INTRODUCTION

Alberuni is one of those scholars of the world who by the nature and magnitude of their contribution to several branches of learning hold pride of place in the history of science and culture. His analytical and critical faculties are immense. He was undoubtedly a great mind of the medieval period and one may say that in spite of his times was a champion of a liberal and a universal scientific outlook. He was a God-fearing Muslim with a boundless faith in humanity. There is a universalism about him which has an abiding value and interest for all people at all times.

The medieval period between 900 and 1100 A.D. is remarkable for its enlightenment and scientific progress in the history of Islam. Alberuni was fortunate in having lived when this progress was at its zenith. Much had already been done in the sphere of science by the scholars proceeding Alberuni but a good deal had yet to come from him. An overview of the history of the development of science and knowledge of that period reveals that it was Alberuni who gave a scientific language and expression and above all a scientific exactness to that prodigious amount of stray thoughts which had accumulated at various Islamic academic centres. Alberuni's contributions are great not only in the sense that he supplied additional and newer facts but also in the sense that he used his analytical mind sifted out the truth from the large number of prevalent notions and ideas.
There is virtually no field of knowledge in which Alberuni did not try his intellect. A survey of the titles of his works and the contents of his extant books clearly indicate that his interests were varied and ranged over such diverse fields as medicine, surgery, astronomy, geology, geography, chemistry, physics, mathematics, poetry and fine arts. He produced valuable works on topics related to these disciplines. Among his works, those pertaining to geography assume a special place, for prior to Alberuni although some writers did deal with geography, their contribution was only casual or incidental to some other purpose and none of them could be described as a geographer. It was Alberuni, as the following pages would show, who emerged as the 'first Arab geographer'. He had a deep insight and a clear understanding of the terrestrial phenomena which govern our earth and affect human life. None of the Arab writers before him had developed in geography the causal approach. It was Alberuni who adopted the principle of causality in dealing with the genesis of problems. He also studied the earth from a human angle and tried to explain socio-economic diversities on the basis of regional diversities. He often made it abundantly clear that physical laws are important not only because they govern physical happenings but also because they effect human habitation and occupation. His approach however was not wholly deterministic for he emphasized the significance of the free will of man.

Although Alberuni presented a number of revolutionary ideas in the field of geography, this aspect of his learning has somehow received only scant attention. A great deal of work has been done
to highlight the other facets of his intellectual life but none so far to assess his geographical thoughts.

We are indebted to a number of western orientalists such as Nicholas de Khonkoff, Eduard Sachau, C. Schoy, J.H. Kramers and Max Mayerhof who have rendered into various European languages his original works. In this connection two English translations of Alberuni's works are notable: they are *Ather al-Baqiya 'an al-Qurun al-Khaliya* (Chronology of Ancient Nations) and *Kitab fi Tahqiq ma li'l-Hind min maqalatin maqbulatin fi 'l-'aql au mardhulatin* (Alberuni's India). Both of these translations were ably done by the noted German orientalist Eduard Sachau. Another English translation of Alberuni's third important work, *Kitab Tahdid Nihayat al-Amakin li-Tashih masafat al-masekin* (The determination of the coordinates of positions for the correction of distances between cities), has recently been translated by Jamil Ali and published from Beirut. The book, *al-Gamun al-Mas'udi* (Canon Masudicus), which is rightly considered Alberuni's greatest work, still remains largely untranslated, though abridged translations into French and German are available. The introductory part of what is probably the last of Alberuni's works, *Kitab al-Saydala fi'l-Tibb* (The Book of Medicinal Drugs) was rendered into German by the late Dr. Max Mayerhof, and which after being compared with the original manuscript has in part been rendered into English by F. Krekow. Beside these valuable works other scholarly attempts have been made to highlight the achievements of Alberuni by eminent scholars and orientalists such as Mallison, Minorovsky, Marquart, Kratchkowsky, Boilet and Sarton — and in India by Burni, Enayet Ullah, Abdullah
Khan, Maqbul Ahmad and Musaffar Ali. These attempts did focus attention on Alberuni but the writer feels that there is a considerable scope for work on Alberuni as a geographer. The present work is an attempt in that direction.

