

REPAIRS TO THE TĀJ MAḤAL

By M. S. VATS

(Plate IV)

Most wartime visitors to the Tāj MaḤal found its dome obscured by scaffolding. The Superintendent in charge of the Northern Circle of the Archaeological Survey of India at Agra here gives the reason.

THE Tāj, which deservedly ranks amongst the finest tombs of the world, stands on the right bank of the Jumna, about a mile below Agra Fort, and contains the remains of the Emperor Shāh Jahān (1627-58) and of his favourite wife, Arjumand Bānū Begam, better known as Mumtāzu-z-Zamānī or Mumtāz MaḤal. She was the daughter of Abu-l-Ḥasan, entitled Āsaf Khān Āsaf Jāhī, son of I'timādu-d-Daula Mīrzā Ghayāth, and niece of the illustrious Nūr Jahān, wife of the Emperor Jahāngīr (1605-27). In her twentieth year she was married to Prince Khurram, afterwards the Emperor Shāh Jahān, on Friday the 9th of Rabī' I, 1021 A.H. (10th May, 1612 A.D.) and died on the 7th Ziqa'da, 1040 A.H. (28th June, 1631 A.D.) after giving birth to her fourteenth child, Princess Gauharārā, at Burhānpūr in Khāndes whither she had accompanied her husband on his expedition against Khān Jahān Lodī, the rebellious Governor of the Deccan. Her body was temporarily interred in the garden of Zainābād at Burhānpūr, whence, under the orders of Shāh Jahān, it was brought to Agra after six months on the 17th Jamādī I, 1041 A.H. (11th December, 1631 A.D.) by Prince Shajā', Wazīr Khān and Satīu-n-Nisā Khānam, sister of the poet-laureate, Mīrzā Tālib Almi.

In the meantime a suitable site was selected which, being the garden of Rāja Jai Singh of Jaipur, was duly exchanged for equally valuable State land, and her remains were again temporarily deposited near the present *Bāoli* in a domed structure on the 15th Jamādī II, 1041 A.H. (8th January, 1632 A.D.) until their permanent burial in the mortuary chamber of the Tāj. The Emperor himself died on Monday the 26th of Rajab, 1076 A.H. (1st February, 1666 A.D.) and was buried in the same chamber to the west of Mumtāz MaḤal's grave.

The question as to who designed the Tāj is disputed, but there is epigraphical evidence to show that it was Ustā Aḥmad of Lahore¹. The mausoleum was constructed under the superintendence of Makrāmāt Khān and Mīr 'Abdu-l-Karīm, the dome being built by Ismā'il Khān of Turkey and the inscriptions executed by 'Abdu-l-Ḥaq, better known as Amānat

¹ The *Mathnawī* of Lutfullāh Muhandīs, second son of Ustā Aḥmad of Lahore, which, according to a chronogram in it, was completed in the year 1066 A.H. (1655-56 A.D., i.e. during the reign of Shāh Jahān) pointedly states that Ustā Aḥmad was responsible for the construction of the Tāj, the Delhi Fort and the Jāmi' Masjid at Delhi, besides other imperial buildings.

