

**REPORT OF THE EXPERT COMMITTEE ON  
ATMOSPHERIC ENVIRONMENTAL QUALITY AND  
PRESERVATION OF TAJ MAHAL AND AGRA MONUMENTS**

**VOLUME II**

**Volume I : Report and Annexures**

**Volume II : Additional Relevant Documents and Bibliography**

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VOLUME II

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NOTE ON CONSERVATION OF TAJ MAHAL

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I. HISTORY OF MAJOR STRUCTURAL CONSERVATION

Introduction : The Taj Mahal, one of the finest garden tombs in the world stands on the bank of Yamuna at Agra and it was built by the Mughal Emperor Shahjahan to enshrine the mortal remains of Arjumand Banu entitled Mumtaz Mahal, the empress whom the emperor loved immensely. The piece of land was given by Raja Jai Singh, grandson of Raja Man Singh and the emperor gave him lofty residences from the crown lands in exchange. The construction of the tomb was begun in 1631 A.D. and it was completed in 1643 A.D. According to the court historians the project was completed in about twelve years at a cost of 5,000,00 rupees under the superintendence of Makramat Khan and Mir Abdul Karim the Superintendent of Buildings (Darugha) incharge of buildings at Agra. The architect responsible for the construction was Ustad Ahmed Lahori. Mulla Abdul Hamid Lahori, under instruction from Shahjahan has recorded a detailed history of Taj in Padshahnama (Appendix - A). The account of Taj is also given by Abdur Rahman in his book Mirate - Aftab - Numa (Appendix - B).

The symmetry of design combined with vastness produce a unique everlasting effect. The Taj is situated on the other end of the garden in the centre of marble terrace between two buildings of identical design, a mosque on the west and a Jamat Khana (assembly hall) on the east. Terrace has four domed minarets having four storeyed. The masoleum has vaulted arched recesses in the facade and smaller arched recesses in two storeyed on the sides. With four chattris on the corners the double dome slight bulbous placed in the centre of the lofty drum has a very pleasing appearance. All these components are perfectly balanced. The core of the masoleum is made of bricks with lime mortar faced with white marble veneer. The whole surface of the marble inside and outside is full of pietra dura ornamentation delicate traceries of marble railings and beautiful, inscriptions in black marble on white surface.

"All these different parts have been combined to form a perfectly balanced composition of great architectural merit in itself : at once the most famous and most beautiful of all the monuments made by the hand of man incomparably designed like a palace and finished like a Jewel'. But what has made the Taj ' milk white amongst its dark cypresses' astoundingly beautiful and dream like is the chaste marble".

The Court Historian Mullah Abdul Hamid Lahori mentions that the foundation of this great monument was laid in 1632. The inscriptions on the great apse facing west on the southern wall of the cenotaph chamber and on the main gateway bear the dates of 1046 A.H. (1636 A.D.), 1048 A.H. (1638 A.D) and 1057 A.H. (1646 A.D.) respectively, denoting presumably the year of completion of the various parts on which the inscriptions occur. The author gives a vivid description of the main and subsidiary buildings, but his account is ~~mainly~~ confined mainly to the architectural and decorative features; all the relevant information that can be gathered from the Badshahnama is, first, that the foundations were taken to the subsoil water level, second, that the masonry below the ground is stone-in-lime and third, that the platform above ground is of brick-in-mortar faced with marble veneer.

HISTORY OF MAJOR REPAIRS.- In the history of repairs, the problem of the leakage of the dome has plagued immediately after the completion of the mausoleum. The earliest reference to leakage in the dome reported in a letter from Aurangzeb to Emperor Shahjahan dated 1652 AD, not long after the completion of the mausoleum. Prince Aurangzeb pointed out, "the dome of the holy tomb leaked at two places towards the north during the rainy season and so also the four semi-domed arches, many of the galleries on the second storey, the four smaller domes, the four northern compartments and seven arched underground chambers, which have developed cracks. During the rains last year the terrace over the main dome also leaked in two or three places. It has been repaired, but it remains to be seen during the ensuing rainy season how far the operations have proved successful. The domes of the mosque and the Jamat Khana leaked during the rains and were made water tight. The master builders are of the opinion that if the roof of the second storey is reopened and dismantled and treated afresh with concrete over which half a yard of mortar grout is laid, the semi-domed arches, the galleries and the smaller domes will probably become water

tight, but they say that they are unable to suggest any measures of repairs to the main dome". It is not recorded what steps were taken to repair the dome (Appendix C)

During the construction of Taj, it is stated by contemporaries that wood was scarce and so, brick masonry scaffolding was used. Tavernier's statement that "the scaffolding above cost more than the entire work, because, from want of wood, they as well as the supports of arches, had all to be made of bricks; this has entailed much labour and heavy expenditure" clearly reveals that Prince Aurangzeb could not have gone in for major repairs requiring scaffolding and would have actually confined himself to some sort of patch work repairs. Till A.D. 1810, nothing is known about any repairs to the Taj. Probably no repairs were carried out; for, after A.D. 1707 when Aurangzeb passed away the Mughal empire declined rapidly and political condition in north India was in a state of flux.

The Jats of Bharatpur took away the silver doors of the entrance of the Taj. These were set up by Shahjahan at a cost of Rs.1,27000 and were " studded with nails the head of each of which was made of a rupee. A large number of precious stones of the inlay work were also taken away. A covering of pearl strings worth several lakhs of rupees used to be placed over the grave of Mumtaz Mahal every Friday or on her death anniversary. It is said to have been seized along with other precious articles belonging to Mumtaz Mahal and Nurjahan by Amirul-Umara Hussain Ali Khan when he held temporary possession of the Agra Fort in 1719 A.D.

Taj was first drawn by William Hodges between 1780 & 1783 and the most famous drawing of Taj was drawn by Thomas Daniell in 1789. In 1803 when Lord Lake occupied Agra his soldiers stripped the Taj of its final and pietra dura inlay. Later this was followed by the favourite British pastime of hammering the marble veneer. Between 1828-33 Lord William Bentinck decided to demolish the Taj and auction its marble slabs in England. The demolition squad arrived with its machinery and camped in the grounds of the Taj when the order for stoppage of the demolition also arrived. This happened because the first auction of such materials in London was a total failure. Nature has also brought

In 1809 a Committee was appointed to supervise the repairs to Taj and Akbar's Tomb at Sikandara and upto 1814 a lakh of Rupees was spent.

A later account of repairs carried out to the structure of the Taj Mahal building appears in the proceedings of the Rt. Hon'ble Governor General in Council in the General Department on the 4th December 1823, wherein it has been mentioned that Captain Taylor was appointed by Government in the year 1810 to execute the repairs to the Taj Mahal at Agra in the manner and to the extent suggested by Col. Hyde, the acting Chief Engineer. Col. Hyde stated that "Several of the marble slabs which composed the coating of the body of the building are broken and many of the ornaments of inlaid coloured stone have tumbled out. Instead of filling up the vacancies in the ornaments with coloured chunam I should recommend that original pieces of coloured stones should be inserted. Rs.7,000/- will be abundant for this purpose."

In November 1814, Captain Taylor reported that the repairs, as far as authorised by the Government, had been completed. The whole of the outer surface of the body of the Taj had been thoroughly repaired and cleaned, the stones which had fallen out replaced and the mosaic work completely renewed. During the heavy rains of 1822 the ornamental work carried out by Capt. Taylor on the exterior body of the Taj was damaged though it had been repaired only eight years since. The matter was reported by the local agents at Agra to the Board of Revenue in the <sup>Nerb</sup> Western Provinces. They stated that the original decorations were inlaid in coloured stones whereas Capt. Taylor had used coloured chunam; moreover, they pointed out that whereas the joints of the marble slabs of the minarets had formerly contained pieces of black stone, they were replaced by coloured mortar. This shows that Col. Hyde's recommendations with regard to the filling up of recesses on the body of the Taj with marble were not carried out by Capt. Taylor.

No substantial repairs appear to have been undertaken after this period until 1864 when Dr. Murray, Inspector-General of Hospitals, N.W.P. addressed the Magistrate and Collector of Agra on the 15th of September in the following terms. "The mosaic work has been much injured particularly during the Mutiny, great number of flowers have been picked out, their place has been filled by lime and painted imitation of the original flowers but the effect is abominable. The flowers in the octagonal room are a good deal injured by renewal and by subsidence of the North-East wall cracking the marble, but the flowers in the vestibules are little injured." The estimate of Dr. Murray for replacing the flowers in the vestibules are little injured". The estimate of Dr. Murray for replacing the flowers and certain other repairs to broken marble in the wall amounted to Rs.5,900/-.

Besides the replacement of the flowers mentioned above, there seems to have been need for other repairs. This fact became apparent in the course of the next 10 years when Mr. Alexander Executive Engineer, Agra, was asked to carry out repairs amounting to Rs.70,926/-.

In 1876 the masoleum was entrusted to Public Works Department.

In December 1903 Lord Curzon, then Viceroy of India, visited the Taj, and since then, the Taj has received constant care and attention. Under Lord Curzon's orders, not only the main masoleum but also the buildings in the fore and outer court received attention. The marble lining of the soffit of the dome was restored and the fall of marble pieces from the dome was arrested. The floor of the dalans were replaced as the original floor was damaged beyond repair. The garden was relaid with lawns. Earlier it had densely planted different varieties of flowering and fruit bearing trees as borne out by the earlier drawing and photographs.

The Gazetteer of Agra records that in first five years" over Rs. 1,27000/- were spent in repairs..... The affairs of Taj are now entrusted to a Committee formed by the Commissioner, Collector, Judge and Executive Engineers assisted by the Superintendent of Govt. Garden". This was the status position of Taj in 1905.

Thirty years later cracks appeared again. The large number of cracks gave rise to public apprehension. The Hindustan Times dated 7th & 11th November 1937 commented editorially on this. As a result Sir Ziauddin Ahmed raised this matter in the Central Assembly. The government of India sanctioned an estimate amounting to Rs.52944/- for repairing the roof of the second floor of the monument.

Taj Advisory Committee 1941 : Before the Archaeological Survey of India (ASI) could commence the repairs the Government appointed in January 1941 an Advisory Committee consisting of five experts.

The recommendations of this Committee were as below :-

1.(a) Record of reduced levels prepared by this Committee should be carefully preserved.

(b) The 104 bench marks carved on the floor of the building and shown on Drawing C.E.8445 should be checked every year and subsidence in foundations cautiously watched.

(c) The verticality of minarets should likewise be regularly examined.

2. All the stones in the super structure, that have bulged out or cracked, should be reset and renewed. The Joints should be carefully filled with Sika and white cement and surface made perfectly water tight. This process should be repeated whenever necessary. A permanent record should be kept of all substantial repairs whenever such repairs may have to be resorted.

3. All visible clamps should be scraped and the rust removed and embedded thoroughly in cement grout. The fractured stones should then be patched up in a way that they become impervious to dampness.

4. Cracks in brick masonry should be filled up with cement mortar. A record should, however, be kept of any re-appearance of these cracks in future years. At places where disintegration of mortar inside the walls

is suspected, cement under pressure should be resorted to. The whole surface inside should be scraped and renewed with cement plaster.

5. The masonry of the dome and the drum should be treated with cement under pressure and reinforcing bars inserted in the manner described by Francois Cementation Co.

6. Masonry between the soffits of vaults of 2nd floor and the roof should be strengthened also by the treatment of cement.

7. The four chhatries should be dismantled and resea. The dowels should be of rustless steel and embedded in cement mortar. Reinforcement should be employed to hold the columns together, but should be thoroughly surrounded with cement. Good stone available from the dismantled material should be utilized.

8. Loose stones of the minarets should be reset and damaged ones renewed. The entire surface should be pointed with specified mortar and made waterproof.

9. The inside surface of the drum may be left unplastered for two or three years to observe the effect of grouting and the external water-proofing of the dome and the drum.

10. All loose skin of the red stone lining inside the main dome should be removed, hollows filled in with cement concrete and the surface protected by a coating of liquid cement applied under pressure with the help of an atomizer.

11. Old concrete over the top of the interior dome should be removed and replaced with fresh fine cement concrete.

12. The entire exposed roof surface should be made water-proof. Covering with water proofing material or with other similar material laid in asphalt should be resorted to.

13. The inside of the dome should be mechanically ventilated. A duct and exhaust fan may be employed.

14. To prevent birds and bats from getting inside the dome no sulphur should be burnt to drive them away, but a door with wire netting should be fixed.

Expanded Taj Advisory Committee 1942 : The above Committee was expanded in 1942, and five more experts were added. The setting of these Committees and implementation of their recommendation was the beginning of a Scientific approach to the structural conservation of Taj. The important recommendations of the enlarged Committee were as under :

1. The entry of rain water in the masonry and dome should be arrested. Before rendering the dome water tight, cracked and out of the plumb stones should be removed and replaced or reset in hydraulic lime mortar to the full height and thickness of the course. The joints to be sealed with special lime mortar.

2. Cracks in brick masonry should be filled with hydraulic lime mortar, where disintegration of mortar is suspected, grouting under gravity with cement mixture is to be adopted.

3. All exposed clamps and dowels should be removed and replaced by gun metal clamps and dowels embedded thoroughly in cement grout.

4. The joints of the outer facing of marble should be filled with special lime mortar to make the surface water proof. The pointing of these joints should be done after raking out to a depth of 8 cms if possible, or 2.5 cms if not, and filling them with special lime mortar.

5. The plaster on the interior surface of the dome should be stripped for observation of the efficacy of the treatment recommended above.

If not ill effects are observed for two years, the surface should be replastered with hydraulic lime mortar.

6. The decayed concrete atop the inner dome should be removed and fresh cement concrete should be laid.

7. The cracks in the masonry between the soffit of the vaults and the roof of the second floor should also be filled in with hydraulic lime mortar.

8. The columns supporting the four Chhatris on the roof of the mausoleum should be rebuilt, though the Chhatris need no repairs.

9. The loose and damaged stones on the minars should be reset or replaced in hydraulic lime mortar. The entire surface should be pointed with special lime mortar and made water proof.

10. The entire roof of the mausoleum should be made water proof, but bituminous compounds should be avoided.

11. The 104 Bench Marks on the building should be checked once in ten years or after every earthquake and subsidence. Similarly, the verticality of the minars are also to be tested.

12. The brick work behind the marble veneering of the dome and drum should be grouted by gravity food. Holes of 4 to 5 cm should be bored in the marble facing wherever voids are located.

13. The accumulated water in the lower parts of the outer surface of the drum should be removed.

14. A permanent record of any reappearance of cracks and also of substantial repairs should be kept.

Following the recommendations of the Expanded Taj Advisory Committee during 1947-49, besides other conservation work, repairs to the berm of the dome were carried out. M.S. Vats records, "Modern accretions from the berms of the chabutra of the main dome and the corner Chhatri as well as from the parsets all around the terrace were removed and made water tight. The decayed plaster to a height of 65 feet from the interior of the drum of the upper dome was also removed and the entire surface replastered out the salts. This process of eliminating salts has to be repeated every second or third year till the wall is completely free from salts when final plastering will be done in hydraulic lime. The decayed concrete from the top of the inner dome was removed. On examination it was found modern to an approximate depth of 14 to 15 inches, of which the upper shell of about 9 to 10 inches was even more loose than the stuff below it. Having removed all this about a dozen loose pockets here and there in the dome were filled to an average depth of about 12 inches and then the whole of the dome was treated with kankar lime-concrete for a depth of 3 inches. Above this was laid another layer of cement concrete 1:2:4. In order to break the joints the inner dome has, for the purpose of the upper shell, at the apex a circle 4 in diameter, and from this radiate 16 equal trapezoidal panels in a concentric circle to a distance of half the diameter of the inner dome. Below this the outer diameter of the dome is again divided into 16 panels of the same trapezoidal upper form, but in order to break the joints the lower trapezoidal panels bisect to contiguous upper trapeziums.... Again, the berm round this dome, of which the width is 3 feet 6 inches between the drum and the lower edge of the dome, was cement concreted in sixteen panels. A great deal of load over the inner dome of which the depth, as stated above, was 14 to 15 inches on the average, was reduced, because in its place the lime concrete layer of 3 inches with the overlaid of 1 1/2" inches of cement concrete in sixteen radiating trapezoidal quadrants was only 4 1/2" inches thick".

Committee of Engineers 1956 : The implementation of the recommendations (Appendix F) were taken in hand in the following years. A body of engineers was constituted in 1956 to examine the monument and review the implementations of the Committee of 1942. The engineers were satisfied about the stability of the monument and also the repairs executed upto date. They also advised fixing of tell-tales all along the cracks in the underground vaults on the river front and some special repairs to the dislodged south-west pilaster of the main mausoleum, like removal of flat strips of stone fixed on either side of the pilaster and resetting of the dislodged veneer stones in position by cramps and dowels after thorough grouting of the voids behind them. The tell-tales were fixed and the work on the pilaster was taken up.

During 1957-58, the work on the pilaster was completed. Instead of iron clamps, copper ones were used for resetting the stones; the iron clamps were full of rust.

The appearance of cracks and presence of water in the underground vaults on the river side led to the opening of the drain running at the base of the wall along the river front. The percolation of water was due to the longitudinal cracks on the chequered pavement beside the drain. The cracks (one of them more than 60 ft in length) were thoroughly grouted.

Excavation To Find the Nature of Foundation : Trial pits 50 feet long were dug along the outer wall on the river face to find out the foundation strata. This exposed a series of wells filled by marble in this area used as a groin to ward off erosion. The wells were 11.5 ft. from centre to centre.

contd..... 12.....

During 1958-59, the repairs to the N.E. Minar was taken up. The items of work carried out are (1) resetting the dislodged stones of the dome (2) Chiselling off of the fractured surfaces of marble and inserting new ones at these places. (3) resetting and restoring 100 so and missing in-lay pieces and bars (4) resetting of dislodged stones of marble railing (5) provision of doors (6) replacing decayed and exfoliated red stones of the interior and filling up of vertical and horizontal joints faced with in-lay bars.

During 1959-60 the stones jalis of the S.W. corner Chhatri were reset.

During 1960-61 rubble pitching encased in G.I. wire netting was done to a length of 70 m along the plinth of the north wall (i.e. wall on river side) to prevent the scouring of the foundation.

During 1961-62 the cracked and decayed store slabs were replaced by new ones. Broken Chhajjas and railing in all the three storeys were restored. Exfoliated red sand stones in the interior were replaced by new ones. The missing inlay pieces of black marble were replaced by similar ones of Alwar marble. The decayed plaster of the soffit of the crowning Chhatri was removed and fresh plaster substituted. The rusted iron dowels were replaced with copper ones.

During 1962-63 and 64, the loose black marble horizontal bands in the N.W. Minar were reset. The foundation of the N.E. dalan, a portion of which had settled was strengthened. The arches and walls of the dalans flanking the Fatehabad gate were underpinned.

The Survey of India, Geodetic Branch checked the verticality of the minar once again.

In 1972 spurs were constructed on the river bank by CPWD to prevent damage to northern wall. In the following years repairs to Chhattris, Ghajjas and Minars replacement of missing inlay stones were carried out besides repairs of routine nature.

Water Leakage In 1985 : A news item entitled "The Taj is leaking" appeared in the "Times of India" dated Saturday the 12th October, 1985 at page 5. Accordingly on the morning of 13.10.85, Jagat Pati Joshi, the then Addl. Director General and R. Viswanathan, Director conservation ASI went to Agra and inspected the dome at the Taj carefully

On the inspection of the site it was observed that the sixteen sided octagonal central platform on which the drum of the outer dome rests had a lime concrete surface (berm) about 1 m. wide with an incline. In this the surface in the north-east side of the dome, in an area of 3m.x1m., the lime concrete which was laid in 1949 had become weak to bear the onslaught of the recent incessant rains. This was a spot which had been well identified by the Superintendent Archaeologist of the Circle as the cause for the present see page. At the time of inspection, this area was found well covered with thick tarpaulin. As a matter of fact, for the inspection of the spot of leakage this had to be removed. The area was carefully examined. The lime concrete in fact, had pulverised very much in this area and has led to the present see page due to heavy rains. Immediately after the inspection it was covered by tarpaulin as it was

still drizzling in Agra. Besides this, an examination of the entire berm around the dome showed that at quite a few places in the lower portion of the veneer of the berm exfoliation has taken place on the outer surface of the stones and blackish moss formation was indicative of the fact water had been imperceptibly entering through minutes pores of the weak lime concrete. It had further been observed that see page of water in this part of the monument had affected the veneer in marble inside the north-eastern side of the upper mortuary chamber. This could be seen by the expansion of the iron dowels leading to cracking of marble veneer due to oxidation of iron of the dowels. This had, perhaps taken place slowly through the years.

Instructions on the spot were given to cover the entire berm first with thick alkathene sheets and them tarpauline. Further see page for the time being would thus be warded off not only from the identified spot of see page ut also area around it. Taking into account the exigency and the importance of the monument, spot instructions were explained for the line of work for repairs to be followed.

As per inspection note and instructions of the Additional Director General given on the spot, an estimate was framed for Rs. 49,844/- for the special repairs to the roof terrace of the main mousoleum at the Taj Mahal, Agra. The following items of works were undertaken and completed within a record time of two months. The repairs done have withstand the rain and vagaries of weather of all these years since then and there has been no see page of water or in other structural faults noticed so far on the roof terrace of the main mousoleum.

- (1) Dismantling lime concrete in terrace carefully without disturbing any structure.
- (2) Cutting lime concrete in shape of small cavities average (20 cm. X 15 cm) section on the berm of dome carefull with chisels and cleaning the same with brush for grouting the masonry around the drum of the dome.
- (3) Picking up the lime concrete upto 2.50 cm. to 4 cm. depth carefully with chisels and cleaning the surface.
- (4) Grouting the joints or cracks with neat Portland cement.
- (5) Plain cement concrete 1:2:4 with cement, coarse sand and stone grit 2 cm. gauge and 1 to 1.3 cm. gauge mixed with water seal compound.
- (6) 2.50 cm. thick average plain lime concrete with 2 cm. gauge brick ballast mixed with 50% mortar in proportion 1:1:2:2 cement, lime, coarse sand, surkhi mortar mixed with water proof compound.
- (7) Providing 2 to 3 mm. thick floating coat of cement and marble dust in proportion 1:3.
- (8) Lime concrete with 2 to 2.50 cm. gauge brick ballast mixed with 50% mortar in proportion 1:1:2:2 cement, lime, coarse sand and surkhi as in roof terrace mixed with water seal compound.
- (9) Applying thin coat (about 2 mm.) of Araldite and coarse sand over stone surface joints including complete finishing.

- (10) Recessed pointing with 1: 2 cement and coarse sand mixed with red oxide including repairing of joints.
- (11) Providing and laying in position bitumen sealing compound for exterior joints, etc. after racking the joints.

EXECUTION OF WORK :

As it was observed that the lime concrete of dome berm had pulverised and thereby became weak to bear the thrust of rain water the decayed lime concrete over the berm of the dome and corner chhatries and the roof surface were scraped out. The berm of the dome and corner chhatries were then grouted with lime concrete and sand mortar to fill up the cracks and joints, if any, followed by providing a damp proof course layer of 25 mm. thick of 1: 2: 4 cement, coarse sand and granite grit 20 mm. thick size mixed with water proofing compound. Lime concrete with brick ballast was then laid, rammed, cured and finished properly. The thickness of the cement concrete and lime concrete were kept as per original to avoid any extra load over the roof.

The joints of marble facing upto the thickness of the berm of the main dome was pointed with Araldite and coarse sand carefully. Fresh lime concrete was laid on the floor of the corner Burjis and finished with special lime mortar. Marble coating of the dome facing neck was water tightened by pointing with special lime mortar upto a height of one meter above lime concrete. The red sand stone facade of the dome and plinth of the corner chhatries was pointed with mortar mixed with red oxide. The Parapet of the terrace constructed partly of red sand stone and partly of white

marbel was watertightened by cement, sand, red oxide mortar mixed with white cement and marble dust mortar. The joints of roof terraces were filled up with Tarplastic compound of Shalimer Products.

Regular structural repairs and chemical cleaning is undertaken by Archaeological Survey of India every year. The details of which are available in Indian Archaeology - A Review 1953-54 to up to date.

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## II ERA OF ENVIRONMENTAL THREATS AND COMMITTEES

Prior to 1972, it must be admitted that no attempt was made to evaluate the impact of the environment on Taj. Besides this, between 1942 and 1972 and later, ASI had made some studies on the building materials used in Taj Mahal. This included (1) Study of marble and sand stone and examination of weathered red sand stone lining of the interior of the dome. (2) environmental parameters temperature variation moisture attack, rainfall pattern, impact of meteoric waters and humidity gradient 3. Factors of deterioration, thermal damage, salt crystallization and growth of moss lichen and algae. These investigations have given very important and interesting results which are dealt with else where in this note.

The study of environmental factors for the preservation of Taj were triggered off by the decision of Govt. of India to establish a Oil refinery at Mathura in 1972-73. This is a land mark which ushered the beginning of an era of intense environmental consciousness, and scientific research for the preservation of Taj.

In the year 1973-74, the Government of India decided to erect a refinery at Mathura after the technico-economic survey, submitted its feasibility report. This is based on proximity of the demand area and availability of communication. During this time, apprehensions were raised with regard to possible adverse effects as a result of gaseous pollution due to emission on Taj and other monuments in and around Agra.

Varadarajan Committee :

1. The then Petroleum Minister held a meeting with Indian Oil Corporation, Bhabha Atomic Research Centre, Bombay, Planning Commission, New Delhi, National Environmental Engineering Research Institute, Nagpur in September, 1973 and directed I.O.C. to take necessary precautions to safeguard the monuments against all possible adverse effects and the Government of India appointed an Expert Committee in 1974 with the purpose to guide and take suitable remedial anti-pollution measures. This committee was headed by an eminent scientist. Dr. Varadarajan.

Before the Committee gave its recommendations it instituted a number of scientific studies considered for its recommendations.

1. Existing level of pollution in the Agra Mathura Region carried out by NEERI from November, 75 to March 77 (15 Months) and found that the sulphur dioxide content in the atmosphere was negligible.

2. Studies in disposal of pollutants by Indian Meteorological Department (I.M.D.) and TECNECO (ITALY).

3. TECNECO was also requested to ascertain the present status of the monuments in respect of their physical, chemical and biological factors.

4. Tecneco Experts collected samples from different places in various monuments of Agra. Pieces of old marble and other stones which were removed from the monument for

previous conservation work were also used by them for scientific studies. They also collected samples of marble and sandstone from the original quarries at Makarana in Jaipur. They conducted petrographic, chemical and physical analysis on the samples, Superficial layers of marble were analysed by X-Ray diffraction, chemically and microscopically. They came to the conclusion that the major cause of alteration at Taj was biological. Presence of soluble salts was found to be extremely low. Sulphate, a sign of the effect of pollution, was not found to be present.

Among the soluble salts, the percentage of chloride was larger.

Biological investigations indicated that both marble and sandstone were similarly altered by black spots. This type of alteration is attributed to multiplication of microscopic algae which are also accompanied by decomposing organisms or atleast using their organic and inorganic remains. Algae responsible for black spots was generally found to be blue-green algae, i.e. cyanophyceae. Since this type of algae has pigments they can survive even in low light conditions. The major portion of the algae that was determined by Tecneco specialists is of covering and corrosive type, because of action of their constituents, like Oxalic and Muramic acids. These forms can cause disintegration and splitting of the stone. Other forms are able to fix atmospheric nitrogen components which are used by nitro-bacteria, causing further corrosion

attack. This type of attack, however, was not noticed in the Taj at that time.

The Tecneco specialists also monitored the air quality and also measured meteorological parameters like air temperature, inside and outside monuments, and their surface temperature. Their finding was also that pollution in the atmosphere was not very high.

