Chapter 1

1. INTRODUCTION

The magnificent group of rock-cut caves at Ajanta is situated in the Aurangabad district of Maharashtra. These caves are world famous for the mural paintings of both the Hinayana and Mahayana faiths of Buddhism. The complex of monasteries at Ajanta, built in 2nd century B.C. and 5th century A.D., appears too unique to us today because no other ancient Indian site has been as well preserved in its paintings as well sculptures. Ajanta offers a wealth of pictorial expression, a way of grasping the ideas and images that characterized an entire era. The devotional and ornamental paintings make up the majority of murals at Ajanta and include both the large scale murals depicting the mythical landscapes of Buddha Veneration, along with purely ornamental paintings on the pillars and ceilings. Bodhisattva kinds surrounded by landscapes were placed at main entrance, at the entrance to the vestibules and to the shrines. The narrative paintings were positioned on the side walls of the caves and in some cases side walls of verandas. Ceiling and pillars were adorned with geometric, floral or figurative ornamentation. Despite these rigid arrangements guidelines there are many, sometimes hundreds of Buddha depictions indicating original plan was abandoned. In the terminology used by Walter Spink, the Buddha paintings are intrusions while other paintings belong to painting programme. Those individually donated scenes were inserted in places which has remained empty in the initial decoration process. These intrusive paintings are often placed in rather unsuitable locations.

1.1 The Discovery of Ajanta.

The cave temple of Ajanta, excavated out of living rock is true representative of Buddhist art and culture in a land that gave birth to this religion. The monks exploring their way to ravine of Ajanta some time in 2nd B.C began heavily blow hacking out the basaltic rock by hand and heaving it down into the river below. Then they set out decorating the wall, the doorways and the ceilings probably with the help of large mirrors that reflected the sunshine from the ravine outside. The work was subsidized by wealthy merchants and princes of surrounding country side. There is an
inscription in one of the earliest-cave that reads “Meritorious gift of a dwelling with cells and halls by the merchant Gahanna Dada”

No one knows why the monks abandoned Ajanta. Whether, it was because of plague or persecutions or for some other occult reason. By 600 A.D Buddhism itself was dying out in India (It has never succeeded in returning except in the Himalaya) and it may simply have been that the rich merchants refused to subscribe anymore. The monks vanished and the valley returned to its dislocation.

For the next 1500 years, the Ajanta cave appeared to have been effectively lost and forgotten like Pompeii was after the eruption of Vesuvius in 79 A.D. Perhaps from time to time hermits or wandering tribes made home in them, but for outside world Ajanta ceased to exist. Tigers and other wild animals prowled through the halls of the caves and made their lairs under the paintings. Over the years, due to monsoon rains, the doorways fell in and shrubs and creepers over grew the entrance. Then at last in 1819 the caves were discovered again.

The most important discovery of the nineteenth century was that of the Ajanta caves and their paintings. Ajanta was discovered by a group of British officers attached to the Madras army, who were taking a few days off from military maneuvers in the Sahayadari hills, to the north of Ajanta, to hunt tigers. The men arrived at the head of the gorge-Ajanta pass and there fell in with half wild boy who was minding a group of buffaloes. The boy said, he knew some tiger lairs and led them down over rocky ground towards the bed of the river. Then he pointed through the trees to a part of the cliff that was thickly overgrown with creepers and bushes. Hacking their way in through this under growth, the officers suddenly found themselves confronted with the large doorways of carved stone. At the far end a huge figure of Buddha sat quietly smiling in the darkness with the walls covered with brilliant paintings.

It is pity that more is not known about these Army officers and what they did at this first moment of discovery. Other caves, of course had been found in India but none were so spectacular and none contained anything like this galaxy of paintings.
There would certainly have been some dangers in such an exploration as no one knew what snakes or other wild animal were lurking in the darkness.

In 1822, dull little references appeared in a paper read by Mr. William Erskine to the Bombay Literary society “Very extensive excavation has recently been discovered at the top and bottom of the Ajanta pass. They have been very little visited on account of the difficulty of approaching them. The only information regarding them I possess is contained in a memorandum of captain Morgan’s of Madras Establishment, which states that they were described by the officers who visited them in 1819 as having sitting Buddha figures with curled wings. No trace of Brahmanical religion was discovered. The paintings were in a decent state of preservation”.

In 1824, a much livelier observer appeared on the scene. This was Lieutenant James Edward Alexander of the 16 lancers and one is grateful to him for the first full account of what Ajanta looked like in those days. Alexander reported in the journal of the Royal Asiatic Society that he was travelling on leave from his regiment when he reached the walled village of Ajanta, about four miles away from the caves and he decided to visit them. He set off in the morning on horseback, dressed in a Muslim costume, accompanied by a guide and servant and well armed with sabers, pistol and hunting spears. As he left the village, he reported, one of the Muslim officials called out to him. “La illah illi ah - there is but one God! You will never return. If you escape the tigers, those strong hearted robbers, the Bhils - will destroy you”. The Bheels or Bhils were half-savage tribe who were supposed to be particularly active around the caves. “We had not advanced far up the glen”. Alexander reported, “When a low whistling was heard above us to the left and was quickly repeated from the opposite cliff. This proved to be Bhils intimating to one another that strangers were approaching. The guide evinced strong symptoms of fear and on being remonstrated he proceeded onwards. Some of the Bhils showed themselves peeping out from behind the rock. They were more savage looking race, perfectly black and nearly naked. Our firearms prevented them attacking and we were allowed to proceed.” Pistol cocked, Alexander advanced on the caves and found them full of danger of every kind. Bats flew in his face, bees were buzzing from the hives that hang from the ceiling and in the dust and debris on the floors be noticed the foot prints of tiger, jackals & bears. Remains of cooking fire were lying and in one corner he came on a
human skeleton. On the whole, the frescoes were still intact. He visited one cave after another and discovered them to be in excellent state of preservation. Here & there the monsoon rains have seeped through the cracks in the rocks, many pillars have collapsed bringing down part of the ceiling with them. But somehow because of the Indian climate, most of the paintings have survived with a freshness of colour.

The next man to write a description on the cave was Mr. Ralph, Who went there in 1828. His description appeared in the journal of the Royal Asiatic Society of Bengal and he is worth quoting as he manages to convey better than perhaps all the experts. Mr. Ralph has a style that was entirely his own, a kind of dramatic dialogue, as if he were having a conversation with some second person.

Now, Ralph, look here, can you see this figure? No, bring the torch nearer, give me the torch; can you see it better now? Hardly, let us light-dry grasses, bring grass now, and place it here. Now watch while the light is strongest you may now see the whole figure. Yes, I can see it now, but throw water on it. Now, the colours are more vivid. Here is lovely face-a Madonna face. These are all Hindu face-nothing foreigner. What a lovely female. Here is another heavenly face. The last one we discover seems always the greatest.

And so Mr. Ralph goes on from one fresco to another, the procession of Buddha, the hunting scenes, an inexplicable white woman and it does not seem to occurred to him that he himself with bundles of dry grass and water might be contributing to the destruction of the paintings.

It happens that at the time Mr. Ralph was at Ajanta, a doctor James Bird arrived. He is described in the journal of the Royal Asiatic Society of Bengal as “an intelligent young medical man from Bombay,” and he has been sent by the Governor of the province to make an examination of the caves and see what could be done to preserve them. The Doctor’s method was peculiar. He proposed to scrape off with a knife as many paintings as he could conveniently, carry and take them back to Bombay. Mr. Ralph himself had been making a few little experiments of this nature, and he assured Dr Bird that the plan would not work “As for carrying away the paintings, you can do so in powder”, he warned him. Not deterred by this, the Doctor
set to work peeling off a number of figures. Using great care he was able to get them from the wall more or less intact, but when they arrived at Bombay all that was left was powder.

