CONCLUSION

The proceeding pages must have shown that Alberuni did make a remarkable contribution to the field of geography. He wrote on almost every aspect of this science and made concrete and substantial additions to geographical knowledge. It should be borne in mind that he lived at a time when geography had yet to attain an independent professional status and it was generally studied along with and as a part of other natural and social sciences. Alberuni's work mark the beginning of scientific geography in the Islamic world. Many of his ideas were a prelude to the modern concepts in geography.

It is often believed that the most productive and fruitful contributions to Muslim geography came in the ninth and tenth centuries A.D. Alberuni's contributions belie this assertion and it is certainly he who represents the culmination of Muslim geography. Many of his concepts and theories were ahead of his time and sometimes was very close to the modern period. With Alberuni, it may be said, Arab geography entered new vistas and abandoned the narrow and limited sphere in which it had operated. A resume of his major contributions would not be out of place here.

In the field of descriptive geography Alberuni made some very remarkable contributions. Although this branch of geography was probably the first to attract the attentions of Arab geographers,
the writings in this field were generally stereotyped and hackneyed. The books of routes and kingdoms which generally characterize this period are encyclopaedic. Alberuni not only redesigned the scope of this branch but also treated its subject matter very differently. He brought under review many new lands and people which had previously been unknown or ignored. For example, he was the first to describe the river Angara and the population of the Baikal region in Eastern Siberia. He also described the Scandinavians (Warangians), gave an account of the metal-works in Northern Europe and provided a good deal of information concerning the Ice Sea situated to the northeast of Europe. He also gave dependable description of South Africa and Mozambique. Besides these purely descriptive items his theoretical concepts are also very commendable. For instance, his conception of the existence of a united and contiguous landmass surrounded on all sides by an ocean is very significant. He believed that this landmass did not abruptly end at the equator but continued beyond it, penetrating deep into the sea. Likewise, his postulation of the presence of another landmass is west of this Afroasian continent/significant. He furnished a well balanced topographical account of the "inhabitable world". His description of the rivers, islands and mountains of the world are very graphic and exact. He presented a radical concept when he postulated that the Indian Ocean was not a landlocked sea, as had been hypothesized by Ptolemy and his Arab followers, but had in the South of terra firma, two openings on either extremes -- openings which connected it with the Eastern and the Western Seas. He thus emphasised the possibility of circum-navigations.
In the field of regional geography Alberuni's accounts of India are superb and of great interest. He is unique in his grasp of the geographical and sociological problems of India and in this respect surpasses all his predecessors such as Abu Zaid, Sulaiman Tajir, Ibn Khurdadhbih, Ya'qubi, al-Jaihani, Ibn Hauqal and even al-Mas'udi. It is indeed a monument in regional writing and has no parallel in all the writings of the Muslim medieval period. The details are so impressive that it seems as if little has escaped his attention. Boundaries and frontiers, coasts and towns, physiography and drainage, climate and rainfall, animal and plant life, people and their commercial and religious activities make a huge canvass. He proves himself to be a genius when he declares that the Plain of Hindustan is an aggradational plain made up of the alluvium brought by the rivers which now traverse this plain.

Following the Greek notions as also the views of some of his contemporaries, Alberuni divided the inhabitable part of the earth into seven 'climates' on the basis of the length of a day. There was little original in this concept, except that his range of 'climates' differed from the classifications given by others. He took note of the different accounts of 'climates' and observed that the anomalies in these versions were due to three factors, namely, (i) the estimation of maximum declination, (ii) the evaluation of sine of a degree of an arc, and (iii) the transmission of sine tables. The merit of Alberuni's classification of 'climates' lies in their being based on mathematical and
astronomical observations as against arbitrary evaluations.