On the basis of their experiments and analysis of data of a large variety it was stated that the state of conservation of the marble was 'good' but on the other hand, the sandstone did not appear to be in good condition, mainly because of the natural causes of deterioration. Alterations both in the marble and the sandstone were assigned to algae. It may be mentioned that the main thrust of Tecneco studies was towards the likely effect of pollution and so other types of deteriorations were not dealt with by them in any great detail. Recommendations of Varadarajan Committee

- (a) Shutting down of 2 Nos. coal based plants (10MW Cap each) of U.P. State Electricity Board located in the Agra Zone.
- (b) Dieselisation of coal based locomotives in the Marshalling Yard of Railways in Agra.
- (c) No new pollution causing industries to be located on North East of Taj Mahal.
- (d) Existing small scale industries particularly foundries should be relocated in South - East of Agra beyond Taj Mahal.

- (e) No new large industries such as Fertilizer and Petrochemicals is to be set up in the neighbourhood of the refinery. Location of any new industry in Agra region should be so chosen to exclude any increase in environmental pollution in the area of the monuments.
- (f) The pollution level in the Agra Region be monitored by an appropriate authority on a continuous basis. Studies should be conducted periodically to determine whether any deterioration has occurred in the monuments and if so measures should be taken to arrest the same. The Committee recommended the Archaeological Survey of India to take such studies.
- (g) Use of coal in the power plant of proposed Mathura Refinery should be deferred till suitable technology is available for reducing emissions from the same.

MGK Menon Committee :

Yet another High Power Committee was set up by Government in 1979 with Prof. M.G.K. Menon as Chairman and an expert group to assist the High Power Committee to oversee the implementation of the necessary air pollution control measures. The committee decided to enlist and zone the pollution producing sources in such a way so that the pollution emitting sources should be dealt with carefully and they identified the sources as following :-

1. Power Plants - 21100 Tonnes of coal daily (Steam coke)
2. Foundries - 200-300 Tonnes daily (Hard coke).

3. Coal based locomotive 40-50 Tonnes daily.
4. Industries 2000 Tonnes/-.
5. Brick Kiln 480 Tonnes/-.

(A) This committee took action in getting the 2 thermal power plant closed by May 31, 1981 and dieselized the railway marshalling yards.

(B) Monitoring stations between refinery and Agra were put up by I.O.C.

(C) Geographical area which in the shape of a Trapazium covering 10,400 Sq. Km. within which location of new polluting industries have been prohibited and the polluting load of existing industries was considered for reduction.

Joint Parliamentary Committee :

A joint parliamentary committee headed by Dr. Karan Singh visited Taj and Mathura Refinery under Construction on 1st Oct. 1978 to evaluate the effect of air pollutants on Taj and it reported to the Parliament (Lok Sabha) on 18th May 1979 and considered Mathura Refinery a threat to Taj. The JPC recorded. "The committee after examining the matter carefully and weighing the pros and cons have come to the conclusion that Mathura is one of the worst possible sites for setting up of a refinery from the archaneological, ecological and environmental points of view. The Committee are of the opinion that in order to save the Taj Mahal and other monuments in Agra and Braj Mandal from the ill-effects of air pollutants from the refinery, the Government should also look into the refinery problem afresh and examine the feasibility of shifting

at least the most polluting units of the refinery to the Etawah Region."

T.N. KHUSHOO COMMITTEE :

Another expert committee to monitor pollution abatement measures was constituted in 1982 with Department of Environment (DOE) Secretary Dr. T.N. Khushoo as Chairman. Further work on laying out of the green belt around Taj was also undertaken.

The committee further suggested the following :-

1. Crude with less than 2% sulphur content should be used.
2. Stack height should be raised to 80 Mt.
3. Electrostatic precipitators should be installed.

Several sub-committees were constituted to attend to specific jobs like the fixing up of the threshold value, analysis of marble, plaster, cause of pitting, carbonate reductions studies, discolouration etc.

DAVE Sub-committee :

It was this sub-committee under Prof. H. Dave which fixed the conditional threshold value of  $SO_2$  in relation to marble.

High Power Committee of Department of Culture :

In regard to the Taj Mahal, a High Power Committee under the Chairmanship of Secretary Culture which was

constituted in 1984 by the Government of India for looking into all aspects of its preservation such as the (a) Structure Problems (b) Scientific Studies of materials (c) Pollution Problems and (d) Aesthetics and Tourism. The High Power Committee has also established various sub-groups to look into the above aspects and has been reviewing the implementation of the recommendations of the sub-groups.

The work of the High Power Committee was also reviewed in a meeting of the Secretaries under the Cabinet Secretariat. The High Power Committee reviewed the following in 1988 :-

A. Action to Control Pollution :

- i) Action to shift industries & foundries around Agra to be expedited by the Prabandhak Zila Udyog Kendra, Agra.
- ii) Creation of green belt required to be expedited.

The work of planting of trees was undertaken by the Forest Department of the Government of Uttar Pradesh. Trees were also planted along the roads, canals banks railway tracks and other available government lands around the monument. This green belt will eventually reduce the possibility of gaseous pollution and possible deleterious effect on the monument.

- iii) Further expansion of Mathura Refinery should be undertaken only after a complete study of its environmental impact on the Taj Mahal. Indian Oil Corporation was addressed by ASI and they informed vide their communication No. PC/P8/53 dated 13.10.87

that the proposal to increase the capacity of Mathura Refinery from 6 million tons to 7 million tons was under implementation. This proposal was cleared by the Department of Environment, Govt. of India. The emission of sulphur dioxide from the refinery shall be within the limits prescribed by the Vardarajan Committee.

- iv) Four UNESCO Experts were invited to give opinion on Taj in 1987. They opened regarding the condition of Taj which is dealt with later in this note.

#### WRIT PETITION BY M.C. MEHTA IN THE SUPREME COURT OF INDIA.

In 1984, a Writ Petition was filed in the Supreme Court of India by Shri M.C. Mehta alleging that the industries in and around the Agra and the Refinery would destroy the monuments and sought Supreme Court's direction for effective implementation of the various Acts available at that time.

In his petition Shri M.C. Mehta prayed to the Court to

- (a) Close down chimneys of the refinery and shift the polluting units to Etawah region.
- (b) Close down the foundries and thermal power plants in the vicinity of Agra and/or to shift them to some other locations.
- (c) Declare Agra area as an air pollution control area.
- (d) Grant permission to enter the refinery projects, thermal power plants and foundries in order to make an assessment

The case came up for hearing in May, 1993 and the Hon'ble Court ordered that the U.P. Pollution Control Board would submit to the Court the status of pollution control in the 511 polluting units which were operating within the Agra-Mathura Trapezium. In the next hearing in August, 1993, it was ordered that the U.P. Pollution Control Board would review the compliance status of these units and classify them accordingly. The U.P. Pollution Control Board gave a list of 212 industries which had not taken any step towards compliance of air pollution standards. The Hon'ble Court ordered the closure of these industries.

In Jan., 1993, the Ministry of Environment and Forests had requested the National Environmental Engineering Research Institute to undertake a study of Agra Mathura Region in order to redefine the Taj Trapezium and to draw up an Environmental Management Plan. This report was finalised in July, 1993 and has suggested the following measures :-

- (i) The City of Agra should have a dedicated power supply such that use of diesel generators as an auxiliary power source would be stopped by the industries, commercial houses, hospitals etc.
- (ii) As far as possible, natural gas should be used by industries instead of coal, and L.P.G. should be utilised for domestic purposes.
- (iii) The foundries should switch over from single blast furnace (traditional cupola) into divided (secondary) blast type, and existing coke fired cupolas may be replaced by gas fired cupolas or induction furnace

(iv) LPG/NG should be used in the thermal power plant of the Mathura Refinery.

(v) Location specific Green Belt development plans and plantation schemes should be undertaken.

The Hon'ble Supreme Court, while considering the petition, further directed in Feb. 1994 that the U.P. State Industrial Development Corporation should locate sufficient land area outside the Taj Trapezium where foundries and other industries could be ultimately shifted.

In another order dated 11th April, 1994 the Hon'ble Court directed Ministry of Environment and Forests to take the implementation of the green belt development plans as suggested by NEERI in its report. Regarding the shifting of industries from Agra to outside the Taj Trapezium, it has directed to U.P. Pollution Control Board to issue notices and get the necessary information from the owners of the industry.

EXPERT COMMITTEE UNDER THE CHAIRMANSHIP OF S. VARDARAJAN (1994)

In a further order of April, 1994, the Hon'ble Court directed that it would be in the interests of affected parties to have another investigation/report from a reputed technical/engineering authority. The court directed the Ministry of Environment and Forests to examine this aspect and appoint an Expert Committee. Accordingly, the present Committee under Dr. S. Vardarajan as Chairman and Dr. B.B. Sundaresan, Sri Jagat Pati Joshi, Dr. N. Sen Roy and Sri K.K. Bakshi has been constituted vide office Memorandum No. Q 17012/21/93 CPW dt. 18.5.94 and 8.6.94 of Ministry of Environment and Forest.

Some of the issues which require the attention of the Committee include :

- (a) To undertake the survey of the Taj Trapezium environmental area and to make a report regarding the source of pollution in the Trapezium.
- (b) To identify the polluting industries in the Taj Trapezium.
- (c) To suggest long term and short-term measures to be adopted to control such pollution which is harmful for the Taj Mahal.

The Committee is finalising its report

COMMITTEE UNDER THE CHAIRMANSHIP OF COMMISSIONER AGRA.

The U.P. Govt vide order No. 970/18-13-51/Bha/94 dated 30.5.94 under the Chairmanship of Commissioner Agra formed a Committee.

The Committee's " Report is based on the views expressed by the committee members and various reports prepared earlier by different agencies on this subject particularly NEERI, university of Roorkee CPCB, PPDC, and others .

The industries in TTZ are located mainly in Agra or Firozabad cities. The meteorological conditions for 10 months in a year are such that smoke from Firozabad not likely travel towards Taj Mahal during 2 months of rainy season the wind is easterly but due to rains it is scrubbed and impact on Taj Mahal would be minimal. This report mainl

relates to industries in Agra & Firozabad

THE CONCLUSIONS SUMMARY & RECOMMENDATIONS OF THE COMMITTEE  
ARE AS BELOW :-

1. "The increase in pollution level at Taj from 1981 to 1993 is not prima facie due to industries because there has been a ban for any new or expansion of fossil fuel using industry in TTZ since 1981.

The impact predictions as generated by NEERI and after applying correction for fuel usage also confirm this view.

2. The impact of pollution from industries in TTZ except Mathura Refinery is minimal on Taj Mahal.

A scientific and detailed study by a very reputed institution should be carried out to find out the pollutant/pollutants from which Taj Mahal is really threatened.

A detailed emission inventory of all sources in TTZ and their impact on Taj Mahal should be established.

For any Air Environment Management Plan (AEMP) to be realistic above studies are crucial therefore U.P. Govt should commission such a study by University of Roorkee or I.I.T..

3. UPPCB need not follow CPCB blindly while fixing emission standards and should revise the permissible level of SPM in view of high background dust in this area as follows :-

Cupolas upto 5 Ton/hr capacity - 450 mg/NM3

Small Boilers - 1660 mg/NM3

The standard for down draft kiln (600 mg/NM3) should also be revised.

4. Most industries in TTZ have installed APCS and a majority is able to achieve standards.

The units which have not achieved the norms are all SSI units and do not have adequate technical and financial resources. UPPCB should give the technical assistance and a grant of 50% or soft loan at 6% interest be given to these units so that proper APCS are installed by these units.

SHIFTING OF units is not required as it will render all these units financially unviable. If closed it will render a very large number of people unemployed. This step is not desirable.

Impact of pollution from industries other than MR on Taj Mahal is insignificant as such threat if any to Taj will remain even after SHIFTING of industries.

5. The pollution from industry can be controlled by following steps :

- (a) Better design of equipment such as divided blast cupola.
- (b) Better process control such as metal fuel ratio use of soda ash etc.

(c) Installation of proper APCS.

(d) Use of better and cleaner fuels like natural and petroleum gas from Auraiya through pipeline.

6. There is need to constantly improve technology/systems for most efficient working of industry which results in reduction of pollution. PPDC at Agra and Glass Technology Institute at Firozabad should be upgraded to international level so that they prove equal to this challenge.

7. Use of Generators should be permitted in existing and new non polluting industrial units with immediate effect.

8. There has been a great set back to the development of industries in TTZ because of informal ban on any fossil fuel using industry right from 1974.

After imposition of formal ban from 1981 there has been very little growth of industries which has not kept pace with population increase. The industries in this area are lagging much behind industries in Faridabad, Delhi, Noida & Ghaziabad and the economy of whole area is stunted.

The existing industry is also unable to modernise in view of the uncertain situation, it is high time that the stranglehold on industry is removed and any industries other than "Major Pollution" industry be permitted with due APCS installed in TTZ so that people of TTZ also enjoy the benefits of economic prosperity and are not deprived of the opportunities

available elsewhere in the country .

9. The area of trapezium need be reduced in view of the evidence and scientific data available. If a large unit like MR can function at a distance of about 45 Kms from Taj Mahal, there is no logic in preventing even pollution free industries from setting up or expanding at a distance beyond 45 Kms from Taj Mahal.

10. Action Plan for control of pollution as given in S.N.O 12 Page-20 should be initiated at the earliest.

11. TTZ area has been in the past very rich in handicrafts but they have languished during recent times. Intensive handicraft development and training in stone inlay. Zari, durry and carpet weaving, ornate metal work, glass toys, luminaires and leather goods etc. should be taken up to provide large scale employment in absence of development of organised industries.

12. The recommendations of the Dr. Vardrajan Committee appointed by GOI is going to be very crucial not only for the existing industries but future growth of the industries in the entire TTZ as such it is important that :-

- (a) There should be a representative of U.P. Govt. on this Committee preferably Commissioner of Agra.
- (b) There should also be a representative of the industries from Agra.

If for some reason it is not possible to have representatives from U.P. then a panel of reputed scientists should present the case before "Vardrajan" Committee.

A list of scientists for the panel is given below :-

1. Dr. Jaweed Ashraf - J.N.U. - Delhi
2. Dr. D.N. Trikha - University of Roorkee
3. Dr. R.P. Mathur - University of Roorkee
4. Dr. M.K. Khare - I.I.T. - Delhi.
5. Dr. C. Venkovachari - I.I.T. - Kanpur.

The city of Agra in TTZ has the distinction of having 3 world heritage sites including Taj Mahal with two others likely to come on the list soon. However, it also has a population of about 15 lacs and was once the largest centre of small scale industry in U.P.

To conclude it is recommended that a holistic approach for the entire "Agra Mathura Heritage Area" should be taken so that Taj Mahal and other heritage sites are well preserved and economic growth/job opportunities which is possible only if industrialisation keeps pace with time and the people of this area are not left behind. That alone can prepare the basis for sustainable development and environmental protection in this region.

The Indo US work shop on Environmental Assessment (7th to 10th March, 1994) had fruitful discussions . The final report is awaited.

STUDY OF INDO US BLUE RIBBON PANEL OF THE AGRA HERITAGE PROJECT IN COLLABORATION WITH NATIONAL PARK SERVICE USA :-

This panel met under the Co-Chairmanship of Sri Abid Hussain of & Rajiv Foundation and Elizabeth B. Moynihan from January 8-13, 1995 and made the following principle recommendations :-

1. "Establish and promptly implement mechanisms for local participation in setting goals and carrying out Agra Heritage area plans.

2. Take immediate measures to prevent worsening conditions within the heritage region, including living conditions for the people as well as the state of the monuments. While priority must be given to the World Heritage Sites, other historic places within the region require early attention.
3. A number of agencies and institutions with multiple responsibilities and overlapping authority are concerned with the region. The Panel urges the establishment of an Agra Heritage Region coordinating authority with power to make final decisions and to monitor matters affecting the integrity of the heritage sites and their environments. As choice of people remains the critical variable, its members must be carefully chosen, it must have continuity and it must be presided over by a person of stature and vision.
4. Create an Agra Heritage Foundation with committees in several countries to raise funds from individuals and non-governmental entities in support of Agra Heritage improvements. Donations to the Foundation should be accorded tax-exempt status.
5. Give priority in government funding to addressing the water, transport, pollution and power problems of the city area as a prerequisite to creating an adequate environment for the heritage sites. This will require establishment of a comprehensive regional plan and a spatial development strategy which may include satellite towns and growth corridors.

6. Carefully complete archaeological exploration and documentation of the Mehtab Bagh site across the Yamuna from the Taj Mahal. If appropriate, create an historically accurate reconstruction on the site thus providing a moonlight park as the basis for development of cultural and artistic space within the planned Taj National Park. Establish guidelines for further development of the trans-Yamuna area.

7. Revive Taj Ganj and establish its central position within an extended and enhanced program of craft demonstrations and production. Link this resource with a varied and carefully considered program of public presentations about the historical heritage of Agra. These programs will be an important element in attracting more and longer-term visitors to Agra."

The panel also made useful observation regarding declaring Agra as a World City; Population growth and need for establishment of 'second Agra' which must be built within next three decades; water, pollutant; energy; transportation which are having a critical level at Agra; Re routing of trunk routes and expressed strong views against lighting the Taj in the night.

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### III SCIENTIFIC RESEARCHES ON TAJ

It will be pertinent to point out here again that Vardarajan Committee Report contains most valuable scientific Data particularly the reports of TECHNECO in three parts and the reports of the Indian Meterological Deptt. on the dispersal of pollutant. After that the following researches on Taj were carried out by different institutions :-

1. The Department of Environment and Forests supported two projects on Air Pollution on Taj carried out by Shri Ram Institute of Industrial Research on weathering of marble-attack of mineral acids on marble and damage by Sulphur dioxide on marble and the Birla Institute, Hyderabad for study of sulphur dioxide on marble.
2. Mortar and plaster of Taj was studied by M. Aslam of CBRRI Roorkee.
- 3.a) National Environmental Engineering Institute, Nagpur.  
b) Archaeological Survey of India.  
c) U.P. Pollution Control Board.  
For monitoring pollution levels.
- 4.a) Archaeological Survey of India.  
For Scientific Studies of Marble and red sand stone.
5. Archaeological Survey funded the following projects on Taj except I and IV from 1987 onwards. Some reports of the project, have been received by ASI and the work in some is still continuing. These projects are as below :-

I. NATIONAL PHYSICAL LABORATORY, NEW DELHI :

- (A) Non-destructive testing by ultrasonic technique to determine thickness of the veneer of Taj (Limited use).
- (B) Ultrasonic surface wave velocity and attenuation.
- (C) Sand scattering-echoes.

II. CENTRAL BUILDING RESEARCH INSTITUTE, ROORKEE :

Alluvial deposits with silt and kankar, bore hole study with dynamic and static cone penetration tests, use of piezometers for measuring variations in water head have been installed. Soil testing in respect of its density, natural moisture & grain size is also going on.

III. NATIONAL GEOPHYSICAL RESEARCH INSTITUTE, HYDERABAD :

- (A) Nature of the foundations and depth, surface seismics, surface and subsurface-electrical-resistivity and magnetic methods, these two methods are responding to some extent in finding out the walls and nubble.
- (B) To map the subsurface with Electro-magnetic reflection curves.
- (C) Bedrock seems located deep as per tests.

IV. SURVEY OF INDIA, DEHRA DUN :

- (A) Substance :- rise and fall of bench mark is of the order of 1 mm to 5 mm which is well with in the standard of error.
- (B) till 1 to 2 cm.

V. EARTHQUAKE RESEARCH INSTITUTE, ROORKEE :

- (A) Assessment of seismisity affecting the Taj.
- (B) Dynamic soil parameters.
- (C) Seismic analysis of Taj

VI. SERC, GHAZIABAD :

- (A) Accrute determination of the Geometry.
- (B) Remapping of cracks in various parts of the structure and their dating wherever possible from the available records.
- (C) Monitoring of cracks.
- (D) Determination of material properties.
- (E) Elastic and inelastic analysis of Superstructure.

Two dimentional elastic analysis of the main dome has been carried out. Three dimentional elastic analysis is in progress.

VII. NRLC, Lucknow. Studies conducted are as below :-

- (A) Discolouration of marble.
- (B) Breaking of marble slab edges.
- (C) Bulging of marble.
- (D) Pitting or erosion of marble.
- (E) Formation of Cracks in Marble Slab.

I. OTHER PROJECTS :

Agra Heritage Project Reports 1991 :-

- i) Studies related to building materials.
- ii) Studies related to Geotechnical Engineering.
- iii) Surface water studies.
- iv) Ground water studies including quality assessment.
- v) Studies related to air quality monitoring.
- vi) Studies related to solid waste management and general aesthetics.
- vii) Studies related to transportation engineering.

II. i) NEERI made an elaborate report entitled, Taj Pollution studies to redefine Taj Trapizium Co-ordinates in July, 1993.

ii) NEERI again submitted a report to the Supreme Court entitled. "Issues associated with fuel supply alternative for Industries in Agra Mathura Region."

iii) Agra Heritage Project, Indo us Workshop on Environmental Assessment March, 1994.

iv) "Air pollution by Industries in Taj Tripeziun Zone (TTZ). Status problems and solution". Report of the Committee under the chairmanship of Commissioner Agra Division was prepared.

v) A Seminar on National Conference on Environmental Pollution and preservation of Historical monument on Oct., 31st to Nov. 1st 1994, New Delhi

organised by the Indian Oil Corporation has some very valuable research papers pertaining to Taj which were contributed by eminent scientists. The latest position regarding Taj has been very well enumerated by the former and present scientist of ASI :

- i) B.B. Lal, Air Pollution at Taj (1994)
  - ii) B.B. Lal, Effect of pollution and other factor on monument (1994).
  - iii) B.N. Tandon, Air Pollution and Taj (1994)
  - iv) R.K. Sharma and H.O. Gupta, Aerometric Surveillance of Taj. (1994).
  - v) Indo-US Blue Ribbon Panel of the Agra Heritage Project has emphasised a 'holistic approach' for the conservation of Taj in early 1995.
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IV TOURISM AND TAJ:

1. At present about 7,500 visitors per day come to Taj and this number swells to about 10,000 on Friday (No Tickets) and same number of people to go to mortuary chamber everyday leaving stains on the marble and causing rise in humidity which is not good for the health of monument. The monument is open on all the seven days of the week.
2. To attract tourists, Agra Development Authority has mooted a proposal for illumination of Taj in the night so that more tourist come in night. In the interest of the monument, to this proposal ASI had reacted as below:-

The experts of the ASI on the basis of on the spot study of the effect of illumination on the Taj Mahal have made the following observations:-

1. " Since the luminaries are placed at the ground level

the effect of artificial illumination can not be compared with the full moon night's effect, both the sources being opposite to each other.

2. The conditions governing the illumination of a museum object may not be applied to the Taj Mahal as the meteorological parameters have no effect inside the museum.
3. The increase in surface temperature of the white marble of the Taj Mahal may be increased by 15 C even in case of the incandescent lamps placed at a distance of about 60 metre away. This increase may be still more when illuminated with metal halide lamps placed at a distance of about 30 metre only. This increase in surface temperature of the white marble though significantly small in comparision to the summer moon temperature requires to be examined from the temperature of the surroundings at night. During the day time, the effect of solar heating is uniform over a very large area whereas during the night when the temperature of the surroundings is significantly low. The relatively high temperature of the stone surface may induce local horizontal causing a sort of small eddy currents around the structure. In such a case, the suspended particulate matter carried by these small eddy currents will deposit on the stone surface. The deposition of such particulate matter which is polluted as well may in the long run cause yellowing of the surface and also other complex reactions.

The effect of heat generated by the luminaires in due time is also expected to cause desiccation of the grass and plants.

Keeping the above technical aspects in view the illumination of the Taj Mahal may not be a viable proposition. In this connection, it is also important to consider that the Taj Mahal has always remained without artificial light in the nights. Perhaps illuminating the Taj Mahal artificially will be a sort of intrusion in the natural environment setting."

The Blue Ribbon Panel also says, " This requires the clarity of vision and the courage to resist pressures towards synthetic re-creations and additions to the monuments which pander to transient popular tastes. An example is the current proposal to light the Taj Mahal at night. The reaction of the panel was unanimous ; not only would the character of the monument be altered; such an installation could severely damage the structure physically. The interests of the region, including the economic interests of the people will be best served through time by rigorous adherence to the highest standards in conservation.

Prof. Jaweed Ashraf has recently observed regarding flood lighting of Taj as below:-

" An off-shoot of light pollution or over illumination in and around the monument as well as on roads leading to Taj is the observation and general subjective feeling of Agra residents and visitors that night view of the Taj has qualitatively gone down. Taj in moonlight does not appear to be as ethereal and shining as it used to be. Even if it needs proving by experimental data, it is worth considering the point that this public opinion may be a consequence of overall increase in the amount of light in the night atmosphere round the monuments themselves due to reflection of large quantity of light that in its turn is substantially and positively affected by the increased SPM in the air in and around Agra in particular and TTZ in general.

It is simply amazing that every one so far has ignored the fact of significant increase in the amount of road and other lights in and around Taj while evaluating the impression of deterioration in visual quality of the monument. Because of this increased light, coupled with the background reflected light of near by sources, the quality of vision under moon light would naturally get seriously affected in the same manner as moon itself, when seen today in major cities the world over, appears more like an intruder than

part of that nature in which these cities exist. It may be pointed out that astronomical observatories like the one at Nainital are being seriously hampered by reflected atmospheric light. It is obvious that SPM too in this context would have an important role to play. These facts are known to all except, apparently, to the high ups in the Ministry of Tourism!

Light pollution in Agra is an aspect which has not attracted that serious attention which it deserves from the point of view of viewing Taj during full moon nights round the year. This aspect of pollution should be recognised and paid attention to. There is no other way of looking at public discontent as, on this count, the ordinary people would not analyse but go by their own comparison of the past and present or what is popularly called the sixth sense.

In other words, it is ideas of the Ministry of Tourism and ITDC that today emerge as not only serious violations of conservational norms but also serious potential danger to the normal prolongation of the existence of the monuments themselves with the ASI lying prostrate and acting as a serious collaborator and accomplice enhancing the dangers to the monuments that are under ASI custody.¶

VI. Translation of Badshahnama by Mullah Abdul Hamid.

The foundation of this peerless structure, which stands on the right bank of the Jumna, was commenced in the 5th year of the Emperor Shahjahan's accession to the throne. Stalwart labourers were employed to dig the earth who took the excavation right down to the sub-soil water level from where a rectangular mass of stone in lime masonry was raised and taken up to the surface of the ground. At this level a terrace 374 zira long. 141 zira wide and 16 zira high was constructed in brickwork in lime. A large numbers of craftsmen comprising stone cutters, carvers in relief and inlay workers, who excelled in their respective trades, were gathered from all corners of the empire and were set to work on the erection of the main building. The facade was built in red stone, embellished with a variety of inlay and decorative art, and the stone-work was so skillfully executed that the keenest eye failed to discover the joints even at a close examination. Pleasing patterns in red stone cut to geometrical shapes formed the material of the paving. In the centre, another terrace 120 zira square, 7 zira high was put up which was faced throughout with marble lining. On top of the second terrace was erected the mausoleum itself, a regular octagon of unequal sides, having a diameter of 70 ziras and a plinth one yard high. The dome, pure and sublime, sheltering the sarcophagus stands in the centre of the building and is built with marble stone both on its interior and exterior faces. It has a diameter of 22 zira and is conical in shape. From the springing to the crown, a point 32 yards higher than the floor, the dome is built entirely

in marble and is so exquisite in beauty and workmanship that it looks almost like a structure carved out of a single block of stone. The main dome comes over this interior dome. Its outline is similar to that of a guava and its gracefulness and stateliness compare to those of the heavens. The dome measures 110 yards along its circumference and is crowned with a golden finial which glitters brightly under the rays of the sun. The total height from ground level to the top of the pinnacle is 279.2 ft.

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APPENDIX 'B'

Translation from Mirat.

The mausoleum of Taj Ganj was constructed in the reign of Shah Jahan as is stated in the Shah Jahan Namah that the construction of this great mausoleum, which is situated on the southern bank of the river Jumna was started in his reign.

