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Read the following papers:—

No. 194. From Surgeon E. NICHOLSON, British Medical Service, on special duty, Public Works Department, to Colonel G. W. WALKER, R.E., Secretary to Government, Public Works Department, dated Bangalore, 26th August 1874, No. 88:—

I HAVE the honor to forward this day by packet-mail a part of my concluding report on limestones and cements. The remainder (the descriptive list of limestones) will be finished by the 31st instant and forwarded without delay, but I have thought it advisable to send the first part at once, and to state that the work will be concluded on the 31st instant, the date fixed by order of Government.

No. 195. From the same Officer, dated Bangalore, 30th September 1874, No. 91.

I HAVE the honor to submit the last part of my concluding Report; the part containing the last experiments on limes and cement has already been forwarded; that now despatched* contains the detailed examination of the specimens of limestones sent from various parts of the Presidency.

* By packet post.

2. I have thought that some of these specimens might be advantageously kept for record, and have accordingly prepared two boxes containing—

I.—A series of typical limestones.

II.—A series illustrating the development of the various kinds of recent limestones.

I have forwarded these to the District Engineer, Bangalore, for favor of transmission to you.

3. Thinking that possibly it might be useful for District Engineers to have in their offices a case of typical limestones for comparison with those found in their districts, I have prepared ten similar cases, which can be made available for distribution as far as they go. Should further series be required they can be made up from surplus specimens without trouble, at a cost of about Rupees 4 each for the cases.

CONCLUDING REPORT OF EXPERIMENTS ON CEMENTS AND LIMESTONES.

Experiments on the relative adhesion of mortars to brick and to stone.

1. In the former series of experiments adhesive strength was tested only with regard to bricks; but I found that these, although of excellent quality, often yielded under a strain insufficient to rupture the mortar by which a pair was united. At 300 lbs. to 400 lbs. on the crossed bricks (17 to 22 lbs. per square inch) the bricks peel somewhat at the moment of rupture. Above 400 lbs. the bricks, weakened by a month's immersion in water (often for the second or third time), are liable to break off outside the joint; sometimes the strain will tear a large piece out of one brick, the joint standing perfect. This generally occurs between 500 lbs. and 540 lbs. (28 to 30 lbs. per square inch.) Being therefore unable to ascertain the maximum strength of mortars requiring a greater strain that the bricks would stand, I had

two dozen pairs of bricks cut out of the burnt stone (gneiss) of Bangalore, and of the same breadth as the clay bricks. With these I was able to test the strength of the best cements. I was somewhat surprised to find that the adhesive strength to stone was invariably greater than to brick; the proportion varied with different compositions, but was on the average 1·7 to 1. This rule holds good in the case of the weakest sand mortar as well as in that of the strongest surki or Portland cements.

On the best way of using mortars of sand and fat lime.

2. In paragraph 14 of my last Report I stated that "the hardening of this mortar being entirely due to dessication, it is not necessary that the bricks should be soaked in water * * * saturation of the bricks is positively detrimental; it is sufficient if they are dipped into water for a few seconds immediately before laying." I have since made some experiments on this point:—

TABLE I.

Adhesive strength of joints made with mortar of 1 *shell lime paste*, 2 *sand. Means of five trials.*

	Breaking Weight.	Lbs. per sqr. inch.
	LBS.	
A.—Bricks dry, mortar rather stiff	39	2·1
B.— Do. mortar rather thin	57	3·1
C.— Do. do. do. but the bricks dashed with water from a pot ...	67	3·7
D.—Bricks soaked 10 seconds, mortar rather stiff	82	4·5
E.—Bricks soaked 2 hours, do.	56	3·1
F.—Bricks soaked 2 hours, drained 1 hour, do.	67	3·7
G. Stones wetted, do.	136	7·2

These experiments show that the opinion I ventured was correct, the best results being given when the bricks were soaked for a few seconds only, the next best when wetted in the fashion usual with careful bricklayers. However, bad is the best with mortars of this kind.

On the necessity of keeping hydraulic mortars wet.

3. The former series of experiments included numerous examples of the great advantage obtained by the immediate immersion of joints made with mortars of fat lime and surki. The rule did not hold good in the case of mortars made with moderately hydraulic lime and surki, but it was invariable in the case of fat lime even when the joint had had the advantage of being made with bricks already saturated with water. The following series illustrates this point, one of considerable importance in practice. The sample of mortar was not a good one, but the relative strength of the series is not affected by this.

TABLE II.

Adhesive strength of brick joints made with 1 *shell lime paste* 1 *surki, after* 28 *days.*

	Lbs. per sqr. inch.
A.—Bricks dry, mortar rather thin	1·4
B.—Bricks dipped in water 1 minute do.	2·3
C.—Bricks saturated, do.	6·7
D.—Same as C., but immediately immersed	16·7

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Perfect immersion, though beneficial, is not absolutely necessary. If the bricks C. had been kept moist for a month they would have given results nearly as good as D.

4. I also found that brick joints immersed at once gave better results than those kept 24 hours in air before immersion. Stone joints are not so much affected by dryness, the porosity of stone being so small that the joint retains its moisture much longer. It has frequently happened that joints kept in air have shown nearly as great strength as the immersed joints; but for once that this happens I have found five times that the dry joints are much weaker than those which were kept immersed.

On the best proportions for mortars of fat lime and surki to be used in masonry and brickwork.

5. In my last Report it will be seen that the strength given by different proportions of shell-lime paste and of surki from Sappers and Miners bricks was as follows:—

TABLE III.

Composition of Cement.	Adhesive strength.	Tensile strength.
	Lbs. per sqr. inch.	Lbs. per sqr. inch.
1 Lime paste, 1½ surki	20·5	62
Do. 2	11·1	91
Do. 3	17 to 27	95
Do. 4	10	114
Do. 5	9	90
Do. 7	5	57
Do. 10	4·4	50

The results obtained with three parts of surki were exceptionally good, while those given by one part and by two parts were exceptionally low, hence a discrepancy. I therefore made a fresh series of experiments, and found that while the adhesive strength remained very fair with as much as five parts of surki, yet that it diminished with each increase. The tensile strength, on the contrary, increased with the proportion of surki up to five parts. As this question of the best proportion of surki is mixed with that of the substitution or the addition of sand in these surki cements, I give the experiments on both in one Table (IV.)

6. The brick joints were immersed at once and tried after 28 days; the brickets were immersed after one day and also tried at 28 days of age.

TABLE IV.

Composition of Cement.	Neat Surki Cement.		Cement with equal Volume of Sand.	
	Adhesive strength.	Tensile strength.	Adhesive strength.	Tensile strength.
	Lbs. per sq. in.	Lbs. per sq. in.	Lbs. per sq. in.	Lbs. per sq. in.
1 Lime paste, 1 surki	32	130	20·8	144
1 do. 1½ do.	16·9	145	8·9	120
1 do. 2 do.	18·8	130	7·1	116
1 do. 3 do.	11·2	125	1*	156
Mean	.....	132	.....	134

* This is rather low. It may rise to as much as 11·2 lbs. (see paragraph 22), but at this point the strength is very capricious.

From this table it will be seen, 1st that, adhesive strength, though good with all proportions within rather wide limits, yet decreases with an addition of surki beyond one part; 2nd, that the adhesive strength of these mixtures diminishes still more rapidly when they are diluted with sand; 3rd, that for tensile strength the proportion of surki is immaterial; 4th, that the tensile strength is on the average fully as good when the cement is diluted with sand as when it is used neat.

7. Another set of experiments showed that a half-part of surki is too small a proportion, and confirmed the inference to be drawn from Table IV. that the adhesive strength is affected by the addition of sand in proportion of the quantity of surki. These experiments were made with a kunkur lime very slightly hydraulic; the joints were tried after 28 days immersion.

TABLE V.

	Neat lime or sand mortar.	Surki Cement.		
		Neat.		With equal volume of sand.
	Lbs. per sq. in. Brick.	Lbs. per sq. in. Brick.	Lbs. per sq. in. Stone.	Lbs. per sq. in. Brick.
Lime paste, neat	3·8	.....	.....	.....
Do. 1 sand	2·7	.....	.....	.....
Do. 2 do.	7·8	.....	.....	.....
Do. ½ surki	.....	18·3	27·6	19·4
Do. 1 do.	.....	29·3	59·3	15·6

8. From these last two tables the following practical rules may be deduced:—

a.—The best surki cement for masonry is made with one of surki to one of lime paste (or an quivalent quantity of slaked lime); after 28 days under water it is stronger than the best bricks, and with stone it stands a disruptive force of nearly 60 lbs. per square inch.

b.—When rapidity of setting is an object the proportion of surki can be increased to two parts; this proportion causes quicker setting, but with some loss of strength.

c.—When economy is an object the cement made with one of surki to one of lime paste may be diluted with an equal volume (1½ parts) of sand; the mortar will be as strong as good bricks.

d.—When greater economy is an object, especially in the case of rubble masonry, where a great quantity of mortar is used and the work is more of the nature of concrete (requiring tensile rather than adhesive strength), two parts of surki may be used to one of lime paste, and the cement diluted with an equal volume (2½ parts) of sand.

e.—Where the rubble masonry is required to be specially good, two proportions may be used:—one lime to one surki for laying the stone; one lime, two surki, two and a half sand for grouting; the latter of course to be filled in before the jelly is placed in the interstices of the stones.

f.—The latter proportion, one lime two surki, diluted with an equal volume (two and a half) of sand, may advantageously be employed where the bricks are of inferior quality. It is still much stronger than ordinary country bricks. I prefer throwing in the sand after the lime and surki have been mixed together in the mill with a full quantity of water.

g.—When the lime is more or less hydraulic the foregoing proportions still hold good. There is some advantage in the lime being hydraulic, as the adhesive strength of the surki cement which it yields is less dependent on moisture than is the case when fat lime is used. For superstructures a surki cement made with fairly hydraulic lime gives perhaps the best guarantee of strength.

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On the use of Surki cement for concrete and for plastering.

