the upper reaches of the Bujang river, Quaritch Wales discovered the ruins of more than 20 ancient Hindu and Buddhist shrines in 1936-37. Twenty years later, in 1957, a team from the University of Malaya, led by D. M. Sullivan discovered additional ruins and objects further south at Bukit Batu Lintang and at Matang Pasir and Tikam Batu near the Muda river (*The Straits Times*, Singapore, Monday, July 29th, 1957, p. 6).

\* In the spring of 1409, Cheng Ho visited Malacca and brought rich presents for the reigning sultan.

the Philippines, Ceylon, Malabar, and East Africa. One result of these voyages, which were undertaken during a very brief period only, was that objects and animals such as giraffes, zebras and ostriches formerly unknown in China made their appearance in that country.

Some time later European ships came to the Far East. The Portuguese reached India via the Cape of Good Hope in 1498 and captured Malacca in 1511; Magellan landed at Cebu in the Philippines in 1521; the Dutch and the British arrived in the first part of the seventeenth century.

The sea-routes between Europe and America, in use after Columbus' discovery and the conquests of Mexico and Peru, allowed European physicians and scientists to become acquainted not only with parasitic infections and diseases,\* previously unknown in Europe, but also with new remedies of which the cinchona bark was the most important.

#### SEVENTEENTH AND EIGHTEENTH CENTURIES

Several parasites among them *Loa loa*, were brought to various ports of the American Continent in consequence of the slave trade. Ships carrying infected slaves went from the West coast of Africa to various American ports. The first publications on *Loa loa* are reports from cases observed in Cayenne, Bajon, 1777, abstract, 1805,<sup>13</sup> and the West Indies, Mongin, 1770,<sup>14</sup> Arrachart, 1778.<sup>15</sup>

#### B. The Influence of Conquests on the Spread of Knowledge

In the previous section dealing with important land- and sea-routes, reference was made to conquests; in the following we shall very briefly mention some of the greatest conquests in history in as far as they influenced the spreading and exchange of knowledge and ideas.

Persian conquests: In the sixth century B.C., Cyrus, by bringing Greek islands and Greek settlements in Asia Minor under Persian rule (defeat of Croesus in 546 B.C.) and by invading the lower Indus region, began to build up the vast power of the Achaemenid Empire. In 525 B.C., Cambyses, 530-522 B.C., conquered Egypt and, where Cyrus had partly failed, Darius I (reigned 521-485 B.C.) was successful in establishing Persian rule in the north-west of India and in the Sind on the lower Indus. A consequence of these conquests was that for

\* Early printed records of the sand flea are those by Fernandez de Oviedo, 1547, and by A. Thevet, 1558, *Les Singularitez de la France Antartique, Autrement nommée Amérique, etc.* Paris (see Singer, 1912, p. 99, *Notes on some early references to tropical diseases*, Ann. Trop. Med. Parasit. 6, 87-101 & 379-402).

Descriptions of Leishmaniasis americana (Anti-onccoy) were sent from Peru to Europe by early Spanish chroniclers who were greatly impressed by the destruction caused by the disease.

about 190 years, until the Persian Empire was destroyed by Alexander in 331 B.C., Mesopotamia acted as a link in cultural relations between Egypt, Greece and India. Darius had Greeks deported to the Indian border, for example, after the fall of Barca in Cyrenaica, the inhabitants were resettled in a new Barca in Bactria (*Herodotus* IV. 204) and this must have favoured the introduction of Greek ideas and knowledge to the Indians. Darius even brought Greeks and Indians together for discussions at his court (*Herodotus* III. 38).

Alexander the Great, 356–323 B.C.: The conquests of Alexander are so well known that it will be sufficient merely to mention as some of their results, the suddenly increased spreading of Greek medical and scientific knowledge and ideas throughout the Near East to India and Egypt and the fact that corresponding knowledge and ideas of the conquered people, gradually found their way to Greece and Rome. Alexandria, which was founded in 332–331 B.C. and which became one of the great centres of learning, owes its existence to Alexander's campaigns.

The Roman Empire: The Roman Empire, with its vast territories and good communications especially at the height of its power at the time of Trajan, A.D. 98–117 and Hadrian, A.D. 117–138, after pacification of the different conquered countries, facilitated an exchange of knowledge between the people of Europe, North Africa, Asia Minor, India and even the Far East.

Islamic rule: The establishment of Islamic rule over the Mediterranean Basin, the Middle East and parts of India, allowed similarly as in Roman times, an exchange of knowledge from Spain to Persia, India and throughout the north of Africa.

The Mongolian Empire: The Mongolian Empire, although it was only short-lived, contributed to an exchange of knowledge from Budapest and Baghdad to the coast of China. The coming and passing of different rulers in Mesopotamia, Persia, India, and South-East Asia resulted in the spreading of knowledge and ideas to neighbouring countries.

Spanish conquests in America: Columbus' discovery of the New World and the subsequent conquests of Mexico, Peru and large parts of South America brought to Europe, as already mentioned, the knowledge not only of diseases hitherto unknown, but also of new remedies.

It is obvious that while these conquests and the establishment of different empires formed the base for subsequent peaceful contact of various populations and men of learning, they had, with rare exceptions, no immediate effect on scientific thought and activities. In many cases these were at first unfavourably influenced by the victorious army or its ruler, although it must be realized that

some conquerors, like Darius I, Alexander the Great, Asoka, the third king of the Maurya dynasty, one of the greatest of rulers, c. 273–232 B.C. and Kublai Khan personally considerably stimulated the exchange of ideas and knowledge by calling distinguished foreign scholars to their courts and by sending others as their diplomatic envoys to far distant countries.

C. *Different kinds of Travellers who may have contributed to the Spread and an Exchange of Knowledge and Ideas*

Generally speaking there were six main kinds of early travellers to distant countries who are of interest to us in connection with the present study: 1. diplomatic envoys; 2. merchants; 3. priests; 4. physicians; 5. scientists; 6. explorers and adventurers. This classification is somewhat artificial as in some instances a person had several occupations and therefore could be placed in different groups; priests, physicians and merchants, for example, were occasionally entrusted with special missions and acted as diplomatic envoys. For the sake of convenience however, we will use the mentioned classification and will give a few examples for each group.\*

I. DIPLOMATIC ENVOYS

In dealing with diplomatic envoys in their rôle as transmitters of knowledge and ideas, we have to keep in mind that very different from our present time such persons were left much more to use their own wits as far as travelling and contact with different people were concerned. By the comparatively slow progress to the place of their destination and the often considerable length of their stay there, they had, provided their personal interests and curiosity were sufficiently great, good opportunities of becoming acquainted with medical and scientific achievements and ideas. Most of the early diplomatic envoys were not career diplomats in the present-day sense, but people of different professions: high magistrates, experienced in law questions; priests; scholars of various kinds and, occasionally, a famous physician. In consequence of the very rudimentary state of hygiene and the practical absence of preventive medicine, it was unavoidable that envoys, especially on long journeys to far-distant countries, occasionally fell ill and although attended by their personal physician, they would also have had contact with local representatives of the healing class.

