THE PALLAVA PAINTINGS AT CONJEEVARAM—AN INVESTIGATION INTO THE METHODS[1]

By S. Paramasivan

(*Archæological Chemist, Government Museum, Madras*)

Received August 1, 1939

I. Introduction

Conjeevaram (12° 51′ N. & 79° 43′ E.), the ancient Pallava capital, is situated 45 miles west-south-west of Madras on the South Indian Railway. It is rich in temples and shrines. Of them the most important are the Kailasanatha and the Vaikunṭhaperumal temples, which contain ancient wall paintings.

In the Kailasanatha temple, which was built during the time of the Pallava king, Narasimhavarman II *alias* Rajasimha (680–722 A.D.),[2] there are paintings of the 7th–8th centuries A.D. on the inner walls of the narrow cells lining the outer walls of the courtyard.[3] They depict scenes from Hindu mythology. But most of the paintings have faded or disappeared through the vicissitudes of time and elements. The few that have survived were covered with lime wash during recent times. But Prof. Jouveau Dubreuil, the French archæologist of Pondicherry, removed the layer of white wash here and there and brought the paintings to light.

Nandivarman II *alias* Pallavamalla (725–790 A.D.)[2] constructed the Vaikunṭhaperumal temple. The paintings in this temple, probably dating from the 8th–9th centuries A.D., have almost disappeared but for a miniature head under one of the eaves of the central tower or the *Vimāna*. But there are traces of paint everywhere under the eaves and in the niches (*küdus*) of the central tower.

These Pallava paintings are on the classical or Ajanta style, and represent some of the best specimens of Hindu mural art.

II. Experimental Investigations

In order to reconstruct the methods and materials used in these paintings, one has to study and experiment on the *carrier*, the *ground*, the *pigments* and the *binding medium*.[4] Investigations were carried out on some damaged fragments of the *painted stuccoes* which were collected from the two temples.* The *painted stuccoes* consisted of *rough plaster* of lime, which had been applied to the wall, with two successive coats of *fine plaster* and of paint applied one over the other. Some of the *stuccoes* in the Kailasanatha

* The author is indebted to Mr. T. N. Ramachandran of the Archæological Survey of India for his help.

temple were very thin. They had no *rough plaster*, being made up of a layer of lime wash or *fine plaster* supporting the layer of paint. The methods of production of the paintings in the two temples are so similar, that a common discussion of their experimental results will suffice.

(1) *The Carrier.*

The inner walls of the cells in the courtyard of the Kailasanatha temple, and the eaves and the walls of the niches (*küdus*) of the *vimāna* of the Vaikunthaperumal temple serve as the mechanical foundation of the paintings directly supporting the *ground*. They are of sandstone, which are mechanically firm and durable. Their rough surface holds the plaster fast.[5] Their material, being hard and compact, eliminates any possibility of efflorescence occurring on the surface of the paintings.[6] In the Vaikunthaperumal temple, the *ground* and the *paint* have fallen down in several places. The *carrier* has thus become exposed to the elements resulting in further damage to the paintings.