9. It has been seen that the greatest tensile strength was obtained by the use of three or four parts of surki to one of lime paste, and that this cement would bear dilution with an equal quantity (three parts), or even more, of sand not only without loss of tensile strength, but even with positive gain, besides acquiring hardness. I would not, however, advise greater proportions than three of surki to be used, as beyond this limit the cement becomes soft; nor more than an equal volume (or perhaps a volume and a half) of sand in dilution. The proportions I have mentioned, one lime, three surki, three sand, may be taken as the standard when the lime is fairly rich. When the lime is meagre or slightly hydraulic the proportions of surki may be reduced to two with advantage. The standard proportion gives a tensile strength (after 28 days, of which 27 in water) of 127 lbs. per square inch, according to the experiments in my last Report, or even more in the present series. The mean tensile strength of the four compositions given in Table IV. is 134 lbs., the most economical of them being the best. This strength is little inferior to that of Portland cement diluted with an equal volume of sand, and far superior to that of the more diluted mixtures ordinarily used.

10. For work in large masses, such as foundations or large blocks of artificial stone, I can see no objection to the use of this concrete mortar in any place where the material can be procured. But for thin work, such as plastering, there is an objection, though not so formidable a one as would at first appear. There is no doubt that surki mortar plastering has a great tendency to crack; this can be in a great measure, if not entirely, obviated by keeping the surface constantly wet, and by good workmanship; yet these precautions are often inapplicable. However, I have not found much practical disadvantage in this respect; I admit that cracks are unsightly and impair the water-tightness of walls, but they can generally be avoided in hydraulic works where impermeability is most important, or in the interior of buildings; and in work exposed to the sun, such as the outer plastering of a building, they are of little consequence, and are filled up when the walls are whitewashed or colored.

I have used this mortar in making terrace roofs; they are lighter than those made with common mortar, as only two or three layers of tiles are required; they do not get saturated in wet weather, and much less timber is needed to support them, not only from their lightness but also from their strength. In many cases the timber is principally useful as a centering, and could be in great part removed after three or four weeks. If I may be excused giving my experience on a part of the subject which is hardly within my professional competence, I would submit the following examples of work done with this mortar:—

a.—I made a verandah to a stable, it is 36 feet long, 7 feet wide; supported on the outside by four stone posts and bearing on three bressummers of jungle wood, each 10½ feet between the supports, and of very light scantling (4 inches deep, 3 inches broad). The rafters are bamboo, the reapers junglewood. The roof is 2 inches thick, composed of two layers of flat tiles, the upper layer laid in and covered with the surki cement mortar.

b.—I also made an experimental arch, 10 feet in span with 10 inches rise; it is flat above, being 12 inches thick at the haunches and 2 inches at the crown. Its width is 2 feet; it abuts on two piers each of 2 feet square. The middle half of the arch, where it is less than 4 inches thick, is made of mortar alone (one lime, two surki, three sand,) the remainder of concrete, two volumes of gravel with one of mortar. Owing to the thinness of the arch, and either to my neglect of protecting it from the sun by a covering of wet sand, or perhaps to some settlement in the piers, two cracks appeared, one across the crown, another at a foot and a half on one side of the first. These cracks were cleaned out to the depth of one-third inch and filled with Portland cement and sand; and a few days afterwards (one month after the arch was made) the centerings were removed. It was then seen that the cracks extended right through the arch; yet there are no signs of weakness, and it supports a weight of 1,000 lbs. on the crown.

c.—The impermeability to wet of plastering made with this mortar is so good, that brick in mud walls are perfectly protected by it, even when exposed to constant wet.

Small cisterns in earth, made of brick in mud, half a brick thick, and plastered inside with this mortar, can be filled with water within a few hours of the plaster being polished.

d.—For floors and walls of bath-rooms this mortar is well adapted; it does not become saturated with water; it is always clean, and as a floor it lasts much longer than the ordinary mortar.

On the best way of using mortars of sand and hydraulic lime.

11. In the foregoing observations I have referred principally to surki cements made with fat lime, such as that obtained from shells, from Cuddapah stone, from chalky kunkur, etc., (see paragraph 38.)

Where hydraulic limes are procurable, there is of course less advantage in the employment of surki cement mortar, except from economy, and the use of sand mortar then has advantage in certain circumstances. Sand mortars of hydraulic lime doubtless deteriorate by keeping, and by having to be beaten up again when required for use, though to a less extent than surki cement mortars.* Sand mortars also require less moisture during setting; they do not demand such skilled labor or so much supervision. Moreover, good hydraulic lime is often

* Where the work does not require any very great strength, as in the case of plastering, or of grouting for rubble masonry, surki cement mortar may be kept for as much as a week without notable detriment. In this case the mass should be broken up and allowed to dry rather than to set, so that the powder can be beaten up again with water when required.

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procurable very cheap in parts of the country where good surki may not be obtainable except at a considerable cost. For these reasons sand mortar is sometimes preferable to surki cement mortar, especially for petty works. To give an example, in Bangalore excellent hydraulic lime can be procured, but at a high price, 1 Rupee to 1½ Rupee per parah; as surki can be made very cheaply it will still be economical to use surki cement mortar. But 20 miles away the same lime may cost only half a rupee, while it is difficult to ensure good surki being used: water may have to be brought from a long distance, and supervision may necessarily be irregular. In this case there is manifest advantage in using sand mortar, of course on the understanding that the lime is up to a certain hydraulic standard. This standard I place at the ability to set within seven days under water when tested by Vicat's needle, (B. in Table VI.)

12. But whatever combinations be used in making mortar with hydraulic lime, I would recommend that the usual method of slaking and beating the lime be abandoned. The hydraulic limes from kunkur stone are usually so little homogenous that the nodules may separate, when slaked, into flakes of fat lime and cores so strongly hydraulic as to be incapable of slaking. The latter are separated by beating and usually rejected as 'kuppy.' I need hardly say that I am supposing the lime to be well burnt; and since paying attention to the subject, I have found, as far as my small experience goes, that the Indian lime-burner works very honestly. Any quantity under 10 per cent. of carbonate remaining in a lime may be taken as moderate, and I have never found this number exceeded in a Bangalore quick lime; 4 or 5 per cent. is the more usual number. These facts, which I obtained since using the calcimeter regularly on every sample of lime burnt or bought, are in correction of my remarks on the nature of kuppy in paragraph 15 of my former Report. The cores, when hydrated and left to the action of the air, soon become carbonated and simulate a refuse of badly burnt and very meagre limestone.

13. The following experiments illustrate the ill-effects of the usual treatment of hydraulic lime. The specimen was the common lime of Bangalore, bought from the bazaar; it is made from a good clayey kunkur, and had in this case the following composition:—

Silicates	40
Carbonate of lime	8·8
Quick lime	(51·2)

When the lime was slaked and beaten the kuppy was found to contain 10 per cent. of carbonate.

TABLE VI.

	Setting days; with the 3 loaded needles.			Adhesive strength, neat; bricks 28 days immersed.
	A.	B.	C.	
Lime slaked and beaten free of kuppy	8	13	24	2 lbs. per square inch.
Kuppy alone, ground	1⅝	2	2½	25·4*
Lime slaked and ground with kuppy	8	15	28	2
Lime ground quick and then slaked	3	4	7	19·6
The same, with equal volume of kuppy added ...	1	2	3	27·6*

* The bricks broke off at this strain, joints standing good.

14. From these experiments it would appear that the proper way to obtain the full hydraulic properties of the lime is to grind it quick and slake it afterwards. Slaking it and then grinding it yields very poor results; I surmise that the kuppy when hydrated already is incapable of exercising any influence over the remainder of the lime, but if distributed through the lime before slaking its full effect is obtained.

15. From some experiments on a large scale, I may state that there appears to be no practical objection to this plan of grinding hydraulic lime before slaking. The quick-lime is ground in the common lime mill and sifted through a 12-mesh sieve; it may now be left heaped under cover; it slakes spontaneously without any loss of hydraulic properties and absorbs carbonic acid very slowly. When the sand to be used is dry I would recommend that the lime thus ground be at once mixed with it (two or even three parts) and left until required for mixing. One advantage of this plan is that the lime is less liable to be stolen.

16. Absorption of carbonic acid from the air affects a heap of ground quick lime very slowly; some Bangalore quick lime ground very fine and left undisturbed in a bucket was found after four months to contain the following proportions of carbonated lime:—

At the surface	... ...	9·2 per cent.
One inch below	... ...	5·2 ,,
In the middle	... ...	4·8 ,,

Some of the same lime kept in a bottle contained 4·6 per cent. of carbonate. The lime left in the bucket had increased in volume by about one-half; when reduced to paste it gave out but slight heat, being nearly completely slaked; its hydraulic qualities were present as when it was fresh.

On mixing the materials for surki cement mortar.

17. If the lime is fat and slakes freely, leaving little or no 'kuppy' except foreign matters, it can be slaked and mixed with the surki, the mixture being kept until wanted. The volume of lime after slaking is rather variable, and as the paste is taken as the active volume of the lime, it is needful to ascertain how much of it is equal to one part of paste. The following examples show the quantity of slaked lime and paste obtained from some typical limes. All, except the first, were measured ground; 110 parts quick lime ground are roughly equal to 100 or 120 of it in lump.

TABLE VII.

Sp. Gr. in bulk.	Kind of Lime.	Quick.	Slaked.	Paste.
1·06	Shell lime (fat) not ground and underburnt ..	100	200	133
1·05	No. 13 (slightly hydraulic)	100	252	132
·91	,, 16 (slightly hydraulic)	100	210	144
·91	,, 26 (fair hydraulic)	100	200	108
1·04	Bangalore (fair hydraulic)	100	149	100
1·	No. 75 (good hydraulic)	100	112	88
·96	,, 24 (very strongly hydraulic)	100	111	63

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18. Roughly speaking the fatter a lime the more slaked lime and paste does it produce. Quick lime ground gives more slaked lime than when slaked in lump; but the quantity of paste will be the same.