\* They are in their majority taken from G. Sarton, *Introduction to the History of Science*, Vol. 1–3, 1927, 1931, 1947.<sup>1</sup> The reader will find in this most valuable work much additional information. The writer has likewise used some material given by J. Needham in the very informative volume I of his *Science and Civilization in China*, 1954.<sup>2</sup>

The Greek historian and geographer Megasthenes, fl. c. 300 B.C., was sent as ambassador by Seleucus I Nicator, king of Syria, 312-280 B.C., to the court of Sandracottus (Chandragupta Maurya) in Pataliputra, c. 302 B.C.. The remaining fragments of his lost work on India give much information regarding anthropology and zoology and even refer to Malaya under the name of 'Chryse,' Sarton, Vol. 1, p. 161; Needham, 1954, Vol. 1, p. 177.<sup>2</sup>

Among other early diplomatic envoys of whose travels we have records are the Buddhist missionaries sent by Asoka to the Hellenistic kingdom about 250 B.C. Asoka was in communication with Antiochus II Theos of Syria, Ptolemaeus II Philadelphus of Egypt and Antigonus Gonates of Macedonia.

In the reign of Wu Ti 武帝, 140-87 B.C., Chang Ch'ien 張騫, died 114 B.C., was sent on a diplomatic mission to Bactria in 138 B.C. For ten years he was a prisoner of the Hsiung Nu 匈奴 (Huns) and returned to China in 126 B.C. His journey represents one of the most remarkable explorations of antiquity. Although his mission was originally undertaken for political reasons—the wish for an alliance between the Chinese and the Yüeh-shih 月氏—Chang Ch'ien brought back a great variety of plants, among them alfalfa, a kind of lucerne, and the grapevine, and other objects together with much valuable information regarding different countries and trade routes which ultimately led to the establishment of the so-called old silk road and indirectly to a great western expansion of Chinese rule. Soon after Chang Ch'ien's return, the Chinese conquered Eastern Turkestan, Sarton, Vol. 1, p. 197.

At about A.D. 50, the ruler of Taprobane (Ceylon) sent four noblemen as his envoys to Rome where, as mentioned by Pliny, they aroused considerable curiosity.

Among Chinese envoys the following may furthermore be mentioned: Wang Hsüan-ts'e, fl. c. A.D. 643-664, who went four times to India. At the time of Chingiz (Genghis) Khan, Yeh-lü Ch'u-ts'ai, 1190-1244, accompanied Chingiz Khan on his successful campaign against Persia in 1219. On this occasion the Mongols collected books, herbs, and scientific instruments for him out of their loot. He wrote an account of this expedition, *Hsi yu lu, Account of a Journey to the West*. He was not a Chinese but a Mongol as his family belonged to the Liao or Ch'i-tan, Eastern Tartars, Sarton, Vol. 2, p. 574. Soon afterwards Wu-ku-su Chung-tuan was sent as ambassador to the Mongol court which at that time was still in Persia. Ch'iu Ch'ang-ch'un, 1148-1227, was sent by Chingiz Khan to Persia and the Indian border and a detailed report on his voyage was written by one of his disciples, Sarton, Vol. 2, pp. 644-45. In 1259, Ch'ang Te went from Qaraqorum, the Mongolian capital, to Baghdad, and Yeh-lü Hsi-liang,

great grandson of Yeh-lü Ch'u-ts'ai visited Central Asia in 1260-1263, Sarton, Vol. 2, p. 1067.

Chou Ta-kuan (Ts'ao-t'ing) born at Yung-chia, Chekiang, accompanied an envoy sent by the Yüan Court to Cambodia in 1296. He returned with the embassy in 1297, and wrote *Chen la feng t'u chi, Memoir on Cambodian customs*, in which he gave valuable information on Khmer customs and on Angkor-Vat, the famous group of temples dating from the twelfth and thirteenth centuries. These temples represent the last period of Khmer art and only about 150 years after Chou Ta-kuan's visit, Khmer civilization had disappeared and the temples were buried in the jungle, Sarton, Vol. 2, pp. 1067-68.

The thirteenth century witnessed a number of long journeys across Asia by European travellers, the majority being Italians who went to the East. They are included in this group as some acted as envoys of the Pope or had other official missions; some were interested chiefly in missionary work and some travelled as merchants. Among these travellers were Giovanni del Pian del Carpine, c. 1182-1252, who visited the Mongolian capital Qaraqorum on the Orkhon, south of lake Baikal; John of Montecorvino, c. 1247-c. 1328, founder of the first Catholic missions in India and China who became the first Archbishop of Khan-balıq (Peking) in 1307, and the Venetian brothers, Niccolo and Maffeo Polo and Niccolo's famous son, Marco who was born c. 1254 and died in Venice in 1324. He was the first to cross the whole continent of Asia from the Mediterranean Sea to the Pacific Ocean. He left Venice in 1271 and returned there at the end of 1295. Whereas his father and uncle were only merchants, Marco, besides being a merchant, must be regarded as an explorer. As a favourite of Kublai Khan, he was sent on various official missions and may have even acted temporarily as a magistrate (Governor of the city of Yangchow near Nanking).

In 1253, Guillaume de Rubruquis, c. 1215-1270 (Rubrouck, not Ruysbroek as sometimes stated) a Franciscan friar, was sent as head of a delegation by Louis IX of France (Saint Louis) to Mangu Khan who resided at Qaraqorum. The delegation left the Crimea in May 1253, reached the court of the Great Khan at the end of that year, stayed there until July 1254 and reached Tripoli on their return journey in the middle of August 1255. The travellers covered more than 10,000 miles. The delegation achieved nothing, but Rubruquis brought back much interesting information contained in *Itinerarium fratris Willielmi de Rubruquis de ordine fratrum Minorum, Galli, Anno gratiae 1253 ad partes Orientales*,\* Sarton, Vol. 2, pp. 1053-54.

\* He was the first European to mention the wild ass (Kulan) of Central Asia and the great sheep of the Pamirs (*argali, ovis argali, ovis poli*).