After the baildars had completed the excavation of the foundation and the masons had laid the stones to the level of the ground the plinth of the mausoleum was laid in stone in the shape of a platform three hundred seventy four zira long equal to 967 feet and one hundred and forty zira broad equal to 373 feet and sixteen ziras in height. A large number of stone masons skilled in cutting, shaping and sculpture were collected from all parts of the kingdom and anyone else who possessed accomplishments in this art was called to work on the mausoleum. Along with them were other craftsmen who shaped and moulded red stone in different ornamentations and workmanship in laying and raising the basement walls and the floor of the platforms. In the middle of this platform another plinth in white marble was laid with length and breadth of one hundred and twenty zira equal to 320 feet and with a height of seven zira equal to 19 feet and again in the central part of this platform another plinth laid seventy yards diameter in the shape of octagon on the Baghdad pattern. The height of the plinth is one yard. The dome of the tomb which is in the centre of the building is throughout made in marble stone both inside and outside. It is on an entirely new base and is a regular octagon of twenty two zira equal to 59 feet.

Over this octagon is placed the dome which has been raised to a height of thirty two zira equal to 85 feet from the floor of the building and has entirely been built in marble stone which have been cut, shaped and finished in the most exquisite form. Above this dome stands another dome of 'Amroodi' shape and on the top of this dome which has a circumference of one hundred and ten zira equal to 293 feet is placed a gilded pinnacle eleven years high. From the ground to the top of the pinnacle the height measures one hundred and seven zira equal to 285 feet. Inside the dome in the eight sides are made eight 'Nashemans' in double vertical rows each having a length and breadth of six yards. Round the outside four 'Nashemans' which measure four and a half yards are front niches which are sixteen yards long and nine yards deep with a height of twenty-five yards. In the corners of the square are four octagons of ten yards diameter and having eight 'Nashemans'. In the third storey is a room octagonal in shape and in three sides of this octagon three niches each having a length of seven yards have been made. Above the grave is a platform made of marble stone and on this the grave has been reproduced and round this has been made an octagon of most exquisite construction. The door of this has been made with Yeshp stone with most beautiful in laid work on which ten thousand rupees were spent. Inside this chandeliers of gold have been hung. On one side of this a doorway has been made and in every angle of the plinth which is made of marble stone and is three yards high is a staircase of marble stone.

APPENDIX 'C'

Translation of a letter from Aurangzeb to Shahjahan,  
Adab-i-Alamgiri page 29.

On Friday I made my pilgrimage to the illustrious sepulchre and gained the blessings of paying homage to that holy shrine. The buildings in the sacred enclosure stand exactly as they were completed in your Majesty's August presence, except for the dome of the holy tomb which leaked in two places towards the north during the rainy season, and so also the four semi-domed arches, many of the galleries on the second storey, the four smaller domes, the four northern compartments and the seven arched underground chambers which have developed cracks.

During the previous rainy season, the terrace covering the internal main dome also leaked in two or three places, but it has been repaired, although it remains to be seen how far the operations meet with success during the ensuing rainy season. The domes of the mosque and the Jamiat-Khana leaked during the rains and were put in order.

The master builders state that if the roof of the second storey is opened out and treated with concrete, over which half a yard of mortar grout is laid, it is probable that the semi-domed arches, the galleries and the smaller domes will be set right, but they confess their inability to prescribe any corrective measures in respect of the main Dome.

My reverend guide and benefactor, may you live long !  
This great edifice has curiously sustained some injuries, but

it is believed that if the pious disposition of the Emperor inclines to its repairs, the defects will forthwith be set right.

The Mehtab Garden was submerged under water and for that reason it was wanting in cleanliness, but it will soon gain its freshness again.

The octagonal tank and the buildings in its vicinity are nice and clean.

Whatever has been heard of the floods in the river Jumna is surprising. The river has now receded to the open ground and is flowing past it.

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APPENDIX 'D'

Extract from report of J.W. Alexander Esquire, Executive Engineer Agra Provincial Division, (Government of India P.W.D. 1874 Civil Works Buildings Progs. Oct. B. Nos. 7).

The Taj.

11. Four estimates for the restoration of the Taj were sanctioned in July 1873 to the aggregate amount of Rs. 70,926 of which Rs. 23,776 were allotted in 1873.4. The expenditure amounted to Rs. 21,320. I have taken in hand the restoration of the eastern facade first. The principal part of the work the removal of the broken marble, and substitution of new pieces in the vaulted opening is completed and the restoration of the inlaid work is in progress. It is a slow and laborious process and necessarily progress Pinnacle.

12. The upper pinnacle (30 feet high) that surmounts the dome has been taken down and the work of regilding it is nearly completed. I hope to have it up in position by the end of August. The estimate for this item, Rs. 3,600 will I regret to report, be exceeded by about Rs. 1,000/- which I hope to save on other items. The effect of the regilding will be such a very great enhancement of the beauty of the Taj that I trust the additional expenditure will not be grudged. It may be of interest here to state that on taking down the crescent that forms part of the pinnacle the following inscription was found cut into the copper :-

" Joseph Taylor, 1811 "

A few days after, I discovered in the Cantonment cemetery the grave of Lt. Col. Joseph Taylor under whose

direction the Taj and Sikandra were restored to beauty. One old man has been found down, and that Taylor re-erected it and also did some repairs to the building. I can discover nothing about repairs at Sikandra.

Dome.

13. The pointing of the great dome with Portland cement is also in progress.

Inlaid work.

14. The restoration of the inlaid work on the lower panels has been completed, at a cost of Rs. 1,634 (which is included in the general total of Rs. 21,320).

Gateway.

15. The re-erection of the pinnacles of the gateway, which were blown or fell down, has been completed with inlaid marble work, at a cost in 1873-74, of Rs. 1,567.

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Contd...  
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APPENDIX - E

THE EXPANDED ADVISORY COMMITTEE ON THE RESTORATION  
AND CONSERVATION OF THE TAJ MAHAL AT AGRA, 1943.

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The Government of India vide their letter No. F.5-1/48)/41-F & L., dated the 11th June, 1943, appointed an expanded Committee to review the report of the Advisory Committee and to report whether the measure recommended therein constituted a suitable basis for action in the light of the defects found in the structure of the Taj Mahal and whether any modifications or additional measures were necessary. The expanded Committee thus constituted met at Agra on the 16th and 17th August, 1943 and examined the structure thoroughly in the light of the report of the Advisory Committee appointed for the repairs and restoration of the Taj.

The following members attended the Committee :-

1. Sardar Bahadur Sir Teja Singh Malik, CIE, ISE
2. Khan Bahadur Mohd. Sulaiman, CIE, ISE
3. Nawab Zainyar Jung Bahadur, FIIA
4. Mr. H.A.N. Medd, BRIBA.
5. Mr. M.S. Vats, M.A.,
6. Mr. S.B. Tyabjee, ISE., MIE.
7. Mr. Syed Ali Raza. B.A., B.Sc., AMICE, MIE
8. Mr. T.R.S. Kynnersley, O.B MC. MICE., MIE
9. Mr. K.T. Divecha, BE, MIE., AIAA.
10. Rai A.C. Mitra Bahadur, B.A., B.E. MIE

Sl. No. 1 to 5 were members of the Taj Advisory Committee 1941 and Sl.No. 6 to 10 were added in 1943 to make it expanded Taj Advisory Committee.

APPENDIX - F

THE COMMITTEE TO EXAMINE THE TAJ BUILDING 1956

I. In view of the alarmistic reports that appeared in the press during the last few months about the condition of the Taj, the Director General, though personally satisfied about the sound condition of the monument, requested, in view of its international importance, Shri M.L. Nanda, Addl. Chief Engineer, and Shri T.B. Bhonsle, Superintending Engineer, C.P.W.D. to examine its condition, including those parts of it on which no recommendations had been made by the Expanded Advisory Committee on the Taj of 1943.

II. Accordingly, Shri Nanda, Shri Bhonsle and Shri Shanker Das, Archaeological Engineer, examined the monument on the 17th and 18th July, 1956; Shri A. Ghosh, Director General of Archaeology, joined them on the second date.

III. The Committee examined the recommendations of the Expanded Advisory Committee and the action taken thereon and made further recommendations where necessary.

ACKNOWLEDGEMENT

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THE AGRA HERITAGE PROJECT

JOINT BLUE RIBBON PANEL

"A Vision Uniting Heritage and People"

Notes and Observations Arising From Panel Deliberations

New Delhi and Agra

January 8 - 13, 1995

New Delhi, India  
January, 13, 1995  
(Final revisions  
1/28/95)

## "A Vision Uniting Heritage and People"

### Preface

It is the Panel's hope that by the year 2020 the City of Agra and its environs will be acclaimed for the unique cultural experience it provides visitors and the quality of life which it affords for all its residents. If this vision is to be fulfilled it is imperative that action be taken now. The need is urgent. If neglected any longer, the city will continue to deteriorate and the integrity of Agra's World Heritage Sites will vanish.

A first step to be taken is the designation now of Agra as a World Heritage City. Mathura, Bharatpur, Fatehpur Sikri and Vrindaban must be included within a larger heritage region in the future. The panel is aware that the term "Taj Trapezium" has been used to define this region but notes that the term lacks precision and may not be broadly understood. The Panel used the terms World Heritage Site, World Heritage City and the Agra Heritage Region during its discussions. Designation of Agra as a World Heritage City would attract widespread interest and support; intellectual and financial as well as technical.

The conservation and development task is enormous but achievable; saving the Yamuna River, providing essential infrastructure for the city, eliminating pollution, re-routing heavy traffic and creating an appropriate ambiance for the monuments in addition to the preservation of the monuments themselves. Massive resources will be required.

The citizens of Agra must be included in the process from the outset, for without their active participation at all stages, the conservation and future development of Agra as a Heritage City will fail. A special effort must be made to involve those with knowledge of the rich past of the city, especially in the areas of music, arts and crafts.

Public awakening through education will be necessary to convey to each new generation knowledge of the city's history, of the importance of its monuments and awareness of the economic and social benefits of maintaining their legacy as a World Heritage City. The cooperation of Agra's citizens is vital to the achievement of the goals sought by the Panel. Poor people cannot support splendor along the Yamuna unless they benefit and are invested with power.

## Pri cipal Recommendations

1. Establish and promptly implement mechanisms for local participation in setting goals and carrying out Agra Heritage area plans.

2. Take immediate measures to prevent worsening conditions within the heritage region, including living conditions for the people as well as the state of the monuments. While priority must be given to the World Heritage Sites, other historic places within the region require early attention.

3. A number of agencies and institutions with multiple responsibilities and overlapping authority are concerned with the region. The Panel urges the establishment of an Agra Heritage Region coordinating authority with power to make final decisions and to monitor matters affecting the integrity of the heritage sites and their environments. As choice of people remains the critical variable, its members must be carefully chosen, it must have continuity and it must be presided over by a person of stature and vision.

4. Create an Agra Heritage Foundation with committees in several countries to raise funds from individuals and non-governmental entities in support of Agra Heritage improvements. Donations to the Foundation should be accorded tax-exempt status.

5. Give priority in government funding to addressing the water, transport, pollution and power problems of the city area as a prerequisite to creating an adequate environment for the heritage sites. This will require establishment of a comprehensive regional plan and a spatial development strategy which may include satellite towns and growth corridors.

### Land documentation

6. Carefully complete archaeological exploration of the Mehtab Bagh site across the Yamuna from the Taj Mahal. If appropriate, create an historically accurate reconstruction on the site thus providing a moonlight park as the basis for development of cultural and artistic space within the planned Taj National Park. Establish guidelines for further development of the trans-Yamuna area.

7. Revive Taj Ganj and establish its central position within an extended and enhanced program of craft demonstrations and production. Link this resource with a varied and carefully considered program of public presentations about the historical heritage of Agra. These programs will be an important element in attracting more and longer-term visitors to Agra.

## Background

Within the four day period available the Panel has sought to assess the current status of the Agra region's World Heritage Sites, to learn of their condition and of plans for their further conservation and development. The Panel also met with senior officials responsible for the implementation of the next stages in the development of the Agra Heritage Region.

The Panel and the concerned Agra officials agreed that a holistic approach to the conservation of the Agra Heritage Region was required. This recognizes the unsurpassed international significance of the Taj Mahal and the priority of Agra as a Heritage City. By conceptualizing an overall regional vision, the Panel intends to give appropriate prominence to Mathura, Vrindaban and Bharatpur as well as Agra Fort, Sikandra, Fatehpur Sikri and the Taj Mahal.

With support of both Indian and U.S. professionals who have been associated with aspects of the work undertaken under the Agra Heritage Project since 1987, the Panel sought a broad understanding of the state of planning and of conservation activities related to the monuments and the development of infrastructure essential to the future of Agra. The Panel recognized from the outset that it would be unrealistic to suppose that a detailed vision could be formulated, justified and articulated during the short time available to the Panel.

Not only was time severely constrained but the Panel did not have documents which could provide an overall framework for assessing alternative growth and conservation strategies. This has handicapped its work. Unanticipated delays in publication have resulted in the Panel having to operate without access to the full range of the scientific and technical work undertaken since 1987 under the aegis of the U.S. National Park Service in cooperation with the Agra Development Authority, the Archeological Survey of India and the Ministry of Tourism. Despite presentations made and documents reviewed, the Panel was troubled by the absence of a coherent strategy linking various agency and institutional objectives into an over-arching vision of desired outcomes for the Agra Heritage Region. The Panel was informed that the Agra Development Authority has insufficient authority and resources to implement a comprehensive plan for the region. A single authority to plan, coordinate and implement is needed.

Thus, the Panel has not found it easy to relate its recommendation to a broad regional framework. We were unable to fully access and utilize the knowledge, experience and past planning which would have permitted us to assess the implications of alternative proposals for an updated Agra Development Plan. Without a clear spatial strategy and a careful articulation of the short, middle and long-term goals underlying such a plan it has not proven feasible to undertake an evaluation of the merits of individual proposals, albeit many suggested appear both sound and feasible.

These deficiencies were compensated for by the excellent presentations made by the Agra Commissioner and by the senior officers from relevant disciplines who met with the Panel. The Panel would like to record its appreciation to all who gave so unstintingly of their knowledge and their time. We also wish to incorporate by means of this reference the detailed and illuminating note prepared by the Commissioner as an Appendix to this report.

As an important first principle, the Panel was agreed from the outset that no vision for the future of Agra could be meaningful unless the people of Agra were actively involved at all stages. While the monuments are of global significance, their future will only be secure within a civic order which provides first for the well-being of the people of Agra and imbues them with an appropriate sense of pride in the heritage of the city.

Thus, the vision for Agra which the Panel believes will best serve the World Heritage Sites is one which is shared by the citizens of Agra. While officials have heavy responsibilities for shaping and implementing critical aspects of that vision, local leaders, non-governmental organizations, private sector entrepreneurs, educational and cultural institutions and those concerned with tourism and the arts must bear the major part of the burden if a vision for Agra in the year 2020 is to become reality.

In shaping that vision, the Panel urges that the historical and cultural integrity of the region be assigned the highest priority. Without the capacity to maintain and share an authentic experience which draws upon the richness of the region, the principal attraction which brings visitors to Agra will be eroded. This requires the clarity of vision and the courage to resist pressures towards synthetic re-creations and additions to the monuments which pander to transient popular tastes. An example is the current proposal to light the Taj Mahal at night. The reaction of the Panel was unanimous: not only would the character of the monument be altered; such an installation could severely damage the structure physically. The interests of the region, including the economic interests of the people, will be best served through time by rigorous adherence to the highest standards in conservation.

The Panel was reminded that the Governments of both India and the United States are signatories to the World Heritage Convention and that both take their obligations seriously, domestically and internationally. The future designation of Agra as a World Heritage City could be an appropriate move towards establishing and implementing a more holistic program of development for the region.

To enhance the visitor experience broader infrastructural needs must be addressed. Communications and transport must be made more reliable and convenient. Marketing techniques which convey the richness of the Agra experience beyond the three major monuments must be evolved.

Visitor centers and guides must be brought to a high standard and carefully supervised. Basic amenities such as rest rooms, safe water, catering services and protection from exploitation must be assured. Such organizational arrangements can only result from close, mutually beneficial, collaboration between the government authorities, the private sector, non-governmental organizations and the local community.

The Panel recognized the need to insure that responsible institutions have the authority to coordinate overall direction of regional, multi-faceted activities with a minimum of duplication or delay. While study of alternative approaches may be appropriate, the panel believes that, because of the multiple responsibilities and overlapping jurisdictions of concerned agencies, establishment of an Agra Heritage Region coordinating authority is warranted.

The Panel also urges creation of a non-governmental body such as an Agra Heritage Foundation, with private funding from Indians and from abroad. Contributions to such a Foundation should be tax exempt to the donor. Such a body with assured independence could play a constructive and reinforcing role while providing long-term continuity too often lacking where official policy dictates frequent transfers of key officials. Observations concerning such a foundation are appended.

Population growth constitutes a major factor in future planning. Sustained high rates of urban and regional population growth will likely lead to a further doubling of the region's population by 2020. Agra City, now estimated to have more than 1.3 million citizens must plan to provide for more than 3 million by 2020. Such rapid growth is a potentially destabilizing factor affecting the future development of Agra as a heritage city. Indeed, it demands that a "Second Agra" must be built within the next three decades. Until the basic needs of the people can be met, the capacity of the civil authorities to undertake other development and conservation work will be severely constrained.

The Agra Commissioner noted that the problems of the city are monumental. Water, pollution, energy, transportation are all critical. As long as the people do not feel that these issues are being successfully addressed, they are unlikely to be sympathetic to the commitment of finite resources for heritage conservation. Indeed, the closing of two thermal power plants to reduce pollution near the heritage sites created an understandable negative backlash among those whose economic well-being was adversely affected.

Water is inadequate both in quantity and quality. The River Yamuna, source of virtually all of Agra's supply, becomes a sewer south of New Delhi. Despite plans for improvement and agreements to cost sharing arrangements between the Center and the State, funds have not been forthcoming. Sewage, drainage, sanitation and waste disposal all constitute major demands requiring attention and resources. At present, the city does not have the machinery required to dispose of its solid waste.

The location of a crematorium upstream from the Taj Mahal was noted as was the construction by the Agra Development Authority of a new electric crematorium on the same site. Long-term planning may consider alternative locations.

Air pollution, despite the closure of two major coal-fired thermal generating plants, remains at unacceptable levels for both the monuments and the people. Although private generation of power with diesel, gasoline or kerosene generators is illegal within the city, the failure to bring on line any supplemental source of energy has made Agra a city of lawbreakers. Without private generators the city and its tourist trade would collapse virtually overnight. To survive and prosper, industry requires assured power. Tourism depends upon it. High level attention to development of a coordinated long-term program is required.

Less polluting alternative fuels are simply not available and, allegedly, will be too expensive to be economically competitive. Lead free petrol is mandated by 1997, but many small internal combustion engines in the city will, even then, operate on cheaper, more polluting fuels. A small number of electric buses is a start as is the proposal to create a walking mall one kilometer around the Taj Mahal. Much more will be required. European cities have successfully established the "Centrum" concept. The historic areas of Agra City could be embraced in such a Heritage Centrum.

Reduction of urban road congestion, emissions, noise levels and damaging vibrations was sanctioned in the 1972 Agra Development Plan to build a bye-pass ring road at some distance from the city center. Funding has not been provided. Now, through the initiative of the Commissioner, a start has been made on one critical section west of the city along a canal embankment. While this is a welcome first step, it is under-funded as there is no provision for the four railway overpasses required and not a substitute for major program to implement an updated regional transportation plan. Such a plan may include development of the growth axis from Agra through Mathura to New Delhi where very rapid industrial expansion has already taken place. High speed light electric rail systems may also be explored as an alternative to combustion driven transport.

Agra's rapid growth within the region has been a function of its importance as a transportation center. National highways from Calcutta in the east, Nagpur to the south and Bombay in the southwest converge here before flowing northwards along the Yamuna to Delhi and beyond. The principal alignment of the proposed Asian Highway (A-1) is directly through Agra. This might well be rerouted to proceed northeast from Firozabad to the east of the Yamuna River and west of Aligarh, bye-passing Agra City and entering Delhi by means of a new bridge south of Okla. Railways from north, south, east and west also meet at Agra. To meet the needs of the next century more than a ring road will be required. Relocation of both road and rail lines, especially those which bisect the old city should be carefully considered.

For the major part of its foreign tourist traffic, Agra continues to be dependent upon airport and hotel facilities in New Delhi. Despite excellent rail service, the result is that substantial revenue which might benefit Agra is captured by Delhi. A case for a major new, non-military, international airport should surely become part of a longer-term vision for Agra. Indeed, an alternative airport of international standards in Agra could enhance the safety of New Delhi as an international destination in foggy and inclement weather.

A commercial conference center is currently under construction in Agra. There may be room for additional facilities, possibly located in the trans-Yamuna area behind the Taj National Park, where the needs for both conference and cultural groups could be met. A concept akin to the successful India International Center, possibly combined with an arts center similar to the Triveni Kala Sangham might be a worthy long-term goal. Such facilities, needed for Agra's growing populace, would also enhance it as a longer-term tourist destination.

While the Panel recognizes the magnitude of the challenge faced by Agra, it believes that it will be possible to meet that challenge if the people of the city can be mobilized to take an active role in the transformation which is essential. Once Government of India, working in unity with the state and local community, is clear its concerning goals, resources will follow.

The Panel believes that it would be timely for the Agra Development Authority to re-visit all past plans, including the Agra Development Plan of 1972 as revised, taking a twenty-five year perspective through to the year 2020. A bold and imaginative vision can only be achieved if it is stimulated by bold and imaginative thinking now. The re-routing of major trunk roads and the gradual closure of the railway line from Yamuna Station through the Agra Fort station to Agra Cantonment would make possible the re-establishment of the unity which existed before 1857 between the Agra Fort and the Jama Masjid courtyard which was then destroyed. The preservation of the railway right of way as a heritage walking mall could enhance the visitor experience. The southern railway bridge could then be converted to provide access for visitors to the Taj National Park and the proposed moonlight garden. The integrity of Agra Fort would be enhanced if alternative locations were found for current occupants. The possibility of establishing a performing arts center within the Fort should then be considered.

The Panel believes that the economic advancement of the people of Agra must be central to future development. Education and training provide means to that end. Consideration should be given to development of opportunities for enhancing the artisan, restoration and the professional skills of Agra's citizens so that they may fully participate in the flow of benefits which development of Agra as a World Heritage City can provide.

The most exciting development during the Panel's field trips was a visit to the site of Shah Jahan's Mehtab Bagh (moonlight garden) on the north bank of the Yamuna, opposite the Taj Mahal and within the projected confines of the Taj National Park. The location and dimensions of the Mehtab Bagh were confirmed by a partial clearing of the site by the Archaeological Survey of India in February 1994. Because it reveals that Shah Jahan had a much more extensive plan for the Taj Mahal complex than has been known previously, the site is historically and architecturally important. One element cleared so far is a foliated, octagonal pool in diameter on a riverfront terrace equal in width to the Taj enclosure.

The Panel believes this site is of the highest significance and that the ASI should be fully supported in its excavation and documentation which are necessary before there can be any discussion of its preservation, restoration or development. The Panel believes the verification of the Mehtab Bagh site will heighten interest and help in the creation of international Committees in support of the Agra Heritage Foundation.

#### Conclusion

It is for the Taj Mahal primarily - and only later the other historic buildings - that the majority of non-business visitors come to Agra. Exploration, conservation and reconstruction of the newly excavated Mehtab Bagh as a moonlight garden across the Yamuna from the Taj Mahal would greatly increase this interest and provide reason for more overnight visits and the generation of increased income - important goals of the Agra Heritage Project. It would also require appropriate regulations for future development of the Taj National Park and the trans-Yamuna area.

Many additional and very important but rarely visited buildings exist in the Agra region as well. If the physical upkeep of these monuments could be assured and access to them enhanced, Agra would make better use of its extraordinary and unique resources while providing further reasons for longer visits.

By such means as the development of hotels for a range of income levels and havelis in the older part of the city, clearly defined walking routes, accurate information provided through specific guidebooks and other means, visitors to Agra can better utilize the extraordinary opportunities that already exist within the city. The development of artificial re-creations of the historical past should be avoided or, at a minimum, carefully controlled, considering the wealth of original resources available. There is no need to create a synthetic experience when an authentic one is at hand. Agra's designation as a World Heritage City can only be justified if its unique heritage is preserved.

The agreement between the Government of India and the United States National Park Service which made possible the technical studies and assessments undertaken since 1987 is now coming to an end. The Panel suggests the Government of India create a time-limited Working Group, Panel or Task Force to develop detailed proposals based upon previous studies by, say, December 31, 1995. The time constraints imposed upon the Panel have made it impossible to undertake the detailed assessment which the urgency of the situation of Agra as a Heritage City warrants. Without thoughtful and timely follow-up the work of the Panel will not count for much. There is, however an opportunity to do constructive work and much depends upon that follow-up.

The Panel members wish to express their appreciation to the Ministry of Tourism and to the agencies and officers of the Government of India, of the State of Uttar Pradesh and of the City of Agra for their unfailing courtesy and timely support throughout our deliberations. The Panel will await with great interest the response of the Ministry to its recommendations. We express the collective hope that our efforts may contribute to the well-being of the people of Agra and to the preservation and conservation of the city's monuments and the unique heritage of the region.

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ECOLOGICAL SITUATION AND CONSERVATION  
OF MONUMENTS  
IN  
AGRA AND THE TAJ TRAPIZIUM ZONE

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24th of April, 1995.

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## SUMMARY

1. Data so far available is not comprehensive; it lacks civic and societal sources of pollution. It is suggested that a comprehensive Bench Mark Survey be conducted that should include not only Industry but also agriculture as well as urban and rural civic situation into account.

2. As air pollutants in Agra have increased even after the imposition of ban on industry and its expansion, and inspite of the instalation of special devices to control pollution, ~~now~~, there is no reason why the ban on the functioning of industry and on its expansion and diversification be continued.

3. It is, however to be most heavily emphasised that the freedom to function be granted to industry under most stringent and strict pollution control norms. These norms should be better than any country of the world and should specifically and explicitly take local ecological, climatic and those ground realities into account that have not been focus of attention in the west.

4. Ministry of Tourism and ITDC, through flood lighting and over illumination in and around Taj and other monuments are creating a situation that not only destroys beauty of Taj in moonlight but is most likely to cause insect damage to the monuments. It is in total violation of all conservationist norms of the ASI. ASI norms of conservation should be immediately restored and be made more stringent so that no such situation is ever created anywhere under pressures from various lobbies pursuing their own goal of profits. This new situation created under pressure from Ministry of Tourism and ITDC be discontinued forthwith.

5. In order to control gaseous pollution in Agra, development of a closed underground system and sewage treatment is a must as it releases into the air molecules that are measured as pollutants by various instruments. Hence, it is imperative that a covered system of city sewage collection and processing be developed immediately.

6. Multiplicity of authority, absence of land use survey and violation of Agra Master Plan are major hinderences for greening the city. This situation be reversed. Taj Nagri Avas Yojna next to Taj compound wall, planned in total violation of Agra Master Plan and unauthorised settlement opposite Taj across the river be removed immediately.

7. To check sand damage the area opposite taj be given for vegetable cultivation as was the practice earlier. This whole area be developed as a large public orchard.

8. Regular supply of electricity be guaranteed to Agra to dessuade citizens from using other sources that pollute.

9. Agra by-pass be immediately constructed.

10. Ring railway in Agra be constructed. For this purpose laid down and electrified track is already in place.

11. Agra be supplied gas by pipeline and a distribution system for the same be developed immediately.

12. Road transport for tourists be on the basis of electric transport, viz. trolleybuses and electric vans.

## ECOLOGICAL SITUATION AND CONSERVATION OF MONUMENTS IN TTZ

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### INTRODUCTION

Present problems of Taj Trapezium Zone(TTZ) in general and of Agra in particular, are relatively speaking, recent. This ecological decay is primarily due to neglect of the area round monuments at various places, if not of the whole region of TTZ, by all concerned with prime place in this context occupied by a combination of politicians of all shades and colours and neo-rich real estate cum hotel businessmen. Administration, both of the city and of the UP state, for a long time in the past, has been simply playing second fiddle to the tune set by the above combination. During very recent times, while local administration is awakening to the situation, it is a section of High ups in UP administration and officials of the Ministry of Tourism who are teaming up with real estate and hotel industry profiteers to convert TTZ into an area where concern of local people is sacrificed for hard currency tourism; even Indian tourists are brushed aside in this context. Naturally, in this situation the Archaeological Survey Of India (ASI) is forced into compromising with standards and norms through Tourism ministry diktats and manipulations as well as through high level fiats. Appointment of IAS officer as chief of ASI has made the organisation completely non-professional and submissive to steps that are being forced by Ministry of Tourism all around the Agra monuments that are harmful from the point of view of conservation in the long run.