Fat lime slaked in lump, 1 paste = 1½ slaked or ¾ quick.
Do. ground, 1 ,, = 2 ,, or ⅔ ,,
Hydraulic do. do. 1 ,, = 1⅓ ,, or 1 ,,

19. If a hydraulic lime is to be made into surki cement, it may advantageously, though not necessarily, be treated in the same way as for sand mortar. The ground lime is mixed with the proper proportion of surki and left heaped under cover until required. If a fairly hydraulic lime, one part of ground lime (which is about equal to its volume in paste,) is mixed with two parts of surki for concrete, rubble masonry or common brickwork, with one part if for the best masonry or brickwork. When required, three parahs of the mixture are placed in the mill and mixed along with a sufficiency of water. If mortar be required, then to the mixed cement two to three parahs of sand are added, according to the quality of the work.

20. When the lime is fat and slakes perfectly, there is no object in grinding it before slaking; one and a half part of slaked lime (equal to one of paste) can be mixed with two or even three of surki if for concrete, with one of surki if for fine brickwork or masonry. When required for use three parahs of this mixture are taken, mixed in the mill and sand added if required.

21. I prefer to add the sand after the cement has been mixed. If the mortar is for concrete, it is important that it should be as stiff as possible, and this stiffness is attained by mixing the cement with sufficient mortar to temper it well and adding the sand afterwards. When the whole of the materials are placed in the mill at once much more water is required, and the mortar is generally too thin for concrete. There is no difference in the strength (tensile) of the concrete whichever way it is made (see next section). When the ground quick lime and surki have been kept together as I have suggested, it is advisable to mix them well into paste before adding the sand in order to ensure perfect slaking. I have never found any defects from this possible cause, but it is a reasonable precaution to take. After the sand is added very little more mixing is required.

22. But I have reason to believe that, while tensile strength is not affected by the addition of sand being made before or after the mixing of the cement, or by rough mixing, the adhesive strength is often seriously affected. In carefully conducted experiments on a small scale the effect of sand is often capriciously detrimental to adhesive strength, and on a large scale the risk of reducing it should be avoided as much as possible. In the experiments detailed in paragraph 24 with a sand mortar made from surki cement, containing three parts of surki to one of fat lime, the tensile strength was as nearly as possible the same under both conditions of mixture, but there was a considerable difference in the adhesive strength of the mortar. When the sand was added *after* the mixture of the cement into paste the brick joints broke at 170, at 240, at 198 lbs., giving a mean of 203 lbs., or 11·2 lbs. per square inch. When the sand was added to the dry ingredients the adhesive strength was 120 lbs., 156 lbs., 0. Even eliminating the last, as possibly an accident, the mean is 138 lbs. or 7·7 lbs. per square inch. I must say that

both were good, much better than the standard results given in Table IV. But the effect of sand or adhesive strength appears to be very capricious.

23. The following case in practice illustrates this point. The mortar used in building the additions to the Division Cutcherry at Bangalore was made thus:— Baskets of slaked kunkur lime, of broken brick and of sand, in equal numbers, were thrown into a steam mortar mill, along with a sufficiency of water; and, as the mixing was done with great rapidity, in less than five minutes the batch of mortar was taken out, apparently well mixed. The composition of this mixture may be taken as 1 lime-paste, 1½ surki, with 1½, or somewhat less than a volume, of sand. The tensile strength of this should be about 116 lbs. per square inch, the adhesive strength at least 9 lbs. per square inch (Table IV). The actual results obtained were as follows:—

Tensile strength, 28 days in air, 247 lbs., or 110 lbs per square inch.
Do. do. in water, 252 lbs., or 112 lbs. do.
Do. 118 days in water, 333 lbs., or 148 lbs. do.
Adhesive strength, 28 days in water, 110 lbs., or 5·5 lbs. do.

Now the tensile strength is very fair, 112 lbs., being a close approximation to the strength given in the standard experiments, showing how little the mode of mixture affects tensile strength, but the adhesive strength 5·5 instead of 9 or more is decidedly poor. In fine, I consider that it is better to add the sand after the lime and surki cement has been thoroughly incorporated, with the requisite quantity of water.

On the proportion of actual strength to the tensile strength obtained with standard brickets of mortar.

24. When using my lever-testing machine, I take care that the weight is drawn along the lever at a regular speed, so that the increase of strain is equal; it is generally at the rate of 5 lbs. per second, perhaps somewhat quicker in very strong specimens. The following experiments were made with brickets of surki cement mortar to ascertain what proportion the actual strength of the mortar bore to the breaking weight. The composition of the brickets was:—

Shell lime slaked 1½ = paste 1
S. M. brick surki ... ... 3 } 1 cement.
Sand (vol. = vol. of mixed cement)... 2⅔ 1 sand.

They were 28 days old, of which 27 under water.

First series.—Sand added after mixing the cement.

Bricket A. breaking weight, 314 lbs.
B. ,, 293 lbs. } Mean 311 lbs., or 138 lbs. per square inch.
C. ,, 326 lbs.

The mean breaking weight being divided into tenths, three other brickets were tested by a portion of the strain at first, the remaining tenths being added at intervals of time. The following were the times during which the increasing strains were supported:—

Bricket D. stood for 10 minutes, ·5 of the mean breaking weight.
,, 15 ,, more ·6 ,, ,,
,, 10 ,, ,, ·7 ,, ,,
,, 15 ,, ,, ·8 ,, ,,
,, 3 ,, ,, ·9 ,, ,,
Total 53 minutes when it broke. ,, ,,

Bricket E. stood for 3 minutes ·75 of the mean breaking weight.
Bricket F. for 20 ,, ·7 ,, ,,
,, 20 ,, more ·75 ,, ,,
,, 22 ,, ,, ·8 ,, ,,
,, 13 ,, ,, ·85 ,, ,,
Total 1 hour 15 minutes when it broke.

Second series.—Sand added to dry lime and surki.

Bricket G. breaking weight, 284 lbs.
H. ,, 317 lbs. } Mean 306 lbs., or 136 lbs. per square inch.
I. ,, 317 lbs.

Bricket J. stood for 5 minutes ·6 of the mean breaking weight.
,, 18 hours ·75 ,, ,,
Total 18 hours 5 minutes when it broke.
Bricket K. stood for 1½ hours ·6 of the mean breaking weight.
,, 1½ ,, more ·75 ,, ,,
Total 3 hours when it broke.

25. It would appear then that the breaking weight being 100 when attained rapidly, 60 could be supported for at least twenty-four hours perhaps longer, and 75 for a time varying between three minutes and eighteen hours. The tenacity appears to be favored by a slow increase of the strain. It is probable that the permanent strength of this mortar would be little short of 50 per cent. of its breaking weight.

Experiments with Limed Surki Mortar.

26. I have not had time to pursue my experiments on cement made with the improved, or limed, surki, but such further experience as I have had shows the value of this puzzolana where quick setting and hardness are required.

A.—Surki made from blue clay treated with 20 per cent. of lime. A cement made of one shell-lime paste two surki set hard (c needle) in sixteen hours. It gave the following results:—

Adhesive strength after 1 day's immersion, 2·2 lbs. per square inch.
,, 28 day's ,, 25 lbs. ,, (bricks broke).
,, stones 28 ,, ,, 48 lbs. ,,
Mixed with equal volume of sand.
Tensile strength after 28 day's immersion, 156 lbs. per square inch.
,, after 118 ,, ,, 201 lbs. ,,

B.—Surki made from common brick clay treated with 10 per cent. of lime.

A cement made with one shell lime one surki gave an extraordinary rapidity of adhesion.

Adhesive strength after 1 day's immersion 5·8 lbs. per square inch.
28 day's ,, bricks broke at 25 lbs.
Mixed with equal volume of sand.
Adhesive strength of bricks after 28 day's immersion, 28·7 (bricks broke).
,, stones ,, ,, 49·5 lbs. per square inch.

From pressure of time I had to discontinue the experiments.

Experiments with Lime and Clay (twice-kilned cement).

27. Further experiments with this cement show that it has no advantage over the surki cements except in quick setting under water. It sets fully (c needle)

within 24 hours, and in the same time attains an adhesive strength of 4·5 to 4·8 lbs. per square inch. Its ultimate adhesive strength is not better than that of the surki cements; moreover, it has the disadvantage of being unable to bear dilution with sand. It also has a very poor tensile strength whether neat or mixed with sand. Its quick setting under water is counterbalanced by a loss of strength when immersed at once.

28. I tried the admixture of magnesite before burning, but the results were not encouraging.

On a process for revivifying Portland cement and rendering it quick setting.

29. Having a large number of broken brickets of Portland cement (neat) lying about, I burnt some on top of a charge of limestone in my furnace, for different lengths of time, between six hours and twenty hours. The burnt cement, ground and sifted, was found to be possessed of extraordinary hydraulic energy; while the original cement when new, set in the following times:—A six hours, B (Vicat's needle) ten hours, C 16 hours; this reburnt cement set hard in less than 10 minutes. Two months after burning, the weather being also very damp, about 20 minutes were required for setting. I made some brickets from the reburnt cement when new, not without difficulty, for it set hard before I could tamp it and get it out of the moulds; and I found that the strength, compared with that of Portland cement, was as follows:—

Seven days old (6 under water). 28 days old (27 under water).
London standard, 178 lbs. per square inch.
Original cement, 181 lbs. " 219 lbs. per square inch.
Reburnt cement, 91 lbs. " 153 lbs. "

It appears that this cement follows the usual rule of quick setting being obtained at the expense of strength; however the strength, though poor at a week old, is very satisfactory after a month. There are many cases where a considerable sacrifice of strength may be made in order to obtain quick setting, for example in tidal works or in stopping springs.

30. It is probable that by using the caked portion always found on opening casks of Portland cement (which has been estimated as a wastage of 10 per cent.) or cement which has become unserviceable through age, this quick setting cement could be produced very cheaply. The damaged cement could be mixed with water made into bricks and burnt in a kiln in the usual way.

I found that specimens burnt for different lengths of time were equally good, provided they were not clinkered. The burnt cement grinds easily, no more powerful means than that for grinding surki being required. It should be sifted through a 48 mesh sieve and kept in air-tight packages. But it would be well to keep the bricks and burn them only a short time before the cement is required for use.