Although the distance covered on his journeys can in no way be compared with those of the above-mentioned travellers, attention must be drawn to Ogier Ghiselin (Ghiselin) de Busbecq, Flemish diplomat and author, 1522-1592, who was sent by the Emperor Ferdinand I to Turkey as ambassador to the court of Suleiman the Magnificent in 1555 and again in 1556. He was temporarily imprisoned and suffered various other ill-treatments, but succeeded in having a peace treaty ratified after his return to Vienna in 1562. Busbecq collected coins and manuscripts and brought back the *Codex Juliana Anicia*\* as well as two other texts of Dioscurides. He was interested in the customs of different countries, in ancient monuments—he discovered the *Monumentum Ancyranum*—and especially in the flora and fauna of the places he visited. He brought tulip seeds and probably also bulbs back to Vienna and introduced various other plants into Germany including the lilac and the horse-chestnut tree. The *Memoirs* of his Embassy to Turkey, published originally in Latin in letter-form, still make very interesting reading nowadays.†

It is hardly necessary to point out that besides the given examples of diplomatic envoys and embassies there were many others which here need not to be mentioned.

## 2. MERCHANTS

Out of the great number of merchants who, as stated before were occasionally entrusted with diplomatic missions, we will only give a few examples: At the beginning of the Christian era merchants who in all probability came from southern Arabia brought, as tribute, a living rhinoceros to the Chinese court, A. Herrmann, 1922, p. 8.<sup>6</sup>

From the early part of the second century A.D. Roman merchants are known to have come to China. In the reign of Marcus Aurelius Antoninus, A.D. 121-180, emperor 161-180, a group of people went from Rome to China. They came by sea to Tongking in A.D. 166 and proceeded by land to the capital Loyang. While this visit is mentioned in the records of the later Han, no reference to it is known in Roman literature. The Chinese regarded the visitors as envoys of the Emperor 'An Tun' (Antoninus), but were surprised by the small value of the presents which they had brought. One has therefore suspected that the envoys were self-styled and that they were actually merely merchants who posed as envoys to gain advantage from this pretence.

\* The *Juliana Anicia codex* of Dioscurides with excellent illustrations dates from c. A.D. 512. It was written for Juliana Anicia, the daughter of the West Roman emperor Flavius Anicius Olybrius (A.D. 472).

† Tablets with inscriptions recording the deeds of Augustus, found on the walls of a temple in Ancyra (Angora).

‡ *The life and letters of Ogier Ghiselin de Busbecq*, translated and edited by Ch. Th. Forster and F. H. Blackburne Daniell. London, 1881, 2 vols.

Two Islamic travellers have to be mentioned: Sulaiman 'the merchant,' first half of the ninth century, travelled to the coasts of the Indian Ocean and of China. An account of his travels was published by an anonymous author in 851. It represents the first Arabic report on China and records the use of finger prints as signature by the Chinese, Sarton, vol. 1, p. 571. Ibn Wahb, another Muslim, visited China in 870. His travels and the information given by him about China, India and other Eastern countries were recorded by Abu Zaid, first half of tenth century, Sarton, vol. 1, p. 571.

For many centuries, especially in the T'ang period, Persian merchants who occasionally acted as diplomatic envoys, visited China; their centre was Ch'ang-an which had Zoroastrian temples as well as Nestorian churches, Needham, 1954, vol. 1, p. 187).<sup>2</sup>

## 3. PRIESTS

To this group belong, besides those already mentioned before, some Buddhist monks who made remarkable journeys. Their purpose was mainly to seek deeper learning and to collect religious scriptures. The Chinese Buddhist Fa-hsien, in an extraordinary journey, left Ch'ang-an, crossed the Gobi desert and the Hindu-Kush mountains to visit India. He returned to China by sea via Ceylon and Java, landing on the Shantung coast near Chiao-chou; his voyage lasted from c. 399-414. In his travelling account *Fo kuo chi*, *Records of the Buddhist Kingdoms*, he gave some information on plants, Sarton, vol. 1, pp. 390-91. Sung Yun, born in Tun-huang, another Chinese Buddhist, was sent to India in 518 by the Empress Dowager Hu of the Northern Wei Dynasty, capital Loyang, to study Buddhism and to collect books; he returned to China in 522, Sarton, vol. 1, p. 431. Hsüan Tsang (Ch'en I), born in Honan 602, died 664, spent 16 years in India and returned to China in 645 with many Buddhist books; he wrote *Hsi-yü chi*, an account of his travels, Sarton, vol. 1, p. 477. In 671, the Buddhist monk I-ching (Chang Wen-ming, 634-713) went from Canton on a Persian ship to Sumatra and subsequently to India; he returned to Loyang in 695 with many collected books. He also wrote an account of his long voyage, *Ta-t'ang hsi-yü ch'iu-fa kao-seng-ch'uan*, Sarton, vol. 1, p. 497.

Nestorian monks were probably responsible for the introduction of sericulture from Khotan into the Byzantine Empire c. 552, under Justinian, 527-565. It is likely that the mulberry tree *Morus alba* was introduced at the same time. The Chinese Nestorian Rabban Bar Sauma, born in Peking, died in Baghdad in 1293, reached Western Europe between 1287 and 1288. He followed almost the same route as Marco Polo in the opposite direction, Sarton, vol. 2, pp. 1068-69. Bar Sauma wrote in Persian a diary of his journey.

The Italian Jesuit Matteo Ricci may serve as the last example of priests who contributed to a spread of knowledge and an increased contact between scholars and scientists of different countries. Matteo Ricci (Li Ma-tou 利馬竇) was a remarkable linguist and an eminent scientist and mathematician. He reached Macao in 1582 and went to Peking in 1601, where he died in 1610. He and his Jesuit co-workers, by adapting themselves to the ways and customs of Chinese scholars, achieved acceptance as their colleagues. Ricci, on account of his remarkable knowledge and his abilities, was held in greatest respect. He participated in the calendar reform and together with some learned Chinese converts, translated scientific works into Chinese. He and his collaborators formed a collection of western scientific books and themselves wrote a number of scientific works. This collection is in part still preserved and kept today in the library of the old Pei T'ang 北堂 in Peking where in preparing the present publication the writer had an opportunity of using the works of Mattioli, Paré, Kepler and others which were not available elsewhere in Peking. The Pei T'ang 北堂 Library also preserves manuscripts of the early Jesuits.\* Needham correctly points out that after the coming of the Jesuits, Chinese science fused with universal world science, for literature on the very interesting influence of the work of early Jesuits in Peking, see Needham, Vol. I, 1954, p. 149.<sup>2</sup>