A number of committees have gone into the issues involved; with the exception of Dr.Karan Singh Committee, none has so far recommended de-industrialisation of Agra. It is this very demand of de-industrialisation of TTZ and especially of Agra, that is the real bone of contention today.

While sources of pollution in the TTZ are many and varied, and we would not repeat the points that have been covered by earlier committees between 1974 and 1993 as those sources, identified so far, are valid and be taken care of. However, we feel that three very important sources of pollution have not been given their due attention so far.

Most significant of these that have been neglected so far, is the sea change in the pattern of agricultural crop cultivation and agro-technological practices in the TTZ itself. Other major polluting sources not paid enough attention are Light factor, especially flood lighting that is forced through by the Ministry of Tourism, and open sewage sources within the cities of Agra, Mathura, Firozabad and Deeg (Bharatpur). Both these sources, as we will see, are important elements contributing to pollution in the whole region. This includes SPM and gases released in the air.

#### CONSEQUENCES OF AGRO-TECHNOLOGICAL CHANGES IN THE REGION

While earlier, even as late as the 1960s, tilling of the fields was overwhelmingly done by animal power, this has now almost completely been replaced by tractors. This itself has already led to a number of interesting irreversible socio-cultural and ecological changes that till now have been ignored by all. Major consequences of this shift from animals to tractors in the region are:

Firstly, a shift from natural / partly planted vegetation in the fields to large scale removal of all type of such greenary from the area under cultivation. Earlier these plants provided shade for chaining and resting of animals and relaxation for working men during the day. Tractors do not need any such vegetation. Moreover, thanks to admirable BDO efforts, the peasants today realise that shade hinders crop growth. Greenary, other than crops sown has no use in the fields under the new ethico-cultural dispensation focussing on maximisation of cash profits. Removal of vegetation and cutting down of trees is primarily due to this conciousness and implied profits through timber sale.

Secondly, the new attitude is already resuling in large scale utilisation of chemical fertilizers in the fields to maximise yeild even if it has not reached the record levels of some other parts of the country. This also means, as shown by European experience, that the soil fed on high doses of chemical fertilizers begins to demand more of it with passage of time. In other words, the damage has a dimention that accelerates with time. Hence the input of various chemicals and water has been on the rise and shall continue to show this tendency in future. It is obvious that the decomposition products of these chemicals will ultimately go into the air.

It may be noted that in terms of chemical parameters these decomposition products from agriculture have predominantly the same components that so far have been measured and attributed to non-agricultural sources. The point has convincingly been brought out by the UP Government Committee Report of 1994, presided over by the Commissioner Agra Division. It is shown in this Report (p.10) that inspite of closure of two thermal power units and diesalisation of railway yard,  $\text{SO}_2$  levels have gone up in Agra. No report so far has explained this anomoly. In other words, there may be sources of pollution other than those yet identified.

It should also be realised that agro-technological changes not only manifest themselves in consumption of fuel but also in maintainance and repair infrastructure that in its turn may be adding to certain types of polluting elements all around.

As no specific study has been done to identify this aspect of various chemicals in the air of TTZ, it is imparative to do so even now. It should be realised that agriculture being spread over wide area all around the cities of the TTZ, no conclusion can be drawn for these cities on the basis of partial studies and a priori assumptions that are heavily loaded against industry and soaked in politics of

shifting Mathura Refinary to regions politcally more advanyageous for some.

Third serious consequence of this shift from cattle to tractors in agricultural practices can be seen in changing cropping pattern wherein under the new trend the middle crop between those of Rabi and Kharif, called Zaid or extra, sown around first rains and harvested latest by the end of the rainy season, has almost disappeared. This crop supplied green fodder or Chari for the cattle. In other words, the fields now remain predominantly fallow for substantial duration of time i.e. from March-April till the begining of the next sowing. This lying fallow without green cover results in the growth of weeds. Decomposition of these chemical inputs through out the year releases their products in the air. Unknown, unestimated but obviously substantial volume of decomposition products of fertilizers, pesticides, herbicides etc. are all the time being added to the air through out the year. Their role in polution of air and water as well as in increase in the SPM due to fallow land for about 4 months, has not been estimated for the TTZ.

Without any green cover around, the fallow lands during summer add to SPM in the air. Obviously, the amount of such suspension would be directly proportional to removal of greenary in the fields which in turn shall be a function of tractorisation in the given area in the TTZ. It will be more in developed Agra-Mathura-Firuzabad sector and less in Bharatpur. Even within the developed sector it will vary from place to place depending upon factors other than industry and MR. Attribution of every thing to industry in such circumstances is not justified. It is also not justified to blame Mathura Refinary (MR) for all polution while other reasonable plausable sources for similar molecules are readyly available everywhere in the TTZ. <sup>6</sup>X

Our understanding of prevailing ground reality in the TTZ can explain otherwise unexplainable observation that in the Agra region Shamsabad has a maximum of SPM of 739 with an avarage of 385 as compared to Agra Ind.-II of 632 and 519 respectively. It is the same story in case of Mathura where Baldev has a maximum of 643 SPM and an avarage of 493 as compared with Mathura Ind. of 429 and 199 respectively. It is repeat performance in case of Rupwas with 1039 and 625 compared with Bharatpur Ind. of 337 and 225 respectively. (Table 3.9, p.III-24 of NEERI Report of 1993 titled Air Pollution Studies To Redefine Taj Trapezium Coordinates). NEERI report simply sidesteps the explanation issue on all such counts.

On the basis of the above we may conclude that increase in SPM in the TTZ is, in fact, predominantly not a funcction of various industries. It obviously is the result of drastically changed agro-technological practices in the TTZ as a whole; a fact that has not only not been taken into account in various documents concerning TTZ but has not been studied at all. If it is true for SPM, it could also be the same for the unstudied factors like decomposition products of various origins like chemical fertilizers etc. in the fields.

<sup>6</sup>X Please see Times of India, 24.4.95, p-3 for pesticide residues within Delhi UT limits.

This is an illustration to underline the correctness of the argument forwarded by us. It is not a detailed analysis of any of the reports so far submitted.

#### GASEOUS POLLUTION IN AGRA AND ROLE OF INDUSTRY

As pointed out above, not only SPM but gases in the atmosphere could also be a consequence of changed agricultural practices. This contention seems to explain abnormal rise in SO<sub>2</sub> in such places as Govardhan, Baldev and Freh in Mathura sector (NEERI,p-III-40) where industry is conspicuous by its absence on any substantial scale.

It is the same with CO, HC, NO<sub>x</sub> and SO<sub>2</sub> as given for such places in Agra region as Khairagarh, Achhnera, and Fatehpur Sikri; for SO<sub>2</sub>, NO<sub>x</sub>, and HC in Rupwas and Bayana; for SPM in Vrindavan, Mat and Nandgaon in Mathura; for SO<sub>2</sub> in Vrindavan, Raya and Sadabad; NO<sub>x</sub> in Mat, Nandgaon and Vrindavan; HC in Mat, Vrindavan and Sadabad; CO in Vrindavan, Mat, Sadabad, Govardhan and Raya (ibid.-table 4.12,p.-37).

This again is an illustration and not detailed analysis of the data presented by NEERI.

Our understanding is supported by Table 4.2 (ibid. p.IV-5) indicating that there has been only 5% increase in Ferrous casting; reduction of about 48% in Ferro alloys; marginal increase in chemical and engineering industries; no change in refractory bricks; marginal increase in lime processing; 85% rise in rubber processing in Agra between 1981 and 1993. In other words the data presented in NEERI report exposes the fact that the measured parameters are being substantially influenced by sources other than those pointed out and so far studied. However, the report does not dwell on this point.

From the data available, it is obvious that role of industry per se in pollution of the TTZ cities has been rather limited.

In absence of any hard evidence, and in the light of the possibilities inherent in the presently fast developing agricultural situation, identification of MR as the source at best is a surmise and belongs to the category of an a priori conclusion not based on data and hard facts.

As has been pointed out elsewhere (annex.A), foundries at Agra, including those casting heavy artillary under the Mughals, are as old as establishment of the Mughal empire itself, i.e. to the first quarter of 16th century. These are mentioned by Babur in his Tuzak. Some of the processes employed in handling various metals during the reign of Akbar are described in Ain-i-Akbari of Abul Fazl. Other facts of casting canons and manufacture of iron, copper, brass, and other products are also mentioned in historical records. It is the same story with various aspects of textile and silk manufacturing, indigo production, tanning of leather etc. that predominantly used water from wells and the river and discharged their waste in the river or in the soil itself as there was no other way out. What may have happened during the recent past is a shift from natural to synthetic chemicals

that are not bio-degradable. Similarly, brick making and other such technological practices are also as old as the city itself as these catered for people residing in the city in the same manner as today. We have no observation from any quarter, Indian or European, that these aspects of medieval or early modern Agra urbanisation, or that of any other urban centre in TTZ, spoiled nature during the past since 16th to 19th century or posed any discomfort for urban population.

Pollution of Agra is not mentioned as an important fact even under the British who had their contentment by the city itself. How come the problem has assumed such serious dimensions predominantly within last three decades? Reason for pollution does not lie with either primitive technology or various sectors of present day industry. It obviously is due to socio-cultural and agro-technological changes that have taken place recently and has emerged in its present serious dimensions only after attainment of independence and implementation of certain laws like Consolidation of landholdings, and commercialisation of agriculture with complete tax holiday till date. It has its roots also in politicisation of every aspect of life and profit orientation of all aspects of society as reflected in total neglect of civic facilities in the city of Agra during last four decades.

#### SEWAGE PROCESSING IN THE CITIES OF TTZ

Agra was described as rivaling medieval Damascus and Baghdad in the Orient and London or Paris in the Occident. Obviously it was a neat and clean city without any foul smells emitting from sewage inspite of the fact that we have so far got no evidence of any underground sewage collection and disposition system. However, today it is a very different story. While it would be irrelevant here to point to a number of other facets of this problem in both Agra and Mathura, it is pertinent to note that decomposing sewage in its wet form produces gases with molecules very closely similar to those of bio-gas. This is the conclusion one can draw from the recent explosions in Delhi sewage system. This point is extremely relevant for our discussion because the TTZ monitoring parameters identify substances that are common to both bio-gas and certain emissions from MR and a section of industry located in the TTZ. In absence of any survey for this concrete identification we have no way to apportion blame for such emissions either to MR or industry located in TTZ. Consequently, our conclusions till date are at best conjectures and subjective assumptions that are not based on hard facts. Any one having any experience of such localities in Agra as New Shahganj, Madia Katra, Raja Ki Mandi, Loha Mandi and a number of other old residential localities, and in Mathura of such localities as Bharatpur Darwaza, Deeg Darwaza, Holi Darwaza, ISBT, etc. or of Bus terminus, CFC Community Centre and all the highly romanticised narrow lanes of the holy Vrindavan, would vouch for the stink that comes out of the open gutters and flowing sewage during most part

of the year. What we smell are the same air born molecules that are recorded by automatic monitors and largely attributed to MR as there is no industry worth the name in these parts of Mathura or Vrindavan. Present situation is the cumulative consequence of neglect of sanitation by those in power in the Agra and Mathura District and city civic structures over last about 3 to 4 decades. Inspite of all the talk about dry waste that is dumped at various places, this aspect of wet waste or sewage has not been properly studied and analysed. Without this study it is futile to argue about concrete sources that pollute the air in TTZ. Bharatpur is not different from the above two cities.

#### SHOULD INDUSTRY BE PERMITTED IN THE TTZ?

A ban on expansion of industries using fossil fuel in Agra was clamped by the government in 1981. It is yet continuing. These industries are not allowed to expand. During this time, while this industrial activity was put in limbo, two thermal power plants were completely closed and the whole railway yard was desalised. These steps drastically reduced the amount of  $\text{SO}_2$  in the ambient air of Agra. The contribution of hard coke and steam coal, according to DIC data, came down from 23 microgram/ $\text{NH}_3$  in 1981 to 5.6 microgram/ $\text{NH}_3$ , even in 1982. However, it is amazing that from 1982 till date there has been a continuous rise in  $\text{SO}_2$  in the ambient air over Taj. This  $\text{SO}_2$  reached its peak in 1991. From official data it is clear that there has been a decrease of about 25% in the consumption of coal/ coke by the industries. However, during this very period  $\text{SO}_2$  content of the ambient air went up by 4-6 times.

It is obvious from the government data itself that industry in Agra has not been primarily responsible for  $\text{SO}_2$  pollution in the ambient air over Taj at least after 1981. If anything, contribution of industry has been marginal while non-industrial sources obviously are the major contributors today in the inventory of pollutants of the air.

There is ground to suspect that NEERI report calculations for  $\text{SO}_2$  emission by industrial units consuming fossil fuel are grossly exaggerated, subjective, argumentative and based on lopsided and biased assumptions.

As underlined through citations above, there is no solid ground or reason based on facts that industry in the TTZ is a major contributor to various elements of pollution for which different parameters have been measured. There also seems to be no ground backed by hard facts for continuing the total ban on industrial development in the TTZ. Besides, as most of the presently functioning industrial units have installed the recommended instruments for pollution control as per the directive of the Supreme Court of India and specifications of the Central / UP Pollution Control Boards, and, as these units have been complying with the standards of emission as laid down by various bodies, the reason for any restriction under present circumstances, seems to have been eliminated. Hence there is no reason de etre for the imposed

ban to continue any further. However, it should not only be made explicit but emphasised that this functioning of the industrial units and their further expansion or diversification should be under strict monitoring and within stringent pollution control limits suitably imposed through proper legislation and control.

It should not be lost sight of that industrial development in the whole TTZ, and especially in Agra, has been a historical process that has been such an integrated element in the demographic and cultural fabric of the urban centres that its cesarian removal would create a serious crisis in the whole society with potential of ugly and violent manifestations that may destroy and nullify all the advantages that this attitude of de-industrialisation implies.

It should be noted that no Committee should be seen as a direct or indirect helper to various industrial groups widespread over India. If such units are permitted in Goa inspite of Rashol rare collection of 15th-16th century monuments and original paintings that are being conserved with the help of UNESCO again as part of the Heritage programme, or in Delhi with a number of Heritage monuments, and with Poona belt bleeching polluting smoke all around with complete immunity, undue restrictions on Agra would certainly amount to indirectly helping some industrialists at the cost of the others. Hence, while there should be most stringent measures of pollution control, the industry in Agra must, at the same time, helped in various ways to cope up with the <sup>the</sup> costs involved and not only to survive but to expand without endangering the monuments. The restrictions on functioning and the ban on expansion is *prima faci* not required.

While manefucturing industry is one aspect of this type of activity, the other facet of industry can be seen in cottage or small scale industry that is as old in Agra as the city itself. This sector had sustained life in Agra in the centuries past and is doing the same today.

The Basti of Tajganj, located opposite Taj and connected with it through maintanence and repair work since Taj was built, as mentioned earlier, was of those artisans who built the Taj and were repairing it when the need arose. Today many of their decendents living there have related professions like marble inlay, stoneware, wood and other production, carpet making as well as some catering for food of the tourists and other residents of the area. It is only in carpet making that wool dying uses coal as energy source which causes some pollution. However, this pollution is nothing in comparison with diesal of transport of various types that plays without restrictions. If these artisans are provided with reliable gas or electricity, present problem of pollution from their side shall disappear in no time.

The only way to get rid of pollution in Agra, as pointed out in the Report of the Committee presided over by the Commissioner of Agra (p.20-23) requires some steps that are highly desirable. However, it may be noted, that the government of UP is so non-serious about these measures that they have not taken any steps, even formal and routine ones,

so far to even simply begin the process in this direction. UP government should be forced to initiate steps in the direction of implementation of the recommendations that are in its range and start the process of consulting central government in this direction where the items require central intervention. There can be no other conclusion from the facts available on record that the governments at Lucknow and New Delhi are paying only lip service to the various recommendations and only Ministry of Tourism is active in taking harmful steps. This attitude has to be reversed.

The governments, as a matter of their official policy as seen in practice, are pushing de-industrialisation of TTZ without any basis for this step and in violation of all reports, policy resolutions and public posture, again on record in respective Legislative Assembly and Parliament.

#### FLOOD LIGHTING, LIGHT POLLUTION AND MINISTRY OF TOURISM

We have discussed this problem in detail elsewhere (Annex.B). The story of Konarak is likely to be repeated in Agra if the insistance of Ministry of Tourism is permitted to be implemented and Taj and other monuments in TTZ are allowed to be flood lit through out the year.

It is a tragedy that Ministry of Tourism, with lots of Indian money and hard currenency at their disposal, is trying to introduce into India ideas and practices of Europe and USA but without any consideration for concrete climatic conditions of the given region. This climatic difference has to be taken into serious consideration in the over all picture of controling potential damage to monuments.

#### FLOOD LIGHTING, LIGHT POLLUTION AND NIGHT VIEW OF TAJ

An off-shoot of light pollution or over illumination in and around the monument as well as on roads leading to Taj is the observation and general subjective feeling of Agra residents and visitors that night view of the Taj has qualitatively gone down. Taj in moonlight does not appear to be as ethereal and shining as it used to be. Even if it needs proving by experimental data, it is worth considering the point that this public opinion may be a consequence of overall increase in the amount of light in the night atmospher round the monuments themselves due to reflection of large quantity of light that in its turn is substantially and posetively affected by the increased SPM in the air in and around Agra in particular and TTZ in general.

It is simply amizing that every one so far has ignored the fact of significant increase in the amount of road and other lights in and around Taj while evaluating the impression of deterioration in visual quality of the monument. Because of this increased light, coupled with the background reflected light of near by sources, the quality of vision under moon light would naturally get seriously affected in the same manner as moon itself, when seen today in major cities the world over, appears more like an intruder than

part of that nature in which these cities exist. It may be pointed out that astronomical observatories like the one at Nainital are being seriously hampered by reflected atmospheric light. It is obvious that SPM too in this context would have an important role to play. These facts are known to all except, apparently, to the high ups in the Ministry of Tourism!

Light pollution in Agra is an aspect which has not attracted that serious attention which it deserves from the point of view of viewing Taj during full moon nights round the year. This aspect of pollution should be recognised and paid attention to. There is no other way of looking at public discontent as, on this count, the ordinary people would not analyse but go by their own comparison of the past and present or what is popularly called the sixth sense.

In other words, it is ideas of the Ministry of Tourism and ITDC that today emerge as not only serious violations of conservational norms but also serious potential danger to the normal prolongation of the existence of the monuments themselves with the ASI lying prostrate and acting as a serious collaborator and accomplice enhancing the dangers to the monuments that are under ASI custody.

#### ENHANCED DAMAGE POTENTIAL DUE TO MINISTRY OF TOURISM

We have pointed to the damage flood lighting is likely to cause to Taj under climatic conditions of Agra. This apprehension is based on experience of Konarak. In this context one would like to point out the steps already implemented round Taj under pressure from Ministry of Tourism and the consequences implied in such steps.

One can only surmise on the basis of tradition as to what the passage to Taj up to the main gate was during the Mughals. One knows from records that during the British it was Kachcha road with Bajri cover that was sprinkled with water from time to time to keep it cool during the summers and to keep dust from rising during other seasons. Today, thanks to the efforts of the Ministry of Tourism, the road has been covered with red sandstone. One may note that even under the Mughals the space opposite Taj was occupied by artisans and traders. These craftsmen were settled there as the site was a traditional Manzil and their profession was a component of all such establishments (Annex.A). Moreover, as the contemporary accounts show, these were the craftsmen who had built the Taj and their services were required for its maintenance and upkeep. This settlement then, as now, was no source of danger to Taj as their technology and trade practices posed no threats to Taj complex. This aspect of danger to Taj from practices and way of working of these people today needs investigation to ascertain technological inventory and its effect on surroundings as of date.

Under the British the road remained Kachcha. Was it because of the fiscal and monetary constraints of the Crown? It seems the reason for continuation of this norm was conservationist as it was easy to keep such road cool by

sprinkling water through a Mashak that was normal for those times. Today this can be done by machanical means. Kachcha road approach was meant to avoid micro- level heat generation through absorption and its re-emission by stone. It was meant to keep the surroundings of the monument cool. What Ministry of Tourism has done is to reverse the trend even in violation of NEERI Reoport understanding on this point.

Under pressure from the Ministry of Tourism the entire road aproaching Taj has been paved with red sandstone. Normaly, motorised vehecles are not allowed on this stretch though, when protocol requires, this can be done. The point is not that. Red sanstone paved passage absorbs heat all the time during the light hours and emits it back during night. In other words, this change under pressure from the Ministry of Tourism has increased the ambient temperature in the immediate vicinity of the Taj inspite of the fact that all the reports submitted so far underline that such increase in temperature is harmful for the monument conservation. No body but the Ministry of Tourism is responsible for this decision.

It is simply amaizing that highly vocal press, otherwise pointing to all real or even imaginary dangers to the monument, including Taj being shifted to NOIDA, and analysing all the reports so far submitted, has remained totally silent about all the doings of the Ministry of Tourism! One is simply wonderstruck by this fact.

#### VISUAL OBSERVATION OF TAJ AND OTHER MONUMENTS TODAY

Much is talked about yellowing of Taj and other decadance in the visual aspects of the monument. Besides many others, there are two problems involved. Technical aspects can be ascertained from experts of the ASI.

Firstly, these days it is a norm with the ASI that they do not want to have the building look like original after renovation and repair. They want it to look old! This point can easly be evaluated after looking at Iris pannels at the enterance to the cenotoph sector. On one one side there is a restored piece and there is another that is repaired. While the restored one is impossible to seperate from the original, in the repaired one the distinction is recognisable. This comparison shows the capabilities of the team of restorers and specialists in the ASI. The visible distinction on the other hand is a matter of policy decision on part of the ASI. It is also the trend and the in-thing in professional circles the world over. The same can be seen in Qutab Minar at Delhi, Sun Temple and other monuments at Konarak, Aitamad-ud-Daula and Sikandara at Agra and a host of other monuments both ancient and medieval; both Hindu and Muslim. Hencce it would be a foly to consider the old-look of the monument as a manifestation of neglect on part of the ASI.

In so far as the Taj is concerned it is a fact that there is no sign of decay or neglect of the monument as a whole and its stones in particular. Only the sand stone part of the balcony on the river side is sand-damaged, in all probability only recently. There are some minor aspects that

need periodic attention and repairs and that has been provided to them for last more than a hundred years. Otherwise the monument would not have survived so far. Repairs were required since the times of Shahjahan when first repairs were necessitated as a consequence of quality of stone and some other construction defects. Nothing extraordinary has happened since last three decades in so far as maintainance and repair of the Taj is concerned. Taj has certainly not been neglected by the ASI so far. Now it is being seriously compromised under pressure from Ministry of Tourism and local politician-hotel lobby.

In this context it may be recalled that the marble slabs used for surface dressing are quite thick almost everywhere. These are not going to be influenced substantially by the surface environmental changes. Hence, primarily, the underlying bricks and mortar is safe and sound though its life span may not be exactly the same as mentioned in the NEERI report because they seem to be assuming the building in its totality to be made of the marble slabs and that too of ordinary thickness that is now a days used in building construction. This assumption is *in toto* based on ignorance of the fact that under the marble there is brick and mortar that constitutes the realy damageable part of the monument if water leaks to these depths. It is this danger of increase in capillary action of cracks in mortar developing due to large fluctuations in ambient temperature of the surroundings that is further enhanced by the recent steps of the Ministry of tourism due to large ~~area~~ stone surfacing of the pathways outside Taj and by flood lighting the whole monument as this may lead to insect damage to mortar at the joints, leading to passage for water to enter and spoil the underlying bricks.

It is the red sandstone surfacing in the Taj complex, and the surface mortar layers on the boundary wall, that are vulnarable to climatic as well as biotic damage and degradation. However, significance of this aspect is marginal in comparison with the main building and its important structural components.

Hence, one can conclude that climatic and other damage to Taj compex as a whole in fact has been only superficial and marginal, not deserving so much noise.

In places like Sikandara and Aitmad-ud-Daula there is serious problem with fungus and leachen colonies on red sandstone slabs. Other damage is due to human factors; It is not climatic or due to pollution.

Taj, as well as other Heritage monuments, have retained their architectural and visual impact since at least the times these were taken over by the British, i.e. since the establishment of the ASI.

We should remember that all these monuments before their take over by the ASI, especially during the last phase of the Mughal empire, were very seriously and repeatedly vandalised, looted and burnt. Hence, their takeover by the ASI *ab initio* was in a damaged, depleted and neglected state.

It is worth recalling that Taj in fact had been sold to American businessman from California. It was only at the

shipment permission stage that Lord Curzon, the then Viceroy, came to know of it. It was he, not any Indian of any religion, cast, region or conviction, who saved the Taj for India and took real care for its conservation. This is why the schandalier presented by him to Taj today occupies pride of place in the canotaph of Shahjahan and is mentioned to all by the attendents. So much for Heritage conciouness!

The demands for saving of Taj on the one hand and demolition of monument in Ayodhya without any protest from heritage lovers on the other are the epitaphs of our heritage consciousness. If any thing, recent demolition in Pune of the historic late medieval Chabutra of Ghasiram Kotwal, about 300 years old, and not a single whimper on this count by any body of any politics or cultural pride, once again underlines that tall talks about monument conservation simply do not fit with the ethos of people seeped in the traditions of practicing and believing in the concepts of Kama, Artha and Moksha. This in fact is what we as a people are. This point is also underlined by the fact that the people of Agra, so much agitated about Taj and pollution, have done precious little to overcome filth, an important source of air pollution, for last four decades inspite of elections and change of parties holding majority in civic bodies of the city and in the government at Lucknow.

#### **ASI AND BLATANT VIOLATIONS OF ALL CONSERVATION NORMS**

In this contex the sublimely subservient and dosile posture of the ASI at various levels of their organisation needs special attention. It is worst at the top.

No^where in the world, i.e. in the west from where we took the rudiments of the concept of monument conservation and paying attention to heritage, and grafted it on our own cultural ethos where such concepts have been traditionally conspecuous by their entire and absolute absence, the norms of monument conservation and their up keep are compromised under any circumstances. Nowhere like in London, Rome, Paris, Madrid, Lisbon, Amsterdam, Berlin or even Moscow, St. Petersberg and other old cities of financialy starved CIS countries, these norms and practices have ever been changed for attracting tourists. Their visiting hours, ticket costs, residential limit laws, norms for commercial activity etc. that emerged historiacaly have not been modified either for VVIPs or foreign tourists in general or to help in making money by the commercial interests. This is not the case at Agra where such norms are thrown to winds as a matter of norm and where harassment to tourists by touts is common.

In relation to the question of Agra the ASI simply lies prostrate before the Misistry of Tourism and ITDC and permits them to do with its legitimate custody all that they desire. They do not even whimper in the manner of a mongrel that is badly treated. As a matter of daily observation ASI abets violations by vested interests from the city; from UP; or from Centre. Their attitude is this respect is most glaringly seen in the case of demolition of Babri Masjid, a protected

monument belonging to 16th century.

In the hue and cry about the structure being mosque or mandir, it was never underlined that it was a protected monument. After its demolition, the ASI did not even symbolically registered any case under relevant Act(s) and legislations against any body. They simply did not register their case! It is the same story with flood-lighting of various monuments at Delhi, Agra, Konarak, Goa, etc. where serious breaches of conservationist norms are lumped up as a matter of routine.

#### CLIMATIC SITUATION IN TTZ : ARID / SEMI-ARID OR SUBTROPICAL?

It is not justified to attribute increased SPM to arid climate, as NEERI report does, and, on this basis, tries to explain the high SPM observed through out the TTZ. It is just not a fact for Agra-Mathura region situated on river banks of Jamuna and even otherwise part of the rich Doaba part of the Ganga-Jamuna river systems.