Results obtained in the examination of limestones from the different districts of the Madras Presidency.

31. With a view to conciseness, the list appended to this report has been drawn up according to a scheme of description giving—

1*st.*—The physical character of the stone;

2*nd.*—The chemical character;

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3*rd.*—The probable or actual character of the lime yielded.

32. Of these three heads of description the last is the most important when the character of the stone can be determined by actual experiment on the lime obtained from it. Such a procedure would, however, demand a heavy outlay of time, when several hundreds of stones have to be examined, each stone requiring on the average two or three days' work. But experience shows that attention to the physical appearance of the stone with a short chemical examination will give such preliminary information as will render experiment on the burnt stone unnecessary except in the case of specimens promising good results. These are unfortunately but few in number, and the information obtained under the first two heads, or even under the first alone, eliminates at least nine out of ten specimens under examination as not being sufficiently promising to repay the labor of burning and practical trial.

Determination of physical character.

33. The use of the following terms enable the physical description to be given concisely:—

Morphism.	Consistence.	Form of deposit.	Hardness.	Color.
Crystalline... ...	Compact... ...	Rock... ...	Intensely hard ...	White.
Splintering... ...	Honeycombed ...	Boulders... ...	Very hard ...	Buff.
Semi-crystalline...	Mammillated ...	Masses (irregular)	Hard... ...	Grey.
Almond-like ...	Conglomerate ...	Marly lumps ...	Friable... ...	Pink.
Amorphous... ...	Geodic... ...	Nodules* ...	Soft... ...	Red.
Chalky (or marly).	Sub-geodic... ...	Incrustations* ...	Rotten ...	Greenish.
Clayey... ...	Tufaceous ...	...	...	Ochreous.
Sandy... ...	...	...	...	Mottled with mica.

Examination of the numerous specimens sent from all parts of the Presidency show that they may conveniently be referred to the following types:—

I.—Chalky or Marly Kunkur.

Sometimes found as soft marl, more often as rounded lumps of chalky appearance, or less soft, of amorphous texture. Sometimes this passes to marble having an effloresced and somewhat crystalline appearance; the marly kind passes to the semi-crystalline type. The lime yielded is generally fat.

II.—Clayey Kunkur.

Nodules or incrustations, mulberry-like or mammillated, with very distinct central cavity (geodic), hard but brittle, grey to dark slate color, fracture concentral choidal, amorphous and dull, the cavity generally lined with a fine granular layer. Yields more or less hydraulic lime according to the degree in which these characters are present.

III.—Tufaceous Stone.

Irregular masses, of loose and pumiceous texture, perfectly amorphous, light and friable, white or buff color. When the silicates amount to upwards of 30 per cent. as is frequently the case in this type of stone, the lime yielded is of

* Nodules or incrustations when not larger than road metal or large gravel are known as *kunkur*.

strongly hydraulic character, only differing from a true cement by its comparative slowness in setting.

IV.—Semitufaceous Stone.

Similar to the preceding; but the character, especially the lightness, less marked. Tends to the semi-crystalline type. Quality depends on the amount of silicates present, but if these be the same as in the preceding type the lime yielded is equally good.

V.—Amorphous Compact Stone.

Generally large boulders or masses of dull granitoid fracture. Rarely homogenous, and yielding usually a lime which is fat or but slightly hydraulic. Sometimes it is of rotten structure, not to be confounded with the friability of tufaceous stone.

VI.—Semi-crystalline kunkur boulders or masses of stone.

Generally honeycombed, mammillated or conglomerate, occasionally geodic, of more or less semi-crystalline structure. Color various, often dark grey or red. Contains much quartz, felspar, decomposed gneiss and black mica. Garnets, chlorite, asbestos or lepidolite (golden mica) often present.

The lime yielded is generally fat or only slightly hydraulic. As a rule no quantity of silicates less than 20 per cent. gives it the slightest hydraulic properties.

VII.—Almond-like Magnesian Stone "Paloday."

In boulders or compact masses. Intensely hard, fracture dull and almond-like, color yellowish white, frequently with patches of white magnesite visible. Always more or less magnesian. Yields fat lime devoid of hydraulic properties. Called in Tamil *paloday* from its milky or creamy color.

VIII.—Semi-crystalline Splintering Rock.

In large compact masses or slabs (Cuddapah stone). Intensely hard, splintering with a clean fracture, grey to bluish black. Usually yields a fat lime, and, if much silicates (30 per cent.) be present, a meagre rather than a hydraulic lime.

IX.—Napa Stone.

This is the name (Telugu?) given to a variety of the preceding; it has a rather smooth feel and fibrous texture. Yields fat lime.

X.—Marble.

The marble of Southern India is a kind of calcspar, resembling alabaster rather than statuary (saccharoid) marble. It is pure and yields a perfectly fat lime.

XI.—Shells or Coral.

Yields a perfectly fat lime.

34. I consider that all these, with the exception of the last, are forms of carbonate of lime dissolved by and deposited from rain water. The carbonate of lime (and of magnesia) dissolved by rain water out of weathered gneiss and other metamorphic rocks is deposited in the lower parts of valleys. The marly deposits harder and assume in time a crystalline form, varying according to the following circumstances:—

a.—If pure they may crystallize into *marble*.

b.—If magnesian they assume the almond appearance of *paloday*.

c.—If mixed with mica and other debris of gneiss they become *semi-crystalline kunkur*.

d.—If mixed with clay they shrink in drying and form the rounded septarious nodules of *clayey kunkur*.

Chemical Examination.

35. The analysis of a limestone is an operation requiring a well appointed laboratory and skill in chemical manipulation. Even when a complete analysis is not required, when we only want to know the amount of silicates and of magnesia present, the operation by ordinary good methods is difficult and tedious.* Or even the simplest kind of information, the determination of the amount of silicates (and sand) remaining after solution of the limestone in muriatic acid, is too long for performance in an extended series of investigations. I have devised a method by which a complete analysis can be done in little more than the time usually required for the determination of silicates; and when the percentage of silicates is alone required, I do it indirectly by means of the calcimeter; the process takes but a few minutes and is of considerable accuracy. The original form of the instrument was devised by a German Chemist, Mr. Schiebler, for the determination of carbonate of lime in the spent bone black of sugar refineries; it was a rather complicated piece of apparatus, but I have simplified it considerably, indeed so much that I constructed two instruments with the aid of a carpenter and such materials as are ordinarily found in laboratories.

36. I purpose taking an early opportunity of giving a full description of the calcimeter and its use in the examination of limestones and limes, in accordance with the intimation conveyed in G. O., 5th August 1874, No. 2,156; it will be sufficient at present to state the principle of its action. If the carbonic acid gas be expelled from a carbonate by the action of muriatic acid, and the quantity of gas be measured, the equivalent amount of carbonate of lime can be ascertained. Now, if we operate, first on a weighed quantity of pure carbonate of lime, then on an equal quantity of limestone or other impure carbonate, any deficiency in the quantity of gas evolved from the latter (as compared with the quantity evolved in the standard experiment) must evidently be owing to the presence of impurities and be proportionate to their quantity. The character of the silicates can be approximately judged by the appearance of the insoluble residue. They may be sand, mica, clay, silica, etc. The percentage amounts of silicates given in the descriptive list were usually obtained by the calcimeter. They were frequently checked by other processes and found to be accurate.

Determination of the character of the lime yielded by a specimen of limestone.

37. Great mistakes would be made if the limestones of Southern India were judged solely by their chemical composition. Most of them are anything but homogeneous, and specimens containing as much as 20 or 30 per cent. of silicates may yield a limeslaking with all the energy of fat lime and totally devoid of hydraulic properties. The reason of this is that few of them contain

* In every treatise on limestones with which I am acquainted the analytical processes laid down are very inaccurate, without any compensation in simplicity or in rapidity of execution. The Authors are not responsible for this; the chapter on analysis being generally quoted, or contributed by another person who has not had an opportunity of testing the processes as to their applicability to the special character of the investigations.

clay, the silicates being the more or less fine *debris* of metamorphic rocks. Yet, on the other hand, it is found that specimens equally devoid of clay but containing a quantity of silicates (of very sandy appearance) which would theoretically render them quite meagre, furnish excellent hydraulic lime, even cement, *e. g.*, the tufaceous stones.

As a rule the quantity of silicates required to impart hydraulic properties is far greater than in the case of the European and American cements of which analyses are recorded. It may also be taken as a rule that the limes yielded by Indian limestones do not show the meagre quality which one would expect from the quantity of inert silicates present. The great variation in composition also produces much practical inconvenience; for a lime which is, on the average, of good hydraulic quality may be separated, on slaking, into fat lime and a residue of strongly hydraulic lime incapable of slaking.

38. It was only after considerable practice in experiments on the lime yielded by different qualities of stone that I could venture to depend on the appearance of the limestone as indicative of its quality, though aided by a knowledge of its chemical composition. Even with considerable experience errors may occur; they are, however, on the safe side, for it is hardly possible to pass over a limestone possessing hydraulic properties, the error being always in taking for hydraulic a limestone which is simply meagre or non-homogeneous. The physical appearance of limestones, combined with a determination of the percentage of silicates, will then be sufficient to eliminate those specimens which are not promising, and to point out those which are deserving of final experiment after burning. The following table shows the type and chemical character of limestones yielding limes of the different degrees of hydraulic energy.

Classification of limestones according to the quality of the lime yielded on burning.