#### 4. PHYSICIANS

Quite a number of physicians were sent as envoys to foreign countries or became court physicians to foreign rulers; others went abroad as teachers or for study, or established themselves abroad as practitioners to gain wealth, some became known as writers, for example Ctesias; some of these physicians will have contributed to a spreading and exchange of medical knowledge. Democedes of Croton, born 558 B.C., a famous physician, had first been attached to Polycrates of Samos and, after the latter's defeat, was sent in 522 B.C. to the court of Darius I. He treated Darius successfully for a severely dislocated foot and his wife Atossa for an ulcerating tumour of the breast; he later returned to Croton with the secret help of Atossa, *Herodotus* III, 125–137. Ctesias of Cnidus went to Persia in about 416 B.C. and remained 17 years at the court of Artaxerxes II, Mnemon. He wrote a work on Persia and on India, fragments of which have been preserved by Photius. Ctesias' writings contain quite a number of fabulous reports; he was back in Greece in 398 B.C.

\* After the Second World War the books were carefully checked, repaired and a carefully prepared catalogue was published.

A very interesting story illustrating Arab-Chinese contact is told by Abul-Faraj Muhammad ibn Ishaq ibn Abu Ya'qub al-Nadim, died 995, called al-Warraq al-Baghdadi, the stationer of Baghdad, in his *Fihrist al-ulum, Index of the Sciences*, finished in A.D. 988. The story concerns Rhazes (Muhammad ibn Zakariya al-Razi, A.D. 850–925), Sarton, Vol. I, p. 662, 1927<sup>1</sup>; Needham, Vol. I, p. 219, 1954.<sup>2</sup> The great physician met a Chinese scholar who had come to Baghdad and remained there for some time. Within five months he learned to speak and write Arabic fluently. About a month before he intended to return to China, he asked Rhazes to dictate to him the 16 books of Galen. Rhazes who did not believe that he could copy this great work in such a short time, nevertheless began to dictate and to his amazement realized that the Chinese could write more rapidly than he was able to dictate, apparently he used 'grass-writing' (ts'ao-hsieh 草寫).

In the first half of the fifth century A.D. Korean physicians were called to Japan. In 414 a physician from Silla was consulted by the Emperor of Japan, Fujikawa, 1911, p. 96.<sup>16</sup> They established what were among the earliest cultural relations on record between Korea and Japan.

In 608 several young Japanese physicians were sent to China for study. They brought back to Japan the medical knowledge and the medical theories of the early T'ang period, Fujikawa, 1911, p. 97.<sup>16</sup>

#### 5. SCIENTISTS

Al-Mazini of Granada, a Hispano-Muslim geographer, born c. 1080–81 in Granada, died 1169–70 in Damascus, travelled extensively in Egypt, the Near East and in Russia; in 1136 while staying at Bulghar, near the junction of the Volga and Kama rivers, he observed the trade in fossil bones (ivory?) which were exported to Persia, Sarton, vol. II, p. 412.

Two more scientists who belonged to the greatest of Islam have to be mentioned: the Hispano-Muslim Ibn al-Baitar, born near Malaga towards the end of the twelfth century, died in Damascus 1248, was the greatest botanist and pharmacist of Islam and of the Middle Ages. He made long journeys in North Africa in order to collect plants, spent some time in Cairo, visited Asia Minor in 1224 and ended his days in Damascus,\* Sarton, Vol. II, pp. 663–64.

The second one Al-Biruni (Abu Raihan Muhammad ibn Ahmad al-Biruni, 973–1048) a Persian by birth, spent a considerable time in India. He wrote numerous books on a great variety of subjects. His description of India is based on his

\* Ibn al-Baitar wrote two great works: *Kitab al-jami fil-adwiya al-mufrada*, a collection of simples in alphabetical order, and *Kitab al-mughni fil-adwiya al mufrada*, the material arranged in therapeutical order.

personal observations and a profound study of the country and the people. He translated several works from Sanscrit into Arabic and, on the other hand, transmitted Muslim knowledge to the Hindus, Sarton, Vol. 1, pp. 707-709, see below.

The astronomic observatory at Maragha in Azerbaidjan, south of Tabriz became a meeting place for astronomers from China and from Islamic Europe. This observatory owed its existence to Hulagu Khan, 1256-65, who had sacked Baghdad in 1258 and had put an end to the rule of the Abassides. He ordered the famous Nasir al-Din al-Tusi, 1201-1274, to build an observatory at Maragha. Hulagu sent Chinese astronomers who met at Maragha their Muslim colleagues some of whom had come from Spain. The library at Maragha had allegedly c. 400,000 volumes. The books as well as the astronomic instruments have been lost but the latter were probably similar to those made in China under the direction of Kuo Shou-ching 郭守敬 in 1279 and kept from the time of the Yüan dynasty, in the observatory on the city-wall in the south-east corner of the Tartar City of Peking until their removal to Nanking in recent times.

#### 6. EXPLORERS

The wish to visit far-away unknown countries must already have stimulated some people in remote antiquity to undertake voyages of exploration. A number of such voyages, some of extraordinary length, have been recorded from antiquity, but as with very few exceptions they did not spread any new information regarding parasitic infections, it will be sufficient here merely to mention a few examples. The circumnavigation of Africa by Phoenician ships sent by Necho II, 609-593 B.C., mentioned by Herodotus, IV. 42, and the Carthaginian expedition under the command of Hanno, about 530 B.C., along the west coast of Africa southward to the Cameroons represent two large-scale enterprises of exploration.

According to Herodotus, IV. 44, before his conquest of the Sind, Darius I ordered Scylax, a Greek from Caryanda in Caria, to explore, with a number of others, the lower Indus region in about 519 B.C. They started from Caspatyrus, nowadays Multan, sailed in their ships down the Indus until they reached the Ocean and crossed to Egypt. Thirty months after the beginning of his voyage Scylax reached the Egyptian port whence the Phoenicians had started for their circum-navigation of Africa.

In the reign of Nero, A.D. 54-68, two centurions ascended the Nile above Syene, in an attempt to find the sources of that river. They seem to have reached the great marshes on the course of the White Nile above its junction with the Sobat at about 9°N. This region was only re-discovered in 1839-40, Pliny, *Nat. hist.* VI. XXXV. 181; Seneca, *Naturales quaestiones* VI. 8; Sarton, vol. 1, p. 258.<sup>1</sup>

#### L. EXCHANGE OF KNOWLEDGE AND IDEAS

The Egyptian geographer Cosmas Indicopleustes, a Christian, fl. second quarter of the sixth century, who travelled to Ceylon and Ethiopia, knew the sources of the Blue Nile. He wrote a book on geography, c. 534-547, *Topographia christiana* in which, among many other interesting information, he gave a re-description of the Ethiopian rhinoceros, Sarton, vol. 1, pp. 431-32.