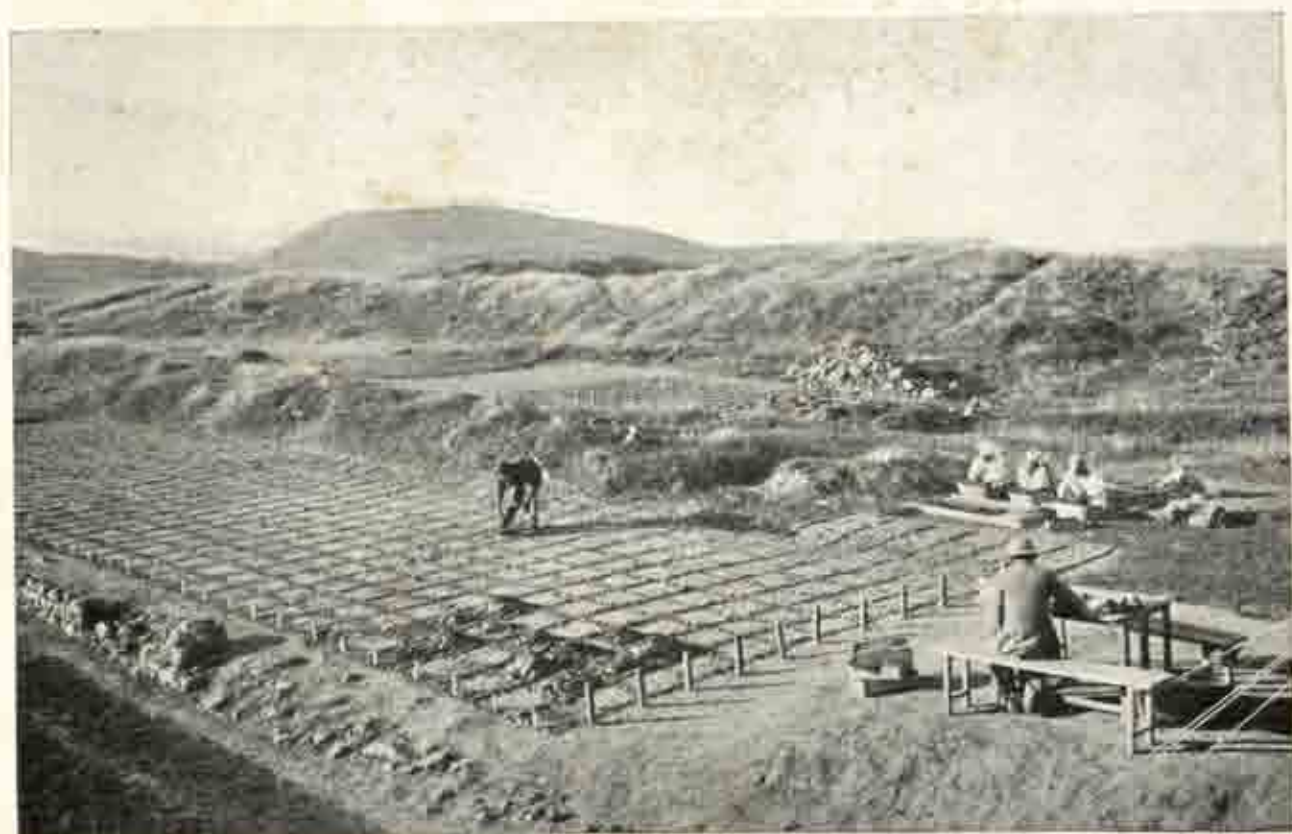
Ustā Aḥmad's eldest son, 'Atāullāh Rashīdī, in his work entitled *Khulāṣatu-l-Hisāb*, also written during the reign of Shāh Jahān, mentions his father as *Mīmār-i-Kul* (Chief Architect) of Shāh Jahān.

His third son, Nūrullāh, was responsible for the inscriptions in the Jāmi' Masjid at Delhi. These facts indicate that Ustā Aḥmad and all his sons had been working at the royal buildings.