Lieutenant Blake, also of Madras Army arrived at Ajanta in Jan 1839 as he appears to have had some trouble with both Bhils & the bats. In the Bombay courier, he described the “Bhils Raja” as rude, Jungle individual and he says that he was nearly blinded by a heavy of bats that bore down towards the entrance on seeing his flambeaux. He says that when the cave was discovered, it contained a great deal of rubbish and mud that has worked its way inside. British soldiers has been sent to try to drain a few of the caves, but the mud was still very thick everywhere.

Experts sent to decipher the inscriptions, retired defeated saying that they have never seen the language before. Some scholars concluded that the caves are 3000 Years old; other thought that they were the work of a group of Greek artist left behind by the Alexander, the great when he made his way down the Indus valley from the north in 327 B.C. None of the scholars shown any interest in protecting the paintings from the souvenir hunters and the weather until 1843, when James Fergusson, one of the leading historian of the day, send a memorandum to the court of the Directors of East India Company praying them to take steps to prevent further desecration and destruction of this monument and to appoint someone to make drawing of fast perishing fresco of Ajanta. The company responded by appointing a captain (later Major) Robert-Gill, an artist attached to Madras Army. He was provided with an elephant, a gang of coolies and body guard to protect him from Bhils and he arrived at Ajanta in May, 1844.

There is supposed to be a curse upon Ajanta. It is said that anyone who tries to deface the painting in any way or even to reproduce them will be over taken by misfortune. Ajanta curse has not proved very violent (it claims only one case of suicide and one of madness) but it has proved remarkably persistent. Major Gill’s hardship alone is almost heart breaking. One large slab of painting was stolen off the walls of the very cave in which he was working. In 1857 Indian mutiny drove him away and on his return he nearly died of fever and dysentery. Then when he was already well passed middle age, he was riding in a bullock cart and the animal bolted.
He was spilled out on to some rock and his thigh was broken. Still he kept on at his job taking stereoscopic photo with the aid of the magnesium lamp and making tracing and colored drawing with care. Among all the people who worked at Ajanta, he was perhaps the most devoted. He rejected the comfortable house that had been provided for him in Ajanta Village and instead lived either in one of the caves or in a crude hut just outside. There are surviving photographs showing the Major at the scene of his work bearded, hermit like and not willing to accept defeat in difficult situation. For months on end, while he painted by the light of the oil lamps, he never saw another Whiteman and in all the twenty seven years there was hardly a time when he was not in some danger either from the Bhils or from wild animals. Gill clearly was enchanted by Ajanta. Having spent his life painting the extremely beautiful exquisite woman of the frescos, he chooses just such a woman for his life. She was a native dancing girl named Paru, from Ajanta Village. Gill was extremely fond of music and he loved to watch her performing the same dances with the same costumes and same kind of Jewels.

As Gill finished each of his paintings, he dispatched it by bullock cart and sailing ship to London. At the end of twenty years, he had copied almost every one of the most important frescoes in the caves, and all but five of his canvases were put on exhibition in the crystal palace and while they were there in December 1866, fire broke out. The entire collection was destroyed. On top of this, as if to complete the destruction of Gills lifework, his stereoscopic photographs have yellowed and spotted with age and the book that contained them has long been out of print.

Gill struggled on for five more years after the crystal palace fire, but accomplished nothing very much. In the end he sold what was left of his drawings and sketch book to the Bombay Government for two hundred pounds and soon afterwards he fell ill and died. His tomb can be seen at Bhusawal and his wife Paru at Ajanta village.

Nearly ten years went by after the Gill debacle; it was decided that a new expedition should be sent to Ajanta. In 1870, it was understood that Ajanta reveal data on a long period of Indian history about which very little was known. It was agreed that 29 caves fell in two groups. The five earliest, the Hinayana group had
been excavated and decorated over a period of two hundred years, starting soon after
the death of great Buddhist Emperor Ashoka in 232 B.C. or there about. It was easy to
fix these early caves from the nature of the carving and form inscriptions on the
columns and doorways and more particularly from the fact that Buddha who died
about 483 B.C was nowhere represented in them as a sculpture or painted image, as
that period if would have been sacrilege to represent him, for much the same reason
that early Christian artist refrained from depicting Christ as an actual man. Buddha
was simply indicated by a shrine, a stupa that was supposed to resemble one of the
urns containing his ashes. In the 24 other caves Buddha was represented as man
usually a large stone figure sitting cross legged in a shrine.

It was with the object of getting a full record of this civilization that an
expedition was organized with the Bombay school of arts and financed by a grant of
2000-3000 pound from some London banker in the year 1875. John Griffiths, the
principal of the school was put in charge of the work. He took with him a mixed team
of art students Zoroastrians, Brahmans, Jains & Christians and they spent four seasons
making detailed copies of the frescos. Griffiths urged his sponsors in London to
photograph each of his facsimiles as it was finished. But it was decided that the
expenses will be too great. This was much regretted later as the Ajanta curse was still
active. On June 12, 1885 fire broke out in the Victoria & Albert Museum where
Griffith’s collection was then housed. It began during lunch hour when burning soot
from the kitchen chimney lodged in the wooden rafters supporting the roof. Almost an
hour went by before the horses of the Kensington fire brigade came dashing to the
rescue. When the fire was put off at 3.30 PM, it was found that eighty five of the 125
paintings most of home large canvasses from 20-30 sq.ft has either damaged or totally
destroyed. It was a curious fact that although the fire burned for 3 hours, the only
object of any real value, it touched was Ajanta reproduction.

After the fire, Griffiths’ went back to Ajanta and managed to recopy enough of
the frescoes to enable him to bring out- “The paintings in the Buddhist caves at
Ajanta” in two volumes in 1896. These were the first volume of reproduction to
appear. Then in 1906, Lady Herriangham, wife of a London physician came to India
and in three season completed a volume of water colour reproduction called Ajanta
Frescoes. Ajanta was still a pretty wild place not much visited. Lady Herriangham
reported that while she was working, green parrots, monkeys, boars and panther roamed about the ravine outside the caves and that deadly snake were not uncommon. Bee appears to be the worst menace. At the beginning of this century “Murrays Hand book of travelers in India, Burma & Ceylon was still warning tourists of the danger and hardship of the journey to the caves.

Nevertheless, Ajanta was gradually becoming the goal of Buddhist scholars and art lovers. Mr. Mukul Dev, the Indian artist, relates that in 1918 he found a team of Japanese copyists there, headed by Sentaro Sawamura, a professor of oriental art at Kyoto University and the painter kampo Arai. They were working with extreme care, using sheet of thin Japanese art paper which they dampened and pressed against the carvings. They took off hundred of exact impression in this way and shipped them back to Japan. The entire collection was destroyed by an earthquake few years later.

