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16**SCIENCE AND SCIENTISTS OF
MEDIEVAL INDIA**

You have read about Science and scientist in India during the Ancient Period. During the medieval period, Science and Technology in India developed two facets: one concerned with the already chartered course of earlier traditions and other with the new influences which came up as a result of Islamic and European impact. We will read in some detail about these developments in this lesson.

**OBJECTIVES**

After reading this lesson you will be able to:

- *discuss the educational practices that emerged during the medieval period;*
- *trace the developments in science & technology in Medieval India; and*
- *list some well known scholars in the field of science & technology and their works during this period.*

16.1 SCIENCES IN MEDIEVAL PERIOD

As you know, the medieval period marks the coming of Muslims in India. By this time, the traditional indigenous classical learning had already received a setback. The pattern of education as prevalent in Arab countries was gradually adopted during this period. As a result, Maktabs and Madrasas came into existence. These institutions used to receive royal patronage. A chain of madrasas, opened at several places, followed a set curriculum. The two brothers, Sheikh Abdullah and Sheikh Azizullah, who were specialists in rational



science, headed the madrasas at Sambal and Agra. Apart from the talent available locally in the country, learned men from Arabia, Persia and Central Asia were also invited to take charge of education in madrasas.

Do you know that the Muslim rulers attempted to reform the curriculum of primary schools. Some important subjects like Arithmetic, Mensuration, Geometry, Astronomy, Accountancy, Public Administration and Agriculture were included in the courses of studies for primary education. Though special efforts were made by the ruler to carry out reforms in education, yet sciences did not make much headway. Efforts were made to seek a kind of synthesis between the Indian traditional scientific culture and the prevalent medieval approach to science in other countries. Let us now see what developments took place in various fields during this period.

Large workshops called karkhanas were maintained to supply provision, stores and equipments to royal household and government departments. The karkhanas not only worked as manufacturing agencies, but also served as centres for technical and vocational training to young people. The karkhanas trained and turned out artisans and craftspersons in different branches, who later on set up their own independent karkhanas.

16.1.1 Mathematics

Several works in the field of Mathematics were produced during this period. Narayana Pandit, son of Narsimha Daivajna was well known for his works in Mathematics – *Ganitakaumudi* and *Bijaganitavatamsa*. Gangadhara, in Gujarat, wrote *Lilavati Karamdipika*, *Suddhantadipika*, and *Lilavati Vyakhya*. These were famous treatises which gave rules for trigonometrical terms like sine, cosine tangent and cotangent. Nilakantha Somasutvan produced *Tantrasamgraha*, which also contains rules of trigonometrical functions.

Ganesa Daivajna produced *Buddhivilasini* - a commentary on *lilavati* - containing a number of illustrations. Krishna of the Valhalla family brought out *Navankura* on the *Bijaganit* of Bhaskara-II and elaboration of the rules of indeterminate equations of the first and second orders. Nilakantha Jyotirvida compiled *Tajik*, introducing a large number of Persian technical terms. Faizi, at the behest of Akbar, translated Bhaskara's *Bijaganit*. Akbar ordered to make Mathematics as a subject of study, among others in the education system. Naisiru'd-din-at-tusi, was another scholar of Mathematics.

16.1.2 Biology

Similarly, there were advancements in the field of Biology. Hamsadeva compiled a work in the field of Biology entitled *Mrga-paksi-sastra* in the thirteenth century. This gives a general, though not always scientific, account of some animals and birds of hunting. The Muslim kings, who were warriors and hunters, maintained a fleet of animals such as horses, dogs, cheetahs and falcons for hunting. Animals, both domesticated as well as wild, have been



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described. Both Babur and Akbar, in spite of being busy in their political preoccupations and war, found time to study the work. Akbar had a special interest in producing good breeds of domestic animals like elephants and horses. Jahangir, in his work - *Tuzuk-i-jahangiri* - recorded his observations and experiments on breeding and hybridization. . He described about 36 species of animals. His court artists, specially, Mansur, produced elegant and accurate portraits of animals. Some of these are still preserved in several museums and private collections. As a naturalist, Jahangir was also interested in the study of plants. His court artists have drawn around 57 plants in their floral portraits.

16.1.3 Chemistry

Do you know that in the medieval period, use of paper had begun? An important application of Chemistry was in the production of paper. Kashmir, Sialkot, Zafarabad, Patna, Murshidabad, Ahmedabad, Aurangabad and Mysore became well known centres of paper production. The paper making technique was more or less the same throughout the country differing only in preparation of the pulp from different raw materials.