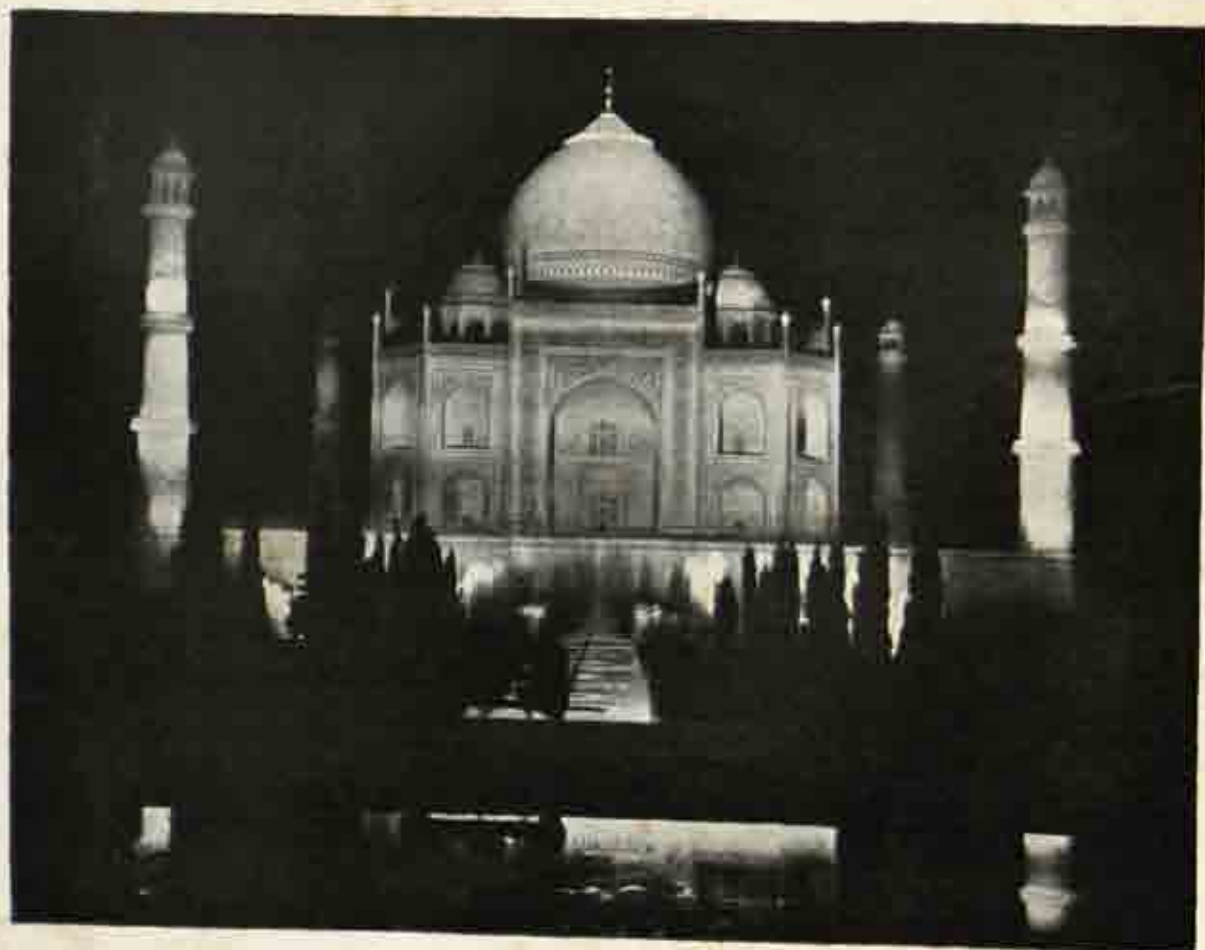
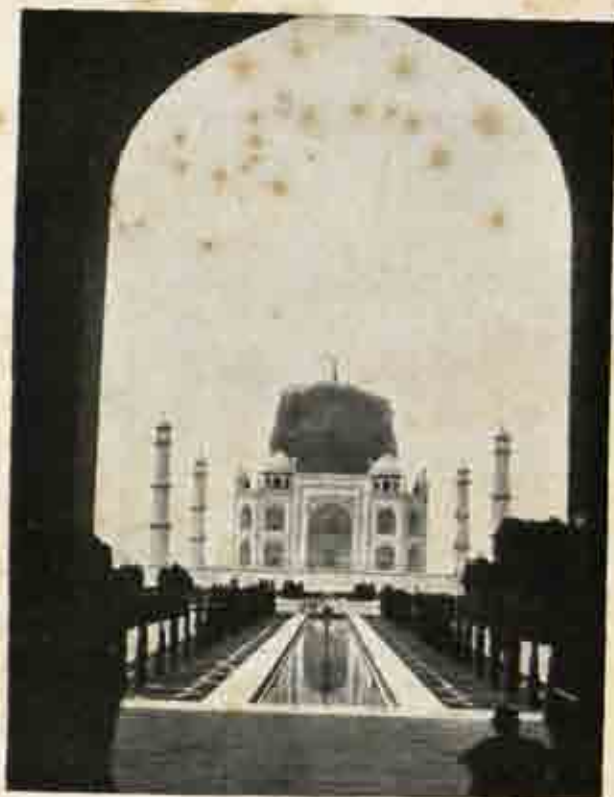
Again, Lutfullāh, in the epigraph engraved by him on his father's tombstone at Aurangābād, confirms that Ustā Aḥmad was the builder of the Tāj, Delhi Fort and the Jāmi' Masjid at Delhi. The cumulative effect of the above evidence is that Ustā Aḥmad of Lahore was probably the designer of the Tāj as shown above; *vide* also the Annual Number of the *Kārwān* for 1934 (Lahore) compiled by Majīd Malik, pp. 125-34.



A. *The Taxila training school: photography at Sirkap.*



B. *The Taxila training school: squares, labelled with the horizontal and vertical locations of strata, for the purpose of sorting pottery as it is brought in from the excavation. In the right foreground the pottery is being marked and registered; in the background it is being washed.*



*The Taj Mahal, Agra. Top right, recent view of scaffolding.
Below, flood-lighting by U.S.A. troops on 'VE' Day, 1945.*