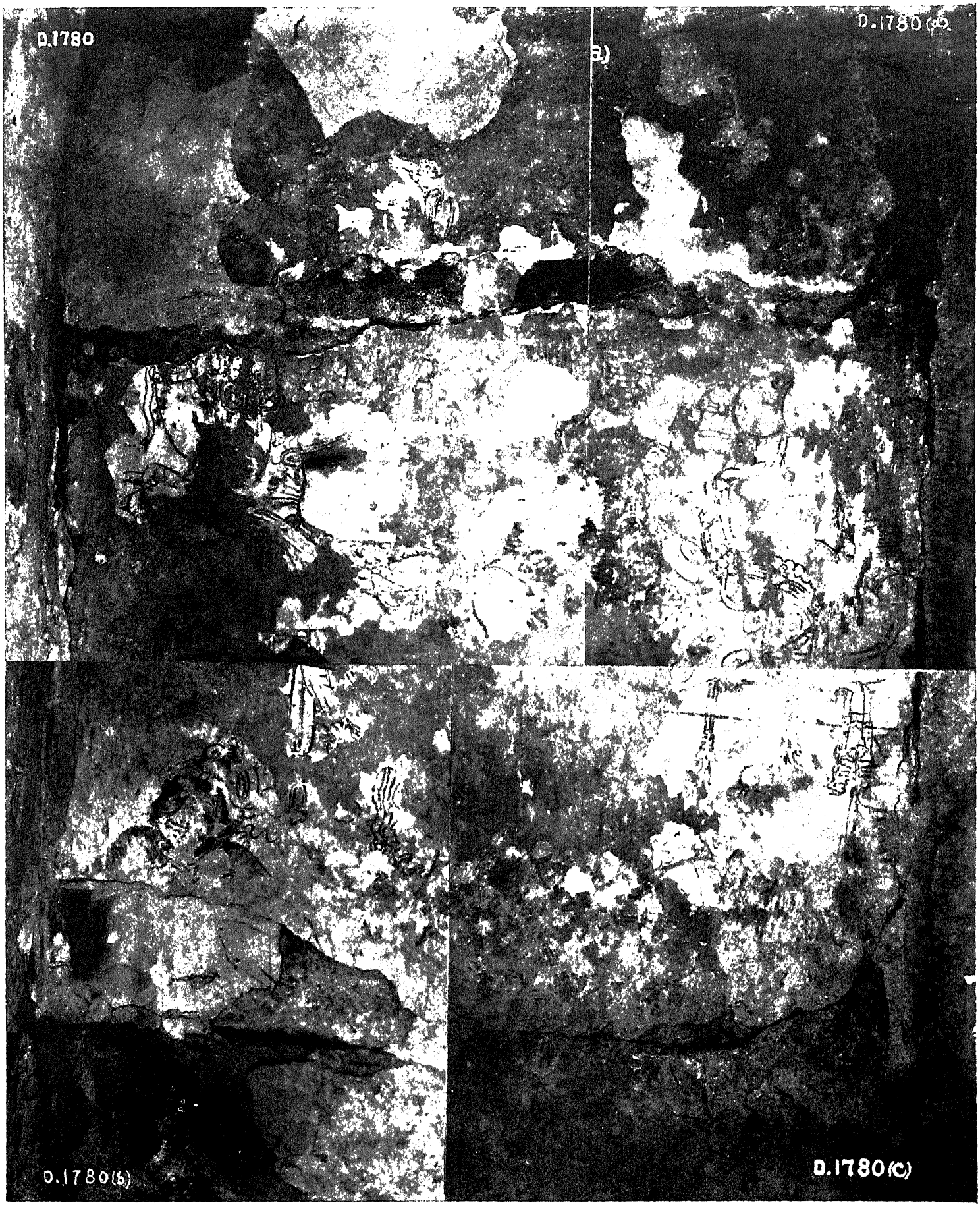
(2) *The Ground.*

In order to determine how the *ground* was prepared and what materials had been used in it, the following experiments were carried out:—

Study of the Microsection. Microsections of the painted stuccoes showing all the different layers composing them, were prepared.[7] On examining them under the microscope, they showed two lines of cleavage or junctions separating three distinct layers, namely, of (1) the *rough plaster*, (ii) the *fine plaster* and (iii) the *paint*. It was possible to effect a separation between the layers of paint and the *fine plaster* with a sharp pin. But it was very difficult to separate the *fine plaster* from the *rough plaster*. In a few places, such separation could be effected with ease. The significance of these results will be discussed later.

The thicknesses of the different layers of the painted stuccoes were as follows:

	Kailasanatha temple mm.	Vaikunthaperumal temple mm.
Painted Stucco ..	2·1–4·3	3·4–4·7
Rough Plaster ..	1·5–3·7	2·8–4·1
Fine Plaster ..	0·3	0·3
Paint film ..	0·3	0·3



3. D. 1780 to 1780 (*c*)—Mutilated painting showing Somaskanda with two attendants in a niche on the north corridor, Kailasanatha temple, Conjeevaram, Chingleput District

The *rough plaster* in the Kailasanatha temple is relatively thinner than in the Vaikunṭhaperumal temple.

Size of Particles in the Rough Plaster.—The *rough plaster* was completely separated from the *fine plaster*. The particles composing it were mechanically separated by Robinson's method[8] and graded according to size. The sizes of the particles and their proportions were as follows :—

	< 200 μ	200 μ–700 μ	> 700 μ
Kailasanatha (*Rough Plaster*) ..	29%	57%	14%
Vaikunṭhaperumal (*Rough Plaster*) ..	29%	57%	14%

Particles less than 200 μ were composed of lime, clay and finer particles of silica. The larger particles were mostly of silica.

Analysis of the Plaster.—In order to ascertain how the *ground* was prepared for supporting the paintings, a few samples of the *rough plaster* completely freed of the *fine plaster* and samples of *fine plaster* completely freed of the *rough plaster* and the paint film, were analysed. The results of chemical analyses of representative specimens of the *rough plaster* were as follows :

	Kailasanatha temple (Per cent.)	Vaikunṭhaperumal temple (Per cent.)
Moisture	1·08	0·17
Carbon dioxide, CO_2	9·45	21·52
Combined water and Organic matter ..	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 alkalies) ..	0·67	0·13
TOTAL ..	100·00	100·00

The samples of *fine plaster* were treated with dilute hydrochloric acid. They disintegrated, dissolved with effervescence and evolution of carbon dioxide, and left behind a residue of fine particles of silica. The acid solution gave tests only for calcium. Thus the fine plaster consists of lime wash.