Since major Gills day, the chief damage to the frescoes has been done not by bats (gates were put up to keep them out) but by enthusiastic visitors, eager copyists and the restorer themselves. Griffith’s pupils, for example, resolutely smeared some of the finest group with clean varnish in order to bring out the colour and in time this varnish turned yellow, cracked and broke away from the wall, taking the paint with it. Others helped to destroy the things by burning naked lamps which darkened the ceiling with the soot. Where insects had bored into the paints, some restorers filled hole with plaster of Paris, smeared on thickly with palette knife. Then they washed the walls down with dirty water. The visitors were free to cut their initials or full name into the frescoes with pen knives or even to remove whole slabs of paintings from the wall. In this way captain Williams of Hampstead, London cut a group of five male heads about a foot square dating probably 5 A.D. The piece was put on auction of Sotheby’s in London in 1922 and fetched a 1000 pound. It is now in the museum of fine arts in Boston. But worse than all these people was a man named Narayan Eknath, who really seems to have been the archfiend of Ajanta. He was appointed curator of the cave for a time in 19th century and he was specially charged with keeping the vandals at bay. Narayan was underpaid and badly in need of whatever tips he can get from the passing tourists. If a visitor showed interest in some fragments of paintings, the curator will be delighted to cut it off and offer it as present. His specialty was removing faces and whole heads.
It was largely as a result of strong protest made by lady Herriangham to the Nizam of Hyderabad that at last in 1920 something was done to protect what has come to be recognized as greatest collection of paintings in whole of India. Two Italian experts, Count Orsini and Singor Lorenzo Cecconi were summoned and by casein & other means they accomplished a great deal in fixing the frescoes to the wall. At the same time arrangement was made to install electric light, to plug the cracks in the ceiling with gunite and to establish an adequate guard. There have been two more attempts to capture the frescoes in reproduction. The best of this is the monumental work containing excellent colour photographs and outlines /drawings with accompanying text jointly undertaken by Nizam of Hyderabad and Oxford University press. It is the four volume work of Gulam Yazdani who was deputed to undertake this monumental work. The other attempt to reproduce the frescoes was made by Victor Goloubew with team of French expert. But he was not fortunate as he writes in the preface to his volume of photographs, “He does not say what the accident was, but one can guess negative are highly inflammable in the Indian heat”. When the Chinese traveler Hiuen Tsang visited India in about 640 A.D, he was told that, somewhere near the middle of horse shoe river bed one turned up a steep path between two stone elephants that guarded the entrance of the caves. Now a days the approach through the prosaic gateway look like entrance to a convention of public monument. The feeling of the movement in the frescoes is the extraordinary thing. It is almost cinematographic. Wherever you look, you see people in a state of continuous motion-people gesticulating, dancing, stooping to kneel to Buddha, half turning the one another as something they eagerly has to say. It is not at all like the Michelangelo frescoes in the Sistine chapel where the figures are nobler than life. In the Ajanta civilization, it was rich, the privileged and the beautiful that went naked often as we see painting to the group of servants clothed drably from neck to knee. Finally, in the year 1953 Ajanta came under the protection of Archaeological survey of India and the survey gave utmost importance for the preservation of murals.

The Ajanta paintings are not just a milestone in the history of development of world art; they also convey unique insight into the life of Ancient Indians and their culture. The painted Buddhist legends proclaim ethics, in which help for being distress is valued higher than one’s own personal welfare. About 2000 years have
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passed since the creation of oldest wall paintings and about 1500 years for more recent one and the ravages of time have left their scares on the pictures. Many paintings have fallen off the walls with layer of plaster on which they were painted and have thus irretrievably lost; parts that are preserved are often faded or worn off, darkened by soot from lamps or washed out by bat’s urine, badly scratched by visitor’s graffiti or discolored by amateur attempts at restoration.

1.2 The plan and location of various caves at Ajanta

The Ajanta caves consist of two architectural phases devoted to two faiths of Buddhism i.e. Hinayana and Mahayana. The early and inaugural phase at Ajanta is dedicated to the Hinayana faith, the oldest form of Buddhism while the later excavations are mostly dedicated to the Mahayana faith, which practiced the worship of Buddha in his human form. The paintings that adorn the walls of the Mahayana caves at Ajanta are almost complete in all respect, exhibiting the culmination of years of practice of the art. Among the later excavations, the caves I, II, XVI and XVII have paintings on large surfaces though fragmentary in some places. The walls, pillars and ceilings of these caves have been painted with colorful Jataka stories and a vast range of decorative as well as symbolic motifs. However, a number of small fragmentary remains of the paintings are also seen in other caves (Caves IV, VI, VII, VIII, XI, XIX, XX, XXI, XXII and XXVI).

According to Fergusson and Burgess, the Caves IX and X are chaitya caves, the early Hinayāna excavations at the site. Among them, the cave IX is the earliest chaitya in the Ajanta group as well as the earliest in the west of India. This chaitya belongs to the 1st century B.C perhaps, even a few years earlier. Some of the paintings in these caves belong to the later half of the 2nd century A.D.; however, a few fragments depicting Buddha figures belong to the later date between 4th and 5th centuries A.D. The paintings in the caves I, II, XVI and XVII are Mahāyāna caves. These caves were excavated during the 4th century or 5th century A.D. The paintings in these caves could be attributed to the 4th or 5th century A.D. The plan and location of various caves of Ajanta is shown in Figure 1.
Technically, the Ajanta paintings, a category of mural paintings, are characterized by application of paint on a lime/mud plaster - thus ensuring long life of colors. At Ajanta, murals were made in a specific way, involving several stages of work. The walls and ceilings of the caves were specially prepared for paintings. The rock surface was purposely kept rough with deep furrows of chisel-marks to hold plaster. In addition to this, the compact volcanic trap-rock or basalt characterized by vesicles and amygdaloidal cavities helped to hold thick layer of plaster. The rough surface of the walls and ceilings was plastered with a mixture of clay, water and organic matter containing vegetable fibers, paddy-husk, grass and rock-grit or sand. The plastering was done in two layers: the first, thick and rough and the second, thin and fine. This was further rendered smooth by the application of a thin layer of lime wash. In some cases, a fine mesh cloth was pasted on the plaster over which a smooth layer of lime wash was applied as in the cave XI. Plastering was done by really skillful artisans—even some of sculptures were plastered to get effect of smoothness. Unusual shining was achieved by adding powdered conches and seashells—such polished plaster has glassy surface.
The paintings were done in a range of pigments. Most of them were locally available. Yellow-ocher, Orpiment-yellow, Indian-red, lapis lazuli (blue), Lime (white), lamp black and terre-verte (green-earth), and their mix shades were used. Lapis lazuli, which was used for blue shade, was imported. Excluding black, all colors were of mineral origin. They were opaque or semi opaque in nature. They were easily softened by water-soluble binding medium, such as gum and glue. The painters could be working in batches, e.g. first batch would plaster the rough surface of walls where as another batch would transfer the outlines of the drawings made on cloth. They would begin with outlines in light red or black and then fill suitable colors in the line drawings.

The techniques used in making Ajanta paintings still reflect much of their original glory even after 1,500 years of abandonment in tropical climate. However, time is relentless - some paintings miraculously have survived but many paintings have deteriorated at varying degrees, at some places heavily due to several reasons. They include deterioration of paint and varnish layers, water seepage, occurrence of whitish incrustation, dark accretions and bats’ excreta on painted portions, unfavorable environmental conditions, and insect activity, etc. The discovery of Ajanta cave is still a mystery and interesting to the public. After the demise of Buddhism in this part of country, the place become abandoned and was in a condition of total neglect for many centuries. The general condition of basalt rock, the plaster, the pigments from that time onwards have important beating on its state of conservation now. Many art lovers, historians, and copyist visited Ajanta caves after its discovery and applied varnish layers for copying the painting that has now posed a great challenge to the conservators.

1.3 Art and Architect of Ajanta.

The murals in the Buddhist monasteries of Ajanta (2nd B.C. to 4th A.D.) are of same significance for the history of Ancient Indian culture as the fresco of Pompeii for Greco-Roman antiquity. The development of art at Ajanta (WHS) influenced the art and culture of Asia. India had a great cultural evolution called The Golden Age [1]. The conventional view is that the Golden Age is specifically associated with great Gupta dynasty [2,3] and that it gradually lost its luster with the Gupta’s decline in the late 5th and 6th century A.D. [4]. But now the arguments have lead to quite different
conclusion [5]: that it was the Vakataka emperor Harisena who brought the Golden Age during his brief but dynamic reign over central India [6].