There have been a great number of explorers throughout the centuries who were prompted by different reasons to undertake their voyages. While some of them were evidently stimulated by genuine scientific curiosity, others became explorers by chance but, being good observers interested in their new surroundings, occasionally gave valuable information of various kinds; Marco Polo belongs to this group. There was also a large group of adventurers who may occasionally have made interesting observations but who were fundamentally induced to their travels by restlessness and probably often by the wish to get rich in a short time.

The greatest traveller of Islam and the greatest of the whole medieval period was Ibn Battuta, 1304-1377. He was born in Tangiers in 1304, left his native city in 1325, returned 1349, left again for a new journey and came back to Fez in 1354. Sir Henry Yule has estimated that in his travels Ibn Battuta covered by land and sea about 75,000 miles. (For a brief account of his travels which took thirty years, see Sarton, vol. 3). After his final return to Fez he dictated an account of his travels to Ibn Juzayy, a secretary of Sultan Abu Inan Faris; the title of the work is *Rihla* (journey) or *Rihlat ibn Battuta*, A.D. 1355. The book gives a wealth of interesting information on a great variety of subjects. In a previous chapter we have already referred to his description of Chinese ships sailing the Indian Ocean. In the field of natural history he described the betelnut and coconut from southern Arabia, pepper, cinnamon and brazil wood from the Malabar coast. In Sumatra he found camphor, aloe and clove; he gave a long list of trees, fruits and eatable plants of India, and described the rhinoceros. In Ceylon he observed a white elephant and 'flying leeches.' In the western Sudan he noticed the use of grasshoppers as food by the native population; in Zafar he saw many cases of elephantiasis, Sarton, vol. 3, pp. 1614-1623.

#### D. Centres of Learning—The favourable position of Islamic-Arabic Countries.

The great centres of learning which existed from ancient times in different parts of the world played an important rôle in the exchange of knowledge and ideas. Alexandria, Athens, Rome, later under Islamic rule Cordova, Damascus,

Baghdad, Cairo and in the Christian world Salerno, Montpellier, Paris, Bologna, Padua, Pavia and Pisa were among the outstanding ones during various periods. They and their rôle are so well known that it will be sufficient merely to recall their names. In addition a few words may be said about some great centres of learning which were closely connected with the sect of the Nestorians as they were of special importance for the exchange of ideas between East and West.\*

The Syrian priest Nestorius who had been consecrated patriarch of Constantinople in 428, was deposed at the Council of Ephesus in 431. He retired to Arabia and Upper Egypt and died after 450. His followers, the Nestorians, migrated eastward. Nestorian scholars established themselves temporarily at the centuries-old school of medicine in Edessa which flourished under Nestorian influence until 489, when it was closed by order of the East-Roman Emperor Zeno, 474-491. This caused a further dispersion of the Nestorians who spread over the whole length of Asia. The Medical School of Edessa was succeeded by the school of Nisibis further east in Mesopotamia which at that time was under Persian rule. It likewise received many Nestorian scholars. Later, in the first half of the sixth century, the Nestorians found a refuge in the famous school of Jundishapur (Gondishapur). This school dated back probably to the fifth or even the fourth century and reached its zenith in the reign of Chosroes I the 'Just' (Anushirwan) A.D. 531-579, the greatest of the Sassanian rulers. It became especially important after the banishment of the Neo-Platonists from Athens in 529. At the height of its influence Jundishapur was one of the greatest centres for an exchange of philosophic and scientific ideas. Greek, Jewish, Christian, Syrian, Indian and Persian scholars, physicians and scientists compared and exchanged their knowledge and beliefs in a very tolerant cosmopolitan atmosphere. Jundishapur was especially famous as a medical centre. The medical teaching was essentially Greek, with Hindu, Syrian and Persian influence. This medical school suffered little from the Arab conquest of the seventh century† and flourished until at least the tenth century. Beginning from the latter half of the eighth century its influence was widely felt in the Islamic world.

The Nestorians brought with them Syriac translations of Greek medical works. Many of these translations were made during the fifth century and this translation-work continued until the ninth century. The later translations were made from Greek into Arabic, but generally with the help of Syriac versions. Latin translations were made from the Arabic texts and, beginning from the twelfth century, directly from Greek. The Nestorians played an important rôle

\* For additional information see: Sarton<sup>1</sup> and C. Elgood, *A medical history of Persia and the Eastern Caliphate*, Cambridge 1951.

† Jundishapur surrendered in A.D. 636.

in this translation-work on account of their frequent knowledge of several languages: Greek, Syriac, Arabic and occasionally Persian.

The sect of the Nestorians was transferred in 498 to Seleucia-Ctesiphon on the Tigris, and in 762 to Baghdad. Nestorians went eastward as far as China where they established churches in many places.\* Marco Polo found them along the main roads as far as Peking. In Ch'üan-chou, the old Zayton of Marco Polo, long dead as a great sea-port, the writer himself saw in 1927 a stone with a Nestorian cross and an inscription which was venerated by Chinese with candles and incense. In Ch'üan-chou which still has its famous well preserved pagodas of the Sung period built of granite with their walls covered with reliefs, the writer saw carved wooden figures in human shape with wings† used as decoration in the great K'ai-yuan temple which has also two stone columns in Hindu style. Of special interest is the recent discovery of many ancient stones formerly buried in the old city wall of Ch'üan-chou with carvings of similar figures, some with mustaches; of crosses supported by a lotus or by clouds, and of Buddhist, Christian (Roman as well as Nestorian) and Islamic inscriptions. All this and also the ruins of a great mosque in Arabic style‡ show the former spiritual character of this ancient city which at the time of Marco Polo was one of the greatest ports and shipping centres of the world (see L. Carrington Goodrich, *Recent Discoveries at Zayton*. Jour. Amer. Oriental Soc., vol. 77, No. 3, 1957 and John Foster, J.R.A.S., April 1954, 1-25, furthermore his article in the *Illustrated London News*, May 14, 1955, pp. 878-879. Prof. Foster believes to have identified with great probability among the discovered stones the tombstone of Andrew of Perugia, the Franciscan Friar, who was bishop of Zayton in 1330).§