For a full appreciation of Alberuni's contributions in the field of geography it is necessary to gain familiarity with the ideas and notions which were prevalent in his times. It is also quite necessary to note the mental and cultural level of his contemporaries. It is generally known that as the Muslims of the medieval world, specially the Arabs, came to occupy the earlier centres of learnings in Iraq, Egypt, Syria and Iran, they became the fortunate beneficiaries of the rich scientific and cultural heritage of the past. This added further impetus to their already inquisitive mind. The conquest of a large part of the world also meant the union of varied cultures, a very significant episode in history. It was a period when Europe had already gone into a slumber and the ancient centres of learning in Alexandria, Harran, Damascus and Jandi Shabur were decaying and losing their past glory. The Arabs took up one of the most daring challenges in the history by accepting the guardianship of that treasure of knowledge and it is well known that they not only safeguarded but also augmented this treasure very well.

The growth of geography as a science in the medieval Arab world was at a rather slow pace in the beginning. But gradually with the growth of other sciences, specially astronomy and
trigonometry, geography also began to produce positive concepts. The pace of this growth was quickened by factors such as exploration, charting and cataloguing. Travelogues, accounts of roads and routes, i.e., itineraries and their charts went on multiplying and providing the raw material for the science of geography. Later on both terrestrial phenomena and human geography engaged the attention of Muslim geographers. For a long time, however, there was more chorography than geography. It was in the beginning of the eleventh century that a number of Arab scholars, who may rightly be called geographers, came on the scene.

The three or four centuries following the inception of Islam constituted a period of scrutiny, consolidation and exploration. The prevailing theories and concepts were put to test and to closer observation; the fundamental elements of Ptolemy's *Almagest* and *Geography* were re-examined and, in part, improved; certain astronomical mistakes were corrected; latitudes and longitudes were calculated and determined; the measurement of a terrestrial degree was fixed; the circumference of the earth was worked out. In physical geography, searching enquiries were made into the processes of denudation, deposition and earthquakes; meteorological phenomena, e.g., thunder, lightning, wind and rain, were subjected to explanation; the origin of the seas, salinity and tides were explained; the surface of the earth was studied to find out the causes of erosion, deposition and earth movements.

Furthermore, the Arabs developed a critical outlook on the evolution of life, the classification of plants and animals and
their geographical distribution. They attempted to correlate the climatic and edaphic factors with the distribution of plants and animals. They clearly understood the inter-relationship between the physical environment and human activity. They went ahead in explorations. The Arab ships had ports of call in Sri Lanka, India, Malaysia, Java and China, and perhaps as far as Korea and Japan. On the eastern coast of Africa they had regular routes upto Sofala (Madagascar). They also undertook land journeys deep into the heart of Asia and Central Europe and their knowledge about Central Europe, Central Asia, China and India was far greater than that possessed by the pre-Arab scholars, geographers and explorers.

It may be said that by the end of the tenth century and the beginning of the eleventh the Arabs had begun to anticipate the various aspects of geography which are studied today under the heads Oceanography, Climatology and Meteorology as well as Human, Regional and Physical Geographies.

A study of the development in the major branches of geography in this period reveals that the development of the various branches was not uniform. The branch which received most attention was Mathematical Geography. The reason for this was the temperament and inclination of the Arabs. Mathematics and astronomy helped to solve such problems of geography as surveying, navigation and cartographic representation. A number of mathematical works on the lines suggested by Ptolemy were produced. Amongst these were two books by Muhammad Musa al-Khwarizmi, Kitab Surat al-Ard and Kitab al-Qill. The latter being based on Aryabhatta's Siddhanta. Muhammad
Kathir al-Farqhani was another distinguished scholar whose work on astronomy, Kitab al-Markat al-Samawiya wa Jawami 'Ilm al-Najum, gave a description of the world based on seven climates. Works of similar nature were those of Ya'qub b. Ishaq al-Kindi and Ja'far b. 'Omar al-Balkhi. It is interesting to note that the latter knew about the monsoons of the Persian Gulf and the seas of India and was quoted by Roger Bacon in his book Opus Majus. Altogether, Mathematical Geography became a fertile field. Astronomical tables were prepared for the purpose of determining the latitudes and longitudes of the principal cities of the world; attempts were made to measure the terrestrial degree; a map of the world, known as al-Surat al-Ma'muniya, very much on the lines of Ptolemy was made; significant work done by Abu Sa'id al-Barir on the drawing of the meridian; useful contribution was made by Abu Sa'id al-Asturlabi on the astrolabe. Other notable contributors to Mathematical Geography were Yahya b. 'Ali Mansur, Ahmad b. 'Abd Allah al-Habash al-Hasib al-Murwazi, Abu'l Hasan Thabit b. Qurra al-Sabi and 'Abd Allah Muhammad b. Jabir b. Sinan al-Battani. The last mentioned produced a work, Kitab al-Zij al-Sab'i, which is considered a landmark in astronomical literature. He not only calculated the longitudes and latitudes of important towns of the world but also determined very accurately the 'Precession of Equinoxes' and the 'Obliquity of the Ecliptic'. He calculated the length of the solar year as 365 days, 5 hours and 40 minutes. In observational astronomy, the work of 'Abd al-Rahman al-Sufi, who was at the court of the Buwayhid rulers in Persia, is one of the greatest masterpieces. Ibn al-'Alam proved that planets travel
1 degree in 7 solar years and worked out the value of the constant of Precession as 51'4", which compares well with the modern value of 50'20".