Physical and mathematical geography are the two branches of geography where one finds Alberuni's intellectual labours at their climax. He made positive and substantial contributions in both these fields. Perhaps the most outstanding is his concept of isostatic and eustatic adjustments. He does not consider these physical disturbances as isolated or regional phenomena but considers them as related and globular happenings which produce a chain of minor and major activities leading to changes on the face of the earth. It is on the basis of this concept that he explains the emergence and submergence of landforms and the building of mountains and the consequent changes in the drainage of the area. In this connection it is worth mentioning that Alberuni's account of the changes in the course of the Amu Darya is of special interest. In explaining his point of view he examined the whole mechanism of the change and knew well the behaviour of a river flowing in a semi-arid region. Again, his concept of the cyclic evolution of landforms and of the processes of denudation and deposition and also of weathering adumbrate modern geomorphology. He conjectures the existence of an extended ancient inland sea (the Tethys of Suess) and discovers evidences of its presence in various areas such as Southwest Asia, Central Asia and even India. In the last mentioned area he notes that the beds of the sea was gradually filled up by silting and eventually leading to the formation of the Indo-Ganga Plain. Alberuni is remarkable in asserting that Southwest Asia has undergone climatic pulsations. Perhaps he was the only Arab geographer who had a definite idea of
this phenomenon and who elaborately and authoritatively advanced
the theory of climatic changes in the near as well as in the
distant past. His arguments, as has been expressed in his book
Tahdid nihayat al-Amakin li tashih masafat al-Masakin, are
undoubtedly very advanced and support the later researches of
scholars such as Huntington, Brooks, Caetani and others, who
established the concept that the regions of Southwest Asia have
witnessed a desiccation of climate. Further, it may be pointed
out that the phenomenon of tides was clearly understood by him.
He fully appreciated the influence of the moon in generating this
phenomenon. According to him the daily phases of the tides are
related with the rising and setting of the moon while the monthly
phases are the result of the waxing and waning of the moon.
Besides these concepts in the field of physical geography, Alberuni
should be credited with several other views such as the phenomenon
of eclipse, salinity in oceans and cloud condensation and
precipitation.

As already said, mathematical geography is the piece de
resistance of his labours. Indeed, he excels in the presentation
of the problems related to mathematical geography and some of his
contributions in this regard are outstanding. It would not be too
much to say that amongst the Muslims it was Alberuni who may be
regarded as the "father of mathematical geography". A few of his
contributions may be mentioned here. Alberuni worked out an
elaborate sine table which is an excellent piece of work and which
can be compared with any natural sine table. The values of the
sines given in the table are correct up to the sixth place of the
decimal. Alberuni utilized this knowledge in his subsequent computations and deductions and therefore his results in the sphere of mathematical geography are most reliable. Another significant contribution includes his methods for the conversion of an arc into a chord. In fact, Alberuni very effectively used his expertise in the determination of latitudes and longitudes of places and arrived at very satisfactory results. In the determination of latitudes and longitudes of terrestrial places, he employed cumbersome and lengthy methods, yet, judging from the results, they were authentic. It is to his credit that he was able to determine astronomical positions of more than six hundred towns accurately and precisely. The method for their determination is significant. He preferred the "distance method" over the "time method" and very convincingly proved that if out of the four factors relating to a set of towns, i.e., the latitudes and longitudes of both the towns, the longitudinal difference between them and the linear distance between them, any three are known, then the fourth can be very successfully calculated from them. It was this method which he generally employed in his calculations of the coordinates of latitudes and longitudes. These methods show the sharpness and the originality of his mathematical mind. Similarly, his method of determining the value of an arc of a terrestrial degree was a novel device of his own. His assessment of the circumference, the diameter and the radius of the earth, is, therefore, reasonably precise. Alberuni's method for the determination of the direction of the Qibla, based as it is on trigonometrical derivations, is very impressive. In addition to
these remarkable contributions Alberuni will also be long remembered for his development of a stereographic projection for the mapping of the celestial stars and the earth. In the field of cartography he showed his ingenuity by drawing four sea maps which were circular in shape.

In the sphere of cosmology, cosmogony and cosmography, some of Alberuni's contributions are notable. He conditionally accepted the possibility of the helio-centric structure of the solar system but hesitated in accepting the hypothesis that diurnal motion is associated with the earth and not with the sky. He was fully aware of the globular shape of the earth and had several scientific arguments for it. His most notable contribution in the field of cosmology, however, is his concept of the elliptical orbital path of the planets. Regarding the orbital motions and velocities of planets, he found that the planets which are nearer to the earth have smaller circuits and higher speed, while those which are away have larger circuits and lesser speeds.

Certainly Alberuni's services to geography are great. His thinking was deep, his vision wide, his attitude unbiased and his methods precise. He had the expertise and way of thinking which go in the making of a good geographer. His achievements, if properly assessed, must reveal their historical significance and present Alberuni as a towering genius of his times.