The great empire which Harisena created in central India, extending from the eastern to the western sea, broke back into component parts when Harisena’s many Vakataka feudatories rose up against his weak successor and shattered the empire [7]. The key to this conception can only be found at Ajanta [8], as it is Ajanta evolution that unlocks and reveals the connections to epigraphy and literary evidence [9]. Ajanta with its related sites Bagh caves and Aurangabad caves [10] gives us hundreds of architectural, sculptural, painted, technological and epigraphic features, which can be used as spectrum of benchmarks.

Many Buddhist cave created by the Vakatakas in a remote ravine near the ancient town of Ajanta that form a devotional complex which ranks one of the world’s most startling achievements. These caves are for more elaborate than earlier 2nd B.C. caves (9, 10, 12, 13 & 15A) at Ajanta complex. More than 20 caves were excavated by Vakataka dynasty who were allied and related to the Gupta thanks due to the marriage of princes from the reigning house at the beginning of the fifth century [11]. All these later monuments are the result of dramatic burst of pious activity early in the reign of Vakataka emperor, Harisena.

Harisena, with his power centered in ancient Vidharbha (eastern Maharashtra) was the greatest king in India. His reign extended over the whole of central India from western to eastern sea, as we know from the conquests recorded in an inscription of his chief minister in cave no. 16, Ajanta [12]. Like the ancient province of Asmaka just to the north, the Anupa to the south, ancient Risika in which Ajanta was included, were parts of the extensive domains that Harisena inherited when he came to power, he did not have to conquer it. That is the reason that after a year or two of Harisena’s accession, it was possible for the ambitious undertaking of Ajanta to begin [13]. The high powered courtly patrons who initiated Ajanta’s renaissance were surely energized by interests political as well as pious. They included the imperial Chief Minister, Varahdeva, donor of cave 16 as well as Ghatotkacha Vihar, around 12 miles away from Ajanta; the local Risika king, Upendragupta, responsible for the adjacent complex of Cave No. 17, 18, 19, 20 and short lived 29; as well as connected monk
Buddhabhadra who drawing authority from his friendship with the great minister of
Asmaka; “who was attached to him (the monk) in friendship through many successive
birth” [14], sponsored the huge chaitya cave 26 and various related caves, and one
Mathuradasa, both rich and influential, who donated the largest of all caves at Ajanta,
the doom ridden cave 4. A number of other donors also participated in this inaugural
activity but their inscriptions have either been lost or (more probably) were never
written, as many of the Ajanta caves were still very incomplete.

The excavation of these caves represented an extraordinary renaissance in rock
architecture in the Western Deccan after a century of abandonment and decline in this
important artistic form. The main reason for this artistic following at Ajanta is due to
the fact that Harisena succeeded in creating a period of relative stability in the
territories he governed. The site benefited from its position along an important
caravan route, connecting the ports of Western India with the cities of the interiors
and therefore become a stopping place for itinerant pilgrims, monks and merchants as
testified by numerous pictures and sculptures of the Bodhisatva Avalokiteswara, in
the guise of protector of travelers.

Apart from the Brahmanical caves at Udayagiri near Vidisha in neighboring
Madya Pradesh, consisting of single quadrangular room, cut a little more than fifty
years earlier, no other sites have been excavated in the whole of the Western Deccan
for about three hundred years. Architects and workmen employed on the site therefore
had to recover a technique that had been partly lost to living memory. As a
consequence, the artists were totally unfamiliar with the procedures needed to both
laying out and for cutting the caves and had little awareness to the problems presented
by flawed basaltic scarp [15].

Thus, during the first few years of work, the excavators used many of the
features for the simple earlier (Hinayana) caves at Ajanta itself for models copying
the typical early octagonal pillar, the plain windows, the non-trabeated doorways and
pillar less and shrine less vihara interiors. It is to be mentioned that the most ancient
caves of the Vakataka phase appears to have a rather irregular structure as a result of
poor planning and numerous second thoughts, and furthermore has very simple
architectonic elements. However, year by year they incorporated more complex and
up to date forms. Now they were adding peristyles to their vihara and new vihara was planned with the shrine at rear and those that had already been started without such shrines being revised to include them. Moreover, due to rivalry among the artists as well as among the proud donors, the sculptured decoration of the caves approached the lavish norms clearly contemporary to wooden palace structures so often represented in Ajanta murals themselves. A fine example of uncertainty during excavation in initial year (462 A.D) can be noted in cave no.11, Ajanta [8]. The cave was planned as vihara of a similar nature as cave no. 12 excavated before the Christian era. The cave was cut between the ancient chaitya 10 and vihara 12 but the architects did not calculate that chaitya 10 lay on a diagonal axis inside the hill, a detail that is not apparent to the eye and having already started the excavation, they had to modify the traditional vihara plan. The cave should have contained cells on all three sides, but they were forced to abandon the excavation of the living quarters for the monks on the right, the side directly connected with the vault of chaitya 10. Instead of cells, a seat was cut in that portion. Immediately, after the first phase of experimentation, the architects devised more ambitious plans with the excavation of cave 16 and 17, a typical of vihara of Ajanta. In only a few years since the excavation of the first area, the work force had already gained considerable experience and began to develop increasing confidence in handling of the hard volcanic rock of Ajanta.

The addition of shrine completely transformed the concept of vihara that form a simple place of residence for the monks, become the metaphor the paradise in which Buddha preaches to Bodhisattvas. In this microcosmic reproduction of Buddhist paradise, the monks who live in vihara symbolize a short of incarnation to the Bodhisattvas themselves. In the inscription, vihara 16 is linked to the palaces of Indra in the heaven of 33 Gods (verses 27).

The emperor Harisena, obviously approving the vast project, apparently did not get directly involve himself until work at the site had already been underway for four or five years. As a consequence, his ‘regal’ cave 1 had to be cut in less than ideal location at the eastern extremity of the site, since the central area of the scrap had already been taken during the first few years of excavation. However, in compensation, Harisena’s splendid cave benefited greatly from the experiences that the excavators have already gained by this time. Therefore, compared to relatively
clumsy cave 16 started by the Chief Minister, the highly elaborate and dignified cave 1 is truly a monument “fit for a King”. Figure-1 shows the plan and location of various caves of Ajanta.

Looking at the mural paintings, on the other hand, we see no such struggle. This is because painters could decorate the walls of the caves in essentially the same way that they had always decorated the walls of structural palaces, temples, etc. [16]. The great variety of styles seen in the Vakataka period murals were done by many different artists from many different regions, of course, judging from the analysis of “hands” it is clear that there were at least few dozen of different painters working at the site during the course of Vakataka patronage.

The Asmakas, who are mentioned in the inscription of cave 17, were supposed to be responsible for another cave complex situated at the western end of rock face, whose fulcrum is represented by chaitya 26 and dedicated to the monk Buddabhadra. Probably, due to conflict between the Asmaka and local Risika, the excavation of this complex was interrupted for a number of years. As a result of conflict, the activity of the site came to complete halt between 472 to 474 A.D. This was why the Upendragupta ambitious project of excavation was never resumed and Upendragupta cave 19 had never been used for cult worship and was abandoned because of its association with that sovereign. After the conquest of territory of Ajanta by Asmakas, the excavation was instead resumed in the complex that developed around chaitya 26, an undertaking that lasted almost until the final phase of the site.