It may be noted that since the inception of the city there have been repeated reports of high temperatures at Agra; never of aridity. Pathan historical records, personal or official account from Babur to Aurangzeb and even later; reports of a number of European travellers and contemporary Indo-Persian accounts etc. are all available on this count. Historical records do not support this contention of NEERI report. It is just not based on historical facts.

Pleasant evenings and hot days during summers with frost damage to trees and day-time low temperatures during winters have been, and yet are, characteristic of both TTZ and near by areas including Delhi and its surrounding regions in Haryana, Rajasthan and Punjab. While the situation in cities has changed due to high density of buildings and asphalted roads, both emitting absorbed heat to influence micro-level situations, such change so far has never been taken as a basis for designating Delhi and other regions in the said states in arid / semi-arid zone. This confusion regarding climatic conditions of TTZ seems to be based on serious misconception concerning the content of the terms 'semi-arid' and 'sub-tropical'. Even this dryness of the TTZ is not at all late medieval or early modern i.e. from the British times. This is a pretty recent phenomenon and the reason for this change seems to be a drastic reduction of vegetation cover and over drawing of sub-soil water in the whole TTZ. This reduction in plant cover is primarily due to cutting down of orchards in the TTZ, selling the wood and then selling the land to builders and developers to convert agricultural land into urban settlements at a profit for self but at the cost of nature and now of heritage. In other words, this change in the microclimate of the TTZ is due to drastically changed land use pattern in the TTZ. It is primarily due to removal of vegetation cover from the land and, especially in case of Agra, due to destruction of the Agra Canal as a result of water feud between UP and Haryana government as this canal used to irrigate large areas of Agra.

## GARDENS AND ORCHARDS ROUND AGRA DURING MUGHAL TIMES

We may point out that the urban centres viz. Agra, Mathura, Bharatpur and Firuzabad, earlier had large number of orchards all around their respective settlements on the pattern that was common to all cities, viz. Delhi under Firuz Tughlag had 16000 orchards all round the city parameters. Such orchards were age old tradition in India since ancient times as recorded by Chanakya (Annex.C) and continued in this spirit till the end of the Mughal empire. Extent of such orchards may be imagined from the fact that it was in such an orchard, now housing the Lucknow Botanical Garden, that the entire British army encamped during the seige of Lucknow in 1857. It is the same story for Delhi when British army attacked the city from Kashmiri Gate side. Their stay was also in a garden on the outside of Delhi. As a matter of fact cutting down of orchards was most harsh long term punishment to the opponent and many an orchard was destroyed during the various wars including those of 1857 because of this reason.

Once such orchards all round the urban centres in TTZ were gone, especially during recent times for cash money to be invested in other areas, it is obvious that microclimatic situation shall change for the worse, increasing the SPM, temperature and dryness of the soil all around.

It is quite possible that this insistence on change in classification of Agra and Mathura in particular, and of TTZ in general, as semi-arid is also being done with an eye on additional subsidies as per certain governmental norms. Interested elements of these cities have been mentioning this point to various committees and forums to create public opinion on this count even when records till 1950s and 1960s do not support this assertion. This is being done with profit motive as the exclusive driving force behind such demands. Interestingly, those demanding change in Agra region classification do not cite either contemporary facts or historical records as evidence. They want various forums and committees to do their job by accepting this surmise and recommending such change. NEERI report supporting this contention is again not based on facts.

While we have scanty records of Agra before the arrival of the Mughals, abundant Mughal records since early 16th century affirm establishment of large number of gardens/ orchards all round Agra by various kings, their courtiers and nobles as well as by Jagirdars belonging to different religions. Besides these gardens / orchards, each Manzil, or resting place for caravans and individuals that was located at every 12 kos distance on all roads of the land (Annex.A) had large amount of vegetation in and around itself. It was such a Manzil owned by Sawai Raja Man Singh that was bought by Shahjahan and paid for by four other such Manzils. Taj of today is located on this land. Obviously the land, and its surroundings were orchards full of fruit bearing and medicinal trees, some of which, presumably, remained standing even after the monument was constructed. Not cutting mature trees was a tradition at least since the time of Firuz Tughlag as

recorded by contemporary documentation. This point is brought out by the lay out plan of the walled area of the monument now located in the site museum of Taj itself. Interestingly, conceptually the plan of the garden at Taj is fully in agreement with the conclusions drawn by Chanakya (Annex.C). It may be noted that during 1957 the British used much of the wood from this garden and that surrounding Taj that they burnt in the compound itself, causing extensive damage to the monument, presumably, as punishment to rebels.

As pointed out by a number of scholars (Annex.A) trees selected for planting in and around Taj were such that these, in one way or the other, absorbed the harmful effects of various pollutants that are present now and, presumably, were present even during the period of Taj construction as Agra was not only capital city but also an industrial and technological centre of the empire producing gases during manufacturing that are an integral part of the metallurgical processes themselves per se.

It is this role of plants that was, it seems, well understood during the medieval times and is being slowly relearnt today even if with fits and starts.

These trees played a role in conservation of monuments through their micro-level influence. It is this fact that we today have to re-learn and understand.

#### VEGETATION IN TTZ AND ROUND TAJ AS ELEMENT FOR THE PROTECTION AND CONSERVATION OF THE MONUMENTS

Sojan Rai Bhandari, a chronicler of late 17th- early 18th century, mentions Agra as a city where " Jamuna river traverses the city for 4 kroh. There are on both sides high buildings and attractive gardens..." (1918, Ed.Zafar Hasan, Khulasat-at-Tawarikh, Delhi, p.39). This observation can be taken back from 18th century to early 16th century on the basis of available records especially accounts of the times of Babur, Akbar and Jahangir.

It is well known that Babur built his famous Char Bagh at a site right opposite to where Taj stands today and in his memoires mentioned that the side of Jamuna opposite to the Fort was so densely covered with trees that one can see only green that looked like a jungle. Garapes and other fruits, brought from Afghanistan, Iran and Central Asia, were cultivated in this garden. Obviously it was not a small affair though Babur does not mention the area of orchards planted on the other side of the Jamuna during his times. These continued during the reign of Akbar and were further expanded at other places during the reign of Jahangir.

Besides the gardens built by Babur, there were large Havelis of the nobles inside as well as outside the city through out the period Agra remained as a capital, i.e. till the times of Shahjahan. These Havelis had their own large gardens densely planted with fruit trees and medicinal herbs. European traders during the reign of Jahangir to Aurangzeb described Agra as a garden city and the road from Agra to Lahore, passing through Fatehpur Sikri, Deeg and Bharatpur,

as a "garden walk" due to dense plantation of trees all round. Accounts of Thevenot and Carreri are examples in mind.

Tiger hunts of Jahangir and Akbar round Agra, Mathura and upto Delhi (area known as Salimgadh near Red Fort) are well recorded. Elephant hunts in the forest of Bayana, near Agra in the TTZ, are recorded in detail by Abul Fazl in *Ain-i Akbari* itself. We have discussed details elsewhere (Annex.D). Fatehpur Sikri lake, lake near Bharatpur, Jamuna full of water except for the lean summer season etc. are some of the facts of the past that played important role in keeping the whole region green and pleasant. Large forest cover that substantially lasted till early 19th century, and vegetation that was yet substantial even during the first half of the present century, was responsible for amelioration of high temperatures in the whole region now covered by TTZ. It may be of interest to mention that detailed account of migratory birds from across the Himalayas is available right from the days of Qutabuddin Aibak and the foundation of the Sultanat of Delhi. The crisis in the Bird Sanctuary at Bharatpur is exclusively recent and the causes for the same are neither historical, traditional or "natural".

In other words, not only Agra, Mathura and Firuzabad as urban centres but the whole region of present day TTZ was densely covered by vegetation and jungles (Annex.D) that were large enough for hunting parties, including those for elephants and tigers, as well as for waylaying of caravans of nobles and their murders without anybody ever being caught, like that of the teacher of Akbar, Bairam Khan. This vegetation seriously influenced microclimate over large areas. This factor has been totally eliminated from the region today. Influence of such factors has so far not been studied by anybody in the context of the present situation inspite of the fact that modeling methods and computer facilities, both hardware and software, are available to us in this respect.

#### MICROCLIMATIC SITUATION ROUND TAJ DURING MEDIEVAL TIMES

As the land purchased for construction of Taj was a *Manzil*, it, *ipso facto* had large volume of greenery. There was an orchard between Taj and the Fort. On the other hand there were orchards till beyond where the river takes a bend on the right side of the Taj. In front of the Taj, across the river, the whole area was covered by imperial gardens and those of the Mansabdars of high rank. In a word, the site where Taj stands today was surrounded by lush green all around with the river flowing for about 4 miles amidst this greenery. Detailed descriptions are available in such contemporary sources as *Shahjahan Nama* and *Amal-i-Saleh*, besides others composed exclusively about details of Taj construction itself (for Persian extracts and English summary of the above two sources see M.A.Ansari, 1989, *Geographical Glimpses of Medieval India*, Ed.Jaweed Ashraf & Tasneem Ahmed, New Delhi). Hence, we may conclude that while the region itself was densely covered with trees, the micro-level environment all around the Taj was well protected from heat

and dust. In a word, conservational elements for Taj and other such buildings were put by the architect in the buildings as well as in the immediate surroundings itself. Inside the Taj parameter, the front was again covered with dense fruit trees and large bushes providing not only shade but also aroma and colour of various flowers and fruits. Only the immediate space adjacent to walks had flower beds. Area with only grass growing was totally absent from Taj compound. It is only as old as the British cultural influence and their conservationist/restorational norms.

We may remember that for the medieval times aesthetics and medicinal factors played much more significant role than they play today and medieval consciousness of nature was much stronger than ours. Details of the vegetation within Taj parameters one can see in the lay-out plan that is now located in the site museum at Taj itself. As internal humidity is a function of internal and external ambient temperatures, these trees in and outside of Taj walls not only positively influenced humidity outside but also did so inside the Taj and adjoining buildings.

NEERI report correctly points out that rise as well as large fluctuations in ambient temperature harms the building. Plants, in this context, act as buffers to virtually keep the ambient temperature stable. However, NEERI report does not bring this point out or even hint at its significance.

#### SOCIO-CULTURAL ASPECT OF TAJ DURING THE MEDIEVAL TIMES

Taj is not just a mausoleum or burial place of the king and his queen. It has other significance too.

Survey of India documents, now located in the National Archives of India, explicitly mention the role Taj played in identification of the three points to construct the basic triangle for the great triangulation survey of the whole British Empire in the subcontinent. The other being Jama Masjid at Delhi and Jama Masjid at Aligarh.

It was also a source not only for providing job to large scale highly skilled, skilled and unskilled population. As can be seen from primary as well as secondary sources, these medieval monuments were experiments in engineering, building design, mathematical innovations, metallurgical developments, astronomical observations etc. These monuments played a very important role in the development of various aspects of science and technology during medieval times. Ups and downs in intellectual attainments and standards of any given phase of medieval India can today be judged by the quality of monuments the given period has left.

What we know as Taj Mahal, was predominantly known to medieval society as Rauza Tajganj, implying socio-religious sacredness for the people. There is also mention of regular Urs or religious celebrations on a particular date that continued for some time. This practice seems to have been discontinued after Taj was taken over by ASI. ASI rules do not permit active religious performances in protected monuments. All compromises in this respect are very recent.

River bank opposite Fort and Taj was centre place for celebration of rains with Mela and various competitions like those of kite flying, bird and other animal fights, swimming etc. that have been described in detail by such sources as Nazir Akbarabadi.

The complex was open to public for offering of prayers to the soul of the king and queen as well as for recreation. Only on particular days or periods, when family members of the descendants of Shahjahan and Mumtazmahal were to visit the place, it was exclusively for the royalty.

The fruit from the attached gardens was regularly sold in the market and the income was used for the upkeep of the buildings, attached land and its gardens and for paying to the attendants looking after the monument in various capacities.

Taj seems to have gradually acquired an important and central place in the cultural life of the people of medieval Agra and retained this status even after the shifting of the capital to Delhi. The maidan or open space between the Taj gardens and the ramparts of the Fort played an important role in this context as Mela was regularly held there.

#### HUMAN AND ANIMAL DEMOGRAPHIC ASPECTS OF MEDIEVAL AGRA

It should be noted that medieval Agra according to some estimates and assessments, had a settled population of about six lakh; with another estimated one lakh being the floating population of the city, not counting those who used to come daily for work in the city but used to live outside the city in the adjoining villages; and not counting the army encamped outside the city limits in the adjacent gardens and those coming to the city for periodic inspections and verification of Dagh done every day according to a rooster. During the assembly of troops in preparation of various military campaigns, and these were not at all infrequent, the number of persons staying in the city and encamping, along with their transport men and animals and other paraphernalia, in the gardens and orchards adjacent to the city, would double, in all probability, for periods of upto six months. Agra as a capital was the most populous city of the medieval world and in glamour nothing in Europe was comparable to it. It was only after the capital was shifted to Shahjahanabad / Delhi that the population began to dwindle and by the end of the British empire reached the lowest level of about three lakhs within the then urban limits. Today it is about 12 lakh.

This dense population in medieval Agra was the consequence of military strategic location and trade-commerce significance of the city as it was located on the intersection of a number of roads coming from Delhi-Lahore-Lakhnauti and beyond on the one hand and Surat on the other to get linked with the roads going to Ajmer, Burhanpur and Bhopal and then going south. It was this recognition of strategic and commercial significance of Agra that got reflected in the very early establishment of railway line and loco-shed at Agra which dates back to 1884, with

connections going to Bhopal and Bombay on the one hand and Simla and Calcutta on the other. Establishment of a Cantonment, and later an air base, of the British army also points in this direction (National Archives of India, Catalogue of the historical maps of the Survey of India:1700-1900, New Delhi, 1975, Ed.S.N.Prasad).

Estimation of animal population, in the best of circumstances, can only be rough. Some data is given in *Ain-i-Akbari* by Abul Fazl for the Mansabdars of various ranks and for the Imperial household. According to this data elephants, horses, camels, cows, antelopes, leopards, dogs, hunting birds and other birds such as messenger pigeons, hunting and singing birds were the main items in the Imperial household. Large number of these animals, in all probability, were quartered outside the city limits primarily for grazing and other requirements. Never theless comments of some European sources that in Agra leopards roam the streets as cats in London is indicative of the number of these animals located in the city itself. However, at a conservative estimate the animal population with the Imperial household alone would be about 2000 not counting birds. If we assume that at one time only 25% of the Mansabdars of various ranks were in the city and only 10% of their entitlement was with them, an additional figure of about 40,000 animals not counting milch animals, dogs and birds get added up to the above estimate. In other words, the city accommodated about 60,000 heads of major animals, and more, belonging only to those who have been mentioned in the *Ain*, not counting transit animal population comming for inspection or for loading/unloading of goods in the market of the city. One can get an idea of this animal born trade related animal population from the statement of Sir Thomas Roe that while on way from Surat to Agra, he had to stop for 16 hours on the road in order to let a caravan pass that was comming from Agra and going to Surat. There were 16,000 bulls in this caravan, besides horses for accompanying security staff, milch animals and goats etc. for eating on the way, with each of the bulls carrying a load of 10 man and going at a speed of about 60 Km/h. His comment mentions that speed of these bullas was not inferior to that of best horses, and was certainly better than horses in the UK. With milch and other animals of the traders, artisans, personal servants, attendants in Sarais, messangers etc. the animal population inside the city limits would turn out to be more than 200,000 heads, not counting animals brought in for food. Obviously, the city provided living space to these animals and fodder and water for them even if temporarily for a section of it. Their comming in and going out of the city would naturally had to be regulated so as not to cause problems for the population. It was refuse from this population that in all probability provided compost for the gardens outside and gardens and other vegetation inside the city limits that a number of sources mention. Gardening aspects have been discussed by a number of contemporary sources both in Hindi, Sanskrit and in Persian. It is obvious that medieval Agra was manually kept clean and cool.

In this context of conservation of monuments in general and of Taj in particular, one should remember another point that is often ignored in all such discussions:

A culture built a mausoleum.

Another culture with high sense of conservation of heritage, i.e. the British, converted it into a monument with all the consequences it implies.

The Present one, having steeped in tradition of Kama and Artha, is making the monument into a tourist attraction to earn money, especially foreign exchange. In fact the tradition in India has been to destroy monuments of other cults/sects and religions to glorify ones own; to destroy buildings of other kings to glorify oneself. Conservation is transplantation of concept in a strata that numerically and educationally is confined to a very very insignificant strata.

This transplantation of ideas and practices also means a drastic change in the categorisation and, consequently, in the number of visitors and resultant heat and humidity generation inside the monument and other consequences outside the parameters.

With removal of vegetation all around and a number of other similarly negative changes, this increase in numbers of visitors and duration of their stay inside Taj itself is a serious factor for harmful consequences to the monument as Taj was not built for this usage in mind. This factor has hardly been paid any attention to so far.

In this sense micro level ecological and socio-cultural changes that are taking place today have to be seriously looked into from the point of view of their impact on conservation of monuments in Agra as well as in TTZ.

#### NEED FOR REVIEWING CONSERVATION NORMS AND PRACTICES

ASI has its norms for conservation and routine up keep of monuments. They also have their conceptual outlooks in this regard. However, it should be realised that the norms and practices, introduced by the British at the fag end of the last century with their own cultural and conservationist traditions and ecological experience of UK and aesthetic norms in the background, need serious revision at least in the light of the generalisations of the past more than hundred year experience under climatic and cultural conditions of India and especially under absolutely changed ethico-cultural conditions of the society, including large scale removal of vegetation cover, for and through which this conservation of monuments is to be done under contemporary conditions. Technical competency and skill caliber of the specialists in the ASI is beyond doubt; they are second to none in the whole world. However, it seems time has come to streamline and update the attitudinal norms under which the ASI functions and link it more deeply with climatic conditions of India itself. I am afraid in the particular context of Taj, Sikandara, Aitmad-ud-Daula in Agra, and many other medieval buildings at various places, conservation is more and more demanding identification and restoration of

those conservationist elements, like trees and other similar vegetation very different from grass-covered lawns of the British, that were present in the immediate and general surroundings of the monuments themselves. Vegetation round Taj, and the deeply felt need for its urgent restoration underlines this argument. This restoration implies restoration of the tree component within the boundary also. It is felt that the ASI should not confuse building restoration with restoration of the biotic surroundings and, in this regard, continue treating British eco-cultural practices as the last word and only tradition. They have the professional capability to give lead in this new concept of biological protection/ conservation of monuments. They have to, today, sacrifice on photogenic requirements of tourists to help prolonging the life of the monuments themselves. The people of India, who have been vocal in their demand for conservation, should not be seen as opposing such changes in the surroundings. As pointed out earlier, all over the world conservational requirements take precedence over any other consideration. Let this be norm in India too.

ASI today leaves much to be desired in the way it has reacted to various pulls and pressures from various lobbies of vested interests and from various sections of different ministries and individuals especially under the new pattern of leadership that is now existing. It is not for nothing that the image of the ASI is far from shining in the eyes of the general public as well as among the related professionals.

#### ROLE OF CITY ADMINISTRATION

Some times one is wonderstruck about the amount of hypocrisy prevailing about conservation of Taj and prevention of those elements in the surroundings that cause pollution.

The UP government, and government at the Centre take extremely tardy steps in implementing the detailed and voluminous recommendations of various committees, dozens of whom have gone into this problem and submitted their considered reports that are hardly ever been made public.

The people of Agra through their elected representatives at various politico-administrative levels beginning with city and upto Parliament, simply make periodic noises but do not take any serious step to get rid of the abundant squalor and filth that is characteristic of Agra as an urban centre and one of the serious cause of air pollution in the whole region. This is also true for the residents of such holy places as Mathura and Vridavan where filth and consequent pollution of the air is so abundant as to be the main characteristic of the localities.

City administration of Agra is an example par excellance of either incompetency or hypocrisy about Taj conservation. Otherwise one can not explain how it has been possible to permit or tolerate new and recent settlement not only on the otherside of the river but right next to Taj boundary wall. I am referring to officially sanctioned settlement in total violation of all Agra Urban Development

documents and Master Plan, known as TAJ NAGRI AWAS YOJNA that is being planned and developed for a couple of kilometers along the river bank on the Taj side.

To me it is obvious that the YOJANA is meant to serve the interests of the big real estate, hotel and tourism business as well as political sharks of all shades and colour and the excuse of pollution from MR and industry is a smoke screen to get as much land and developed real estate forecably vacated for these elements to control and profit from. This, at any cost, must stop if Taj is to be saved and conserved. City administration of the past and the UP government are directly responsible for all such happenings all round the monuments in Agra.

In the light of the past performance of the city administration as well as of the government of UP the noise about pollution seems to attract more and more funds. Major part of this amount obviously is not going to be properly spent for purposes it should be spent on.

#### SPECIFIC LEGISLATIVE MEASURES AND THEIR COORDINATION IN TTZ

As pointed out above, there is mutiplicity of civic responsibilities in the TTZ with hardly any machanism for serious answerability; two states and a number of city administrations are involved in taking and implementing various measures having a bearing on pollution control and monument conservation. Besides, a number of autonomous bodies and ministries get directly or indirectly concerned with various steps having a bearing on conservation related problems. In other words, prevailing situation, taken together with the damaging steps already taken under the diktats of Ministry of Tourism with full support, total conivence and submission of all levels of authrities concerned, warrants the conclusion that there is no seriousness about either pollution control or conservation of heritage monuments among all sections concerned. All the hue and cry by interested parties seems to be for either ulterior ends of de-industrialisation or for more and more funds pumped into Agra in the name of Heritage for them to have their respective lion's share. Those realy serious about the issues involved are few and their voice means nothing to the powers that be. As huge money, both Indian and, as potential, foreign, is involved, the ground realities manifested in concrete situation of Agra under present socio-cultural, political and ethical dispensation can not be otherwise. This complex situation is made further complicated by property rights and consequent legal wrangles. In this serious situation and context there is dire need for:

(a) specific conservation related legislation applicable to the whole TTZ to be taken up through identical texts by the two state legislative assemblies viz. of UP and Rajasthan as well as of the Centre where such is needed.

(b) Ad interim intervention by the Supreme Court now ceased with the issue of Taj conservation to (i) stop Taj Nagri Awas Yojna forthwith, and (ii) to take such steps that

during the intervening period between legislation and structuration for monument conservation in TTZ, interested parties may not take undue advantage to present a *fait accomplis* situation.

(c) Checking violation of Agra Master Plan violations;

(d) Ban on construction activity and check on building design within a specified limit round all monuments declared to be in the National or International Heritage list.

(e) Creation of an appex body with legal rights, duties and answerability procedures, to coordinate all activity and to monitor with annual submission of report to government, agencies and to the Supreme Court concerning implementation of various decisions and recommendations concerning pollution control and monument conservation in the TTZ as a whole. This body should have representation of public and professionals having expertise in advising and checking on the implementation of various reports and recommendations.

This appex body should be an Autonomoud body having legal status, with responsibility and answerability. Its statutes, rules and regulations to facilitate functioning be on the model of CSIR with its report put before both state legislatures and Parliament. Suitable funds be put at its disposal to act and implement decisions.

#### SUGGESTED MEASURES OF POLLUTION CONTROL

In the light of the above it is imparative that the following urgent measures be taken to remedy the situation:

1. A new *BASE-LINE SURVEY* of the TTZ should be conducted to:

(a) consolidate the earlier observations recorded in NEERI and Rurki University reports and to develop and detail it further;

(b) to include agro-technological aspects left out earlier from detailed investigation;

(c) to take into account the present species content of vegetation within a radius of 3-5 kilometers of outer walls of the Taj compound and to compare it with contemporary accounts that are yet available;

(d) to identify land ownership within this parameter so that greening the area could be taken up in a planned manner with people's participation through their education on involved issues and benifits that will come to them from the suggested measures.

It is strongly suggested that Planning Commission, especiaaly the science and technology wing, be aproched for funding of this phase of investigation and greening of the whole TTZ in general and Agra in particular in a proper manner. This effort at greening and suggested Bench Mark Survey should include not only molecular identification of polutants but also possible socio-economic and civic sources that have been hinted at earlier so that not only inventory

of polutants is proper but that diverse plausible sources for this are identified, analysed and apportioned their proper share in damaging processes to then remedy the situation at appropriate level of administrative structures.

2. An appex body be constituted through proper legislation in the legislatures of UP and Rajasthan to coordinate, supervise and be answerable for all pollution control measure implementation and monument conservation in the whole TTZ. This body should override multiplicity of authority at various levels in the whole TTZ. It should be answerable to public through state legislatures, Parliament and the Supreme Court. It should function in the manner of an Autonomous body or agency.

Governments of the respective states and of Centre should provide sufficient funds to this authority, on the pattern of CSIR and other similar agencies, to function.

3. Department of environment should be asked to establish analytical and monitoring laboratory facilities at Agra and Mathura on a permanent basis to monitor and analyse pollutants in TTZ. This establishment should have mobile facility to cover the rural sector of the whole TTZ.

4. As the land use pattern as well as the ownership of the land configuration has drastically changed between even 19th century and today;,, for this change records are available with appropriate authorities and structures both in Agra, Mathura, Firuzabad, Bharatpur etc. This change requires study as on this factor greening the whole TTZ in general and Agra in particular depends the success or failure of all efforts at air pollution control in the TTZ. As the right to property and consequent privileges, are an important consideration with both law and individuals, this assessment would show the extent to which acquisition is necessary and what other subordinate structures are to be created as the past experience of various government departments involved in tree plantations leaves much to be desired. It is therefore, imperative that a survey be made of present day land use pattern and ownership of land in the entire TTZ to find out, (a) how much and which land is owned by the state so that it could be immediately brought under greening; (b) how much and which land is technically under orchards and has been diverted from its registered use so that people are persuaded to restore official use by greening it; (c) on how much and which land development of orchards is desired from the point of view of public and conservationist interest in order to rejuvenate TTZ to its conservationist optimum. Only after acquisition of this information one can assess the extent of various options involved in the technicalities of greening the TTZ. Without wholehearted participation of all sections of the people of the TTZ itself let us better forget about any greening of the TTZ as a whole.

5. TAJ NAGRI AVAS YOJNA be totally liquidated forthwith.

It is amazing the way Master Plan of Agra has been violated with complete immunity even by the city administration itself. This cannot be without the connivence of the UP state government. In other words, the UP state government is implicitly party to various violations not only of the conservationist principles required for preservation of Taj and other monuments in the UP teretory of Agra and Mathura (about Rajasthan one does not know as Bharatpur is not in the limelight either of press or of the NGOs).

6. No settlement be allowed upto 5 kilometers of Taj on either side on the river bank as well as on the opposite side. If felt unavoidable, the Supreme Court should issue an ad interum order banning such settlements till a suitable law is passed by an appropriate legislature. The goal to achieve is NO SETTLEMENTS WITHIN SPECIFIED AREA ROUND MONUMENTS, BEGINNING WITH TAJ, AITMAD-UD-DAULA, SIKANDRA AND AGRA FORT as such settlements at a later date shall prove much bigger social and legal problem for conservation under the changed ethico-cultural dispensation. In this context role of power-brokers and politicians of all shades and hues should not be underestimated.

In this context one may point out that vote-bank concept, applicable to un-authorised colonies round Taj, not at all unknown in other cities in various contexts, and control of various civic bodies by the same interested parties and elements right upto state level, with this control, used by interested parites for generating politico-administrative pressures for so-called demands for conservation of Taj through de-industrialisation and without any regard for the working people, would nullify all attempts from any quarters to preserve monuments in the TTZ. Hence it is imperative to know how much, and where, the state owns so as to begin from there and, with education to persuade the owners of various land pieces to change from low vegetation profile (grazing, fallow or agricultural) to high vegetation profile viz. orchards etc.

