## Technique of the Painting Process in the Kailasanatha and Vaikunthaperumal Temples at Kanchipuram

THE Kailasanatha and Vaikunthaperumal temples are situated in Kanchipuram, a town forty-five miles west-south-west of Madras by rail. The former was built during the time of the Pallava king, Narasimhavarman II *alias* Rajasimha (A.D. 680–722)[1] and the latter by Nandivarman II *alias* Pallavamalla (A.D. 725–790)[1].

The paintings in these two temples are some of the best specimens of Hindu mural art of the classical or Ajanta school. Those in the Kailasanatha temple are executed on the inner walls of the cells lining the outer walls of the courtyard. But most of them have either disappeared or faded, due to the vicissitudes of time and environment. These paintings probably belong to the seventh–eighth centuries A.D., and were brought to light in 1931 by the French archæologist, Prof. Jouveau Dubreuil of Pondicherry.

The paintings in the Vaikunthaperumal temple, which probably date from the eighth–ninth centuries A.D., are under the eaves and in the niches (*kudus*) of the central tower or the *vimana*. Most of them have disappeared, leaving only a miniature head. But traces of paint are to be seen everywhere on the *vimana*. The paintings in these two temples are older than those in the Brihadisvara temple at Tanjore[2] or in the temple of Vijayalaya Cholesvaram at Narthamalai in the Pudukottah State[3].

As an extension of my studies on Pallava paintings[4] in India, I recently investigated the methods and materials of Pallava artists in these two temples.

The paintings in these two temples are executed on surfaces of sandstone. The painted stucco consists of the *rinzaffo* or the rough coat of lime plaster with fine lime-wash thereon, the latter being applied while the former was still wet. On the lime-wash is a layer of paint film. In the case of some of the paintings in the Kailasanatha temple, there is no rough plaster, and the paintings are executed on the lime-wash directly applied to the sandstone. The thickness of the rough plaster varies with the inequalities of the surface of the sandstone.

The thicknesses of the different layers composing the stucco are :

| | Kailasanatha temple | Vaikunthaperumal temple |
|---|---|---|
| Painted stucco .. .. .. | 2·1–4·3 mm. | 3·4–4·7 mm. |
| Lime-wash .. .. .. | 0·3 mm. | 0·3 mm. |
| Paint film .. .. .. | 0·3 mm. | 0·3 mm. |

The results of analyses of the rough plasters are as follows :

| | Kailasanatha temple (per cent) | Vaikunthaperumal temple (per cent) |
|---|---|---|
| Moisture .. .. .. .. | 1·08 | 0·17 |
| Carbon dioxide .. .. .. | 9·45 | 21·52 |
| Loss on ignition (excluding moisture and carbon dioxide) .. | 5·66 | 2·66 |
| Silica ($SiO_2$) .. .. .. | 65·37 | 46·63 |
| Iron and alumina ($Fe_2O_3 + Al_2O_3$) | 2·06 | 1·97 |
| Lime (CaO) .. .. .. | 15·71 | 26·73 |
| Sulphuric anhydride ($SO_3$) .. | nil | 0·15 |
| Magnesia (MgO) .. .. .. | nil | 0·04 |
| Undetermined (mostly alkalis) | 0·67 | 0·13 |
| | 100·00 | 100·00 |

The rough plasters in both the temples have been laid in true fresco technique, and they contain only sand as inert material.

The pigments used in these two temples are the same. Carbon has been used for black, yellow and red ochres for yellow and red, and terre verte for green. The pigments have been applied in lime medium or in fresco-secco technique.

Full details of the investigation will be published elsewhere.

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## The Tetrads in Apoda (Amphibia)

WORKERS on urodelan spermatogenesis have reported the occurrence of large multiple rings in the first maturation divisions of the animals of that group. These multiple rings form the most conspicuous of the tetrads in practically every urodele studied. Multiple ring tetrads in Anura are very rare, and are practically confined to some members of the Discoglossidæ (*Alytes obstetricans* Janssens and Willems[1] : *Bombina pachypus* Galgano[2] : *Bombina orientalis* Sato[3]). Swingle[4] reported such multiple ring tetrads in the male sexual cycle of the tadpoles of *Rana catesbiana* of 40–60 mm. length, while in the second larval sexual cycle of this animal the typical anuran kind of tetrads (simple rings) were present. Swingle, and later Iriki[5], advanced the view that the multiple ring tetrad must be regarded as the ancestral type of tetrad in Amphibia and this view has been further emphasized recently by Sato[3], who has found such compound tetrads in *Bombina orientalis*.

The position of Apoda is very interesting in this respect. It has already been reported[1,6,7] that in *Ichthyophis glutinosus* the larger chromosomes form multiple ring tetrads. In this animal the two large V-shaped and one large rod-shaped pair of chromosomes form during meiosis three compound tetrads. I have recently examined *Uraeotyphlus menoni*, another example of Apoda from South India, and in this form I have found that there are three pairs of large V-shaped chromosomes which form compound tetrads. Whether the view that the multiple ring tetrad is the ancestral type in Amphibia be accepted or not, the resemblance between Urodela and Apoda in this respect is very striking. A full description of the spermatogenesis in *Uraeotyphlus menoni* will be published separately.

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