It appears that great number of artists, along with allied workers spent the troubled years working on a new excavation at Bagh, in peaceful Anupa [17]. As we know from the historical evidence, the Bagh caves were under the vicegerency of one of Harisena’s son during this period. Indeed, the excavation of Bagh was probably inaugurated at just this time, due to sudden availability of so many out of work and highly skilled craftsmen. Many of Bagh’s features stylistic, iconographic and technological-suggest such an immediate influence from the already started Vakataka cave at Ajanta while in a significant turnabout; we can see a profound influence of forms at Bagh upon post excavation at Ajanta. During the period of disruption, when the administrative control so suddenly collapsed, dozens of anxious devotees, who
had never been able to make offering before, took advantages of the anarchic state and added their own votive images whenever they wished at Ajanta. It is indeed remarkable that deep in the ravine beneath, the unique record of India’s material and spiritual culture still exists.

1.4 Painting Recipes and mural art technique of Ajanta.

The old view [18, 19], that Ajanta later development went for two-three hundred years, under the succession of different dynasties, can no longer be sustained and questioned by many art Historians. After meticulous research and gathering all the scattered information, a short chronology has now been suggested [6] lasting about 20 years. Such an approach to Ajanta’s dating has remarkably revealing implications vis-à-vis considered view on longer chronology. It is obvious that excavation of caves and carving out the decoration was quite time consuming, but the entire mud plastering and painting would hardly have taken a year or so for a few dozen artists. The short chronology theory is based on the famous Visrutacarita [2, 3] that represents almost point to point recollection of fall of great Vakataka Empire. The subject of the wall narratives at Ajanta are various Jatakas, spread out almost like unrolled scroll [20]. As the short/long chronology at Ajanta is based on archaeologists/art historian’s physical features and geometrical designs of paintings and sculptures, necessity was felt to look the mud plaster and painted layer through scientific investigation to explore any differences in material/painting techniques. Hence, under Indo-Italian conservation programme, the components of the mud plaster and paint layers were observed under stereo-microscope and through various scientific instruments such as FTIR, SEM, Micro-Raman, XRF etc at the site as well as micro grains in laboratory [21]. It is assumed that component materials or technique of execution may undergo some modification in 200-300 years period. Hence, it was necessary to investigate scientifically the components to fully understand the Ajanta paintings for its future preservation as well as to gain some idea in support to the chronology of Ajanta. Analysis was carried out for material composition and additives of mud plaster of Ajanta. Further study of the micro-structure of layers and its strata was carried through micro watch, XRF, SEM-EDX etc.
The conservators of Ajanta are also supposed to be able to compare data emerged from the analysis of mud plaster & pigments with what has been described in ancient Indian literature written in Sanskrit language. Evidences of flowering artistic tradition in Sanskrit literature are found in texts on mythological subjects. The main ancient literature dedicated for artistic techniques in ancient India and technical aspects of paintings are the Vastustras (treaties of habitat), Vastuoastras (treaties on dwelling) and Silpaoastras (technical treaties). To be able to write a history of Indian pictorial art, the technical treaties represent complementary instrument of study. The narrative mastery and technical knowledge demonstrated by artists at Ajanta suggest existence of several schools of arts already employed in decorated work of structural buildings & temples. Among the aforesaid text, there are many works where painting technique and procedures to be followed are described. The main Indian texts for painting techniques are:-

- The Vishnudharmottara purana [22] composed in 6-7th A.D. shortly after the mural works of Ajanta.
- The Samaraga sutradhara [23], a silpaoastra attributed to Bhoja king of the Paramara dynasty of 11th century mainly dealing with pictorial and iconographic art.
- The Manasollasa [24], the text of southern India paintings tradition attributed to king Somesvara of early 12th century Chalukya dynasty.
- The Silparatna [25], written in 16th century- a section of which entitled “characteristic of image” which contains lot of information on painting technique.
- The Aparajita peccha of Bhuvanadeva [26], probably composed after Silparatna [25] that describe architecture and contains concepts on decorative design and preparation of paint ground.

There are many other texts written in Sanskrit slokas in which instructions on mural painting techniques are systematically stated. Some of the ancient painting texts have not yet been translated and others have been translated in English, Hindi and Tamil languages. Almost all the text describes the methods of preparation of paint ground and its stages of application along with preparation of colors for painting work.
Although Vishnudharmottara was composed one or two centuries after the execution of Ajanta murals, it may be considered as true reference text for proper understanding of painted procedure on site. The other text written at distant time from Ajanta and pertains to various periods. In all the texts it seems figurative work precedes the literacy both in iconographic and iconological field. The writing works of silpas were allotted to the poets (and not artists) who grasp the basic concepts of paintings during observation but lack first hand knowledge about the real technique being followed. Due to this reason, the prescription supplied in the ancient text does not dwell on the detailed technical processes. The other reason lies in the fact that the main part is written in sutra forms, which simply serves as guiding principle for the artists to recall the various passages of execution. Besides, there are diverse interpretations and translations of sutras by various authors.

In fact there are many conflicting opinion among experts on particular points regarding various procedures described in the texts. Out of many sutra’s the four most important describe the method for preparation of paint ground. Among this the text Vishnudharmottara and Samaraga Sutradhara describe the technique of preparation of paint ground using clays earths. The text Manasollasa and Silpratna represents the preparation of ground under southern traditions of the subcontinent where the basic component is lime or burnt and powdered conch shells or white earth of calcareous nature, available in south of India. Some of the important text showing basic ingredients and procedure to be followed in the preparation of paint ground & colors are elaborated.

1.4.1 Paint grounds & Binders according to ancient sutras.

(A) Vishnudharmottara Purana :-

For the preparation of paint ground this text prescribes three types of brick dust and three parts of mud plaster to which Guggula (gum or resin), madhucchlliioa (bee wax) are added in equal quantity. According to the text, all these must be mixed with third of powdered burnt lime, pulp from bilva (Aegle Marmelos) in two to one ratio along with necessary quantity of salt free sand. The text recommends storing this mixture in water mixed with the bark of picchila (a legume, probably Dalbergia sisoo, Bombax Heptaphyllum) for one month. An experienced artist removes this mixture from the container and applies it to the wall and allows drying. Particular care has to
be observed that this layer is smooth & uniform and neither too thin nor too thick. If the wall that is starting to dry does appear not properly done, then it must be carefully polished to make it uniform with a layer of intonacco (lepna) made up of earth mixed with a juice of oarja (Shorea Robusta). The surface is also polished with a fine lamp black (anjana) and repeatedly spread with milk. The text confirms that the wall plaster treated in this way will not deteriorate even after one hundred years. It also says that the same procedures must be followed to prepare various paint grounds.

For the binder, the Vishnudharmottara prescribes the use of decoctin of skins (Carmakvatha) which corresponds to famous Vajralepa glue, used in the mixture to cover the surface and make it disintegration free. The text provides five different recipes for the preparation of vajralepa. One of the recipes lists ox or buffalo horns among the ingredients, a buffalo or cow or goat skin mixed with juice of bimbo (Monordica Monadelpha) and kapittha (Feronia Elephantum). In Vishnudharmottara use of binders of vegetable origin is also prescribed. One such recipe is the juice of bakula (Minusops Elengi) and sindura (Grislea Tomentosa) which are mixed with decoctin of skin.

For protective agent or fixative, the text recommend application of juice of durva grass to the finished paintings with the help of cloth soaked in it.