The Mughals knew the technique of production of gunpowder and its use in gunnery, another application of Chemistry. The Indian craftsmen learnt the technique in evolved suitable explosive composition. The work *Sukraniti* attributed to Sukracarya contains a description of how gunpowder can be prepared using saltpeter, sulphur and charcoal in different ratios for use in different types of guns.. The principal type of fire works included those which pierce through air, produce sparks of fire, blaze with various colours and end with explosion. The work *Ain -I-akbari* speaks of the regulation of the Perfume office of Akbar. The attar (perfume) of roses was a popular perfume, which is supposed to have been discovered by Nurjehan



INTEXT QUESTIONS 16.1

1. What subjects were taught in primary schools in the medieval period?

2. The subject _____ was ordered by Akbar to be a compulsory subject of study at primary stage.
3. What were the 2 functions of 'Karkhanas'?

4. Match the following scholars with their works:

| Name of Scholar | Name of Work |
|--------------------|-------------------|
| 1. Narayana Pandit | 1. Buddhivilasini |

- | | |
|--------------------------|----------------------|
| 2. Gangadhara | 2. Mrga-paksi-sastra |
| 3. Ganesa Daivanja | 3. Ganitakaumudi |
| 4. Hamsadeva | 4. Lilavati Vyakhya |
| 5. Jahangir | 5. Tajik |
| 6. Sukracarya | 6. Tuzuk-i-jahangiri |
| 7. Nilakantha Jyotirvida | 7. Sukraniti |

Name of Scholar

Narayana Pandit

Gangadhara

Ganesa Daivajna

Hamsadeva

Jahangir

Sukracarya

Nilakantha Jyotirvida

Name of Work

5. Name 4 places in India during the medieval period where paper was manufactured.
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16.1.4 Astronomy

Astronomy was another field that flourished during this period. In astronomy, a number of commentaries dealing with the already established astronomical notions appeared.

Mehendra Suri, a court astronomer of Emperor Firoz Shah, developed an astronomical instrument 'Yantraja'. Paramesvara and Mahabhaskariya, both in Kerala, were famous families of astronomers and almanac-makers. Nilakantha Somasutvan produced commentary of Aryabhatiyaa. Kamalakar studied the Islamic astronomical ideas. He was an authority on Islamic knowledge. Maharaja Sawai Jai Singh-II of Jaipur was a patron of Astronomy. He set up the five astronomical observatories in Delhi, Ujjain, Varansasi, Mathura and Jaipur.

16.1.5 Medicine

The Ayurveda system of medicine did not progress as vigorously as it did in the ancient period because of lack of royal patronage. However, some important treatises on Ayurveda like the *Sarangdhara Samhita* and *Chikitsasamgraha* by Vangasena, the *Yagaratbajara*

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and the *Bhavaprakasa* of Bhavamisra were compiled. The *Sarangdhara Samhita*, written in the thirteenth century, includes use of opium in its material medica and urine examination for diagnostic purpose. The drugs mentioned include metallic preparation of the rasachikitsa system and even imported drugs.

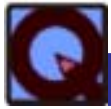
The Rasachikitsa system, dealt principally with a host of mineral medicines, both mercurial and non-mercurial. The Siddha system mostly prevalent in Tamil Nadu was attributed to the reputed Siddhas, who were supposed to have evolved many life-prolonging compositions, rich in mineral medicines.

The Unani Tibb system of medicine flourished in India during the medieval period. Ali-bin-Rabban summarized the whole system of Greek medicine as well as the Indian medical knowledge in the book, *Firdausu-Hikmat*. The Unani medicine system came to India along with the Muslims by about the eleventh century and soon found patronage for its growth. Hakim Diya Muhammad compiled a book, *Majiny-e-Diyae*, incorporating the Arabic, Persian and Ayurvedic medical knowledge. Firoz Shah Tughalaq wrote a book, *Tibbe Firozshahi*. The *Tibbi Aurangzebi*, dedicated to Aurangzeb, is based on Ayurvedic sources. The *Musalajati-Darshikohi* of Nuruddin Muhammad, dedicated to Darashikoh, deals with Greek medicine and contains, at the end, almost the whole of Ayurvedic material medica.