\* A proof of early Nestorian mission work in China is given on a large stone tablet discovered in 1625 in Chang'an in the district of Hsien-fu in Shensi. This stone tablet which dates from A.D. 781 has under an incised Nestorian cross, inscriptions in Chinese and Syriac which commemorate 'The Introduction and Propagation of the Noble Doctrine of Ta T'sin in the Middle Kingdom.' The inscriptions, besides giving an abstract of the Christian doctrine, mention Olapan who had come from Judaea in 636 and was well received in China. Nestorian missions, notwithstanding two setbacks by persecutions at the end of the seventh and at the beginning of the ninth century, flourished; new missions arrived and many churches were built. The whole structure of Nestorian Christianity, however, collapsed in China after the downfall of the Yuan Dynasty and was so completely obliterated that the discovery of the stone tablet in 1625 at first produced stupefaction among the local Jesuit missionaries who could hardly believe that about 1,000 years before their time Christian missionaries had already come to China and had apparently worked very successfully.

† see Ecke, G., *Atlantes and Caryatides in Chinese architecture*. Bulletin of the Catholic University, Peking, No. 7, December 1930.

‡ According to a brief report in *The Straits Times*, Singapore, of 26th February, 1958, the mosque is going to be restored.

§ The writer wishes to thank Dr. G. Ecke, Professor of Art at the University of Hawaii and Curator of Chinese art at the Honolulu Academy of Arts for additional information concerning Ch'üan-chou which by his permission is given in the following: 'The name of the temple is K'ai-yüan ssu, the name of the main hall of the temple (with the winged bracket figures) Ta-hsiung pao-tien, founded in 686, rebuilt after 1150 and in 1398. The name of the Eastern pagoda is Chen-kuo t'a. In its present form it was built from 1238 to 1248. The first tower of this name was built at the end of the T'ang dynasty, between 860 and 874. The name of the Western pagoda is Jen-shou t'a, founded in 916, rebuilt in its present form from 1228 to 1237. Both towers were built as part of the said K'ai-yüan ssu which was founded in 686 and given its present name in the era K'ai-yuan of T'ang, A.D. 738.'

Here we may also very briefly refer to Peking and the great *Encyclopaedia Yung Lo Ta Tien* 永樂大典 commissioned in 1403. It consisted of 11,095 volumes, but was nevertheless finished within four years by the work of more than 2,000 scholars. The *Yung Lo Ta Tien* was never printed due to its enormous size; it was destroyed by fire during the Boxer rebellion in 1901, only about 370 volumes being preserved in libraries all over the world. The section on medicine must have contained more or less all that was known at that time in China regarding parasites and parasitic infections.

#### THE FAVOURABLE POSITION OF ISLAMIC-ARABIC COUNTRIES REGARDING EXCHANGE OF KNOWLEDGE AND IDEAS

The numerous examples given in the foregoing show that from antiquity communications existed between many far distant countries and that an exchange of knowledge and ideas did take place. As far as such exchange between Asia and Europe is concerned, the Islamic-Arabic countries were in an especially favoured position. They possessed the Western heritage from the Greeks and Romans, and on the other hand, they received the ideas and knowledge of India and the Far East both by personal contact and by the works of Indian and Chinese authors.

'In the Northern porch of the Ta-hsiung pao-tien of the K'ai-yüan Temple two stone columns in Hindu style have been employed, each with 12 medallions ('tondos') representing Hindu deities in bas relief, among others Krishna with the Flute, encircled by the polycephalous Naga, and the Man-lion Avatar of Vishnu. All these, and other Hindu motifs from Ch'üan-chou, have been illustrated in *Hindu sculptures at Zayton* by A. K. Coomaraswamy and G. Ecke, *Ostasiatische Zeitschrift*, series 2, IX, 5-11. Dr. Coomaraswamy writes on this material, "It is quite evident that the Hindu trading community of Zayton possessed a Hindu temple there. One may presume them to have been Tamils, as the style of architecture is South Indian; datable between 1200 and 1400."

'The ruined mosque is situated right inside the city of Ch'üan-chou, the Zayton of Marco Polo. It was built from 1310 to 11, its name is Ch'ing ching ssu. It is a reduced copy of the great mosque at Siwas in Asia Minor.

The Nestorian cross is now kept in the temple called Tsou-k'uei kung, likewise inside the city of Ch'üan-chou.'

For further information see: G. Ecke and P. Demiéville, *The Twin Pagodas of Zayton. A study of Later Buddhist Sculpture in China*. Harvard University Press 1935. This publication gives the complete series of the Buddhist sculptures on the two pagodas in excellent reproductions.

It may also be mentioned that during the Yüan period Ch'üan-chou had a Persian garrison which revolted, as described by Chang Hsing-lang in an article *The Rebellion of the Persian Garrison in Ch'üan-chou, A.D. 1357-1366*. *Monumenta Serica* III, 1938, Fasc. II, 611-27. The author states: 'Ch'üan-chou, or Zayton, was the greatest port of the East during the Yüan period; a great number of Westerners, especially Arabs and Persians, had settled there. According to Ibn Battuta's account of his travels all the Mohammedans he met in Zayton were Persians (Yule, in *Cathay and the Way thither*, IV, 119, footnote 2, took a special note of this fact).'

Chang Hsing-lang in his article translated the following from the *Chronicle of Ch'üan-chou fu*: 'Burhanuddin (according to Yule, i.c., p. 120, a Persian and one of the eminent shaiks at Zayton), a native of Kazerun . . . repaired the mosque in 1349 . . . 120 years old at that time; he was said to have enjoyed a longevity of 142 years.' Chang further states: 'The rebellion of the Persian garrison in Ch'üan-chou is recorded in every detail in *The chronicle of Fukien Province*, Fu-chien t'ung-chih, where it is said that the rebellion lasted ten years, 1357-66 . . . they were troops from Ispahan.' Regarding his translation from the mentioned chronicle Chang makes the following concluding remarks: 'these extracts give us an idea of the strong influence of the foreign elements in Zayton. With the collapse of the Persians in Zayton the foreign community and the flourishing trade of that port with foreign countries also ended forever.'

Goodrich, 1957, mentions that Ch'üan-chou was especially active from about 900 to 1474. At the height of its prosperity the city and its suburbs may have had close to half a million inhabitants.