(B) Samaragao Sutradhara:-

The Samaragao Sutradhara describes very clearly to Vishnudharmottara between the first preparatory layer known as bhumibandhana and intonaco, known as Lepkarma. It recommends that juice from various plants, namely Snuhivastuka (Euphoria Antiquorum), kuimaoa (a cucurbit, Beninacasa Cerifera), kuddali (Bouhina Variegata), Opamarga (Achyrantes Aspera) and Ikika(Sugarcane) are left to rest for a week and then mixed with the juice of Siaoapa (Dalbergia Sisso), Ashoka tree, Nimba (Azadirachta indica), Triphala (Myrobalan), kuooja (Wrightia Antidyssenterica) and kaiayaka (Acacia Catechu) together with sea salts. This mixture is sprayed in previously leveled wall where the painting work has to be undertaken. The juices of these plants are used to wash the wall surface that also probably works as insecticides.
Some of the fine earth is mixed with double quantity of sand, to which juice of kakubha (Terminilia Arjuna), Maia (seeds of beans or other legumes), oalmali (Salmalia Malabarica) and oriphala ( Aegle marmelos, bilva or bel tree) in variable proportions are added. The plaster thus prepared by mixing the ingredients are applied to the wall in sufficient quantity to get what has been described as thickness of elephant skin. When the wall is dry, it must be washed with care. Whitish lime stone fine powder is mixed with boiled rice and starch in correct proportions and applied three times to the prepared wall.

After the application of first preparatory layer ( bhumibandhana), a neutral colored, red or brown clay collected from different places ( such as bank of lotus pond, side of the wall under the roof of tree or along the bank of the river etc.) is applied on the wall. For the third layer, the text says that earth from ant hill (free from stone grains) should be added to the juice of Oalmali (Salmalia Malabarica), kakubha (Ferminalia Arjuna ), triphala (Myrobalan), chopped betal nuts (kramukha), bilva pulp (Aegle Marmelos, bel tree), horse hair, ox hair, coconut fiber, a certain quantity of rice husk, and double quantity of mud & sand in one to two ratio in respect to mud is applied on the already prepared wall. A further mixture of mud slip and marble dust, gypsum or sugar dust is applied to the plastered ground with a brush. Finally, the mixture of lime putty & wax is applied.

(C) **Silpratna:-**

Silpratna is the southern Indian traditions of preparing paint ground with lime based materials. The text prescribes that the mixture of first layer is prepared with lime obtained from conch-shells burnt in wood fire and grounded into powder, mixed with a quarter part of mudga juice (phaseolus Mungo), a quarter parts of sand and molasses and a quarter part of paste of banana burnt in fire. After proper mixing these are stored for three months, after which it is grounded in the form of a mortar with molasses until it has the consistency of fresh butter. In the mean time, the wall is first leveled and polished with coconut coir brush. It is then tampered with molasses water to keep it wet for at least a day. The lime plaster prepared as above is slowly applied layer by layer to the wall so that the surface becomes smooth and uniform. While intanaco application is under progress, water must be sprayed on to the surface using coconut coir brush. For the preparation of upper preparatory layer, powered shells or
white earth fine powder mixed with kapittha (Feronia Elephantum) and nimba (Azardirachta Indica) is applied to the wall. This compound must be applied using the bark of ookooa (Trophis Aspera) tree or with a brush made up with the stem of ketaki (Pundunus Odoratissimus) plant until the wall becomes smooth & polished. The same powdered lime having been moistened with the milk of a tender coconut is again grounded and diluted with hot water and applied again to the intonaco as described above.

Along with the primary knowledge of ancient Indian painting technique and preparation of paint ground, identification of materials and their decay process are of great significance. It is also essential to study micro-structures of the layers, their strata and binding media for the paint layer and clay plaster. With the range of scientific methods and experimental procedures, an attempt has been made to identify the method of application of mud layer ground and painting technique followed for Ajanta murals. During the course of studies material structure, composition and additives used in the plasters were also investigated. Such study of ancient technology in terms of materials and its application is essential for undertaking any conservation activity aimed for preserving the painted plaster.

In India beautiful painted remains can be found from prehistoric period to Mughal period of 16-17th century A.D. Most of the prehistoric paintings are found in sand stone shelter of central India where roughness and porosity of sand stone was utilized for painting. Later paintings are either on mud plaster or lime plaster ground. Known as monument of paintings, clay plaster forms backing of lime layer coat and basaltic stone support at Ajanta. The pigments identified at Ajanta are red ochre, yellow ochre, green earth for green color, lapis lazuli for blue, carbon black and shell/kaolin lime for white [27]. The pigments found used in India from prehistoric to Mughal period have remained almost identical and same without much variations [28]. The pigments identified at Ajanta also show close resemblance with Roman painted works of fresco [29]. The outlines of the Ajanta paintings are mostly drawn by carbon black or red ochre. The mud plaster thickness varies from few millimeters to an inch [30] in some cases where basaltic stone is very roughly cut. Organic matters such as rice husks, plant seeds and plant fibers are generally found admixed within the mud plaster. The theme of the paintings is Buddhist Jataka tales with
beautiful human figures, geometrical designs and animal’s figures. Most of the paintings show three dimensional appearances and highlights the artistic skill of Indian painters in 3-4th A.D, known as Golden Age. The raw materials used for the preparation of clay ground are mostly locally available materials collected from either Waghura river in front of Ajanta caves or nearby places. Except blue, all the pigments are locally available materials including green which is the product of basaltic rock disintegration. It appears that aggregate used as fillers to the mud plaster at Ajanta are also byproduct of weathered basalt collected from ravine of Waghura. The aggregates mostly identified are quartz, zeolites and celandonite. It is observed that 8-10% lime with organic additives was mixed in the low swelling clay to prepare the mud plaster at Ajanta. The technique of paintings is purely tempera and animal glue has probably been used [31] as binding agent to the pigments at Ajanta and related sites. Unlike fresco painting [32], the painting technique in India is either tempera or secco and binding medium identified at Ajanta is animal glue. An understanding of the composition of ancient plaster and technology is necessary for creation of new mortar for restoration [33] at Ajanta and other sites.

The Ajanta caves and their paintings have now been extensively explored by art historians [6]. The unstable microclimatic condition is one of the factors that always affect the state of conservation of mural paintings. In the environmental-monument system, knowledge of the functional environment and climatic conditions of the surroundings are necessary for the identification of causes of decay [34]. As half of the Ajanta caves face the east and the other half the south, with 178 ft high waterfall in seven stages just near the caves, the environmental condition plays an important role in the survival of the Ajanta murals. The support of the mural paintings is a Deccan trap defined by cleavages, faults and cracks in the body of the basaltic rock for the rainwater to seep through [35]. The mud plaster used as ground contains clay admixed with natural fibers such as rice husk, plant seeds and fibers. Pigment layers have been applied on the dry mud plaster with colour which is inorganic in nature. The painting is executed in tempera technique with binder which is certainly of organic nature [36] and tentatively detected as animal glue. The binder being organic in nature is also soluble in water. Hence, the nature of support and the pigment layer are vulnerable to environmental conditions.
1.5 Causes of deterioration of Ajanta paintings.

As nature of support and the pigment layers are vulnerable to environmental conditions, due to this reason the Italian conservators of 1920 applied thick protective coating of unbleached shellac thus modifying the physical condition of the painted surface, which in course of time altered the chromatic appearance of the paintings [35]. Nearly two third of the paintings including the paintings in famous cave no 1,2,16 & 17 Ajanta have been applied with shellac varnishes. In ancient cave no 9 &10, we observed many different layers of varnishes applied in the past for copying the painting in 19th century [28]. The Italian conservators have applied shellac resin without removing the earlier varnishes that resulted a very thick varnish coatings on some of the remains of most ancient (2nd BCE) painting of cave no 9 & 10, Ajanta. Fortunately, it is observed that these ancient painting of cave 9 & 10 have been executed on lime plaster ground. As the lime plaster is not as hygroscopic as the clay of mud plaster, the painting of 2nd BCE still survived in spite of thick varnish layer [36]. The ridges, gaps & lacuna observed on 2nd BCE murals are fewer in number as compared to paintings on mud plaster. Since the entrapped moisture of clay particle in mud plaster have to be driven out in hot season, it makes way through shellac coating by making gaps, ridges and lacuna on the painted surface. Thus out of many factors of deterioration of murals at Ajanta, the moisture plays one of the main reason of deterioration for the paintings on earthen support. Hence, anything that causes enhancement of moisture content inside the cave has to be properly regulated. The painting survive better when the humidity inside the cave is 55-60% and temperature around 25°C.