In cartography not only a beginning was made but there were considerable achievements. Baghdad under the rule of al-Ma'mun flourished as a great cartographic centre where the Greco-Muslim School of cartography made significant advances. This school was mainly based on the method and techniques of Ptolemy. It differed from the Balkhi School which was essentially inspired by the teachings of the Qur'an and was founded by the noted scholar of Balkh, Abu Zayd Ahmad b. Sahl, popularly known as al-Balkhi, aimed at drawing detailed maps of the Islamic kingdom, by placing Mecca at the centre of the world. He conceived the Indian Ocean and the Mediterranean Sea as two gulfs entering the western portion of the great landmass of the 'Inhabitable World' from the Encircling Ocean (Bahr al-Muhit) and meeting at the Isthmus of Suez (al-Barmakh). The maps of this school continued to place the north at the bottom of the maps. The importance of al-Balkhi's cartography lay in his regional maps which he drew for each of the several provinces of the Islamic kingdom. The non-Islamic world was left blank, except for the boundaries. These maps are non-extant now but they were incorporated by al-Istakhri in his works. Amongst the most prominent followers of the Balkhi School were Ibn Hauqal and al-Maqdisi. It should be noted that the later geographers of the 13th, 14th and 15th centuries, such as Nasir al-Din Tusi (1201-1274), Zakariya b. Muhammad al-Qaswini (d.1283), al-Harrani (around 1332), Hafis Abu
(d. 1430) followed the Balkhi technique for the drawing of their maps.

Muhammad b. al-Khwarizmi, who belonged to the Ptolemaic School, is another noted cartographer of the medieval period. His map is lost but its description is available in his work. Other scholars who followed the Greek-Muslim tradition in cartography include Thabit b. Qurra (834–901), Ibn Yunus, al-Mu'allabi, Muhammad b. Ibrahim al-Fazari and al-Sharif al-Mrisi. The world map of Ibn Yunus and al-Mu'allabi prepared in c. 963 for the Fatimid Caliph of Egypt, al-Mu'izzli-Din Allah, was drawn on a Tustari silk cloth woven of gold and silk threads costing 20,000 dinars.

Besides the substantial progress in Mathematical Geography and Cartography, much valuable work was done in branches such as Physical Geography and Biogeography. Although no separate and comprehensive treatise was written on physical geography, the random physical descriptions mixed up with other descriptions show that the medieval Arabs did give much attention to physical laws and phenomena. The first known work on Physical Geography is that of al-Kindi. The work of Mutahhar b. Tahir, Kitab al-Bad'wa'l Tarikh, summed up the knowledge gained from the Muslim, Iranian and Jewish sources on the description of the earth, the extent of its population, its division into 'climates' and the description of seas and rivers. The Rasa'il by 'Ikhwan al-Safa was a kind of encyclopaedia and deals with astronomy, the 'climates', the classification of plants, the creation of animals and so on. Kitab Ijabat al-Hiyah al-Khafiya by Abu Bakr Muhammad b. al-Hasan al-Nasib al-Karkhi was a very valuable treatise
on the description of the earth, its mountains and rocks, its dry
lands and waters, and also on the manner of utilising underground
water. In Biogeography, Kitab al-Nabat by al-Dimawari (Abu Hanifa
Ahmad b. Daud) was a pioneer Arab work. Another work Kitab el-
Falahat el-Nabatiya by Abu Bakr Ahmad b. 'Ali al-Wahshiya al-Kaldani
al-Nabati contained useful information of botanical and agricultural
interest.