In the light of the above one should realise that creation of orchards implies sale of the produce as otherwise no body will opt for it. During medieeval times the king or the nobles, who owned such orchards, would consume the products or get it marketted and the peasant would earn the gratiude for innovations in terms of not only praise but also monitorily. Under changed dispensation one has to not only assure but built into corresponding structures this element of sale of the produce to make the plan realy workable and to get people owning this land interested in developping orchards from the point of view of their own economic interest. In this context the orchards developped on government lands can act as attractants in the same manner as in Agriculture when new varieties are introduced for the first time. Demonstration is a better way of convincing people than any amount of lectures by any body.

As the state government is overtly populist, i.e takes decisions with an eye to election consequences, it is a

substantial question of law if in public interest as summed up in the present litigation itself, either the state or the Supreme Court can introduce a change in the land use pattern of the TTZ region or not. Irrespective of this legal aspect, it is desirable that the masses are educated about the need for conservation and its various aspects that concerns them.

It is suggested that efforts be made on serious scale to educate the people about conservation of monuments in the TTZ so that they are persuaded to shift from one pattern of land use to another, i.e. from agricultural to orchards. If necessary, state, either of UP or of India, should devise schemes to give incentives to cultivators to make such shifts so that they do not suffer economic loss during the transit phase that may last from 7 to 10 years.

7. A barrage be constructed to increase water in that sector of Jamuna that lies between the railway bridge on the one hand and bend of Jamuna down stream adjacent to Taj. The parameters and details be worked out in agreement with the ASI as such rise in water level in all probability would affect the foundation of the monument and its surroundings. Available data for such situations suggests that any improvement in water in the river is likely to elevate underground water table and, consequently, affect the monument per se. As a consequence of elevated level of water in the river, sand damage that is abundantly visible on the river side shall get reduced.

8. As recommended in the Report of the UP Government Committee under the Chairmanship of the Commissioner of Agra (p.20), gas should be supplied to TTZ cities, begining with Agra, for all such purposes where today fossil fuel is being used, including industry and various traditional professions like sweetmeat making etc.

9. In order to sharply reduce diesal use in TTZ, it should be seen that electricity to TTZ is regular and without any serious breaks. So long this step remain wanting, the generators shall have their utility and diesal pollution can not be controled. Besides, in this context, recommendations of the said UP government committee about by-passes and diversions in Agra be fully implemented. As no similar data is available for Mathura, Firuzabad and Bharatpur, the matter of survey should be immediately taken up with the help of UP and Rajasthan governments and the recommendations regarding transport load-shedding and de-desalisation of the atmosphere emerging out of such investigations, be fully implemented.

Even if the common Grid of electricity may be visualised to supply uninterrupted electricity to TTZ through the machenism of getting the power from wherever it is available in the system, and knowing the example of Delhi break-downs, one would like to consider captive electrical generation for TTZ simply to guarantee this supply in order to reducee not only fossil fuel consumptiopn but also to eleminate 'fall back' and 'to be on the safe side' attitude

of the people in relation to electricity supply that is the basis for diesal generator menia in the city. Once uninterrupted electricity supply is guaranteed, many problems of pollution of Agra would get solved by themselves as these are primarily based on uncertainties of power.

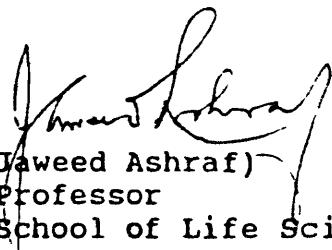
It goes without saying that all steps would cost money. If there is no desire to mobilise money resources for one reason or the other, letus then forget about pollution control. Under such dispensation making industry into a scape goat or bete noir is simply immoral.

10. For a long time various proposals have been with the state / central governments to create diversions and bypasses to Agra in order to avoid consequences of passing traffique. These suggestions and plans should be immediately taken into consideration and, irrespective of costs, transit load on Agra be eleminated from entering the city.

11. To immediately control sand damage to Taj, past practice of auctioning space opposite Taj on the river bank between railway bridge and bend of Jamuna beyond Taj, be revived with immediate effect for cultivation of vegetables and cucurbits as such coultivation would control sand erosion and sand damage to the monument. Steps be urgently taken to convert the whole bank opposite Taj into an orchard or garden for public recreation in order to evolve permanant solution to sand damage to the monument. It may be recalled that such cultivation of vegetables and cucurbits to control sand erosion and SPM content of the air is an age old practice that goes back to medieval times on record. The British continued this practice through out their rule.

12. Efforts be made to electrify internal public transport in Agra in general and within the monument zone in particular through introduction of regular Trolleybuses where possible and electrical batory operated buses, as used in Delhi, where public transport is not feasable. A certain area round Taj be decleared as fossil fuel free zone and within this zone no solid or liquid fossil fuel be permitted.

13. Proposal of Commissioner's report regarding ring railway in Agra is fesable due to availability of lines. It should be immediately taken up.



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Indian culture. On both these counts the later medieval composite Indian culture not only continued this tradition further with refinement, but developed and expanded its influence and implications.<sup>3</sup> In matters of ecological interest medieval and ancient periods in Indian cultural history manifest an unbroken pattern of development both in theory and practice. Like ancient orchards, medieval ones too not only provided fruit and timber but also cultivated medicinal herbs and helped in plant acclimatisation before their large scale introduction and distribution during the medieval times.<sup>4</sup>

Medieval Agra in this context was no exception to the general rule of continuation and further development of this aspect of Indian cultural tradition that had ecology as one of its major ingredient. In a society absolutely dependent upon nature for all its sustenance in every sphere affecting its very existence, it could not have been otherwise.

Agra as an important urban centre of medieval times is of relatively recent origin. It came into existence only during the fifteenth century; at the fag end of the Delhi Sultanat under the r e of Sikandar Lodhi when the place was first selected for locating the capital due to easy fording of the Jamuna at a spot near the present day Agra fort<sup>5</sup>.

The fact of Agra being capital implied not only royal residences, palaces, houses of nobles, places of worship and of commerce as well as all the consequences that this paraphernalia of power and pomp implies, but also heavy concentration of army under normal conditions which used to turn to very heavy

for short durations under conditions of war which were more a norm than exception for most of the times during those days. Army in its turn then implied very large population of draft, feeding, riding and other animals in addition to men and attendents; all requiring not only drinking and bathing water but also fodder, shade for resting during the day, and tying of the various animals during the night. Agra obviously had to be surrounded by very large number of big orchards and gardens covering thousands of hectors in order to provide all that the implications required.

Agra from the begining of the Mughal empire had gardens. Babur, inspite of his adverse comments about Agra, built a number of large gardens on the bank opposite the city facing the fort. Under Akbar and Jahangir such gardens further increased in numbers. Ain mentions gardens of nobles both outside and inside the city but without giving details of the area and floral content. Taken together, Mughal and European sources underline predominantly green surroundings of Agra right till the time of Shahjahan when the capital was shifted from there to Delhi.

While detailed data on number of gardens, their location round medieval Agra and their floral composition is not so far available, the example of medieval Delhi before the capital was shifted to Agra, and of Hisar-Firuza when it was established, can be taken as a pointer to the direction of development of an important city in this regard. We may also take these examples as indicating broadly the content of orchards and gardens of various types.

Contemporary sources from the Sultanat period record

hundreds of large gardens in and round Delhi after the dense primordial forest surrounding the city was totally removed for a radius of sixty Kos due to security reasons. These sources also mention large number of gardens emerging within and around the city immediately after the establishment of Hisar-Firuza<sup>6</sup>. Even the British in one of their maps dated 1807 record a two squire mile garden attached to Ladoo Sarai near Mehrauli and another of one squire mile attached to Shalimar near Hyderpur in Delhi<sup>7</sup> underlining the substantial diamentions of these gardens even at the fag end of the medieval times. This example from the British observation may be taken as sample of the remainants of those gardens that existed in Delhi before its decline and complete decay as a capital. Indications of this fact can yet be observed in various names of the localities. This is especially true because all the medieval urban centres of any consequence were surrounded by a number of *sarais* and *manzils* providing facilities for those comming to the city for various purposes. Even the above map records 28 *Sarais* in the immediate vicinity of Shahjahanabad, as Delhi was then known. As *Sarai* was an integral part of every *manzil*, it is obvious that these places were *manzils* on the final stage for the entry into the city. As each *manzil* dotting urban surroundings imply large green areas, it can be safely assumed that urban centres during medieval times were all surrounded by greenary on all sides. Agra, obviously, could only be more and not less in such respects.

The area where Taj today stands was a *manzil* belonging to Sawai Raja Jai Singh from whom it was purchased in order to

construct the Taj after the death of Mumtaz Mahal. The garden covering the area round this manzil is known to have reached almost the moat round the Agra Fort<sup>8</sup>.

While Agra became capital city before the arrival of Babur during the first quarter of the sixteenth century, the city reached the peak of its real imperial glory only under the Mughals. Babur is full of complaints about natural conditions of Hindustan; His permanent nostalgia for 'running waters' is well known. Inspite of heavy underlining of this opinion in Tuzak, in the light of ancient traditions of the region regarding orchards and gardens of various types, it would be undesirable to absolutise these remarks to conclude that the region was bereft of all dense tree plantations, consequent shade or of abundant water as such.

It is well known that Babur built a number of large imperial gardens in Agra on both sides of the river Jamuna. His famous Char Bagh was located on the site opposite to Taj across the river<sup>9</sup>. Being the royal garden, in all probability it covered substantial part of the river bank facing the fort, blanketing the river bank with dense vegetation that was nice to look at from the fort. One can imagine the quality of the garden from the implications of the statement regarding grape cultivation in these gardens of Agra, the quality of which was appreciated by such a person of fastidious taste as Babur himself<sup>10</sup>. Even such an area as Fatehpur (Sikri), where the city later built was abandoned due to lack of sufficient water, had a small lake that not only irrigated the surrounding land, but was deep enough to permit boating; it also ameliorated the surroundings through

humidification<sup>11</sup>. Babur also records the construction of a garden at Fatehpur (Sikri)<sup>12</sup>

It is also on record that from the days of Babur onwards nobles, traders, craftsmen and others built their *Havelis* on either side of the river. These buildings also included walled gardens of their own with large number of timber and fruit trees<sup>13</sup>. In other words, Agra was a city that had large tree plantations everywhere; on the roadside; within the city gardens; in the courtyards of even ordinary houses. The entire area of medieval Agra was full of green everywhere. It was not for nothing that European visitors to medieval Agra during the reign of Shahjahan designated it as a garden city and called the road from Agra to Lahore as a 'garden walk' due to dense vegetation through out the region providing shade and rest every where<sup>14</sup>.

From some of the comments of Jahangir we may conclude that these large gardens and orchards had high quality fruit growing in them. These fruits included priced varieties of mangos<sup>15</sup> as well as *Ananas*, which, in all probability had its origin in fruits presented to Jahangir by Sir Thomas Roe, Ambassador of East India Company to the Imperial Court<sup>16</sup>.

Besides the immediate surroundings of the capital city, near by region all around was also not bereft of similar dense growth of trees either as orchards and gardens or as jungle of various types and sizes. Not far away from Agra was located the famous dense forest of Bayana where Bairam Khan was waylaid and murdered during the early days of Akbar. It is the same forest that Abul Fazl records as one of the major regions for catching

elephants for imperial stables before eastern parts like Bihar, Orissa, Bengal etc. were fully opened up for this purpose<sup>17</sup>. From the implications of having elephants in Bayana it is obvious that the forest was not only very dense but consisted of big leafed, evergreen to deciduous, mixed, type of vegetation on which the elephants in nature could feed. Tiger hunts in the region round Agra, Mathura and Delhi till seventeenth century underlines the continued existance of some sort of forest area in the region inspite of expansion of agriculture and bringing in of large tracts under cultivation as implied by the 19 years Ain of taxation given by Abul Fazl.<sup>18</sup>

During the reign of Shahjahan, capital was shifted to Delhi. However, it did not meant total abandonment of Agra. While new gardens and orchards were laid down in Delhi, those at Agra continued. Agra continued to function as an important centre of manefecture, trade and commerce as well as of culture. Frequent visits of the king to Agra and shifting of court there during disturbances continued to sustain the importance of Agra as an urban centre under Shahjahan. The same situation continued to prevail during the reign of Aurangzeb and later.<sup>19</sup>

There is ground to assume that even till the establishment of the British rule in India, over all ecological situation everywhere, including Agra, did not seriously deteriorate inspite of almost complete disappearance of the jungles of Bayana and other places.<sup>20</sup>

We may recall that right from the days of Babur onwards Agra being capital of the empire, there were metallurgical establishments catering not only for arms and armaments, both

heavy and light, for the imperial army, but also providing metalworks for the court as well as for the market to trade within and outside the empire. This fact and its scale implied in *Ain-i-Akbari* underlines not only large scale consumption of timber used in house construction and wood for firing the furnaces and brick-kilns providing bricks for the expansion of the city and its facilities acquired through removal of forests of Bayana and other places within the suba<sup>21</sup>, but also points to the role that planned gardens in particular, and over all tree growth in general played in keeping the pollution aspect of this industrial and construction activity under control. No source, Indian or foreign, mentions Agra as a polluted city inspite of heavy metallurgical activity through out the four centuries of the Mughal times. It may be that these establishments were then located outside the city limits to avoid pollution. However, it is more reasonable to assume that socio-biological limitations on pollution through vegetation and greenary<sup>22</sup> was the main reason for this cleanliness in the city as this industrial activity would adversely affect the city in any case if such establishments are located either within the city or within reasonable transportational limits for both products and manpower. However, as this did not happen, we may assume that besides nature, human intervention through behavioral norms of cleanliness were also in force. Pollution control seems to have been achieved through a combination of natural factors and regulations interacting with each other for achieving the same ends even if details of the same have not come to us as records.

We have pointed to bio-protectional aspect of dense plant growth, natural or man-made, elsewhere<sup>23</sup>. However, we would like to repeat that such vegetation in Agra considerably ameliorated the high temperatures within the city inspite of the fact that the city is located in a region that otherwise has high summer temperatures. Taking summer sprinkling of water on unsurfaced roads and lanes, as well as within houses themselves, a practice so very common during medieval times for evening cooling and dust subsidence, and the fact that vegetation itself substantially lowers the surrounding ambient temperatures by as much as four to eight degrees celcius, it is obvious that natural surroundings of the city and the same within the city, provided for comfort during summer and gave biological protection to buildings by lowering humidity in the over all environment of the region as a whole.

We are slowly coming round to understand the role vegetation plays in modifying microclimatic conditions for the better. First protests against removal of forest under the British rule was registered by enlightened officers on grounds of their role in improving micro-climatic conditions and specifically mentioning reduction in rain fall due to denudation of surface of its forest vegetation cover<sup>24</sup>. Any study of ecological conditions of the medieval period would underline that this factor was understood and is implied in many a step taken during hard choice of expanding agriculture and keeping the balance of trees. Obviously, ancient Indian tradition of replacing wild and uneconomic tree cover by dense plantation of economically useful trees either in the form of man-made jungala,

or as orchards and gardens, discussed elsewhere, had some thing to do with this norm<sup>25</sup>. It was this traditional norm that sustained ecological balance under conditions of continuous expansion of urbanisation and agriculture. Agra seems to be an example of how natural conditions were used to keep the consequences of technological development ( metallurgy, brick-klins etc.) under control. Though not paid due attention so far, ecological aspects of medieval urban centres deserve serious and detailed attention of scholars to draw lessons from a number of past practices in this respect which are implicit in their urban lay-outs, building design and environmental planning.

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## **LIGHT, SAND AND THERMAL DAMAGE TO ARCHAEOLOGICAL MONUMENTS**

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A change is increasingly becoming visible; due to inculcation of heritage consciousness through various means protection to monuments is gaining considerable importance in public perception of those having access to the media of various type. Expansion of international tourism is further stimulating this consciousness of conservation as large number of people perceive various benefits for themselves from this inflow of both Indian and foreign visitors to various tourist spots.

Expansion of tourism is also generating negative pressures in the form of a number of hasty steps that in the long and medium run cause damage to monuments themselves. This damage ultimately defeats the very purpose for which such steps are being taken by various levels of decision making in different ministries and departments both at the Centre and in States. In this context a number of damaging agents have been identified and measures are being taken to protect various archaeological remains from the action of these agents. However, insufficient attention has been paid to some important factors that in the long run directly and indirectly cause serious harm to monuments. Two of such agents not yet taken into serious consideration from the point of view of monument conservation, are insect damage as a consequence of flood-lighting of the monuments and damage caused by high humidity in and around the buildings as a result of altered sub-soil drainage of the immediate surroundings of the buildings themselves.

As the idea of flood-lighting the monumental buildings has come to us from the Occident, i.e from the USA and Europe, it is worthwhile to look into the concrete natural conditions of the Occident and of India as the two settings seriously differ in natural conditions surrounding the buildings themselves. In India these lighting practices have been transplanted through simple executive pressures, orders and fiats but without any serious regard to differences in the natural conditions. This neglect of natural reality during decision making is leading to serious consequences which are either non-existent or extremely marginal in the Occident.

#### Apparent Reason For Flood-lighting In Contemporary India

The concept of flood-lighting of monuments has never been part of Archaeological Survey of India (ASI) norms and practices since its very inception under the British colonial rule. Even places like Gateway Of India in Bombay, India Gate at New Delhi and Victoria Memorial in Calcutta, for example, were never flood-lit. These buildings were normally well lighted and were ceremonially and decoratively lighted only for a few days in a year as rare exceptional occasions under the British whose imperial occupation these monuments, along with a number of forts at various Presidencies and Residencies, symbolised. Flood-lighting of Viceregal Lodge of the olden days of the Empire was not a norm even on ceremonial occasions. Absence of such practice from the British norms was obviously not due to lack of funds.

ASI monuments under olden norms were closed and put out of bound for visitors from sunset to sunrise. No body, not even

VIPs, were permitted to enter monuments during dark hours. Keeping these monuments open for tourists after these hours and whole night flood-lighting has recently come to us as a consequence of our perceptions and projections of assumed tourist attractions. Consequently these decisions imply assumed benefits based again on an assumption that fame of major tourist attraction of India in the Occident is based on their image under such flood-lighting and not on their own interinsic merit as architectural marvals. As a matter of fact this tendency in decision making in the Ministry of Tourism shows that we assume the Occidental tourists to be ignorant of the interinsic value of these buildings. We further assume that the foreign tourists want to see in India what they are used to seeing back home. Is it correct understanding of the motivation of the tourists? Decision regarding flood-lighting is based on these assumptions.

#### Flood-Lighting Under Occidental And Indian Natural Conditions

In this race for showing to the Occidental tourists what they are used to seeing at home we have not at all paid any attention to two major factors under which this Occidental practice operates in India. Firstly, our decision makers have not taken the given ground reality of our natural climatic conditions into consideration and, secondly, we have failed to notice that none of the walled monuments all over the Occident is open for tourist visits after certain hours. All over Occident only parks, gardens and such other monuments that are built on the roadside are open all the time. Subdued spot-lighting from out side in the Occident takes place in the context of these realities.

Let us also remember that the idea of flood-lighting of

monuments began in France and UK with such monuments that were made up of metal, glass, cement, concrete and plaster, e.g. Original Imperial Exhibition Grounds in London and Birmingham in UK and the Effel Tower of Paris which is totally made up of metal. These monuments, while being affected by non-biotic natural conditions, are not at all affected by biotic factors except as secondary elements of erosion. Moreover, gross chemical and other treatment to such monuments is reasonable as replacement of their damaged parts is within reach of the society that has built them. Flood-lighting such monuments does not harm them. From such originally flood-lit monuments on exhibition grounds, the practice spread to other buildings in Occident. Most of such lighted buildings are made of cement and concrete while only some are of stone; the quality and age of such stone is also very different from what it is in India. Interaction between this stone and natural elements in Occident also takes place under very different climatic conditions.

Broadly in the Occident such lighting serves two purposes; it visually isolates the building in the night from its surroundings in order to focus total attention to the given single spot and, secondly, in the overall locational background provides general effect of beautification. Most of so lighted buildings in the USA are of relatively recent age and are built of brick and mortar with suitable plaster on the outer surface. Even some sort of chemical surface treatment to these buildings can not be totally ruled out. Overwhelming majority of such buildings are located within cities that themselves are brightly

and uniformly lit as a matter of norm.

In case of Europe such buildings some times are made up of various types of stones. However, climatically the entire Occident belongs to cold temperate and sub-polar zone where temperature and humidity conditions are very different from those in India. This stone in the Occident interacts with light and its consequences under natural conditions very different from those in India in particular and Orient in general.

The cities where spot-lit monumental buildings are located in the Occident in their majority have the following climatic characteristics; (a) Summers days are long and the lighting up period is short. Even summer temperatures during these short nights are much lower than the day while day temperatures in summer are themselves normally not high. During winters, when the nights are long and prolonged lighting is required, the temperatures, both during day and night, are all the time sub-freezing, i.e. these temperatures are biologically inactive. (b) Brightly lit monuments are mostly located within the city limits and do not constitute lighted islands in an area of darkness all around to attract night active insects, birds and other animals. Bright light round the buildings is not only relative to the brightness of the light all around but this light acts more as visual underlining than anything radically contrasting with the surroundings. In most cases it is often subdued colour than bright white light that is used more for its aesthetic effect than anything else. (c) Life cycle of insects that gather in bright light in the Occident is very different from the same in India. As a matter or norm, because of prolonged

sub-zero temperatures these insects have a considerably short active life, hibernating as mature animals during the entire duration of winter. In other words, for more than nine months in a year lighted monuments do not attract insects that gather in light for their reproductive purposes. During summer, when insects are reproductively active, they perform this function more in lighted areas with good vegetation, like parks, so that they may lay their eggs in the soil or in trees rather than in exclusively flood-lit areas because these insects are not attracted to various colours used for lighting effects. In all probability, colours for lighting are selected after due investigations into their biological responses for various groups of night animals. *This is exactly what is not done in India by any of the agencies involved in decision making at any level about flood-lighting archaeological monuments all over the country.*

Occident, as can be seen from their tourist norms, has not compromised with any of their conservationist practices in order to facilitate and promote tourism. Reverse of it is our increasingly alarming practice which is in fact violative of all written rules and norms of the ASI.

India is in complete contrast on both these counts of architectural and climatic conditions of the Occident from where the idea has been simply lifted up and applied without any serious application of mind to various ground realities of climatic and biological peculiarities of the subcontinent.

India predominantly belongs to humid tropical and sub-tropical climatic zone. Temperate conditions prevail only in the

Himalayan foot-hills and adjoining regions. In India, inspite of changes in da length between summer and winter, not only the period of darkness remains significant in comparison with Occident even in summers, but the temperatures in India continue to remain high in the biologically active zone even during the winter nights with the exception of a very short period of low night temperatures prevailing only in the northern parts. This period is hardly of about two months. Hence, lighting-up time involving biological activity among insects on the subcontinent is significant round the year.

Everyone has experienced insect gathering on light through out the length and breadth of India; it is the most common problem on the roads and in the houses during summer and is extreme during the rainy season and in spring. This natural situation is in total contrast with Occident. For flood lighting of the monuments this fact has to be taken into serious consideration as insects do damage to the monuments.

Insects are attracted to light in order to perform their reproductive function. As a matter of fact a large number of them have sexually mature winged stage lasting for a very short time wherein they can gather on light, perform their reproductive function and loose wings to develop further after burrowing holes at the nearest locality or object which may be soil, tree trunks or weathered and moist stone or brick, eg. different white-ants, burrowing worms, ants, etc. Others, like wasps and moths that have normal wings, require large concentration of males and females for their normal reproductive processes involving complicated "dance" movements for natural selection of mates.

Light provides this environment for natural selection. These insects have to burrow almost immediately after mating; lay eggs and look after the prolonged larval stage. It is usual under natural conditions that their burrows are found near by the light source as either their wings fall down almost immediately after fertilization or within a short time they have to lay eggs. Prepondurence of wood-worms at human residences is explained by the fact that both light and dry wood is more easily and readyly available in the houses and there are no natural enemies inside the house to kill and eat the larvae. This is why insect damage to our monuments as these provide all the suitable conditions for laying eggs, developing larvae and safe heaven for both parents and the young. Just as in homes, it is maximal during rains but is also substantially spread over rest of the year with various types succeeding each other as their cycles demand. This damage is more visible as we go towards regions of prolonged rainy season, i.e. south of the Vindhya, east, north-east and west. This damage is nothing new; it has been with us as a marginal factor due to natural conditions. Its marginality is due to the fact that our monuments have never been spots of light saturation within vast darkness on the one hand and on the other due to the fact that even performing and functioning monuments would close down completely after sunset and would not have light in and around them. With Tourism Department going in for flood-lighting monuments with strong white light as a matter of norm, e.g. Konarak, Taj, Red Fort, Qutab Minar, various medieval and British forts etc. there is very serious danger that a marginal damaging

agent present in nature all the year round shall soon become, if it has not already achieved this, a serious menace for various parts of the buildings and, as a consequence, substantially shorten the life of the monuments themselves. Experience of Sun Temple at Konarak underlines this aspect of the potential serious insect damage threat which is now being spread to monuments like Taj through flood-lighting without any body involved in the decision making realising the serious consequences that flow as a logical biological trail of consequences as soon as certain executive decisions are taken and implemented.

#### Flood- Lighting And Insect Damage To Sun Temple At Konarak

Sun Temple in respect of flood-lighting can be taken as a representative case; The monument is old; made of Khandolite that has substantially weathered and become soft with age; is located, like most of our other monuments, outside urban concentration with hardly any light between it and Bhubaneshwar-Cuttuck city complex. In other words, Sun temple at Konark, like similar other monuments located either on the fringes or totally away from residential areas, when flood-lit, acts as an island of bright light in the sea of darkness all around, attracting unimaginably large number of sexually active insects during their many phases of reproductive activity. This mass of insects was earlier absent from the building due to darkness and was distributed over large surrounding rural area with each dimly lit place getting a very limited number. Marginal insect damage could even then be seen and controlled. Now this huge mass of insects is all concentrated within the limited area of the Temple and other flood-lit areas around in the complex because, inspite of availability of

electricity to the villages, the contrast in lighting intensity yet remains significant. As a consequence of this concentration, it was observed during the visit of a team in the late 1970s that entire walls of the temple above human height were punctured with holes borrowed by insects where their eggs were laid and larvae hatched to complete the life cycle. The height chosen for making burrows was the consequence of self-preservation instinct in nesting so that humans moving around as a matter of norm should not harm the nestlings. Once such a small hole is burrowed, strong winds further widen and deepen it and, as this process goes on over time, the damage spreads. With rain and wind further contributing and accelerating the weakening, degradation and decay of the stone, a small begining ultimately results in serious damage to the whole monument. Interestingly, spiders and other carnivorous insects, reptiles and even higher animals are also attracted to the site in the manner of a trail as the bio-ecological food chain develops to manifest its natural logic towards all life processes directly or indirectly involved in the events. Flood-lighting thus many fold accelerates a natural process that otherwise goes on in marginal proportions.

Flood lighting, as we have seen, taken out of the bio-climatic context of the Occident emerges a serious threat to conservation of archaeological monuments in Indian climatic conditions. This transplantation of Occidental practice, in fact seriously damage the very monuments that we desire to conserve for posterity. Having large summs of money available for flood-lighting without investigating the consequences, the decision in

fact amounts to conservationist harakari; this practice in fact kills the building which ostensibly such steps are meant to help conserve as attraction for tourists.

Let us even now realise why the colonial British did not lit the monuments in the night. They had money. It were these considerations that decided against such practices. In our new flush of money and desire to attract tourists we should not compromise on time tested practices and norms of the ASI on grounds that obviously are too slipary to stand serious scrutiny.

Konarak has already been damaged. Climatic conditions on the whole subcontinent do not justify this newly introduced suicidal practice of flood lighting. As a matter of fact spread of this mode of lighting shall bring the same trail of events as observed in Konarak. Medieval Mughal monuments like Taj are next in the line for flood-lighting. As mercyless biological logic demands, these monuments are also next in the line for insect damage on lines of Konarak.

Are we bargaining for this? Do we want this to happen?