The results of analyses of the *rough plaster* show that the principal components of the rough plaster are lime and sand, which have brought about the consolidation[9] of the plaster. Here sand serves merely as an

SOMASKANDA
(Blocks lent by Mr. C. Sivaramamurti)

inert material.[10] The rough plaster has been given a coat of lime wash and probably trowelled over to impart smoothness and gloss to the surface.[11] Hence the *ground* has been prepared out of *rough plaster* of lime and covered with lime wash.

The percentage of iron and alumina in the *rough plaster* is very low. It indicates that a pure rich lime having no hydraulic properties has been

used. Gypsum prevents the setting of the plaster in which it might be present and gives rise to efflorescence on the surface of the paintings. Its amount can be gauged from the percentage of sulphuric anhydride, in the results of analysis. But there is no sulphuric anhydride in the Kailasanatha plaster and the proportion of it in the Vaikuṇṭhaperumal plaster is negligible. The low percentage of impurities such as alkalies and other

MAHAPURUSHA
(Blocks lent by Mr. C. Sivaramamurti)

soluble salts, of iron and alumina and of gypsum, the firm adherence of the plaster, the absence of slaking on the *ground* and the fine gloss of the lime wash indicate that some sort of pit lime or specially prepared lime was used.[12] From the good preservation of these paintings it is evident that the Pallava artists have taken the usual precautions against the wetness of sand and open storage of lime.[13]

The *rough plaster* is very thin and varies from 1·5 mm. to 3·7 mm. in the Kailasanatha temple and from 2·8 mm. to 4·1 mm. in the Vaikuṇṭhaperumal temple. Particles of the *rough plaster* taken at different depths from the surface of the paintings showed diminishing percentages of carbon dioxide content. In other words, the *ground* is so very thin that carbon dioxide should have penetrated from the surface to the back.

Inert Materials in the Plaster.—The results of chemical analysis show that sand alone has been added as inert material in the plaster. But if the artists had added marble dust as in ancient Italy[14] or powdered shell or

limestone—the original materials from which the lime might have been prepared, and which give the same reaction as carbonated lime—they would not have been made known in the course of chemical analyses. But density measurements and microscopic examination[15] of the particles of the *rough plaster* and the *fine plaster* indicated that none of them had been added.

The sand grains which serve as the inert material in plaster looked sharp and angular under the microscope and they had contributed to the firmness of the plaster.[16]

Technique of laying the ground.—The percentage of water and organic matter in the Kailasanatha and Vaikuṇṭhaperumal plasters are 5·66 and 2·66 respectively. The next problem is to determine whether this includes any organic binding medium originally added to the plaster to consolidate it. The *rough plaster* was hard, stood prolonged soaking in cold and boiling water, and hence had no organic water-soluble binding medium in it. Methylene blue, methyl violet, acid green and iodoeosin did not leave any stain[17] on the plaster. Thus the plaster did not contain drying oil, glue, albumin or casein as binding medium. Nor did the plaster give Molisch's tests with α-naphthol. Thus there was no gum present. On treatment with dilute hydrochloric acid, the fragment of the plaster disintegrated with evolution of carbon dioxide and separation of silica, the solution giving tests for calcium. Thus lime alone has brought about the consolidation of the plaster. The same is true of the *fine plaster*.

Method of laying the ground.—Thus it will be clear that the artists applied the first coat of *rough plaster* to a thickness varying from 1·5 mm. to 3·7 mm. in the Kailasanatha temple and from 2·8 mm. to 4·1 mm. in the Vaikuṇṭhaperumal temple depending upon the inequalities of the surface of the *carrier*. Over the *rough plaster* was laid a thin coat of lime wash to a thickness of 0·3 mm. and probably trowelled over to impart a smoothness to the surface. Since the latter was applied while the former was still wet, the binding has been very strong and it was difficult to separate the two layers. Wherever the layer of lime wash could be easily separated from the *rough plaster*, the former should have been applied after the latter had dried. It should be mentioned here that in certain places in the Kailasanatha temple, there is no *rough* plaster, but that the *ground* consists mainly of lime wash.

(3) *The Pigments.*

The following pigments were identified[18] in the Kailasanatha and Vaikuṇṭhaperumal temples :—

Yellow ochre
Red ochre

Terre verte
Carbon
Lime

Thus only a limited number of pigments have been employed by the Pallava artists. This might be due to two causes. Firstly, in the fresco process such as is adopted here—and this will be proved presently—pigments which are sensitive to alkalies should not be used with lime. Secondly, the artists might have employed the locally available pigments, which were probably few in number.