Another factor that impacts the moisture content of cave interior, is the visitors. The visitors have to climb the Ajanta hill to reach the cave. While climbing everyone has to breathe fast and exhale more moisture and carbon dioxide as they rush into the cave 1 & 2 at Ajanta. There is also particular mindset among the visitors to start with cave no 1 & 2 and hence there is quite a rush to these caves. As the sequence has nothing to do with the story of paintings at Ajanta, the guides also follow the same trend with group of visitors at Ajanta. This mind set causes considerably pressure in cave no 1& 2 thus disturbing the microclimatic condition inside the cave [27].
Another way, some of the visitors impact the Ajanta murals is by eating eatable inside the cave. It is estimated that ¼ of Ajanta murals has been lost due to insect activity ever since the cave was abandoned by Buddhist-monks in 6th century A.D. Although Archaeological Survey of India keeps strict vigil, the visitor’s were found sometimes making use of cave for their eating. This process gives way to food chain inside the cave which may cause long term impact on the paintings. On many occasions some non-serious visitors to the cave were found talking loudly increasing the noise level inside the cave. Even some guides in big group were found lecturing loudly so that the voice reaches to all. The Archaeological Survey has put silence board at the entry of cave, but many of the visitor s are not aware about their pitch of the voice vis-à-vis its impact on Ajanta murals. Attempt has also been made to monitor all these parameters inside the Ajanta cave for taking appropriate measures towards its long term conservation.

The problem of the conservation of Ajanta paintings varies from cave to cave, as location, size; architectural features etc. have important bearing on the overall environmental condition within the cave. Ajanta cave 10, located just to the right of the centre of the caves, has one of the highest façades with good circulation of air within the cave. The temperature in the cave remains static around 27-30 °C, but wide fluctuations in humidity from around 80 % in the rainy season to 40 % in the summer season have been recorded. This causes flaking of pigments, formation of cracks, ridges, gaps etc. on the painted plaster. At some points, loss of the pigment layer is also noticed.

From the physical condition of the basalt rock-cut pillars and the wall surface of cave 10, it is observed that in the past muddy water has entered into the cave after the place was abandoned by Buddhist monks [6]. Façade/Stone blocks probably fell in front of the cave and the rain water, which is supposed to flow into the ravine of Waghura river, has continuously entered into the cave carrying with it mud and dirt. This has caused systematic damage to almost all the rock-cut pillars of the cave. In some cases, whole pillars have collapsed. There is thus complete destruction of paintings on the right and left wall around 4-5 feet from the floor level of the cave. Paintings from the stupa of the cave are totally lost and only traces of them remained. The wooden ribs from the dome of the ceiling have collapsed during the course of
time and only their impression on the stone remained. Bats were roosting on the ceiling and back of the stupa leaving marks of their urine and excreta.

The Hinayana paintings still surviving on the right and left wall of cave 10 are found to have thick accretions of varnishes applied in the past during the course of copying the paintings. A thorough survey of the activities carried out at Ajanta after its discovery in 1819 reveal that around fifteen groups of artists visited the Ajanta caves and are responsible in some way for the damage of the paintings. Robert Gill tirelessly worked at Ajanta for 27 years from 1844 to 1870 and made hundreds of copies of the paintings by applying varnishes under a naked oil lamp [37] The next major copying was done by John Griffith of Bombay School of arts along with his students who resolutely smeared some of the finest group of paintings with cheap varnish in order to bring out the colour and detail. With time this varnish turned yellow, cracked and broke away from the wall, taking the pigment layer with it. The Italian restorers of 1920 led by professor Cecconi and his team carried out extensive application of shellac varnish at Ajanta without removing the previous varnish coatings. Since Major Gill’s day the chief damage to the Ajanta paintings has been done not by bats but by enthusiastic visitors, eager copyists and the restorers themselves. The Hinayana paintings of cave 10 are also marked by extensive damage due to visitors’ graffiti as shown in Figure2. In order to stop the human vandalism, in the year 1970 the Archaeological Survey of India put the paintings under glass protection.

Figure 2: Visitors graffiti on painted plaster of cave no. 10, Ajanta
There is supposed to be a curse upon Ajanta. It is said that anyone who tries to deface the paintings in any way or even to reproduce them will be overtaken by misfortune. Most of the copies of the Ajanta paintings that were carried out by various artists in the past have been destroyed due to several reasons, and there is no worthy record of the paintings. On the basis of copies that survived, archaeologists have been helped in the identification of various Jataka tales at Ajanta [38].

Even more damage to the paintings is observed on the left wall of cave 10. Measurements show that the left wall paintings have been damaged up to height of 180 cm from floor level compared to the right wall where damage up to the height of 170 cm is observed. The old watermarks observed on both walls are 65 cm and 50 cm from floor level respectively; hence the excessive damage of the left wall paintings. This is the reason for the difficult interpretation of the paintings of the left wall, as only the upper parts of most of the painted figures remain. Whatever remains of the painting is very difficult to interpret due to thick accretions of varnishes. Some information can be gained only by looking at the paintings in strong light under a magnifying lens. Due to this reason, the paintings on the left wall were falsely interpreted. In one of the most important scenes, which is exclusively present in the paintings at Ajanta (cave 10, left wall), Yazdani mistook the upper part of the wheel for a stupa and labeled the scene [39] “The Royal Party Worshipping a Stupa” which was widely accepted. It was only in 1981 that Schlingloff [40] identified the supposed stupa as the “Wheel of Law.” However, none of these authors were able to see the true color of the paintings under very thick accretionary deposits. The other important task was to count the number of spokes in the wheel, which is very important from an archaeological point of view. Extensive research has been done by Schlingloff [41] and Monika Zin [42] about the number of spokes present at different archaeological sites during that period. However, the need was felt not only to confirm the earlier reports but also to verify the exact colour of the spokes. Hence scientific conservation of paintings was taken up in the year 2001 for the 2.5 sq. mt. Wheel of Law part of the paintings on the left wall of cave 10.

Paintings are layered structures that can be affected by external factors to varying degrees depending on their intensity. Microscopic examination of the painted
plaster of cave 10 shows numerous cracks and fissures in the pigment layer due to thick accretionary deposits as the varnish layer does not allow exchange of moisture. At some places the pigment was found to be totally detached from the ground plaster and at a number of points voids were observed between the plaster and the stone surface. The grey color filleting material used in 1920 by Italian restorers was also found detached at some places. Some of the pigments such as green and red had disappeared from the surface along with the varnish coat, owing to its weaker adherence. Intrusive 5th century A. D. paintings with particular floral design and a red colour umbrella with a flag are found superimposed on the major portion of the Wheel of Law. These paintings are of different artistic significance than the Hinayana paintings. All the above reasons made the scientific conservation of the paintings very complex and challenging.

1.6 Conservation of Ajanta paintings

The conservation of wall murals of Ajanta is based on proper understanding of materials, technology and causes of deterioration that favors minimal intervention and preventive conservation [36]. The research investigation so far undertaken at Ajanta is based on the fact that murals are in their original state and no major restoration interventions have been carried on them except filling of voids with Portland lime and application of shellac varnish on some portion of the paintings by Italian conservators of 1920[30]. The conservation studies so far carried at Ajanta includes monitoring of macro and micro environment of the caves, engineering geological surveys, rocks and minerals analysis [43] along with bio deterioration studies [34]. In addition research investigations have also been conducted about pigments and paintings technique at Ajanta [21]. As there is hardly a publication available on the materials and techniques used by ancient Indians to create Ajanta wall paintings, a dedicated investigation of material composition, structural support, plaster and paint layer etc. is needed for better understanding.