16.1.6 Agriculture

In the medieval period, the pattern of agricultural practices was more or less the same as that in early India. Some important changes occurred in the introduction of new crops, trees as well as horticultural plants by foreign traders. The principal crops were wheat, rice, barley, millets, pulses, oilseeds, cotton, sugar-cane and indigo. The Western Ghats continued to yield black pepper of good quality and Kashmir maintained its tradition for saffron and fruits. Ginger and cinnamon from Tamil Nadu, cardamom, sandalwood and coconut from Kerala, were becoming increasingly popular. Tobacco, chillies, potato, guava, custard apple, cashew and pineapple were the important plants which were introduced to India during the sixteenth and seventeenth centuries. It was during this period that the production of opium from poppy plants began in Malwa and Bihar regions. Improved horticultural methods were adopted with great success. The systematic mango-grafting was introduced by the Jesuits of Goa in the middle of sixteenth century. Imperial Mughal Gardens were suitable areas where extensive cultivation of fruit trees came up.

For irrigation, wells, tanks, canals, rahat, charas and dhenkli charas (a sort of a bucket made of leather used to lift water with the help of yoked oxen) were used. Persian wheel was used in the Agra region. In the medieval period, agriculture was placed on a solid foundation by the State by introducing a system of land measurement and land classification, beneficial both to the rulers as well as the tillers.



INTEXT QUESTIONS 16.2

1. Name the cities where astronomical observatories were set up by Maharaja Sawai Jai Singh-II of Jaipur.

2. Name 2 treatises of Ayurveda written during the medieval period.

3. What is *Firdausu-Hikmat*?

4. Which book brings the Arabic, Persian and Ayurvedic medical knowledge together?

5. Name 4 crops that were started to be grown in India during the medieval period.



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WHAT YOU HAVE LEARNT

- There was a considerable change in the education system. The Arabic system was introduced in a big way. Madrasas and Maktabas were established all over. The rulers tried to introduce reforms.
- Several works were written in the fields of Mathematics, Chemistry, Biology, Astronomy and Medicine.
- Most of the scientific works in this period were commentaries or expositions of the earlier treatises.
- Several important scientific works in astronomy, medicine and other sciences were rendered from Sanskrit to Persian/Arabic and from Persian/Arabic to Sanskrit.



TERMINAL EXERCISE

1. Describe the education system that developed during the medieval period.
2. Discuss the developments in the field of Medicine during the medieval period.
3. How was irrigation done during this period.
4. Write an essay on “Science and Scientists during the medieval period.



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ANSWERS TO INTEXT QUESTIONS

16.1

1. Arithmetic, Mensuration, Geometry, Astronomy, Accountancy, Public Administration and Agriculture
2. Mathematics
3. i) Manufacturing agencies
ii) centres for technical and vocational training to young people
4.

| Name of Scholar | Name of Work |
|-----------------------|-------------------|
| Narayana Pandit | Ganitakaumudi |
| Gangadhara | Lilavati Vyakhya |
| Ganesa Daivajna | Buddhivilasini |
| Hamsadeva | Mrga-paksi-sastra |
| Jahangir | Tuzuk-i-jahangiri |
| Sukracarya | Sukraniti |
| Nilakantha Jyotirvida | Tajik |
5. Any 4 out of Kashmir, Sialkot, Zafarabad, Patna, Murshidabad, Ahmedabad, Aurangabad and Mysore.

16.2

1. Delhi, Ujjain, Varanasi, Mathura and Jaipur.
2. Any 2 out of Sarangdhara Samhita, Chikitsasamgraha, Yagaratbajara and Bhavaprakas.
3. A book written by Ali-bin-Rabban summarizing the whole system of Greek medicine as well as the Indian medical knowledge.
4. Majiny-e-Diyae
5. Any 4 out of Tobacco, chillies, potato, guava, custard apple, cashew pineapple.

ACTIVITIES

1. Try to visit any one of the observatories set up by Maharaja Sawai Jai Singh-II of Jaipur. Write a report bringing out the utility of an observatory and describing the instruments available.



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2. Try to visit a factory that produces paper. Write a report on the process of production.
3. You have learnt about the two systems of medicine – Ayurvedic that was developed during the ancient period and the Unani Tibb system that was introduced to India by the Muslims during the medieval period. Do you know that the doctors whom you generally consult when you are ill follow the Allopathic system, which was introduced by the Britishers during the Modern period. Find out the basic principles of these three systems and how they differ. For this you may do any one or more of the following for getting information:
 - Discuss with your teacher
 - Get books from the library on this and read
 - Search the internet
 - Meet a doctor and discuss

Write a report bringing out the differences in these systems, stating the basic principles of each.

4. Choose any two of the crops that were introduced to India during the medieval period and find out their origin and how they came to India. Write their stories.