We may note that General Geography was developing side by side
with other branches. A number of works bear testimony to this
statement. Notable among these is Kitab al-Sifat by Nadir b.
Shumajil (d. 740). This is considered as the first book on the
subject of General Geography. But the work which had a more direct
approach was Kitab al-Amsar wa'Aja'ib al-Buldan by 'Amr b. Bahr
al-Jahis. In this work al-Jahis discusses the characteristics and
advantages of the important cities of the Islamic world. The expansion
of maritime activities in the Indian Ocean and the oriental seas
had produced rich accounts of voyages. These explorations and their
descriptions opened up further ground for the growth of geography.
The accounts of Sulaiman Tajir as well as those of Sallan, the
Interpretator, deserve special place. While the former wrote about
the seas, islands and sea routes from Siraf to China and threw
light on the social, cultural, religious, and political conditions
in India and China, the latter gave reports of his exploration in
Central Asia and in the region north of Volga. Besides the accounts
of travels, there were books on conquests and routes. Ahmad b.
Ya'qub b. Jabir al-Sulahuri's Kitab Fatih al-Buldan and Kitab
al-Masalik wa'l-Mamalik (Book of routes and kingdoms) gave not only
the trade routes of the Arab world but also of the distant lands such as China, Korea and Japan and also accounts of the southern Asiatic coast up to Brahmaputra, of the islands of Nicobar and Andaman and of the kingdoms of India, Malaya and Java. The scholars who enriched the literature falling under this head are in fact many but the most notable are Ibn Rusta (903 A.D.), Ibn al-Faqih al-Hamadhani (903 A.D.), al-Jahiz (903 A.D.), al-Mas'udi (934 A.D.), Abu Zaid Hasan al-Sirafi, Abu Dulaf Mis'ar b. al-Mu'alihi, and Ibn Faldaan.

It may be noted that in the second half of the tenth century the emphasis shifted from General Geography to Regional and Economic Geography. Hence, new grounds were broken and works began to be copiously illustrated with maps. Abu Zaid Ahmad b. Sahl al-Balkhi's Kitab Suwar al-Qalam was a work in which maps were included for the first time and the world was presented on the basis of geographical and political divisions rather than the traditional seven 'climates'. Other writers who belonged to the Balkhi School, were al-Isakhri, Ibn Hauqal, al-Maqdisi and others, and to them should be given the credit of giving a new and distinctive status to geography. The geographical writings of this school were objective and its contents came to include social and economic conditions.

All this development of geography and allied subjects was made possible by the patronage accorded by the rulers of the Abbasid dynasty. The early rulers of this dynasty established Bait al-Hikama (Academy of Science) at Baghdad, where scholars of different shades and creeds used to assemble and discuss topics of academic
importance. Thus, a healthy and liberal tradition was built up which paved the way for intellectual development. The patronage and financial assistance to the scientists, given by the Caliphs such as al-Ma'mun as well as by their ministers, who were surnamed Paramika (Sanskrit Paramukh), resulted in what is called 'the period of renaissance' in the Islamic world. These Bramikas, before their conversion to Islam during the Ummayyad period, were the guardians of the Buddhist vihāras in Balkh (Central Asia), and after the rise of the Abbasids took keen interest in the transmission of Indian scientific knowledge and thought to the Arab world. Scientific activity began with the translations of Greek, Syriac, Hebrew, Sanskrit and Pahalwi works on science into Arabic in which a galaxy of translators participated and which lasted for several centuries. Thus, Arabic came to possess most of the available literature in different sciences such as mathematics, astronomy, physics, chemistry, geography, medicine, optics, ophthalmology, mechanics, botany and zoology. The Arabs of this period, did not act merely as transmitters but also made original contributions in most of the fields of knowledge.

The plan and scheme of the present work which is rather simple is as follows:

The first chapter takes into consideration the salient phases of Alberuni's personal as well as professional life. As a man and as a scholar he was great. In spite of the fact that at times he had to face great hardships his intellectual greatness never suffered. He was a man of conviction and strong will power.
These two qualities stood him in good stead in life. He was great in his own times and remains greater even to this day. He was undoubtedly a prodigious writer but prodigiosity in his case never meant superficiality or casualness or vagueness.