Khān of Shirāz, who was brother of Shāh Jahān's minister, Afzal Khān, and was the best calligraphist of his age. The tomb was begun in 1041 A.H. (1631 A.D.) and completed in 1057 A.H. (1648 A.D.) with the mosque on the west, the *Jawāb* or *Mihmānkhāna* on the east and the main gateway on the south, the outer court and its cloisters being added subsequently and completed in 1653. The white marble so plentifully used came from Makrāna and Rāiwāla in Jaipur State, the red sandstone from Fatehpur Sikri and the neighbourhood of Agra, and the jewels and precious stones from Persia and elsewhere. Mullā 'Abdu-l-Hamid Lāhori, who was instructed by Shāh Jahān to write a detailed history of the Tāj, further informs us in the *Bādshāhnāma* that the foundation was laid on the sub-soil water-level, that the masonry below the ground is stone in lime, and that the platform above ground is of brick in mortar faced with marble veneer. Owing to the proximity of the river the whole fabric together with the four corner *mīnārs* has been made to rest on a firm bed of masonry which seems to have been supported on piers sunk at close intervals in accordance with the usual Mughal practice. The exact cost of the Tāj with its complementary buildings is not known. The recorded expenditure of 50 lakhs of rupees is rightly construed to mean that the above amount was expended on miscellaneous petty charges and the wages of 20,000 workmen, etc., who worked at the Tāj for so many years, but not on the acquisition of marble and semi-precious stones used for inlay.

The history of its repairs is no less interesting. The earliest record of its repairs is available in a letter,¹ dated 1652 A.D., from Prince Aurangzeb to his imperial father, Shāh Jahān, wherein he points out defects in the dome and vaults of the mausoleum, saying, 'the dome of the holy tomb leaked in two places towards the north during the rainy season and so also the fair 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 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 Jamā'at Khāna leaked during the rains and were made watertight. 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 yard² of mortar grout is laid, the semi-domed arches, the galleries and the smaller domes will probably become watertight, but they say that they are unable to suggest any measures of repairs to the main dome'. History is, however, silent about the actual steps taken by the Emperor on the Prince's letter in respect of repairs to the dome.

From subsequent records it is gathered that under the British rule Captain Taylor was appointed in 1810 to execute repairs to the Tāj with the guidance of Col. Hyde, the then acting Chief Engineer, and the entire outer surface of the Tāj was repaired and cleaned, the missing stones replaced, and the mosaic-work completely renewed. But Captain Taylor's use of coloured *chunam* in place of the inlaid stones of the original decoration proved a failure, as the ornamental work done by him was badly damaged during the heavy rains. After a long gap of over half a century, further steps were taken in 1864 when Dr. Murray replaced a number of flowers and broken marble slabs in the octagonal tomb

¹ The original letter is published in the *Muraqqa'-i-Akbarābād*, ed. by Sa'īd Aḥmad (Agra, 1931), p. 43, footnote 2.

² Abu-l-Fazl, in his *Āin-i-Akbarī* (Royal Asiatic Society of Bengal, 1872, II, Bk. iii, pp. 294-6), mentions the names of various 'yards' used in the reigns of Sikandar Shāh Lodi, Humāyūn and Akbar and gives their exact lengths, which ranged from 41 to 46 fingers. According to the *Bādshāhnāma* (Roy. As. Soc. Bengal, 1867, Persian text, I, part ii, p. 237), the *Zara'* (or yard) of Shāh Jahān measured 40 fingers or digits, one digit being equal to $\frac{1}{4}$ "; vide also Webster's *English Dictionary*, p. 623. Thus Shāh Jahān's *Zara'* was equal to 2 ft. 6 in.

chamber. In 1874 Mr. Alexander, Executive Engineer, Agra, carried out more extensive repairs amounting to Rs.70,926. The principal items of his work were the removal of the broken marble, the substitution of new pieces in the vaulted opening, the restoration of some of the inlaid work, the regilding of the finial surmounting the main dome, the rendering of the main dome with Portland cement and the resetting of the pinnacles of the gateway which had fallen down.

Although, as noticed above, superficial defects in stones, etc., were remedied from time to time, no serious attention was paid to the investigation of factors affecting the stability of the structure as a whole. In 1936, however, the Archaeological Survey of India became apprehensive of its deteriorating condition and proposed that the roofs of the second floor should be repaired, that the joints should be filled up with suitable cementing material, and that the fractured marble slabs of the main dome should be either renewed or reset. The estimated cost of these repairs, amounting to Rs.52,944, was duly sanctioned. But in view of the outstanding national importance of the Tāj the Government of India considered it expedient that before implementing any far-reaching measures for its conservation they should be fortified by the recommendations of a Committee of experts. Consequently in January, 1941, an Advisory Committee of five experts was appointed to investigate the causes of deterioration and to suggest adequate measures of repairs. The Committee was expanded in 1942 to include another five experts, and it will not be devoid of interest to give below extracts from the recommendations of the enlarged Committee:—

(a) Rain-water should be prevented from entering the masonry of the dome and the drum. To make the dome watertight, it is necessary that all the stones that have bulged out or cracked be reset or replaced in 'hydraulic lime mortar' with stones to the full height and thickness of a course. Patchwork should be avoided. The joints should be carefully filled with special lime mortar. This process should be repeated whenever necessary.