Characterization of most industrialized conservation materials e.g. stone brick, wood, concrete, steel etc. are very well established but it is not the case in respect of earthen building materials despite notable progress in last decade. As many problems of decorated architectural surfaces are connected with the structural and support layer, diagnosis and treatment made directly impacts such surfaces as earthen support are
the most vulnerable element in the building. Conservation of decorated surface constitutes a specialized area within the field of earthen architecture and heritage conservation. Published research on earthen architectural conservation is quite limited as there is too small a body of researcher focused on conservation of decorated surfaces [44, 45].

The investigation of wall painting technology is always restricted by limitation of available resources as well as availability of required samples. Further, compounding the problem of deterioration of earthen plaster is the complexity of earthen system in which diverse materials may be used in different layers [46, 47]. The deterioration of earthen cultural heritage including wall painting on earthen support is most often due to loss of cohesion of the base material. Laboratory experiment show that earthen plasters form the cave begins to absorb moisture at about 67% relative humidity. The principle mechanism by which pigment on earthen plaster deteriorates is loss of mechanical strength as a result paint layer can lose adhesion to the ground. In -situ fluctuating climatic condition, the addition of surface coating etc. can be detrimental to the pigment, plaster and earth fabric because of differential dimensional changes of the layers and difference in water vapor permeability [48]. Barrier films may inhibit transmission of water vapor through various substrate layers to the surface. Earthen based paintings are generally water sensitive and therefore methodology developed for treating lime based painting are often not suitable for decorated mud plaster. When there is active deterioration, repair and strengthening of the material without understanding causes and mechanism of deterioration are only temporary measures and often cause more damage in long run [49]. Other factors of deterioration also affect previous interventions and hence there is requirement for critical understanding and through identification of original clay fabric and deterioration process.

Earth, a highly heterogeneous material has been used in construction of shelters for the mankind for thousands of years [50] and about 30% of the world’s present population still live in earthen dwelling [51]. Traditional mud plaster is made with soil composed of sand, silt and clay with straw sometimes added to prevent excessive cracking during drying. For earthen support to function well, an equal distribution of silt, sand and clay is desirable. Too much silt is neither a good binder
nor an aggregate and produces a material that is prone to shrinkage and cracking. Clays also called phyllosilicates a term related to grain size (<2 µm) and grain shape in most cases is that of a sheet much thinner than wider and attracted to one another by electrolytic forces [52]. The non-clays are of grain size greater than clays and are generally divided into the grain size categories of silt (2-50 µm in diameter) and sand (50 µm to 2 mm in diameter). Non-clays materials have relatively small attraction for water because of their small surface as compared to their volume and are also non-plastic. The non-clays grains are shaped in more irregular manner with grain to grain contact surface area reduced and contact cohesion is much lower [53]. Incorporation of water into the clay structure is quite reversible under atmospheric condition, being directly related to ambient water vapor pressure and temperature. The clay minerals in general consist of equal parts of expandable clays (smeitite and mixed layer illite/smeitite) and non-expandable clays (Kaolinite or Chlorite) with minor quartz, calcite and feldspar [54]. The expandable clay minerals are sticky than non-expandable clay and are effective in binding silt and sand particles together. In order to overcome the inadaptability of local resources, other materials are often added to the earth such as vegetal matter [55, 56] or calcite or perhaps lime [57, 58]. In this way shrinkage of the clay is significantly reduced as calcite or lime may also serve as binder. However, possibility of using reactive fillers in earthen grouts has still not been fully explored. It has been observed that materials such as calcite, silica, ferric oxide etc. act like a cementing agent forming chemical bridges between clay micelles that may reduce swelling of clays [59]. It has also been observed that some clay are generally frequented by zeolites, gluconites or iron oxide minerals indicating the existence of high silica activity in aqueous solution, affecting silicate crystallization. Iron oxides are also very strong coloring agent for clays.

Besides, protein may react chemically by the process of exchange of inorganic cations in the clays with organic one-a mechanism relating to the ability of amino acids to encourage clay flocculation [60]. It has been observed that egg white used as an additive in earthen grouts promote adhesion, increase plastic & liquid limit and enhance uniaxial comprehensive strength and modulus of rupture [60]. Egg white has a long tradition of use as an additive in lime plasters and mortars because of its adhesive properties [61]. It is worth exploring addition of proteinaceous materials to
the mud plaster of Ajanta to enhance its binding properties in accordance to ancient Indian paintings texts written in Sanskrit language [22].

About two third of Ajanta paintings have been applied with unbleached shellac varnish in the past that has now oxidized to orange red color in tropical Indian climate masking clear view of original paintings as well as inhibiting water vapor permeability of painted mud plaster. Numerous gaps, ridges, lacuna can be observed on those part of the painted surfaces, applied with shellac varnish. Besides, poly vinyl acetate has also been applied for consolidation and fixing of painted surface including application as preservative coating in modern conservation works. This film forming material also resulted in lower water vapor permeability of the surface causing deterioration to occur below. Enhanced flow of visitors, wide fluctuations in humidity, insect activity within the mud plaster have further added to the deterioration of Ajanta murals [62]. However, many preventive conservation steps have now been undertaken by Archaeological Survey of India to undo the causes of deterioration of Ajanta murals.

In this section, the focus is on in-situ examination of Ajanta painted plaster along with scientific investigation on its nature and characteristics. The analytical technique used for characterization are optical microscopy, laser light scattering, polarized light microscope, scanning electron microscope, XRF, X-ray diffraction, FTIR and sieve analysis etc. Some research was also carried at the site relating to earthen plaster and paint layer which has provided base for conservation in this specialized area of work.

### 1.7 Scope of the work

A detailed investigation about the discovery of Ajanta along with acts carried by various art lovers that has direct bearing on survival of Ajanta murals is proposed. It is also proposed to deliberate on art & architect of Ajanta and nearby sites with scientific data in support of chronology of Ajanta. Mural art technique of Ajanta vis-à-vis ancient Indian painting recipe has to be studied in detail. It is also proposed to study impact of visitors on Ajanta murals for the first time along with variations of temperature, humidity, noise level, insect activity, carbon dioxide, light etc. on the painted plaster. A detailed investigation about the pigments and mud mortar have
been planned so as to prepare a matching repair mortar for restoration. Characterization of materials & mural art technique helped in understanding Ajanta murals for execution of restoration work with similar materials for posterity.

As obtaining samples from archaeological site is a major problem, the investigative studies were carried both on site and analysis of micro grains in the laboratory. On site analysis was carried with non-destructive technique to the maximum possible extent. Destructive analysis was carried in Science branch laboratory, Aurangabad as well as in other sophisticated laboratory for the micro grains of the samples. Environmental parameters and other data’s were recorded on site. Data on environmental parameters are based on long term measurement.

The cross sectional studies of the painted plaster were carried at the site as well as in the laboratory with FTIR and SEM techniques. Portable XRF was used as non-destructive technique for the analysis of pigments of Ajanta and few micro grains were also investigated through FTIR, Raman & SEM methods. The mud plaster samples were analyzed for particle size, petro-logical analysis, XRF, XRD, FTIR, Raman and SEM. For monitoring environmental parameters and study on carrying capacity of cave murals of Ajanta thermo-hygrograph, Lux meter, protimeter, carbon dioxide analyzer, noise meter etc. were used. A detailed literature survey was carried out about the past conservation treatment. Based on the feedback newer techniques were developed for cleaning of paintings. Matching repair mud mortar mix was prepared for filling the gapes, lacuna etc. in the painted plaster based on ancient techniques and analytical data.