Quantity of the Lime.	Type of Stone.	Chemical Character.
Perfectly fat ...	Shell or coral	
	Marble	
Fat or slightly hydraulic.	Almond-like stone (paloday) ...	May contain as much as 20 per cent. of silicates and yet behave as fat limes every respect.
	Chalky kunkur	
	Amorphous compact stone ...	
	Splintering rock	
	Napa stone	
Meagre	Semi-crystalline stone	May contain 20 to 40 per cent. of silicates. A stone containing 36 per cent. of silicates would yield a lime containing one-half of silicates which if inert would render it meagre.
	Splintering rock	
Slightly to fairly hydraulic.	Semi-crystalline stone or kunkur.	Containing 10 to 30 per cent. of silicates, the degree of hydraulic energy varying according to homogeneily nature of the silicates, etc.
	Amorphous compact stone ...	
	Splintering rock	
	Clayey kunkur	
	Sandy kunkur	
Good hydraulic ...	Clayey kunkur	Containing 30 to 50 per cent. of silicates.
	Tufaceous stone	Containing 20 to 30 per cent.
Strongly hydraulic to cement.	Clayey kunkur	Containing upwards of 30 per cent. of silicates.
	Tufaceous stone	

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It may be said that with the exception of some rather rare sandy kunkurs, the only limestones giving really good results belong exclusively to two or three types, viz., geodic clayey kunkur (analogous to the septaria from which the so-called Roman cement is made) and the tufaceous and semi-tufaceous stones containing a large percentage of silicates. I may, however, mention that other types of hydraulic stone may possibly be found hereafter, but it is probable that the specimens sent to me would only exceptionally include any found not to yield a slaking lime. The few really good stones which I have found have been sent to me either without remarks or with remarks that they are bad or inferior, and I should not be surprised if a large number of cement-stones were discovered if *bad* limestones were especially required from the Indian subordinates who possess a knowledge of local mineral products.

39. When the physical characters of a limestone, or its physical character combined with the amount of silicates, indicated that it possessed hydraulic properties in a notable degree, the specimen was burnt. Where numerous investigations are carried on, an assay furnace with a muffle would be very useful for burning a number of small specimens at a time, but, under the circumstances of the present experiments, I found a furnace of the following construction to answer well:—

40. The furnace was 13 inches square in horizontal section, and 2 feet 8 inches high from the fire-bars to the top, exclusive of the ash-pit. It was closed by a lid of iron, faced with clay and paddy husk, working on hinges, and readily lifted by means of a pully over head and a counterpoise. At 8 inches above the fire-bars the furnace was divided vertically and equally into a back grate for the reception of limestone and into a front firespace. The floor of the grate was formed by iron bars or a perforated fireclay plate, the front by a grating of half inch square iron bars; these require renewal after about a dozen burnings.

The grate was 1 foot 4 inches high, just above it was the flue. By this contrivance the limestone could be kept in its place while subjected to a red heat for any length of time.

The fuel used was coke and charcoal loaded at the top. The fire was usually lit at 5 P. M. and kept low all night; in the morning it was allowed to burn well till 5 P. M. when it was let down; next morning the kiln was cool enough for the lime to be drawn.

I usually worked two furnaces; in each were three specimens of limestones separated from one another and from the walls by terrace tiles; above the limestone, specimens of puzzolana could be burnt.

41. When the lime was drawn, a sample was tested by the calcimeter, and if it contained not more than 5 per cent. of carbonate, was considered well burnt. It was powdered in an iron mortar, passed through a sieve of 30 meshes to the inch, slaked and finally reduced to paste. A portion of the paste was pressed into a small chatty (of 2 inches diameter) and immersed in water. The remainder was mixed with an equal volume of sand, and with this mortar pairs of bricks were joined and standard brickets moulded. If the specimen was obviously a cement stone, its adhesive strength was tested without sand being used.

42. The tests for setting were made by means of loaded needles—

A. A needle of $\frac{1}{12}$ inch diameter at the point loaded with $\frac{1}{4}$ lb.
B. Vicat's needle $\frac{1}{24}$ inch do. do. 10½ oz.
C. A needle of $\frac{1}{12}$ inch do. do. 1 lb.

The first and third were very useful for limes showing an extreme of fatness or of hydraulic energy, and were found to give results consonant with those of Vicat's needle. Thus a lime supporting Vicat's needle after six days' immersion would usually support needle A in three days and needle C in nine days.

43. The adhesive strength test was also of great practical value. The pairs of bricks joined with a mortar of lime paste and sand in equal parts were immersed at once and tried after four weeks, and after one week if strongly hydraulic. I found that the addition of an equal quantity of sand obviated some failures in adhesion, while it did not detract perceptibly from the strength attained in four weeks. It was not however necessary in those limes which contained so much silicates as to be natural cements.

44. The system on which limes were divided by Vicat according to their rapidity of setting under water requires some modification before it can be applied to the case of Indian limes. The following table shows the division I have found most applicable :—

Quality.	Slaking.	Setting under water Vicat's needle.	Adhesive strength lbs. per square inch after.		
			1 Day.	1 Week.	1 Month.
Fat	Energetic ; volume increases to 2 at least ; volume of paste 1⅓ to 1½.	Never sets and will be washed away in time if the water is renewed.	...	...	...
Meagre	Energetic, but the volume increases to not more than 1¼.	Never satisfactory...	...	...	...
Slightly hydraulic ...	Energetic ; volume increases to 1½ or 2.	15 to 30 days ...	...	2 lbs.	5 lbs.
Fairly hydraulic ...	Do. do. ...	10 to 15 days ...	...	2 5 lbs.	5 10 lbs.
Good hydraulic ...	Languid ; volume increases to not more than 1½, product lumpy.	5 to 10 days ...	2 lbs.	5 10 lbs.	10 20 lbs.
Strongly hydraulic...	Hardly slakes unless powdered previously. Does not heat much.	2 to 5 days ...	2 3 lbs.	10 15 lbs.	20 30 lbs. equal to the best bricks.
Cement	Little or no heat even when powdered.	Less than 1 day ...	3 5 lbs.	Do.	Do.

It should be observed that a lime may be meagre and yet hydraulic ; the meagreness arises from a large quantity of inert silicates besides the small quantity which are active.

SUMMARIZED DESCRIPTION OF THE LIMESTONES EXAMINED.

Coimbatore District.

45. The Collegal limestones, twelve in number, comprised one good hydraulic limestone and two cement stones. Rather extended examination of these and of the limes which they yield having been made, the results may be given as illustrative of some of the principles of the chemical examination of limestones.

46. The good hydraulic limestone is that numbered 1 in the detailed description appended :—

Assay by the Calcimeter.

Carbonates	73·2
Poor	26·8

Analysis (by the short assay method).

Moisture	2·6		
Sand and clay	25·8		
Carbonate of magnesia	18·9	equi. to carb. lime	21·1 } 73·3
Carbonate of lime	52·2		52·2 }
	99·5		

The limestone when burnt yielded a lime of the following composition :—

	By Analysis.	Composition deduced from that of the limestone.
Insoluble silicates (in acid)	25·6	} 40·3*
Silica	13·9	
Alumina and ferric oxide	6·0	
Magnesia	12·6	14·0
Lime	42·5	45·7
Carbonic acid	0·4	
	100·1	

Considering the difficulty in obtaining a perfectly fair sample of the stone which was actually burnt, the composition of the lime deduced from the unburnt stone corresponds fairly with that obtained by analysis of the lime.

47. The lime set with needle A in three days, needle B (Vicat's) in five days, needle C in eight days. Though setting quickly the adhesive strength was not so good as might have been expected. It was as follows :—

Neat lime	8 days'	immersion,	10·8	lbs. per	square inch.
Do.	28 ,,	,,	13·6	,,	,, ,,
1 lime 1 sand	28 ,,	,,	11·3	,,	,, ,,

This is fair, but yet unsatisfactory. I regret that I had no more materials in order to find out the cause of the adhesion progressing so slowly after the eighth day.

48. The cement stones are those from Ajpuram, numbered 11 and 12.

* Fat limes sometimes yield a large amount of silicates if washed with water, or even with acid. The following are the quantities of silicates contained in the lime yielded by limestones of various degrees of impurity :—

Per-centage of silicates in limestone.	Per-centage of silicates in burnt stone.
5	8·6
10	16·5
20	30·7
30	43·4
40	54·3
50	64·1

As 100 carbonate of lime yield 56 lime, the per-centage of silicates in the lime obtained by burning a stone of known composition is thus found : $\frac{\text{Silicates} \times 100}{(\text{Carbonate} \times 56) + \text{Silicates}} = \text{Silicates in the lime}$. The silicates in the burnt lime are always more or less attacked by acid, as seen in the case of the specimen described above.

They are of the tufaceous type and about equally good. The cement produced from No. 12 gave the following composition on analysis :—

Insoluble silicates and sand	39·5	53·9
Soluble alumina and ferric oxide	14·4	
Magnesia	11·7	
Lime	31·2	
Carbonic acid	1·0	
Alkalies, water and loss	2·2	
	100 0	

Both set with A needle in one day.
B (Vicat's) do. in three days.
C needle in five days.

The adhesive strength shown by the two cements were as follows :—

—	Best bricks			Stone
	1 day in water, lbs. per sq. in.	7 days in water, lbs. per sq. in.	28 days in water, lbs per sq. in.	28 days in water, lbs. per sq. in.
No. 11 neat	.....	15·1 lbs.	31 lbs. (bricks broke.)	46 lbs.
No. 12 neat	3·2 lbs.	12·9 lbs.	26 lbs. (bricks broke.)	34·3 lbs.
No. 11, with 1 sand ...	.....	.....	23·7 lbs.	

I am informed by Mr. Lennon, who was Supervisor in the Collegal Range when the limestones were forwarded, that the deposits of these two cement-stones are very extensive.

49. The stones from Coimbatore Taluq, from Erode, Kodumudy, and Caroor are either fat or only slightly hydraulic.

One of these, from Kodumudy (No. 17), deserves notice, as it is the type of a very common limestone. It is known by the name of *paloday* in Tamil, from its milky white appearance. This specimen was found to contain—

Silicates	2·5
Carb. of magnesia	37·1
Carb. of lime	61·4
	101·0

I examined it (and other similar specimens) with care in view of the disputed point as to the alleged properties of magnesia in rendering fat lime hydraulic. I found that, although this lime at first appeared to set rapidly, supporting the needle A in two days, any subsequent setting was very slow; after seventeen days the set with Vicat's needle was barely obtained, and no subsequent improvement was observed. The adhesive strength was that of a slightly hydraulic lime, viz., 3·5 lbs. per square inch, after a month's immersion.