The second chapter deals with Alberuni's sources of India. It is evident from the Arabic written sources utilized by Alberuni that he was fully acquainted with most of the available literature on astronomy, mathematics, geography and other sciences, and before visiting India, he was already well versed with the classical works on Indian astronomy, mathematics, geography and other sciences through Arabic translations. He gained a good deal of first-hand knowledge by going through the Hindu works in original. He learned sanskrit and some other Indian vernaculars for this. His sources on India are not only the written documents but oral also. Besides taking into study the classical works of the Hindus he made proper and fortuitous arrangement of conversing with the pundits in their language. He quotes profusely from Hindu scriptures, epics and scientific works. A survey, bringing about salient features of those sources, has been taken up in this chapter.

The third chapter consists of an attempt to piece together Alberuni's varied knowledge of India into a geographical coherence. This chapter is based on Alberuni's writings on India as found in his work Kitab fi Tahqiq ma li'l-Hind min maqalatin magbulatin fi'l-'aql au mardhulatin and elsewhere. From this exhaustive work it will be seen that Alberuni had a very sound knowledge of the geography of the country. He not only speaks very correctly and authoritatively
of the towns, routes, coasts, rivers, islands and mountains but equally correctly gives account of the people and their customs. The picture that emerges from the critical observation of Alberuni’s accounts pertaining to India is remarkably clear.

The fourth chapter deals with the accounts of Sind. In all contemporary Arabic literature Sind had always occupied the status of a separate country. It was found different, culturally as well as politically, from the mainland of India. Separate attention has therefore been given to Sind. In fact, Alberuni’s accounts of Sind, by virtue of a multitude of reasons, are more authentic and precise.

In the fifth chapter Alberuni’s various views regarding cosmogony, cosmology and cosmography along with his physical geographical concepts have been assembled and critically examined. Though his cosmological concepts did not add much to the knowledge which then existed, his views in the field of Physical Geography are indeed important. He was the first Arab geographer to hint at the possibility of the earth having a diurnal rotation and present the concepts of cycle of denudation, isostasy, mountain building, periodic rise and fall of tides and currents.

The sixth chapter is on Mathematical Geography. A number of good works on Mathematical Geography already existed before Alberuni, but his greatness lies in the fact that he added new dimensions to this branch by adopting newer methods and arriving at better results. He applied to advantage spherical as well as plane trigonometry in his works so that the results and the methods
can be compared with the modern techniques. His 'distance method' for the determination of longitudes and latitudes of towns was a novel contribution. His astronomical findings are amazingly correct. The masterpiece is his table of sines which compares well with the modern table of natural sines. The astronomical competence of Alberuni was unparalleled in the entire history of Islamic science.

The seventh chapter takes into consideration Alberuni's accounts falling under the head of Descriptive Geography. This branch of geography was not new and almost every writer of the Arab world wrote something in this field. However, a good deal of such writing was loose and superficial. Alberuni, however, maintained his scientific approach here too. His descriptions of the regions of the world show this scientific approach. In this chapter his various writings have been critically examined and presented with comments. Furthermore, Alberuni's regional division of the world into seven *iqlima* (climates) has been assessed in the light of contemporary knowledge.

The last, that is the eighth chapter, presents a wholesome picture of Alberuni as a geographer. It underlines the major contributions of Alberuni to the growth of geography.

In the end a few appendices have been added. Appendix I is an exhaustive table of sines of arc. The table in original is in the traditional sexagesimal system and in the Arabic-letter-letter-system-of-enumeration. The table has been computerised and been presented in the decimal system. The appendix has been
made further useful by providing with it the corresponding natural sines. As mentioned earlier, Alberuni's sines compare well with the natural sines and they are correct up to the sixth place of decimal.

Two other appendices have been added to enhance the utility of the text.

A few maps and a bibliography have been provided to support the text.

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The present writer may claim authenticity without laying any claim to comprehensiveness. Since he had to work within the limits imposed by his rather meagre knowledge of Arabic and Persian -- the languages in which Alberuni generally wrote -- he had to be content with the secondary sources, i.e., English translations and editions of Alberuni's texts and the comments and works in English and Urdu. The constraint, if he may say so, has not been too great, for it is possible to obtain a clear picture of Alberuni's geographical knowledge and concepts from those of his works which have already been translated in English and Urdu.