#### Altered Sub-soil Drainage And Damage To Sun Temple

In 1902-3 it was perceaved by the then authorities that the Sun Temple site was under serious threat of implosion. Hence it was decided that the main enterences to the temple *sanctum sanctorium* be firmly closed and plastered, and the inside be filled with rubble and sand so that implosion could not take place. This decision did not take into consideration the fact that the temple was built with huge slabs of excellent surfacing put one upon another following the technique of open massonary. Under normal circumstances the rain water falling on the temple

stones would have drained off the exposed surface of these huge slabs and would not have penetrated into the building due to, firstly, very smooth surfacing and, secondly, due to very large dimensions of the stones of the slabs. Good aeration through open doors and crevice ventilation kept the building dry under conditions of heavy rains and high humidity of Orissa. However, when the temple fell in disuse and was thus closed, water began to seep in through capillary suction with dry sand filled in side after closure generating and exerting its own suction pressure on outside rain water flowing over the stone. With seepage of water inside the sand became moist, settled down, generated increased suction pressure due to space created by sand settlement and soon the closed inside of the main temple building turned into a virtual water filled tank with liquid spreading from there to all over the building through capillary movement on the surface of the stone slabs, virtually connecting all parts of the building with each other in a water movement network that was active through out the year due to stored water that was renewed every monsoon. Later on, in order to make the building safe from direct rain water penetration from outside during prolonged rainy season, exposed outside roof portions of it were cemented. This surface cementing made the capillary flow of water easier and more efficient. During the summer and winter months when there was no rain, it was this accumulated and stored water of the rainy season that kept the whole temple building humid from inside while large volume of it also gradually moved down into the foundations due to gravity to accumulate there as a pool due to

the subsoil water table being naturally high because of proximity to the sea. In other words, due to this closure, soon the temple virtually came to stand in a subsoil pool of water on the one hand and accumulated water inside on the other. Improvement in drainage after discovery of this situation changed the whole scenario significantly for the better, underlining that humidity damage can be removed with proper drainage and aeration of the building and its surroundings. Now with better subsoil drainage and temple doors open, the building is better aerated, drier and in much better condition to withhold the increased pressure of visitors.

#### Biological Protection To Sun Temple Against Sand Damage

Sand damage was one of the other major problems that Sun Temple faced. Proximity to sea shore and denudation of the surroundings of all vegetation were the main cause of this damage. Surprisingly, this type of damage was due more to man-made causes than nature *per se*. Earlier society that built the temple on the sea shore had provided for vegetation all around as an integral part of temple environment design. According to tradition given in various texts like *Agni Purana* this design was not based on grass lawns but on trees, shrubs and bushes that provided flora for various religion-related practices including traditional medicine besides performing other conservationist functions for the temple. Under the British rule of this orchard was replaced by grass lawns. Further changes, including poverty of the people living in the area, denuded the entire surroundings of all vegetation. Sand prevalence was thus a consequence of changed societal situation and perception. This sand, accompanied

by strong winds, used to strike the stone with substantial force, pitted and weathered the stone, deepened the holes made by insects and widened the cracks created by other elements of weathering. Conservational alternate suggested during the 1970s was to coat the whole temple building with polyacrylic resin that on hardening would have formed a covering layer to stop all water and wind damage. However, this idea was rejected in the light of the bitter experience of Ajanta during the 1920s because, after some time under direct sun light, when micro-cracks appear in such layers, water not only seeps in through these cracks but is trapped in it. This trapped water later on can not be removed. Moreover, there is no known method of removing the entire layer if the need arises. The other alternate suggested was to provide the temple with biological protection through plantation of vegetation.

Improved sub-soil drainage in case of Konarak was supplemented by providing a parameter of cashewnut, Casuarina and Thuja plants all around on the sandy slopes to stop blowing of sand with the wind. It was realised that if we can stop sand loaded wind from directly striking the temple and if we could deflect it upwards so that it forms eddies over the temple to unload the dust, damaging capacity of this sand would be neutralised. Within a matter of about a decade steps taken to provide protective parameter of plantations have improved the situation substantially. With these and other plants cultivated round the monument growing to heights either equal to, or higher than, the temple itself the biological protection provided by

these steps would be sufficient to completely check wind and sand damage as well as reduce soil and atmospheric humidity in the immediate vicinity of the building providing it with better microclimate. These protective steps also improve soil through removal of accumulated salts.

Idea behind biological protection in simple words means, firstly, to identify the damage and its natural agents and, secondly, to then identify those plants that, while growing in the given natural conditions perform the desired function of eliminating the damaging agent. In case of Sun Temple major consideration was sand and humidity damage; Hence Cashewnut, a bushy shrub under Orissa conditions that spreads wide on the soil surface, along with such tall growing plants like bamboo, Caseurhina and Thuja etc. to form a wind break high enough to generate a whirl above the temple so that the dust may settle down under conditions of eddy currents but should not strike the stone with any force to cause damage.

It is unfortunate that more than a century of European conservational norms and practices as well as change in our own aesthetic values due to immitation of the Occident we have to have grass lawns round the monument. However, these grass lawns, strictly speaking, hardly play any protective role for the monument. We may recall that in the past there used to be trees and tall woody bushes planted in the garden all round the majority of the monuments. These trees were meant to provide biological protection to the building itself through generating a chain of events benificial for the building. For this end it was virtually immaterial what species these trees belonged to.

Naturally, preference was given to fruit bearing, aromatics and such other plants that were of high social status and could also be used for worship purposes.

In this context one has to remember that high density of trees in the vicinity substantially lowers the ambient temperature inside the building itself which, in its turn reduces the general humidity of the building and its immediate surroundings. In other words, by greening the surroundings with trees we in the long run achieve the object of reduced monument humidity; provide shade to the visitors and beautify the surroundings, thus underlining the fact that tourist facilities and aesthetic comfort need not necessarily come into conflict with monument conservation. All such factors can be combined and converged to attain both the ends successfully.

We would like to underline that changed society of today has converted a place of worship into a tourist spot. This means drastic change in the visitor load that the building and its surroundings are expected to handle. Such societal modifications in building use necessitate serious change in our attitude towards surroundings and its planning to help the complex breath properly in order to remain healthy and survive. Let us point out that recent attempts at cutting down the vegetation cover from the beach-head to the extent of 2227 acres in the surroundings in order to build cement concrete buildings like hotels shall in the long run cause more harm to temple than is being faced today. In fact such a monstrous idea involves removal of 5,17,778 trees already growing for more than about three decades.<sup>1</sup>

### Harmful Changes In Taj Surroundings: The Temperature Factor

Taj is another important monument that is in the focus of attention. It also shows almost the same attitude of mind in handling problems related to conservation that is manifest in Konarak. Fights on sharing ticket revenue, though ugly in themselves, are the least of the recent manifestations of this mind-set involving Taj as a tourist spot.

Let us begin discussing Taj with the realisation that, unlike Sun Temple, Taj is a burrial place. Its role as a place of prayers is rather marginal inspite of the building being often named as *Roza Tajganj*. Visitor load envisaged at construction time for such spots is much less than at places of worship. However, conversion of it into a tourist spot has drastically changed this load on the building and its surroundings. With each person spending some time inside, the heat thus generated, and the humidity inside thus caused, is large enough to result in damage. Stone spoilation due to tuch and movement is simply a logical consequence of this crowd. Vandalism is another by-product. In other words, present day society is putting a load on the building for which the building was not designed. Damage is to be expected.

Secondly, original surroundings of Taj, both within and without the parameter walls, were very different when the building was planned and constructed than what these are today. We have discussed the ecological details of medieval Agra in a seperate paper in this volume itself. However, for our limited purpose of discussion of various aspects of the problem it is sufficient to realise the implications of the medieval lay out

plan of Taj area on display in the site museum itself. This plan shows that the inside of the parameter wall was densely planted with trees and bushes of different types. Unlike today, in original design it hardly had any areas totally given to grass. Plants cultivated inside the parameters of the monument were selected not only for their aesthetic value but, as it turns out now with our modern knowledge concerning environmental role of various plant species, with an eye on their important role as dust absorbers, temperature reducers and humidity controllers of the surroundings, thus keeping the ambient temperatures down. Lower ambient temperatures of the surroundings are known to reduce temperatures inside the building. In its turn this reduced temperature inside lowers internal humidity. All this again is chain of events wherein any positive movement at one node affects the whole chain and, similarly, any negative movement anywhere has similar negative consequences all along the chain. Plants within and without the Taj parameter were one link in this chain of events. Obviously these plants provided biological protection to the monument in the same sense as discussed earlier for Konarak. Today we know that high humidity inside the building is one of the reasons for alarming high rate of damage to the stone of the Taj. With average rainfall in the region remaining virtually constant or even reduced over centuries, this increased inside humidity, in all probability, is due to removal of lush vegetation from the immediate vicinity of the building. The consequences of this factor have been accentuated by increase in the number of visitors inside. Obviously, removal of the

biological protection to the monument is manifesting its adverse consequences. Some of these aspects have been pointed out by NEERI technical report on pollution damage to Taj.

Thirdly, we should realise that the original design did not provide for either metalled or stone-covered roads and walks anywhere in the Taj or in its surroundings. It is wrong to assume that asphalt was not known to the society that built the Taj. It is true that they never used it for surfacing the roads. Their roads were surfaced, when desired, with pabbles and stones. As a matter of fact none of the Mughal monuments had stone-surfaced paths in or around monumental buildings eg. Red fort, Humayun's tomb, Safdarjang tomb etc. at Delhi and Sikandara, Agra fort, Aitmaduddaula tomb etc. at Agra. It was only in such religious places as Jama Masjids at Agra and Delhi or Fatehpur Sikri that inside was covered with stone. However, all such places as a matter of norm had *Shamiyana* covering to stop direct sun-heating and had ample provision for periodic sprinkling of water.

In case of Taj there was no stone or pebble surfaced road or pathways either inside or outside the monument parameters. It seems the reason for not surfacing the road in any manner was simple and in keeping with the implied Mughal practice of putting or accentuating existing conservationist elements for monument protection. Un-surfaced roads, when sprinkled with water, are normal for use by medieval transport means. Under dry and hot conditions of summer the dense tree shade stops such areas from becoming additional sources of heat retention and later emmission. It is well known that soil is bad conductor of heat. It was not due to lack of money that paths round Taj were not

surfaced by any material.

It was again not lack of money that refrained the British from using either asphalt or stone for surfacing of the roads and passages around Taj. At the maximum the British covered the unsurfaced paths and roads with Bajri or red-gravel that could be sprinkled with water to cool down. British conservationist attitude in the vicinity of Taj underlined dense tree shade on the road which in its turn kept heating of the road surface to minimum. Steps that are being taken today were not taken earlier by the British with an eye to avoid extra heat generation.

Today, under the new leadership of the Ministry of Tourism all these past norms and practices are being changed. Roads and pavements are being covered with asphalt and red sandstone. Both of these are high heat absorbers that significantly add heat load to the surroundings. This increase in heat load, coupled with almost complete removal of trees from inside and outside the Taj parameter wall has further accentuated the heat factor that in its turn is causing serious harm to the monument. Interestingly, these steps are being taken by the powers that be even after NEERI report<sup>2</sup> that has underlined the role high ambient temperatures play in causing damage to the monument. All this has been completely ignored by decision makers at all levels.

#### Dust Or Suspended Particle Factor

The city of Agra at the time of Taj construction was a place lush green with dense vegetation. The site was a Manzil of Raja Jai Singh. This means that the entire area of the parameter as well as its surroundings had densely planted orchards and

gardens. Between the site and the city it was dense vegetation that characterised the area. City limit those days ended with the parameter wall of the Agra Fort.

Other side of the river was also full of plants. It had imperial orchards and gardens as well as the same of the nobles. In terms of today, the other side of the river right upto the railway bridge on the one hand and a few kilometers down the river there was no exposed sand. Famous Charbagh of Babur; Gul Afshan Bagh of Jahangir and a number of other orchards were located in this presently barren area. Hence it would be true to say that this problem of suspended particles was not at all present at the time when Taj was constructed and did not exist right till the end of the Mughal empire or even later.<sup>3</sup>

Under the British rule it was a normal practice that the river bank opposite the Taj was parcellled and given to cultivators for vegetable cultivation. Thus, again, the whole area was under vegetation cover that did not permit rise of suspended dust particles right from the end of the rainy season till the end of summer. In other words, sand problem under the British was minimal and within controlable limits. This problem has aquired serious dimentions only recently.

Today, as NEERI report points out, suspended particles are a serious problem for Taj in particular and the big region round it in general. This situation is the result of mass scale removal of vegetation cover; removal of orchards from the whole district of Agra and Mathura as well as from the adjacent regions of Bharatpur, Haryana right upto Delhi. In this transformation closure of the Delhi- Agra canal has played a significant role.

Presently the whole region remains without serious vegetational cover through out the summer months and dust from fallow agricultural fields rises unhindered to remain suspended over the whole region.

#### Air Pollution Due To Sulpher And Organic Substances

Much has been talked about sub-soil water and air pollution. In this context loud accusations have been made against Mathura Refinary. However, it is usually not realised that large scale usage of chemical fertilisers in agriculture and open decomposition of organic waste of the city in the exposed city drainage system is quite capable of producing all those elements that have been monitored by various instruments both from air and water samples.

Sanitary problems of Agra city in fact are also problems of recent origin that have been exentuated by neglect of about four decades. This neglect obviously is independent of political parties that have been in power from time to time. Till we are able to fractionate the contribution of various sources in the production of various elements that have been polluting Agra air and water it is unfair to single out Mathura Refinary and to put all blame on this one source alone. Just as desalisation of railway yards in Agra did not remove suspended particle problem as smoke from burning coal, though a factor, was not the only source of suspended particles in the Agra air, similarly problem of supher, nitrogenous material and other chemicals in the water and air of Agra is a multi-factoral problem. This problem has taken this serious turn not only because of total neglect on the

one hand and shooting up of the amount of chemical fertilisers in the field that on decomposition release these elements, but has also been compounded by road construction in a manner that blocks natural drainage gradients which in its turn results in blockage of drainage resulting in stagnation and decay of contained organic matter.

Under such complex natural and man-made conditions it is imperative that further detailed investigations be done on all aspects of Agra pollution before coming to any firm conclusions.

### Conclusions

Example of Sun Temple at Konarak, like the earlier experience of Ajanta, points to the hard fact that decisions taken in haste result in more and irreversible harm to monuments. Hence preference should be given to biological protection rather than to chemical means.

We have to realise that monuments have inbuilt measures both in design and in the surroundings that protect the building from various damaging agents of the surroundings. It is desirable to first identify such elements and then to use them for conservational efforts.

Creation of substantial green belts round monuments goes a long way in protecting them from various damaging agents. Plants not only protect monuments in general but specific plants can also go a long way in removing either specific pollutants from water and air or a combination can help attaining the same end.

British practice of grass dominated vegetation is not Indian tradition. It would be better from the point of view of biological protection if we could return to tree plantation in

and around monuments and in this process try to restore as much as possible the original flora of the monument gardens.

We have to realise that what we consider today to be tourist attractions and significant cultural heritage of our country are buildings that were meant for purposes very different from what we are using them today. Hence special care is required to identify the new demands that are being made on them so that additional and corresponding elements could either be put in the surroundings or appropriate corresponding steps are taken for their proper conservation commensurate with these additional demands.

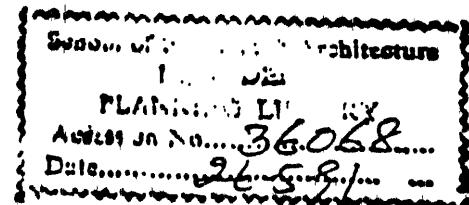
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*medica*), Mulsari (*Mimusops elengi*), Khajur (*Phoenix sylvestris*), Amla (*Phyllanthus emblica*), Ashok (*Polyalthia longifolia*), Imli (*Tamarindus indica*), Ber (*Zizyphus mauritiana*), Kasaunda (*Cassia sophera*), Lal Kaner (*Nerium odoratum*), Chandni (*Tabernaemontana coronaria*), are some of the plants mentioned in these and similar other sources.

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# HUMAN HABITATION Culture Environment Interface



S.K. CHANDHOKE



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## Concept of Forest in Kautilya and its Significance for Emergence of Land Use Pattern in India

*Javeed Ashraf*

Kautilya occupies an important place among the primary sources for cultural and political history of ancient India. However, we have not realized the significance of this source fully. In a situation where much of earlier traditions continue during the medieval period, Kautilyan codification of land use pattern emerges as still more significant. Just as the principle that land belongs to him who has reclaimed it, mentioned in *Arthashastra* (Book 2, Verse 47), continued to be honoured right till the arrival of the British, or for that matter the division of the time of the King (Book 1, Verse 37-39) appears to be the same under the Mughals. Similarly pattern of land use (Book 1, Verse 49-50) also continued to be adhered to even if with some minor modifications here and there. Hence, it is of interest to have a look at the understanding of the term 'forest' in Kautilya to fully grasp the changes taking place in the ecological setting of India during the ancient and medieval periods. Our clarity on this count acquires still more significance as forests appear to occupy considerable area of land till very recent times in the records.

What is the content of the term *jangala* or 'forest' in Kautilya? In what way does it differ from the same as of today?

In *Arthashastra*, Book 2, Chapter 2 Kautilya mentions a number of specialised 'forests': "forest for soma plantations"; "for plantations of delicious fruit trees"; forest with "trees, bushes, bowers and thornless trees, with an expansive lake of water, full of harmless animals"; forests with "tigers, beasts of

prey"; "with male and female elephants," etc. He recommends locating such 'forests', in some cases "on the extreme limits of the country or in any other suitable locality." It is also recommended that in some situations such 'forests' should be "walled with only one opening for entrance".

These observations make it clear that in such 'forests' socially acceptable fruits and other useful plants are dominant. In some cases, like those for elephants, food type requirements imply that particular plants are either preferably preserved or planted in large numbers to satisfy the needs of the animals.

In any case these are not just ordinary forests as we normally understand by the term.

In the very beginning of Book 2, the author makes it quite clear that this 'forest' is not meant for grazing animals. He points out that "pastures are to be made on uncultivable lands."

These 'forests' are quite sharply demarcated from what is termed as "game forest with game beasts, open to all". These are not even reserved hunting grounds for the king.

What is this 'jangala'? What is the content of the term 'forest' in Kautilya?

It is quite obvious from the text that what is described is not just wild plant growth untouched by man. These 'forests' appear to be planned, often purposefully designed and well protected areas. Obviously, the term here means something quite different from what we normally understand by it.

It should be noted that in Book 2, Chapter XV, the same term is used in the sense we normally use it – wild natural dense plant growth untouched by man. From such 'forests' products are collected and socially consumed.

Use of the same term for two different types of plant association – one natural and the other artificial or quasi-natural – may indicate that there is some common denominator equating the two on some basis. What is this basis?

The only characteristic common to both types appears to be plant density per unit area. It seems the term *jangala* in Kautilya designates a certain density of plants per unit area without which the plant growth cannot be designated as a *jangala*. For Kautilya it appears to be immaterial what species

grow, or for what use the product is put to. What seems to matter is just the number of plants in a given area. Without this understanding the passages referred to do not at all make any sense.

This understanding provides for a smooth and harmonious transition from natural wilderness to cultivated gardens; without much change in the number of plants we switch over to a new type of land use. From here to other types of land use the transitions also appear to be smooth and gradual.

If we look at the concept of nature in classical Indian thought we find the outlook to be very 'natural'. Though conscious nature conservation does not appear to be very prominent, it is implied in the concept of a specialised Hell for those who uselessly destroy plants. It is also implied in the benefits, both material and spiritual, mentioned for those who construct tanks, gardens, shady resting places around temples, etc. It is part of the religious outlook. Being a product of this classical Indian tradition, Chanakya deals with 'forests' in the same manner and spirit.

A close look at this understanding brings out another implied concept: that of soil conservation. Soil conservation being a function of plant density per unit area, it is immaterial what the species growing on it are so long as the density remains optimum. We need not argue how both extremes of a normal distribution curve of plant density per unit area would be less productive as well as less efficient in conservation. From this point of view a change in species, or in their dominance relationship would not affect classification inspite of change in economic status. We may also recall that very high density would actually be less productive due to overlap and consequent reduction in the efficiency of solar energy and nutrient utilization.

Recommendation that such 'forests' should be located at the edges of cities and other urban settlements underlines their role in defence. Kautilyan 'forests' are apparently of multi-purpose benefit to society.

Thus, we find cultivated forests forming a transition from natural forests by changing species while keeping the density the same. Garden or orchard would be the next step. The

concept of per unit area would make all types of gardens fall in line from the point of view of nature conservation. Their difference would be in their economic returns. This understanding removes the sharp twists and turns between various types of land use.

Recalling the fact that even cultivated land had quite a few trees planted in and around them for purposes of shade and tying of animals as well as for demarcation of territory, etc., further blunts the sharp distinction between agricultural and horticultural land use. Even transition into road and village areas appear not so very sharp as we normally tend to think. Conservational aspect of this fact should be rather obvious.

Kautilya's mention of 'soma forests' provokes one to think in terms of these 'forests' being used for trying plant introduction into new areas "where they earlier did not grow". Second Rock Edict of Emperor Ashoka is an example in mind. In this edict Ashoka very explicitly mentions that he got large number of medicinal plants introduced and grown in areas where these were earlier not growing. Naturally, such a situation would demand protected growth conditions till, firstly, these plants acquire social acceptance and, secondly, till large amount is available for distribution so that each may grow his own supply. Cultivated 'forests' would offer the best alternate that is nearest to natural conditions but provides protection. We should recall that even during the medieval period, a large number of medicinal herbs were cultivated in large or small walled gardens along with a number of trees. Often margins of natural wilderness were used for such purposes, bringing the practice very near to the one inferred from Kautilya.

There is another very interesting aspect to the above tradition. In a modified form it is reflected in the *firman* of Akbar, the Mughal Emperor, that was issued by him on the construction of Hissar Feroza Canal. This canal was originally constructed by Feroz Tughlaq. However, when it got into disuse, Akbar revived it. The *firman* makes use of two older concepts: economic concessions to those who contribute their labour for the construction of canal and plantation of high quality fruit trees all along the two sides of the canal. The first order has obvious economic advantage for the treasury. The

second one has been explained as follows: good quality fruit will attract people to the banks for rest and enjoyment; they will immediately report any damage requiring repairs, damage would be identified at an early stage so that still larger damage is avoided. Moreover, the denser the roots, the more firmly the embankment soil would be held. It is quite obvious that both medieval and ancient periods were not ignorant of the role roots played in retaining soil.

Any account of almost any big urban centre in India would show large areas designated as 'forests' or 'gardens' all around it. While much from the ancient period has perished, accounts of Shahjahanabad or the Walled City of Delhi are still available in their original. They point out deliberate and planned location of such areas around the settlements. Kautilya can be conceptually superimposed upon such medieval settlements. Once the transition appears to be so gradual, we are not justified in considering all areas designated as *jangals* in the same vein as we do today. For such a planned city as Shahjahanabad, were they not put there specifically from the point of view of their role in temperature regime and soil conservation? The point needs fresh and detailed study.

*Arthashastra* underlines an important aspect: nature conservation and economic benefit are not necessarily mutually exclusive. One can acquire benefits from nature and at the same time conserve it. After all Nature is not static. Even species' composition goes on changing over time. Kautilyan concept of Nature is also not static. In this sense it is really very 'natural'. He does not stop change. He seems to direct it into more beneficial channels. His concept of 'forest' or *Jangala* is in fact Nature in its gradual and slow transitions with better results due to conscious channelisation.

Our wrong understanding of Kautilya seems to be the result of our imposition of a late-nineteenth century European concept on a very different Indian cultural situation. Even in Europe, immediately after the fifteenth century, there were planned or cultivated 'forests' round such important urban centres as Paris, Vienna, Rome, Berlin, Petersburg (now Leningrad), Amsterdam, etc. They can still be seen in parts. Only lined growth of trees and planned footpaths distinguish

them from natural wilderness. These are 'forests'. But these are artificial 'forests'. Gradual transitions seem to be common in all societies that care for Nature. It is not exclusive to India. It is only when everything is turned into a commodity for sale and benefit is counted in terms exclusively of money that the problems begin.

## 2

## Cultural Diffusion and Transformation of Habitat in the Malwa Region - India

R.Y. Singh

The archaeological evidences, gathered through excavations during the last three decades have opened new vistas to the historical geographers interested in the problems of cultural diffusion in India. These evidences throw enough light on the spatial and temporal transformation of the habitat system. The Malwa Region has been a notable area for the transformation of cultural complexes by trans-regional adaptations. Three spatio-temporal diffusion episodes are recognised in the light of which sequent occupancy and transformation of habitat have been studied. During the whole period of diffusion with long gaps between first and third episode (approximately 1,000 years) separating two types of urbanisations, the region has functioned as a great selective filter in cultural diffusion.

It is hypothesized that, undoubtedly, 'give and take' principle has been in operation between various corridors of cultural diffusion, that is, Malwa-Ganga-Punjab, or geometrically, in cyclic fashion but starting from the west. Though the early settlers were living in pits and cave dwellings, later on they lived in houses with several rooms. The dwellings were built with definite plans and the settlements had a certain layout. The present habitat reflects the impact of physico-cultural and socio-economic-cultural milieu.

### Introduction

Cultural diffusion implies mobility and migration of ethnic groups from a hearth, the place of origin, to the place of destination. The distribution and spread of the people are well

## **CHANGING DISTRIBUTION OF WILD ANIMALS BETWEEN 16th and 19th CENTURIES AND ITS SIGNIFICANCE FOR THE DYNAMICS OF ECOLOGICAL CHANGES IN MEDIEVAL HINDUSTAN**

**JAWEED ASHRAF**

Among the many animals which find detailed mention in Medieval records, the Elephant and the Tiger are of special interest as they occupy a position of eminence in the food relationships of the jungle. Besides paintings, sculpture and literature of the Medieval period, these animals occupy a place of significance in the official records. Abul Fazl devotes substantial space to the elephants in the *Ain* (vol. I) and *Tuzak-e-Jehangeeri* is full of detailed accounts with dates as to when and where tigers and elephants were hunted. These accounts are first-hand ones, based on personal observations. Their validity as source material for scientific information has been underlined by various authors<sup>1</sup>.

Tiger today is an endangered species. Its distribution has been shrinking for quite some time<sup>2</sup>. Elephants today are a rarity and their distribution is very highly restricted<sup>3</sup>. Modern authorities<sup>4</sup> record only one species of elephant in India.

Places where Jehangeer personally hunted Tigers are mapped in Fig. 1. Information provided in *Jehangeer Nama* has not been depicted in numbers of tigers hunted. Any place where even one hunt is recorded has been transferred as representative of the area and the district in its contemporary boundary has been taken as a whole without corrections for physical features etc. as the area in which tigers were then available. Places where more than one hunt resulted in a number of kills thus finds itself placed on par with places visited only once. This data is juxtaposed

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2. Guy Mountfort (1981) *Saving the Tiger*, Michael Joseph Ltd, London.
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with the places where tiger is found today (sanctuaries and animal reserves only for which reliable data is available). It is not claimed that today tiger is not to be found in any other place. Data concerning present day Pakistan and Bangladesh is not available. Area where tiger was recorded by Jehangeer and is found today are shaded for present day only. These are a few districts in Rajasthan only.