50. Of the four limestones sent from Mettapolliem in this district by the District Engineer, Neilgherries, one was found to be of considerable value. This (No. 24) is from Podur and Mangalkerry; it is a semi-tufaceous stone, containing 31·4 per cent. of silicates. The lime which it yielded did not slake; when powdered, it heated but did not swell or steam. It set in the following time;—

With A needle in two days.
Do. B (Vicat's) needle in four days.
Do. C needle in seven days.

The adhesive strength of the neat cement was, after seven days' immersion, 10·2 lbs. per square inch; after one month the bricks broke off at a strain of 26·2 lbs. per square inch.

It is evidently little inferior to the Ajpuram cements.

51. Of the limestones sent from the Bhowany valley by Mr. Nordmann, one presented in an eminent degree the character of the tufaceous type. It was the specimen from Kotamangulam, containing 60·9 per cent. of silicates, and described in former reports. When burnt the lime is found to be incapable of slaking, and is, in fact, a cement similar to the cements from Collegal, already described. I think it must have been sent by mistake, for the description accompanying it stated that it was "very pure, burns and slakes freely," and a further supply sent to me at my request from the same locality is a common slightly hydraulic kunkur, described as "the best according to the kiln-burners, and yielding the greatest quantity of powder when slaked." Now the specimen originally sent would not slake at all when burnt. I would suggest, as I have before mentioned, that the lime-burners be especially asked for the bad stones, those which yield a lime incapable of slaking. The stone now described is so valuable that it would be well worth searching for. It is of a loose sandy structure, and of a light brown color.

Malabar District.

52. The two limestones sent are from the neighbourhood of Palghaut; they are only slightly hydraulic.

Salem District.

53. The limestones sent from the Namkal Range are mostly either fat or only slightly hydraulic. No. 54 from Valavendy and No. 44 from Valliaputty are the most promising. Several specimens of magnesite (carbonate of magnesia) were sent from the Thala Malai hills in this range. This substance contains only 7½ per cent. of impurities, and being very plentiful it would be very desirable to find a use for it. The magnesia which it yields on burning at a low temperature sets very quickly under water, but apparently with an amount of expansion which disturbs adhesive strength. When pairs of bricks joined with magnesia paste were immersed, it was found 24 hours afterwards that the magnesia had become perfectly hard but without the slightest adhesion; a strong plate of hydrated magnesia lay loose between the bricks. When the bricks were not immersed, adhesion was very good, attaining a strength of 22·4 lbs. per square inch after twenty-eight days (perhaps much sooner). The tensile strength of the magnesia was very poor.

54. The limestones of the Oossoor range were mostly fat or slightly hydraulic. No. 65 was good hydraulic stone. The lime made into sand mortar gave an adhesion of 6·3 lbs. per square inch after one week, and 13·3 lbs. after eight weeks' immersion. It may be remarked that this stone contains only 7·3 per cent. of silicates, but it belongs to the good tufaceous type. It set in six days to Vicat's needle. No. 71 is a white marble.

TANJORE DISTRICT.

55. The limestones from Tanjore include several specimens of clayey kunkur, very small in size, which promise to yield good hydraulic lime. Nos. 89, 90, 92, 93, 99, 106 may be noted. The remainder are fat or slightly hydraulic.

MADURA DISTRICT.

56. Of the fifty-three specimens examined, the greater part were either fat or only slightly hydraulic. Five only were noteworthy:—

No. 137, a chalky kunkur, containing 23 per cent. of silicates.

„ 113, a clayey kunkur, containing 22 do. do.

„ 125, a semi-crystalline or amorphous stone, containing 50 do. do.

„ 158, an amorphous kunkur, containing 42 do. do.

These promise to give fair or good hydraulic lime.

No. 149, a light semi-tufaceous stone, containing 45·9 per cent.
This promises to give a cement.

TINNEVELLY DISTRICT.

57. Of the twenty-three specimens examined only three are possibly good, Nos. 178, 181, 183. These are of the amorphous compact type, containing only 19 to 20 per cent. of silicates, but this is remarkable as being not sandy as usual, but rather pure silica, very finely divided. I had not enough of these to burn, but they promise possibly good results.

TRICHINOPOLY DISTRICT.

58. Of the fifty-one specimens examined, the following are perhaps worthy of notice:—

No. 190, a somewhat clayey stone, promising fair or even good hydraulic properties.

Nos. 197, 198, are not homogeneous; some parts are rotten, like weathered gneiss, and would possibly yield hydraulic lime.

Nos. 224 and 227 arrived in powder, so that their character is doubtful. They appear to be friable and mixed with a good deal of clay and sand. Further examination of them is desirable.

Nos. 204 and 235 are remarkable as being transitional between chalky kunkur and marble. They are perfectly fat.

No. 212 is fossilized oyster shell.

SOUTH ARCOT DISTRICT.

59. The ten specimens examined were all fat or only slightly hydraulic, with the exception perhaps of No. 239, which is somewhat superior.

CHINGLEPUT DISTRICT.

60. Of the fourteen specimens examined there was one No. 252 (from Umanambakum), which is a perfect specimen of clayey kunkur, and should give good hydraulic lime. No. 247A and 251 are apparently of fair hydraulic quality. The rest are all fat or only slightly hydraulic.

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NORTH ARCOT DISTRICT.

61. The fifty-three limestones from this district belong for the most part to the chalky or marly type; the marl is more or less hardened and is sometimes sandy, but is rarely more than slightly hydraulic, generally fat. Some of the stones from the Polur Range are rather sandy, at least in parts. Nos. 282, 286, 291 are perhaps more or less hydraulic.

NELLORE DISTRICT.

62. The sixteen specimens are all semi-crystalline micaceous stones, yielding fat or slightly hydraulic lime.

VIZAGAPATAM DISTRICT.

63. The nineteen specimens from this district are semi-crystalline, small kunkurs, yielding, with a few exceptions, fat or slightly hydraulic lime. The best of these is No. 340, a geodic clayey kunkur promising a fair good hydraulic lime. Nos. 325, 335, 337, 341, 342 also appear better than the rest.

GANJAM DISTRICT.

64. Of the 30 specimens from this district those from the Berhampore Taluq were either shell (perfectly fat) or semi-crystalline kunkur of but slightly hydraulic character. Nos. 353 and 354 are somewhat better than the rest. In the Goomsur Taluq, the kunkurs were somewhat clayey and sub-geodic, promising better than the preceding. Nos. 361, 362, 363, 366 are the best. Of these No. 362 is a tufaceous stone, containing 49 per cent. of silicates; it promises to yield a strongly hydraulic lime, if not a cement.

BELLARY DISTRICT.

65. There was a remarkable uniformity of inferior hydraulic character in the ninety-one specimens from this district. With few exceptions they were the common semi-crystalline kunkur, derived from hardened marly chalk. The only specimens promising to yield at all hydraulic lime are Nos. 415 and 452. The former is a fair clayey stone; the latter, though only containing 12 per cent. of silicates, is yet of the good tufaceous type. No. 387 is remarkable for its resemblance to the splintering rock of Cuddapah and Kurnool. No. 449 also approaches this type, and is a link in the series connecting recent chalky marl with the old rocks of former geological periods.

CUDDAPAH DISTRICT.

66. The forty-six specimens examined belong nearly without exception to two common types:—

The semi-crystalline or amorphous kunkurs.

The red honeycombed kunkurs.

In both cases they are so very magnesian that any hydraulic character derived from the silicates is considerably neutralized. No splintering rock among the specimens.

KURNOOL DISTRICT.

67. Of the fifteen limestones examined, three were specimens of the compact splintering rock, commonly known as Cuddapah stone. This rock varies in char-

acter; it sometimes contains pure white calcite, at other times it is black, slate blue, or nearly white; its fracture varies from a somewhat fibrous texture to the cleanest splintering. It may be almost pure carbonate of lime or contain as much as 30 per cent. of silicates. These may be either pure white silica or clay of various colors. In some cases the color is variable and appears to have been derived from contact with purple shale overlying the limestone.

68. When the quantity of silicates amounts to 15 per cent., the stone is of a more or less hydraulic character. The lime produced slakes perfectly well, and has all the appearance of a perfectly fat lime, but it has a fair adhesive strength when joints made with it are immersed. I burnt specimens from the Cuddapah district (Cheyaur river) and found the hydraulic character to be as follows :—

No.	Silicates per cent.	Adhesive strength lbs. per sq. in.		Tensile strength. Eight days in air 20 days in water.
		28 days in air.	28 days in water.	
A.	82	7·2	3 7	67 lbs.
B.	79	...	7·	64 lbs.
C.	84	...	11·8	20 lbs †

The tensile strength was very poor in every case and the setting under water unsatisfactory.

Kistna District.

69. Amongst the few limestones from this district examined, were two specimens of Napa stone. This is a compact limestone resembling the splintering rock (Cuddapah stone), but often with a much less clean fracture. It contains from 10 to 20 per cent. of silicates and mineralogically it differs but little from the compact splintering rock.* Like the latter it gives a lime which is generally fat and sets under water very imperfectly, yet it has fair adhesive power when the quantity of silicates exceeds 10 or 15 per cent.

Godavery District.

70. Of the eighteen specimens from this district there were three kunkurs from Ellore and Peddapur taluqs, eight specimens of rock from the neighbourhood of Rajahmundry and seven from the Upper Godavery. The Rajahmundry stones are amorphous rock or calcite both very pure; the Upper Godavery stones are either of the same character or compact splintering rock.

* Never having been in the districts yielding these stones, I could only appreciate their mineralogical similarity to stones clearly formed from chalky marl. But Mr. King of the Indian Geological Survey has pointed out to me that the Napa stone belongs to strata of the Palæozoic period, while the splintering rocks of Yernagudiem (Godavery) are Lower Eocene. Whatever may be the geological age of these various specimens, I consider that there is little mineralogical difference between those of quite recent formation and those of ancient strata.

In the course of these examinations of limestones, I have come across some specimens in which the transformation from chalky marl was plainly visible in stone which I should certainly have taken to be identical with Napa stone or the splintering rock of the Kistna-Godavery upper country.