It is common knowledge that the translation of Greek works into Arabic and later into Latin was not only one of the main reasons of their preservation but was also the cause for their reintroduction into Western Europe where they had been more or less lost for many centuries. In this connection it is of special interest that whereas Arabian authors, as shown by their writings, were interested in Indian and Far Eastern ideas and knowledge and incorporated such information in their own writings, those Arabic works which only dealt with Islamic, Indian and Chinese subjects were not subsequently translated into Latin or some other European language differing thereby from Arabic works dealing with Greek authors. In consequence the ideas and achievements of India and China remained little known in Europe. J. Needham, 1949,<sup>17</sup> in an interesting study dealing with this question,\* has given a number of examples which show that Arabian scholars had a considerable knowledge of Indian and Chinese medical and scientific ideas but that this knowledge was in general not transmitted to Europe in as far as it was not under Islamic rule. Needham points out that already in the ninth century Ali al-Tabari of Baghdad, in his *Firdaus al-hikma, Paradise of Wisdom*, A.D. 850, quotes Indian physicians such as Caraka, Sushruta and Vagbhata II, together with Hippocrates, Galen and Dioscurides. Al-Tabari's work was not translated into any western language for a thousand years. Similarly the *Tarikh-al-Hind* of al-Biruni, 973-1048, written after the conquest of parts of India by Mahmud the Ghaznawid, 967-1030, which al-Biruni witnessed, was still not translated into any European language in 1888. Al-Biruni's work deals with the various fields of science in India. Another example of the interest in Far Eastern science and medicine is the *Jami al-Tawarikh*, *Universal History*, of the Persian Rashid al-Din al-Hamdani A.D. 1247-1318, physician and Prime Minister of Ghazan Mahmud Khan, the great Mongol ruler of Persia, 1295-1304; it gives much information on China. About 1313, he arranged the preparation of an encyclopaedia of Chinese Medicine, the *Tanksuq-namah-i Ilkhan dar funun-i-ulum-i Khitai, Treasures of Ilkhan on the Sciences of Cathay*.

There were reciprocal scientific influences between India and China, as shown for example in the bibliographic catalogue of the official history of the Sui dynasty, 589-618. In this work a number of books on astronomy, mathematics and drugs are listed with titles beginning with 'po-lo-men' (brahmanical),

\* The question is discussed in greater detail by Needham in his *Science and Civilisation in China*. vol. 1, 1954, pp. 214-223.<sup>2</sup>

<sup>†</sup> The Muslim physician Abu-l-Hasan Ali ibn Sahl (ibn) Rabban al-Tabari, flourished under the Caliphate of al-Mutawakkil, 847-861; his *Paradise of Wisdom* (*Firdaus al-hikma*) was completed in A.D. 850. It deals chiefly with medicine but also with embryology, physiology, zoology, astronomy and philosophy. It is based on Greek and Hindu sources and ends with a summary of Hindu medicine, see Sarton, 1927, vol. 1, p. 574.<sup>1</sup>

indicating their Indian origin for example Polomen Yao Fang, *brahmanical drugs and prescriptions*. In the study mentioned, Needham shows that, notwithstanding the Western and Indian contact, Chinese science and medicine were not greatly influenced by it. He also points out that whereas the achievements of pure and abstract science of India and China became known to the Islamic-Arabic world, such knowledge did not spread further westward but that, on the other hand, Europe became acquainted with the Oriental achievements in the applied sciences.

#### E. Examples of Ideas and Knowledge regarding Parasitic Infections spread by early Communications

In the foregoing we have described in some detail different ways and means by which, from Antiquity up to the Renaissance, ideas and knowledge concerning parasitic infections may have spread. It could be shown that traceable relations between distant countries go back over more than three thousand years to remote antiquity and prehistoric times. The given examples dealt mainly with the rôle of outstanding travellers and of some great events of history, especially conquests. We have, however, to keep in mind that besides the comparatively few mentioned famous travellers, there must have been innumerable other persons whose names are forgotten who may also have contributed to the spreading of parasitological ideas and knowledge.

Parasitology, as a special field of science, did not exist until very recently. We cannot therefore expect to find many instances in which a specific kind of knowledge concerning parasites can be demonstrated as having been transmitted at a fixed period in early times. In the following we shall first show the spreading of certain parasitological ideas and beliefs and shall subsequently give a few examples of the spreading of true knowledge regarding parasitic infections by early communications and contacts.

Indian medical theories were transmitted to the Tibetans who accepted them in all details, Filliozat, 1949, Introduction p. II<sup>10</sup>; one may therefore assume that the ideas and beliefs concerning parasites held by Tibetan medical men until recently, were in principle more or less those expressed by Indian writers. Indian medical theories also spread to China without, however, greatly influencing Chinese medicine.

Islamic physicians and scientists inherited the knowledge of their Greek predecessors. It is therefore not surprising to find, for example, the views of Avicenna regarding helminths and ectoparasites essentially similar to those expressed in the works of Greek writers.

The doctrine of spontaneous generation which was generally accepted from antiquity to the first half of the nineteenth century is in the works of some Arabic writers regarding parasites similar even in details to the statements of the Greeks.

A relationship between the human microcosm and the macrocosm of the world was already assumed in Babylonia as well as in ancient China and India. This theory had a number of outstanding Greek and Roman representatives as well as more recent ones in the Middle Ages and the Renaissance.

The existence of this theory in widely-separated countries may in some cases have been due to an exchange of ideas by early contact and communications. On the other hand, it is possible—indeed even likely—that it may have been developed independently by different persons in different periods. It played a rôle in connection with the assumed spontaneous generation of parasites, see I. 5. The assumed origin of parasites—the doctrine of spontaneous generation.

Early communications and also independent development have likewise to be considered regarding the belief in a tooth-worm as the cause of tooth decay and toothache. The peculiar gnawing pain and the nerve which must occasionally have been observed when a tooth was extracted, strengthened this belief. In the West it apparently originated in Mesopotamia, whence it spread to Egypt and the Near East. It was also widespread in China and other parts of the world. It is likely that while it spread from Mesopotamia, it may also have originated independently in some other countries.

Whereas the spreading of theories and of certain superstitious beliefs concerning parasites had no practical value, it was different with the spreading of true knowledge, especially in the field of therapy.

The knowledge of the existence of the Guinea worm and of the clinical picture of the infection with which the people on the shores of the Red Sea were familiar, was transmitted from Egypt to Greece, probably chiefly orally by travellers, but also by the writings of Agatharchides and Plutarch.