(4) *The Binding Medium.*

The paint layer is fairly adhering to the *ground*. The painted surface could be brushed without any damage occurring to it. It stood prolonged soaking in cold and boiling water. Thus there was no water-soluble binding medium in the paint. Methylene blue, methyl violet, acid green or iodoeosin left no stain[19] on the paint film. Thus there was no drying oil, glue, albumin, or casein as the binding medium in the paint. At the same time no vehicle could be extracted with ether, chloroform or carbon disulphide. Under the action of dilute hydrochloric acid a fragment of the paint film disintegrated completely with effervescence and evolution of carbon dioxide, the acid solution giving tests for calcium. Thus only lime has bound the pigments to the *ground*. Since the pigments have not interfused[20] in the plaster *ground* and spread beneath the *stucco* surface, the technique employed is one of *lime medium*. This is also confirmed by the absence of brush marks on the *ground*.[21]

Black wets poorly and a little glue or gum must be added to it before grinding.[22] It has already been shown that the paint film gave no reaction for organic binding medium and that the technique employed in laying them is one of *lime medium*. But the black paint, quite unlike others, answers Molisch's test, giving a violet ring with α-naphthol, which is a characteristic reaction for carbohydrates including gum. At the same time, lime water should have been used in mixing up the pigment to impart to the paintings the characteristics of *lime medium*.

Since the pigments have been laid in *lime medium*, it is not easy to note the extent of the ground that was covered in the course of a single day from an examination of the joinings from day to day's work.[23] Joinings in the plaster are more easily visible in *true fresco* technique than in *lime medium*. Further the coloured background and the considerable damages to which the paintings have been subjected render it impossible to perceive such joinings.

REFERENCES

1. *Nature*, 1938, **142**, 757.
2. C. Minakshi, " Administration and Social Life under the Pallavas " (Madras University), 1938, p. 117.
   N. Venkataramanayya, " The Date of Nandivarman Pallavamalla, " *Jour. Ori. Research*, **8**, p. 1*ff*.
   For other dates, *vide* Prof. Jouveau Dubreuil, Ancient History of the Deccan, (Pondicherry : Modern Press), 1920, p. 70.
3. "A Discovery of Some Ancient Paintings of Southern India," *The Students' Own Magazine*, Calve College, (Pondicherry: 1931, **1**, No. 2).
   T. N. Ramachandran, " The Royal Artist Mahendravarman I, " (Reprinted from *the Journal of Oriental Research*, Madras), pp. 27–28.
   C. Sivaramamurti, " Paintings from the Kailasanatha Temple, " *Jour. Ori. Research*, Madras, (1938), **11**, pp. 73–76.
4. Daniel V. Thompson, " The Materials of Medieval Painting " (Yale University Press : New Haven), 1936, pp. 43–47.
5. ————, *Loc. cit.*, p. 39.
6. S. Paramasivan, " The Mural Paintings in the Brihadisvara Temple at Tanjore—An Investigation into the Method," *Technical Studies* (Harvard), 1936–37, **5**, 224.
7. ————, " Technique of the Painting Process in the Temple of Vijayalaya Cholisvaram in the Pudukkottai State," *Proc. Ind. Acad. Sci.*, 1938, **7**, p. 284.
8. Norman G. Comber, "An Introduction to the Scientific Study of the Soil" (Arnold), 1927, pp. 48–49.
   G. W. Robinson, " Soils : Their Origin, Constitution and Classification" (Murby), 1932, pp. 12–13.
9. J. W. Mellor, " A Comprehensive Treatise on Inorganic and Theoretial Chemistry (Longmans, Green & Company, 1923), **3**, 677.
10. *Proc. Ind. Acad. Sci.*, **7**, 286.
11. *Loc. cit.*, p. 288.
12. Max Dœrner, "The Materials of the Artist and their Use in Painting," translated. (New York : Harcourt, Brace & Company), 1934, p. 269.
13. *Technical Studies* (Harvard), 1936–37, **5**, p. 231.
14. A. P. Laurie, Greek and Roman Painting (Cambridge University Press), 1910, p. 75–86.
15. *Proc. Ind. Acad. Sci.*, 1938, **7**, 286–87.
16. *Technical Studies* (Harvard), 1936–37, **5**, 230–31.
17. William Ostwald, "Iconoscopic Studies (Microscopic Identification of Homogeneous Binding Mediums) translated," *Technical Studies*, 1935–36, **4**, pp. 135–44.
18. Martin de Wild, The Scientific Examination of Pictures, (London : G. Bell & Sons, Ltd)., 1929.
    R. G. Gettens and G. L. Stout, " The Stage Microscope in the Routine Examination of Paintings," *Technical Studies* (Harvard), 1936–37, **4**, 224–28.
19. William Ostwald, *Loc. cit.*
20. Mary Hamilton Swindler, Ancient Painting (New Haven : Yale University Press), 1929, p. 418.
21. *Technical Studies* (Harvard University), 1936–37, **5**, p. 234.
22. *Loc. cit.*, p. 233.
23. *Loc. cit.*, pp. 237–240.