(b) Cracks in brick masonry should be filled with hydraulic lime mortar. A record should, however, be kept of any reappearance of these cracks in the future. At places where disintegration of mortar inside the vault is suspected, cement mixture should be injected under gravity feed.

(c) All exposed clamps and dowels should be removed and replaced by gun-metal clamps and dowels embedded thoroughly in cement grout.

(d) The joints of the outer facing of marble should be filled with special lime mortar to make the surface waterproof. The pointing of these joints should be done by raking them out to a depth of at least one inch and, if practicable, to three inches and filling them properly with special lime mortar.

(e) The inside surface of the dome should be stripped of plaster and left as such for a couple of years to observe the results of the above treatment of the dome and the drum, and if no defects develop then it should be replastered with hydraulic lime.

(f) The decayed concrete on the top of the inner dome should be removed and replaced with fresh cement concrete.

(g) 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.

(h) The four *chhatris* or pavilions on the roof of the main building need not be dismantled. The domes of these *chhatris* are in a sound condition. The columns supporting the domes have deteriorated and should be rebuilt. The columns can be rebuilt by cribbing the dome and re-erecting the columns in three pieces in marble, namely, the base, the shaft and the capital.

(i) With regard to the *minārs*, the loose stones should be reset in hydraulic lime mortar and the damaged ones renewed. The entire surface should be pointed with special lime mortar and made waterproof.

(j) The entire exposed roof of the main building should be made waterproof by covering it with a suitable waterproofing material. Bituminous preparations should be avoided.

(k) With regard to the inside ventilation of the dome, the Committee urges that the advice of a chemist may be obtained in this respect and that the introduction of a mechanical ventilation device should be held over for the time being.

(l) The Committee considered that 104 Bench Marks on the building should be checked every ten years or after every earthquake and subsidence, if any, and should be carefully watched. Similarly, the verticality of the *minārs* should also be checked every ten years.

(m) A permanent record should also be maintained of all substantial repairs whenever such repairs are carried out.

(n) During the present repairs, it was found that, on raking out the joints of stones in the lower region of the outer surface of the drum, accumulated water oozed out in an appreciable quantity in three places in the south-east part of the dome. Seven gallons of water were found to have accumulated at one of these spots. For further precaution it is suggested that a few more stones, wherever there are signs of dampness in a layer, should be removed and replaced after ejecting the water thoroughly.

(o) The brickwork behind the marble veneering of the dome and the drum should be grouted by means of gravity feed. Holes, $1\frac{1}{2}$ -2 inches in diameter, should be bored in the marble facing wherever there are indications of voids, so that the brickwork behind the marble facing is kept dry.

The above recommendations have been implemented in so far only as they relate to the more urgent work on the marble facing of the drum and the dome and the inlay work on them, leaving the rest of the work to be taken up later when the report of the Committee has been finally approved by the Government of India. In this connection advantage was taken of the scaffolding to reset loose pieces of inlay work and restore the missing ones all over the necking, that is to say, immediately above and below the top of the drum.

During the course of the repairs an interesting detail of construction was brought to light. Behind the marble facing, wherever the surface of the brickwork core did not form an exact circle, it was trued up in the marble facing, the interval between the two, which varied in places, being filled up with lime concrete or with *lakhaurī* brick wedged vertically in lime mortar.

So far, the dead lime plaster from inside the dome has been removed only to a height of 10 ft. all round except on the west where it has been stripped to the full height of 61 ft., that is to say, right up to the red sandstone facing of the intrados of the dome. This also has revealed an interesting feature. Covering the entire surface of the lower part of the drum there is a regular and continuous series of eight relieving arches which adds to the strength of the structure. There are no cracks, worthy of the name, in the brickwork so far uncovered, but some cracks have been noticed higher up on the western side.

Briefly, the report indicates that, whilst much minor repair-work of a somewhat costly kind is necessary and should not be longer delayed, the Tāj is not in imminent danger of collapse and may not be essentially in a very much worse structural condition than when Prince Aurangzeb submitted his adverse report nearly three centuries ago.