Regarding the circum-navigation of Africa by order of Necho II, Herodotus states that the crews spent the unfavourable part of each year on shore to do farming. Concerning Hanno's Carthaginian expedition to the Cameroons, it is known that coastal stations were established probably to protect the route to the Canary Islands. One may assume that the members of both expeditions could hardly have failed to become acquainted with certain parasitic infections, such as infection by the sand flea, *Tunga penetrans*, although writers dealing with these expeditions do not mention this point. Sand flea infection, as mentioned

before, was at an early time described by Fernandez de Oviedo,\* 1547, and by A. Thevet, 1558, from America. Leishmaniasis americana, Anti-onccoy, became known in Europe from the reports of the early writers after the Spanish conquest of Peru.

The knowledge of elephantiasis in a general sense, including elephantiasis arabum (Filaria infection), was widespread on the shores of the Mediterranean, in the Middle East and in India at the beginning of the Christian Era. As cases of locally acquired elephantiasis arabum did not exist in Italy, Roman writers, for example Celsus, must have got their information, or must have seen patients which had reached Italy, through communications with the Middle East or India. The great traveller Ibn Battuta in his *Rihla* mentions the frequency of elephantiasis in certain places.

From more recent times we have already mentioned that negro slaves brought to America from the African West Coast several parasites, among them *Loa loa*, which was first recorded in publications from Cayenne, Bajon, 1777,<sup>13</sup> and the West Indies, Mongin, 1770<sup>14</sup>; it took a few more years for it to be reported for the first time from Africa (Angola), Guyot, c. 1776.<sup>15</sup>

Before considering briefly the spread of knowledge of some plant drugs used in the treatment of parasitic infections, we will merely mention in general a number of plants which became known in different countries in consequence of early travel and contact, see Laufer, *Sino Iranica*, 1919<sup>16</sup>; Needham, vol. 1, 1954, p. 175.<sup>2</sup> The grape-vine *Vitis vinifera* and alfalfa *Medicago sativa* were apparently introduced into China by Chang Ch'ien. Probably between the third and seventh centuries the chive *Allium scorodoprasum*, the coriander *Coriandrum sativum*, the cucumber *Cucumis sativus*, the fig *Ficus carica*, the safflower *Carthamus tinctorius*, the sesame *Sesamum orientale*, the pomegranate *Punica granatum* and the walnut *Juglans regia* were introduced. The Chinese names of five out of the quoted eight plants and trees include the character Hu 胡 which means Central Asian or Persian.

On the other hand, a number of plants reached India and the western world from China. The orange seems to have started its travel from the borderlands of China and Tibet, north of the Himalayas and the peach and pear reached India in the second century A.D. Many centuries later flowers like peony, azalea, camellia, chrysanthemum and numerous others were brought to the West from the western mountainous region of China, Cox, 1945.<sup>20</sup>

Regarding plant drugs probably introduced into China from India, we will only mention chaulmoogra oil, until recently used for treatment of leprosy. Ta

\* Gonzalo Fernandez de Oviedo y Valdes, *Sumario de la natural y general istoria de las Indias*. Madrid, 1526. Enlarged edition, 1535-57; reprinted, edited by J. Amador de los Rios, Madrid, 1851-55, 4 vols.

Feng Tzu 大風子 the oil of chaulmoogra, *Hydnocarpus anthelmintica*, is first referred to in *Pen Ts'ao Yen I Pu I* 本草衍義補遺 in about A.D. 1380, Needham, vol. 1, 1954, p. 213. Regarding anthelmintics we will show that some which had been found effective in some countries, where they had been used from ancient times, were in some instances already introduced into certain other countries at a comparatively early date:

The root and the bark of the pomegranate tree *Punica granatum* which originally came from Persia, see Laufer, 1919,<sup>19</sup> were already widely used in ancient Egypt and India and were later introduced to Greece, Rome and the Far East.

Pomegranate, olive oil, hartshorn and honey mentioned in the Hippocratic collection had reached Greece from Egypt; pepper, likewise mentioned, came from South-East Asia by way of India.

*Semen contra*, containing *santonin*, came from Turkestan and was widely used by Arabic physicians.

Betel nut *Areca catechu* was well known from ancient times to the people of South-East Asia, whence, like the coconut it was brought to the West at an early period; it was known to Avicenna and is mentioned in the *Rihla* of Ibn Battuta.

Among anthelmintics which have their origin in India, South-East Asia and the Philippines is kamala, a resinous substance obtained from the fruit capsules of *Mallotus philippensis*. It was introduced into Europe comparatively late.

The green fruit of the paw-paw, *Carica papaya* containing the proteolytic enzyme papain originally came from the Moluccas; the tree was subsequently grown also in India and the West Indies.

Several locally-obtained anthelmintics (against *taenia*) were used in Abyssinia from ancient times. Apparently, however, they were not utilized in Egypt, in spite of the good trade relations which existed between the two countries. They reached Europe comparatively late, probably due to the geographic position of Ethiopia which became isolated from Europe, after Islam had extended its power to Egypt and North Africa.

Among these anthelmintics is Koussou, *Hagenia abyssinica*, syn. *Brayeria anthelmintica*. It became known in Europe in the second half of the eighteenth century; one used the flowers.

Musenna, the bark of *Acacia anthelmintica* was very well known in Abyssinia; the tree grows on the shores of the Red Sea.

The ships which used the newly established sea-routes from Central and South America to Europe after the Spanish conquests in the New World brought besides the *cinchona* bark which revolutionized malaria therapy, several important anthelmintics to Europe where they had previously been unknown.

Among them were *Chenopodium ambrosioides* var. *anthelminticum* (American worm seed) from North America; the seeds of *Cucurbita pepo* (pumpkin) from Tropical America; various *Ficus* species, especially important *Ficus glabrata* and *Ficus laurifolia* from Central America and Northern South America, the sap of which known as lèche de higuerón, was used there for anthelmintic treatment during centuries; *Fucus helmintocorton* (Corsican moss) a seaweed which came originally from the coast of Argentina; *Schoenocaulon* (syn. *Veratrum*) *officinale*, the cevadilla of Mexico; *Spigelia marilandica* from North America and *Spigelia anthelmia* from Brazil.

Regarding the use of parasites for cosmetic purposes, leeches were used in a rather similar way as cosmetics in imperial Rome and in contemporary China. Their use may have developed independently in each country, but one should not overlook the possible rôle played by early communications.

In conclusion it may be stated that knowledge of certain parasitic infections, of specific drugs and also certain parasitological theories and beliefs evidently spread in consequence of early contact by people from different countries. At the same time similar knowledge, beliefs and practices apparently also developed independently in different parts of the world.

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## L. EXCHANGE OF KNOWLEDGE AND IDEAS