Abstract of Limestones examined.

District.	Perfectly fat.	Fat or slightly hydraulic.	Fair to good hydraulic.	Strong hydraulic.	Total.
Coimbatore	...	36	1	4	41
Malabar	...	2	...	...	2
Salem	7	31	3	...	41
Tanjore	3	22	6	...	31
Madura	8	41	4	1	54
Tinnevelly	...	18	3	...	21
Trichinopoly	3	45	1	(2?)	51
South Arcot	...	9	1	...	10
Chingleput	1	11	2	...	14
North Arcot	...	50	3	...	53
Nellore	...	16	...	...	16
Vizagapatam	...	18	1	...	19
Ganjam	6	18	5	1	30
Bellary	1	88	2	...	91
Cuddapah	...	46	...	...	46
Kurnool	...	13	2	...	15
Kistna	...	3	1	...	4
Godavery	...	17	1	...	18
Total...	29	484	36	8	557

Thus out of 557 limestones only 44, or about 8 per cent., promised to be more than slightly hydraulic.

Descriptive List of the Specimens of Limestone sent for examination.

General No.	Locality.	Summary of description given.	Physical and Chemical character.
		Coimbatore District.	
1	Collegal Range—North of the Honally stream near Collegal.	No. 1.—Found in the bed of the stream, also 2 feet under alluvial soil.	Clayey kunkur, multigeodic, dark bluish grey. Silicates 26·8 per cent. Yields good hydraulic lime.
2	Collegal Range—Anur ...	No. 2.—Found near the surface in sandy soil.	Chalky kunkur, much gneiss gravel contained in it, white. Silicates 33·2 per cent. Very slightly hydraulic; sets only from the quantity of burnt silicates acting as a puzzolana.
3	Collegal Range—Polliam, 6 miles north-east of Collegal.	No. 3.—Near the surface at a hill; considered good and hydraulic.	Semi-crystalline kunkur, geodic, reddish. Silicates 24·4 per cent. Very slightly hydraulic.
4	Collegal Range—Madavanhully, 3 miles east of Collegal.	No. 4.—That most used in the range.	Semi-crystalline kunkur, but of somewhat clayey appearance, greenish white. Silicates 23·6 per cent. Fairly hydraulic.

Descriptive List of the Specimens of Limestone sent for examination.—(Continued.)

General No.	Locality.	Summary of description given.	Physical and Chemical character.
	Coimbatore District.—(Continued.)		
5	Collegal Range—Lohanhully, 16 miles south-east of Collegal.	No. 5.—On the surface in red soil ; scanty.	Chalky kunkur. Silicates 13·4 per cent. Fat, perhaps slightly hydraulic.
6	Collegal Range—Anur ...	No. 6.—In stony ground ; considered good.	Semi-crystalline masses. Silicates 7·8 per cent. Fat.
7	Collegal Range—Madavanhully.	No. 7.	Semi-crystalline [illegible] ...ur. in [illegible] Silicates 21·1 per ent. Perhaps slightly hydra...lic.
8	Collegal Range—Tiganaray, 4 miles from Tahady.	No. 8.—Believed to possess considerable hydraulic properties.	Semi-crystalline kunkur, honeycombed. Silicates 17·1 per cent. Perhaps slightly hydraulic.
9	Collegal Range—Sceragacully jungle between Tahady and Tallamalla.	No 9.—Believed to be hydraulic.	Semi-crystalline kunkur. Silicates 27·5 per cent. Slightly hydraulic.
10	Collegal Range—Between Atgalipuram and Tahady.	No. 10—Considered good, ordinary.	Semi-crystalline kunkur. Silicates 23·9 per cent. Slightly hydraulic.
11	Collegal Range—Ajpuram.	No. 11.—A very poor kind.	Semi-tufaceous masses ; white, hard. Silicates 37·4 per cent. Strongly hydraulic, only differing from a cement stone by the slow setting of the burnt stone.
12	Collegal Range—Ajpuram.	No. 12.—A very poor kind.	Tufaceous masses ; light and friable ; white. Contains fossil shells. Silicates 45·8 per cent. Strongly hydraulic, a little inferior to the preceding.
13	Erode	No. I.—Found 1 yard below the surface, under No. II. The best in the neighbourhood.	Amorphous granitoid boulders. Silicates 23 per cent. Very slightly hydraulic.
14	Erode	No. II.—Found very near the surface.	Semi-crystalline kunkur ; highly mammillated. Silicates 21·3 per cent. Perhaps slightly hydraulic

Descriptive List of the Specimens of Limestone sent for examination.—(Continued.)

General No.	Locality.	Summary of description given.	Physical and Chemical character.
	Coimbatore District.—(Continued.)		
15	Chengapully	On the Trunk Road near the Railway between Avenashy and Perindorai stations.	Semi-crystallized large honeycombed masses. Silicates 22·4 per cent. Perhaps slightly hydraulic.
16	Kunatur	Burns quickly, lime very inferior.	Chalky kunkur ; some of it is rather tufaceous. Silicates 26·4 per cent. Slightly hydraulic.
17	Kodumudy (on the Cauvery below Erode).	Paloday, 1st quality found in white soil ; 100 measures give 320 of lime (slaked !).	Semi-crystalline boulders of milky color and almond-like appearance. Silicates 2·5 per cent. Carb. magnesia 37·1. A fat magnesian limestone, not hydraulic.
18	Kodumudy	Paloday, 2nd quality ...	Semi-crystalline boulders of almond appearance less marked than the preceding. Silicates 13·4 per cent. A fat magnesian limestone, not hydraulic.
19	Kodumudy	Mavoday	Semi-crystalline small boulders (water worn ?) Silicates 16·5 per cent. Perhaps slightly hydraulic.
20	Kodumudy	Nimily Oday	Semi-crystalline honeycombed masses, ochreous outside. Silicates 17·5 per cent. Fat.
21	Kodumudy	Eral Oday	Semi-crystalline honeycombed, flattened masses ; reddish. Silicates 17·2 per cent. Fat.
22	Kodumudy	Sengaral Oday ...	Semi-crystalline honeycombed masses ; flattened, reddish. Silicates 25·8 per cent. Fat.
23	Mettapolliam—Karamudy, 5 miles south by west of Mettapolliam.	No. I.—In successive layers 4 inches thick for a depth of 1 or 2 yards in decomposed granite soil yielding nitre.	Semi-crystalline masses, honeycombed. Silicates 19·7 per cent. Fat.

Descriptive List of the Specimens of Limestone sent for examination.—(Continued.)

General No.	Locality.	Summary of description given.	Physical and Chemical character.
	Coimbatore District.—(Continued.)		
24	Mettapolliam—Podur and Mangalkerry, 4 miles south-west of Mettapolliam.	No. II.—In successive layers 4 inches thick for a depth of 1 or 2 yards. In light red soil yielding nitre.	Semi-tufaceous masses, white. Silicates 31·4 per cent. Yields a strongly hydraulic limestone equal to a cement though setting slowly.
25	Mettapolliam—Yeranapolliam, 4 miles south-east of Mettapolliam.	No. III.—As No. I. ...	Semi-crystalline honeycombed masses. Silicates 13·4 per cent. Fat.
26	Mettapolliam—Dodabari, 3½ miles east of Mettapolliam.	No. IV.—As No. I. ...	Semi-crystalline honeycombed flattened masses. Silicates 24·6 per cent. Slightly hydraulic.
27	Coimbatore—2nd mile on the road to Sundakoymuthoor.	No. I.—Found in cubes of 1 to 2 feet at a depth of ½ to 4 feet below the surface.	Amorphous or semi-crystalline conglomerate masses, grey. Silicates 12 per cent. Fat.
28	Coimbatore—1st mile of the road to Mettapolliam.	No. II.—As No. I. ...	Like No. I. Silicates 19 7 per cent. Fat.
29	Coimbatore—2nd mile of the road to Amur.	No. III.—Found in cubes of 3 to 4 feet at a depth of 1 to 5 feet below the surface.	Honeycombed conglomerate masses of various appearance from semi-tufaceous to semi-crystalline with much gneiss debris. Silicates 22·5 per cent. Fat.
30	Caroor—At the 6th mile on the road to Madura.	No. I.	Semi-crystalline kunkur. Silicates 19·6 per cent. Slightly hydraulic.
31	Caroor—At the 9th mile on the road to Erode.	No. II.	Semi-crystalline kunkur in mulberry nodules, with almond-like kernels. Silicates 5 2 per cent. A fat magnesian limestone.
32	Caroor—At the 8th mile on the road to Aravakurchy.	No. III.	Semi-crystalline kunkur, highly honeycombed and water worn (resembles laterite ironstone). Silicates 11 3 per cent. Fat.

Descriptive List of the Specimens of Limestone sent for examination.—(Continued.)

General No.	Locality.	Summary of description given.	Physical and Chemical character.
	Coimbatore District.—(Concluded.)		
33	Bhowany-Velamunddy, 12 miles north-east of Mettapolliam.	A.—Found near the surface in red soil.	Semi-crystalline boulders, grey. Silicates 16 6 per cent. Fat.
34	Bhowany—Danaikenkota.	B.—Same as A ...	Semi-crystalline flattened honeycombed masses. Silicates 20·8 per cent. Fat.
35	Bhowany—Kodivelli, 5 miles east of Satiamunglum.	C.—More hydraulic than A or B.	Semi-crystalline honeycombed masses. Silicates 32·3 per cent. Slightly hydraulic.
36	Bhowany—Satiamunglum.	D.—Found in black clayey soil, very little hydraulic.	Semi-crystalline honeycombed masses. Silicates 17·2 per cent. Fat.
37	Bhowany—Kotamunglum a mile below the junction of the Moyar and Bhowany rivers.	E.—Found in black clayey soil, Considered unfit for building purposes.	Tufaceous masses, light friable, of a light brown color. Silicates 60 9 per cent. The lime yielded only differs from a cement in its slow setting.
38	Bhowany—From fields at the 2nd mile on the road to Koundapady.	A. Eral Oday.—Found 1 foot below the surface in red soil. Not much valued.	Semi-crystalline boulders; variegated red color; forms a handsome marble when polished. Much quartz, magnesite, chlorite, asbestos, etc. Worthless for burning.
39	Bhowany—At the same place.	B. Velay Oday—Found on the surface or 1 foot below. Considered superior to the other kind.	Amorphous honeycombed masses containing nodules of magnesite. Silicates 18·4 per cent. A fat magnesian limestone.
40	Bhowany—At the same place.	C. Nir Oday.—Abundant on the surface. Considered inferior to B, but useful.	Amorphous conglomerate masses containing much foreign matters; grey, friable. Silicates 25·8 per cent. Fat.
41	Bhowany—At the same place.	D. Karu Oday—Found near the surface; not much esteemed.	Semi-crystalline honeycombed masses. Silicates 9 per cent. Fat.