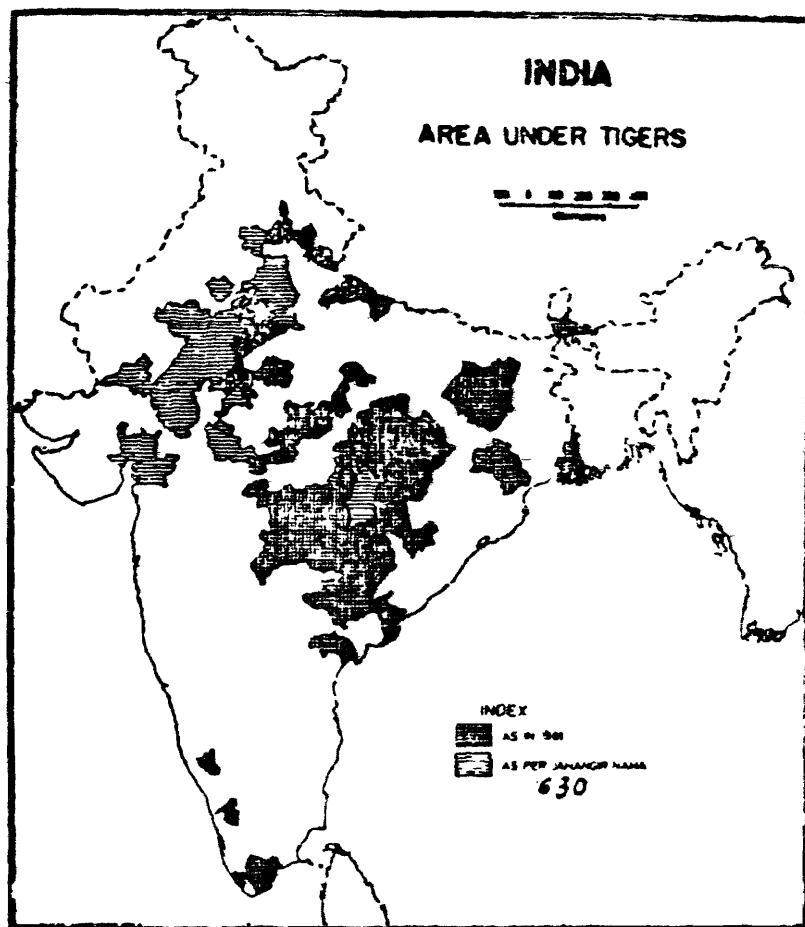


Fig. 1

Information provided by *Ain-e-Akbari* (Book-II, Volume-I) is depicted on Fig. 2 showing the distribution of elephants in his empire. The boundaries are not firm and may require changes in the light of recent studies in the field of historical geography. This fact is not expected to change the basic argument and contentions that the map brings out.

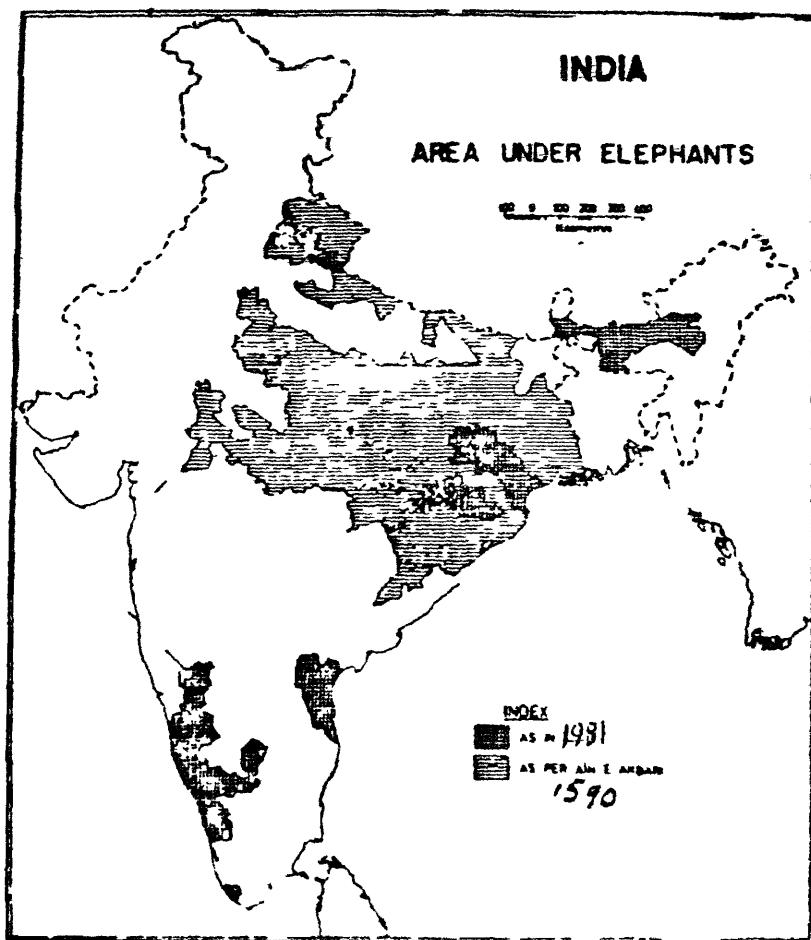


Fig. 2

It is to be noted that in his footnote to the English translation of the Ain, 1873, Blochman mentions the fact that by that time elephants were already extinct from the territory mentioned by Abul Fazl in the Ain. This reduces the time span of disappearance of the elephants to a limit of upto 1850, meaning thereby that in the three centuries lapsing from the time of compilation of the Ain all this territory was cleared of this species. It is of interest to note that Jehangeer goes on record to describe an elephant hunting expedition in the Malwa region in the vicinity of Madu towards Dohad, and, in spite of mismanagement, manages to catch two "excellent specimens"<sup>3</sup>. This account is confirmed by another contemporary

3. *Tuzak-e-Jehangeeri*, (Urdu translation by Salim Wahid Salim, Majlis-e-Tareeqi-e-Adab, Lahore, 1960, p-476.

source<sup>6</sup> indicating that till the reign of Jehangeer, elephants were found in the areas recorded in the Ain. Even as late as the eighth decade of the 19th century Buchanan<sup>7</sup> records the presence of elephants in the Patna district indicating that the distribution of elephants by that time had not changed so completely. The contradiction between Blochman and Patna district report referred to above needs more detailed investigation. It is to be noted that sources other than Ain are not very specific on the subject under discussion.

Tiger fares better in the accounts. In such areas as Mathura and Panipat, tiger hunts of Shahjehan have been recorded<sup>8</sup>. Even during the reign of Aurangzeb tiger was hunted in these areas<sup>9</sup>. Latter accounts<sup>10</sup> indicate that the distribution of tiger has been much wider than that recorded for today. Thus the crucial period for the destruction of tiger can broadly be narrowed down to the present century.

#### **Significance of the Comparative Data**

It can be taken as a fact that major changes in the distribution of wild animals, specially of the tiger and elephants, took place primarily in the second half of the last century and overflowed into the present century. It seems quite probable that this change in the distribution pattern does not imply that the animals have migrated to other localities. There can be only two possible explanations of this fact : either the climate has so drastically changed in the past eight decades so that the forests disappeared due to natural causes or, that the animals have simply been moved down and the forests have been cut down to give way to agricultural expansion during the recent past. Animal-Jungle relations and dependence being what it is, either way if the process begins, the end result is disappearance of both. That this has happened is very obvious.

Before beginning the discussion on the reasons for the drastic change in the distribution of wild animals, we have to make two points explicit. Firstly, presence of these animals and reports of their hunt indicate that the area was predominantly a forest territory and the logic of food rela-

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6. Khwaja Kamgar Husaini (Ed. Azra Alvi), *Maa'sir-i-Jahangiri* (1978), Centre of Advanced Study, Dept. of History, AMU, Aligarh, p. 262.
  7. Francis Buchanan, *An Account of the Districts of Bihar and Patna in 1811-1812*, Vol. II, Books III-V, p. 405.
  8. There are a number of references, e. g. For Mathura see *Amal-i-Salih*, Vol. I, p. 623. for Panipat see Vol. III, p. 198.
  9. *Masahir-i-Alamgiri*, p. 38-39.
  10. For these details see *International Wildlife Encyclopedia*, Vol. 18, pp. 2413-2416.

tions in the form of various food webs chains and pyramids as known today with the implications of their behaviour, both sexual and social was in full operation as demanded by nature. These details are sufficiently well known today<sup>11</sup>. Secondly, the animals being the top of herbivorous and carnivorous food pyramid, imply two different types of forests that dominated in the areas of their presence. Some marginal overlapping cannot be ruled out as the tiger is known to be an animal of not very fastidious choice either in habitat or in food. If true, this fact has serious implication for the study of climatic changes in Hindustan.

Tigers and elephants are not new to India. They have a presence that goes back to the dawn of Indus Valley civilization<sup>12</sup>. Most of this territory is at present devoid of these animals. In Medieval period there are two very authentic reports of personal encounters with another extinct animal, rhinoceros, pointing to very different type of forest that is a logical compulsion of the fact. Ibn Battuta<sup>13</sup> and Babur<sup>14</sup> leave no doubts about the presence of it in Multan area. It has also been reported in the vicinity of Jaunpur as late as the 17th century<sup>15</sup>. This fact implies dense, humid and subtropical to tropical, permanently green forests with high humidity and probably sub-soil water table<sup>16</sup> without which rhino is not likely to survive in nature<sup>17</sup>. This illustration makes it clear that not only the forests have disappeared from this area but the presence of such animals as rhino indicates that the type of dominant forest that existed then, has also undergone a sea-change. Presence of elephants and tigers in nature not only indicates the presence of forest but points to the possible forest type if taken with other collateral and concomitant fact including inferences and observations of modern biology.

Modern authorities have it<sup>18</sup> that the tiger has its origin in Manchuria from where it spread to all the other places, including India. It requires grazing and browsing animals as food, that in their turn require

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- 11. Ibid. also see reference 2 above; Eugene P. Odum, *Fundamentals of Ecology*, 3rd edition (1971) Tappan Co., Japan. Alice, W C. (1931) *Animal Aggregations: A Study in General Sociology*, University of Chicago Press, Chicago.
  - 12. Bridget & R. Allchin (1968), *The Birth of Indian Civilization . India & Pakistan before 500 B.C.*, Pelican Publication
  - 13. *The Rehla of Ibn-e-Battuta*, Tr. & commentary by Mahdi Husain, Oriental Institute of M. S. University of Baroda, Gaekawad's Oriental Series No. CXXII, p. 5-6
  - 14. *Babur Nama*, Book-II, Hindustan, Ed Annette S Beveridge, 1970, p. 657
  - 15. Abul Fazl, *Akbar Nama*, Vol. II & III, Tr. H. Beveridge, 1972, p. 396.
  - 16. *The International Wildlife Encyclopedia*, Vol. 6 p. 709.
  - 17. See ref. 11 above
  - 18. As per reference 2 and *International Wildlife Encyclopedia*, Vol. 18, p. 244.

rich vegetation and dense trees and bushes to sustain and hide them. It has been reported that the Indus Valley was occupied by tigers as late as 1886<sup>19</sup>.

Tiger requires a warm climate with large amount of water that is easily available. It seems that the tiger is not very strict about the type of forest it lives in. "Throughout the Indian sub-continent all types of forests seem acceptable, whether deciduous or evergreen, dry or humid and even thorn forests. In the Indian and Bangladesh mangrove swamps of the Sunderbans...it is completely at home in semi-aquatic surroundings. Along the southern slopes of Himalayas tigers favour the rich forests of the lowland Terai, but although they are seldom seen in the higher coniferous oak and rhododendron forests, they have been not infrequently recorded at altitudes of 12,000 feet and a few even at 13,000 feet. Throughout their huge range, indeed the only limiting factors appear to be the availability of suitable pray, sufficient cover for hunting and ample sources of water, which are particularly vital to tigers in hot south" (emphasis added<sup>20</sup>).

Acceptance of the logic of the above quoted statement means that the area where the tigers were found was jungle with a rich source of diverse fauna and flora. It was certainly not as arid as it appears to be today.

#### The Elephants

Elephants present a different set of logic. While the tiger is not very sophisticated in choice of pray or, consequently, of jungle type, his hunting on an average coming to once or twice a week in so far as the large animals are concerned<sup>21</sup>, the elephants are very heavy eaters. Ain-e-Akbari records the daily ration of food per mature animal as about 2 *man* (maunds) on an average, the variation depending on the category and age of the specimen<sup>22</sup>. It is to be noted that one Man-e-Akbari can be taken to be equal to 55.38 lbs<sup>23</sup>. It is also reported that the animal requires a soft "bed" of fresh leaves for sleeping, indicating that the vegetational requirements for a single animal would be more than the food ration estimates alone. Living in large herds, the concomitant spoilage in movement and "play" should also be taken into account when

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- 19. Reference 2 above, p. 15.
  - 20. Ibid, p. 16.
  - 21. Ibid, p. 27.
  - 22. *International Wildlife Encyclopedia* Vol. 6, p. 709-710. *Ain* (Vol. I, *Ain* 43, 'The Food Allowed to the Elephants', p. 131-132).
  - 23. Irfan Habib, *The Agrarian System of Mughal India*, Urdu translation by J. M. Siddiqui, 1977. National Book Trust, India, p. 499-503.

visualising the type of forest and its productivity to sustain the elephants. Their herds have been reported to be as big as of "upto a thousand elephants". Age of the elephant is estimated to be "one hundred and twenty years"<sup>24</sup>. It is known that elephants eat a large variety of vegetation but not indiscriminately. Their food consists of various grasses, fruits, leaves that are fresh, mostly of the type that grows in subtropical permanent or evergreen forests like banana, sugarcane, mahwa etc.<sup>25</sup> As it is at present confined to coconut growing region, coconuts are considered to be its favourite food. Considering the herd habit, sleeping requirements referred to above and the type of food, it can be concluded that, unlike the tiger, elephants are to be found only in dense perennial tropical or subtropical forests with heavy rainfall or large supplies of permanent flowing water.

From the above data taken from historical sources when coupled with modern and verified knowledge of ecology, one can draw some interesting conclusions as summarised below. Forest line in the period under discussion and the nature of forests in the area under discussion was very much different from what it is today.

#### **Ecological Change**

Naturally the question arises as to why the animals disappeared from the territory that they were occupying once. It can be seen from the information given above that the disappearance in case of tiger is so very recent that evolutionary or slow ecological but natural changes can not account for it, while in case of elephants too it is about a century old, a scale too short for either biological or geological changes to account for it. It seems that both, changes in land use as well as socio-economico-technological factors, played their dominant part in eliminating these apexes of two different types of food pyramids taken as a sample study to establish and verify the method enumerated and tested in this study.

The period under discussion is full of evidence to show that massive expansion of agriculture led to large scale deforestation. Large and dense forests have been recorded, for example, in the Subah of Malwa during the reign of both Shahjehan<sup>26</sup> and Aurangzeb<sup>27</sup>. Large areas

24. Abul Fazl, *Ain-i-Akbari*, tr. & ed. S. L. Goomer, 1871, p. 130.

25. Ibid, p. 128

26. Ibid, p. 132

27. *Amal-i-salih*, 1923, *Bibliotheca Indica*, Vol. 2, p. 110-111.

28. Mohammed Saql Mustaid Khan Ed. Agha Ahmed Ali, 1871, *Ma'atkhir-i-Alamgir*, p. 448-449.

under forests that were very dense have been recorded as late as the end of the last century by Tod for Rajasthan<sup>29</sup>, a region that today is considered to be highly arid and semi-desert. Shifting forest line can be seen by comparing the late 18th century line given by Rennel for East India<sup>30</sup> with that given for late 19th century by the Gazetteer of India, Map Volume<sup>31</sup>. There is concrete evidence to show that the reclamation of forest land had a premium in the form of special concession given to such persons, throughout the period under discussion<sup>32</sup>. Encouragement to forest cutting seems to be the official policy of the time. This must have led to serious shrinking in forest lands, leading to disappearance of these forests and these animals from considerable part of the empire. But this clearing of the forests is by itself not sufficient to account for the big change in such a vast area.

We should recall that introduction of gun transformed the battle field rather fundamentally. Its introduction led to enormous expansion of the killing power of hunters. But then this introduction of a new technology was much earlier to the period in which these animals seem to have disappeared totally. Though it may have increased the amount of kill, the gun cannot be made responsible for elimination of tigers and elephants. Blaming the technology per se would be to delude oneself. Increase in number of killings would have been taken care of by the mechanisms of automatic adjustments of various population levels. Cutting of forests would have restricted the spread. None of these can account for total disappearance as seen today. The facts imply the existence of a social structure or a value-framework that conserved nature either consciously or unconsciously. Their disappearance implies the breakdown of this framework altogether.

There is evidence to show that tiger could only be hunted by the monarch himself or, in case of others, even if a queen, by his permission. Punishment for the violation of hunting norms was death<sup>33</sup>. These hunting norms not only identified the animals that may or may not be hunted, and areas where they could not be hunted freely, but

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- 29. James Tod. *Annals & Antiquities of Rajasthan*. 1971, K. M. N. Publishers, New Delhi, p. 528-529.
  - 30. James Rennell's *Memoir of a Map of Hindustan or the Mughal Empire* (reprint edition, 1975), B. P. Ambashtha, N. V. Publications, Lohapur, Patra-3, sheet-VIII.
  - 31. The *Imperial Gazetteer of India*, Vol. XXVI-Atlas, 1909, Oxford Clarendon Press, New Edition, plate-5.
  - 32. *Ruqqat-e-Alamgiri*, Mustafa Publishing House, Kanpur, 1955 Ruqqat No. 94.
  - 33. *Tuzuk-e-Jahangeeri* p.186; Bernier p. 375.

also identified many other restrictions that were sanctified either by religious or secular edicts and considerations<sup>34</sup>. While some of these considerations have been recorded as shown in documents, it is quite probable that such matters of common knowledge and agreement were not all put down though all of them were practiced. In this socio-cultural milieu gun had very small destructive effect so far as animals were concerned. This point is borne out by the fact that total number of tigers hunted by Jehangeer in his life time between the age of 12 and 50, were only 88<sup>35</sup>. This number stands nowhere to the total of 1000 hunted by the Maharaja of Udaipore or of 1500 killed by the Maharaja of Surguja<sup>36</sup>. Indiscriminate hunting by all and sundry during the recent past bestowed upon the gun that determining significance that changed the total balance against the tiger. May be that the present survival and wider spread as compared to the elephant is due to his eating habits of wide spectrum and non-fastidious living requirements, making it possible to live anywhere on any pray.

While the reasons for the disappearance of the tiger can be seen rather clearly, the elephants pose some problems. They were not only hunted for their tusks<sup>37</sup> but also played an important role in the wars that changed the political map of the country. Being slower breeders and producing smaller litter with a longer period of embryonal development, the elephant had all the elements loaded against him in the battle for survival once the dye was cast. Number of elephants in the army of Akbar was enormous. Military significance of elephants in those days could hardly be over estimated. Because of these reasons Akbar was the first in India who introduced elephant breeding, something that was considered to be undesirable before<sup>38</sup>. The long time taken for the maturity of the animal after birth<sup>39</sup> in all probability kept the army dependent upon catch from the natural reserves and wild state as the major source for the supply. Besides the emperor, others at the lower rung had their own supply from sources that have not always been identified, leaving the possibility of hunts open. The details with which elephant hunting tricks have been recorded strengthens the possibility that catching in the jungle was an important source of replenishment of

34. *Tuzak-e-Jehangeeri* p 41-42, *Ibid* 204-205, *Ain-e-Akbari* (Vol. I, Book II, p 292 308), *Akbar-Nama* (Vol. III p. 333).

35. *Tuzak-e-Jehangeeri*, p 391 92.

36. Guy Mountfort (1981), *Saving the Tiger*, p. 70.

37. *Ain* vol 1 p 127

38. *Ain* Vol 1 p 126

39. *Ibid* p 126-127

supplies at all levels. Besides war, elephant was a source of transport and entertainment<sup>40</sup>. The scale of involvement could be guessed from the fact that there were 101 elephants in the Khalisa or Royal Personal Possession<sup>41</sup>. It is understandable that in any war of consequence their loss would also amount to hundreds, if not thousands in a short span of time<sup>42</sup>. Putting all facts together, it is not improbable that ivory hunting (poaching) at later years and long wars during the reign of Shahjehan and Aurangzeb and later, must have taken a very heavy toll that could not be compensated naturally due to slow breeding. Besides, both during the reign of Shahjehan and Aurangzeb, large tracts of forests were cleared in the Subahs where *Ain* mentions elephants (Ajmer, Malwa, Orissa, Allahabad, etc), thus forcing the animals to gradually retreat as the clearing advanced with time. All this coupled with the introduction of the gun in a changed socio-cultural milieu decided the fate of the elephants. They just disappeared. Being less wide in choice of food and environment they had no way, like tiger, to move out and survive.

#### Conclusions

It can be concluded from the above discussion that during the historical period much has changed in Hindustan. Historical records can go a long way to provide information concerning the ecological conditions of the times gone by and offer some very interesting possibilities for the reconstruction of the ecological past of Hindustan, naturally within reasonable limits of uncertainty. This information, when processed, can go a long way in helping us to understand the dynamics of natural changes, the result of which we see every day. Furthermore, this makes it possible to separate man-made causes from natural causes in the evolution of the environment of the past. Once mapped out, we can have the time series to reconstruct the past that will help us in assessing our natural resource potential for various zones. It is hoped that this method and utilisation of scientific information thus generated, would throw very interesting light on the changing pattern of man-nature relationship during the Medieval period in India.

40. *Ain*, Vol. I, p. 134-139.

41. Ibid, p. 137-138.

42. *Shahnama Munawar Kalam* of Shiv Das Lukhnawi Tr. by Syed Hasan Askari, p. 8.

**Holistic Approach to Projection of Taj Mahal**

**b y**

**Prof. S.C. Pandey**

## HOLISTIC APPROACH TO PROTECTION OF TAJ MAHAL

### 1. Holistic Approach in understanding structure and functions of Environment

It is realised that nature functions as one 'Whole'. Environment is another word for total 'nature'. Total Environment can be visualised as constituted of three components or subenvironment :

- Physical** : constituting all climatic variables (Driving Variables), geology and geomorphology, and Abiotic State Variables as microclimate, soil and water
- Biological** : comprising all plants, all animals, including man as an animal, and microorganism (biotic state variables)
- Socio-cultural** : cultural heritage, social customs, religion, economic status, level of education, politics and crime

The three components are completely integrated to constitute total environment or nature.

We have had several experiences in this country of ill conceived short-sighted gains. Construction of large dams, Ganga Action Plan, Indira Gandhi Canal in Rajasthan, irrational use of fertilizers, pesticides, weedicides, etc., are some of the examples of planning without understanding the holistic functions of nature and have thus resulted into failures and further deterioration of environment. They have created more problems than they have solved. LET IT NOT HAPPEN TO AGRA AND THE TAJ MAHAL.

### 2. The new Integrated Concept of Environmental Management

The importance of World Summit for Social Development in Copenhagen (March 1995) lies in its potential to identify the connections between the political, economic, environmental and social factors intrinsic to equitable and sustainable development. The Summit has the promise to be a watershed in the emergence of a new vision of human development. **THUS, if TAJ MAHAL PROTECTION STANDS AT NO.1, THE PEOPLE AND ECONOMY OF AGRA DO NOT STAND AT NO.2.**

Hence, inorder to find out optimum sustainable relations between the environment and the human society, under the NEW CONCEPT OF INTEGRATED ENVIRONMENTAL MANAGEMENT, we have to develop procedures for the evaluation of environmental consequences of spatially distributed activities. The strategy is to develop integrated analyses of cultural and natural systems. The primary objective of regional environmental analysis is to aid decision makers and managers as they try to cope up with existing problems. Such an effort should :

- i) Forecast and simulate future changes - the science of System Analysis and Modelling
- ii) Evaluate the consequences of alternate plan
- iii) Determine optimum solution to the problem in System context, considering the totallity of environment
- iv) provide the user with information and computational tools so that he can develop solution in the context of totallity of environment.

### 3. Holistic Approach to Protection of TAJ MAHAL and entire TTZ

In Holistic approach, following components of TTZ have to be considered as ONE integrated system :

- :: Macroclimate - Meteorological conditions
- :: Geomorphology, ground and surface water including river Yamuna
- :: vegetation, including crops, and livestock
- :: Man, his cultural heritage, industries, institutes, export and import of commodities, archaeological buildings including Taj Mahal and Tourism

Amputation or neglect or separation of any of the components can not be done since otherwise entire TTZ will collapse. Agra as a whole will suffer in all and every function then.

Towards a functional working solution for sustainable development of TTZ following steps are suggested :

#### IMMEDIATE

#### 3.1 ~~Damage~~ <sup>Protection</sup> and cleaning of Taj Mahal

3.1.1 The white lusture of Taj Mahal is very much present as on

today (Plate 1 - all photographs taken during February 1995). Quality of marble used at all the places in Taj is not uniform. The good quality white marble has been used for graves, Jali around cenotaph and the lower floral designs. All these areas can be brought to original by simple bentonite and water cleaning. On rest of the area marble used has bands of inherent impurites and hence have different shades (PLate 2). The corridor and interior portions of Taj have remained neglected for centuries and so it has turned yellowish due to deposition of dust, dirt and entrapped smoke emitted by burning of candles, incense sticks and the smoke emitted by different modes around Taj in the past, prior to stopping coal engines at Agra Fort, Railway yard and the Thermal Power House, etc. The exterior parts of cenotaph of Taj has the same white lusture as before. Apart from rains, cleaning of Taj has been mostly from outside in the past.

There is evidence right from early days soon after completion of Taj upto as late as now that rain water was seeping through domes and arches. During the seeping of water, it has entered the main structure built of Lahheri bricks and lime plaster, which in turn has dissolved the soluble parts of the material used. This has resulted in some permanent staining and weakening of marble from inside where ever it has remained stagnated behind the inlaid marble slabs and also on where it flowed over through the joints and on the floor (Plates 3 & 4). It has caused some permanent damage like rusting of dowels, joint pins and disintegratin<sup>o</sup> of marble surface near joints. All this has already happened in the past and now complete water tightening of roof and walls is urgently required.

Biological weathering is occurring fast at Taj Mahal. Right at the base of cenotaph, algal blooms (Myxophycease) are coming up (Plate 5). On the outer walls and domes both on sandstone and marble structures, algal blooms and even angiospermic plants have started invasion (Plastes 6, 7 and 8). All this directly proves that SO<sub>2</sub> in the atmosphere is not in effective lethal dose.

On outer sandstone wall calcium and sodium-potassium salts have accumulated upon drying of wet surface and by back-capillary action (Plate 9).

**3.1.2 HENCE, THERE IS IMMEDIATE NEED TO :**

- to find out the existing or possible source of seepage of water in the main structure and all the drainage system be kept properly functioning and no water collection on the marble tiles on the open floor
- replacement of defective marble having cracks or corrosion
- cleaning of Taj Mahal at regular frequent intervals with clean, not saline, water using bentonite clay/aluminium silicate and magnesium silicate and APPLICATION OF PRESERVATIVE COATING ON THE CLEANED SURFACE.

**3.2 Strict enforcement of pollution limits prescribed for the Foundries<sup>and other sources</sup> and immediate closure of defaulting units. But IN THE CONTEXT OF SUSTAINABLE SOCIAL DEVELOPMENT THERE IS NO QUESTION OF SHIFTING the industries out of Agra.**

**3.3 To restore regular electric supply at Agra as the immediate TOP PRIORITY STEPS.**

**STEPS TO BE COMPLETED WITHIN 3 YEARS PERIOD**

**3.4 Regular monitoring by an independent Agency/Institution of Air Pollution at Taj Mahal and 4 other locations in different wind directions understanding monthly contribution, the source, mode and magnitude of journey (of the pollutants) of  $\text{SO}_2$ ,  $\text{N}_2\text{X}$  and SPM from industries, transport, diesel generators and the other major source, the Mathura Refinery; and thereby suggesting suitable abatement measures to minimize air and water pollution.**

The undersigned is ready undertake this work of inventory and monitoring and to prepare dynamic simulation predictive Models valid along long time scale.... It shall be a two-year project.  
Further, the work will also include : understanding dynamics of both chemical and biological weathering and effect of air pollution, if any.

3.5 Liquid and solid waste disposal to be properly managed. Indeed, effect of Air and Water pollution including liquid and solid waster disposal on human and animal health, agriculture and gardens also needs to be urgently known in TTZ. These consituents are effected much earlier than Monuments.

3.6 Covering of TTZ with green mantle and necessarily filling rives Yamuna with water by putting barrage and wier down Taj Mahal. This will immediately minimise the load of SPM,  $\text{SO}_2$  and  $\text{N}_2\text{X}$ .

  
by Prof. S.C.Pandeya

Submitted to Dr.S.Varadrajan  
COMMITTEE for kind perusal.

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