Descriptive List of the Specimens of Limestone sent for examination.—(Continued.)

General No.	Locality.	Summary of description given.	Physical and Chemical character.
		Malabar District.	
42	Palghaut—Walliar ...	Found 3 feet below the surface in white clay soil, somewhat salt.	Amorphous masses, grey. Silicates 19·7 per cent. Slightly hydraulic.
42*a*	Palghaut—Modalamaday, 17 miles south-east on the Paumben road.	....	Hardly different from the Walliar stone.
		Salem District.	
43	Namkul Range—Kosavumputty, 1¼ miles to east of Namkul.	.....	Amorphous compact masses, grey. Silicates 22·5 per cent. Slightly hydraulic.
43*a*	Namkul Range.—Areyandi Uthoo, a spring 4 miles south-west of Namkul.	... .	Amorphous or semi-crystalline mass; grey, with much black mica. Silicates 27·2 per cent. Slightly hydraulic.
43*b*	Namkul Range.—Andapuram, 12 miles south-east of Namkul.	.....	Semi-crystalline honeycombed mass, grey. Silicates 26·2 per cent. Slightly hydraulic.
44	Namkul Range.—Valliaputty, 8 miles south of Namkul.	.....	Semi-crystalline mass, with occasional semi-tufaceous portions. Silicates 22·4 per cent. Probably hydraulic; the most promising of the Namkul series.
45	Namkul Range.—Valaravathoor, 11 miles south of Namkul.	....	Semi-crystalline honeycombed masses. Appears fat or but slightly hydraulic.
46	Namkul Range.—Moraputty, 24 miles south-east of Namkul.	....	Amorphous masses, grey. Silicates 23·7 per cent. Slightly hydraulic.
47	Namkul Range.—Thalagaray, 12 miles north-east of Namkul.	.....	Amorphous or semi-crystalline masses, much black mica. Silicates 17·2 per cent. Fat.
48	Namkul Range.—Maravapolliam, 1 mile south of Paramutty.	.....	Amorphous masses. Silicates 20·7 per cent. Slightly hydraulic.

Descriptive List of the Specimens of Limestone sent for examination.—(Continued.)

General No.	Locality.	Summary of description given.	Physical and Chemical character.
		Salem District.—(Continued.)	
49	Namkul Range—Thatiyengarpet, 21 miles south-east of Namkul.	.....	Semi-crystalline kunkur. Fat or slightly hydraulic.
50	Namkul Range—Mahadavy, 20 miles south-east of Namkul.	.....	Semi-crystalline kunkur. Fat or slightly hydraulic.
51	Namkul Range—Kuducherry, 9 miles west of Namkul.	.....	Semi-crystalline masses with almond-like nodules (*paloday*). Silicates 4·3 per cent. Carb. mag. 55· A fat magnesian limestone.
52	Namkul Range—Kerambur, 6 miles from Namkul.	.....	Semi-crystalline masses. Fat or slightly hydraulic.
53	Namkul Range—Mal Sathambur, 7 miles north of Paramatty.	.....	Semi-crystalline masses. Fat or slightly hydraulic.
54	Namkul Range—Valavendy, 7 miles south-east of Paramatty.	.....	Tufaceous masses, partly semi-crystalline. Silicates 10 per cent. Slightly hydraulic.
55	Namkul Range—Jembumaday, 20 miles south-east of Namkul.	.....	Semi-crystalline almond-like mass (*paloday.*) Fat magnesian stone.
56	Namkul Range—Karagudy, 21 miles south-east of Namkul.	.....	Semi-crystalline mass. Fat or slightly hydraulic.
57	Namkul Range—Komarandipolliam, 9 miles north of Paramatty.	.....	Semi-crystalline mass. Fat or slightly hydraulic.
58	Namkul Range.—Anatharamian Spur, 1½ miles south of Namkul.	.....	Semi-crystalline mass. Fat or slightly hydraulic.
59	Namkul Range—Mrakaray, 19 miles south-east of Namkul.	.....	Semi-crystalline mass, of somewhat almond-like appearance. A fat magnesian stone.

Descriptive List of the Specimens of Limestone sent for examination.—(Continued.)

General No.	Locality.	Summary of description given.	Physical and Chemical character.
	Salem District.—(Continued.)		
60	Namkul Range—Kurpamputty, 22 miles south-east of Namkul.	.....	Semi-crystalline mass. Fat or slightly hydraulic.
61	Namkul Range—Vudamalayputti, 23 miles south-east of Namkul.	.....	Semi-crystalline mass. Fat or slightly hydraulic.
62	Namkul Range—Thullay Mullay Hills, 12 miles south-east of Namkul.	.....	Several specimens of magnesite. Contains 1·3 per cent. of silica. 6·1 ,, of carbonate of lime.
63	Darmapury Taluq—Wuparaputty near Topur.	No. 1	Semi-crystalline masses. Silicates 1·7 per cent. Very fat.
64	Darmapury Taluq—Womaputty near Topur.	No. 2	Semi-crystalline mass. Silicates 4·7 per cent. Very fat.
65	Darmapury Taluq—Samichettiputty.	No. 3	Tufaceous masses; friabel, yellowish. Silicates 7·3 per cent. Good hydraulic.
66	Darmapury Taluq—Sembodykupum.	No. 4	Calcareous gravel, bluish grey, and occasionally of clayey appearance with minute geodes. Silicates 26 per cent. Probably hydraulic.
67	Darmapury Taluq—Eraputty.	No. 5	Amorphous or semi-crystalline masses. Silicates 13·1 per cent. Fat.
68	Darmapury Taluq—Karimunglum.	No. 6	Semi-crystalline masses, occasionally semi-tufaceous. Silicates 9·6 per cent. Fat.
69	Kirstnagherry Taluq—Jagadabu, Kaveriputnum taraf (query, towards Kaveriputnum.)	No. 1	Semi-crystalline masses, occasionally semi-tufaceous. Silicates 4·3 per cent. Very fat

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Descriptive List of the Specimens of Limestone sent for examination.—(Continued.)

General No.	Locality.	Summary of description given.	Physical and Chemical character.
	Salem District.—(Continued.)		
70	Kistnagherry Taluq—Motur, Kaveriputnum taraf.	No. 2	Semi-crystalline kunkur, red. Silicates 33·9 per cent. Fairly hydraulic.
71	Kistnagherry Taluq.—Konderaputty, Motur taraf.	No. 3	Marble, or rather alabaster, some pure white, but mostly with a bluish tinge from black mica. Silicates 1 per cent in the white parts. Very fat.
72	Kistnagherry Taluq—Nullavidy Gundanur, Motur taraf.	No. 4	Semi-crystalline masses. Silicates 8·7 per cent. Fat.
73	Kistnagherry Taluq—Chikiliputty, Motur taraf.	No. 5	Semi-crystalline masses. Silicates 3·2 per cent. Very fat.
74	Kistnagherry Taluq—Burgur.	No. 6	Semi-crystalline small kunkur. Silicates 10·7 per cent. Fat.
75	Kistnagherry Taluq—Maharajaguda.	No. 7	Semi-crystalline small kunkur, sometimes rather clayey and geodic; bluish grey. Silicates 33·3 per cent. Good hydraulic.
76	Kistnagherry Taluq—Dowlatabad near Kistnagherry.	No. 8	Semi-crystalline masses. Silicates 21·9 per cent. Fat or slightly hydraulic.
77	Oossoor Taluq—Kukalapully, near Kamanthady.	No. 1	Semi-crystalline small kunkur. Silicates 32·6 per cent. Probably hydraulic.
78	Oossoor Taluq—Maythony, near Kilamunglum.	No. 2	Semi-crystalline kunkur, reddish. Silicates 26·4 per cent. Slightly hydraulic.
79	Oossoor Taluq—Anasonah, near Kilamunglum.	No. 3	Semi-crystalline kunkur, red. Silicates 38·6 per cent. Fairly hydraulic.

Descriptive List of the Specimens of Limestone sent for examination.—(Continued.)

General No.	Locality.	Summary of description given.	Physical and Chemical character.
		Salem District—(Concluded.)	
60	Oossoor Taluq—Obaypollium, near Komaypully.	No 4	Semi-crystalline small kunkur; variegated, sandy. Silicates 30 per cent. Slightly hydraulic.
81	Oossoor Taluq—Komaypully.	No. 5	Semi-crystalline kunkur; variegated, sandy. Silicates 31·3 per cent. Slightly hydraulic.
		Tanjore District.	
82	Trichinopoly Taluq—Kariomanikam.	No. 1.—Used at Upper Anicut works.	Semi-crystalline or amorphous kunkur; micaceous, red externally. Silicates 22 per cent. Fat or slightly hydraulic.
83	Trichinopoly Taluq—Vaingur, Kovalay Channel.	No. 2.—Used at the Vennaur head works.	Semi-crystalline kunkur; almond color. Silicates 17 per cent. Fat.
84	Tanjore Taluq—Nagathi...	No. 3.—Used at the Vettar head works.	Semi-crystalline kunkur; size of gravel, bluish grey or almond color. Silicates 20 per cent. Fat, somewhat magnesian.
85	Tanjore Taluq—Ovathur.	No. 4.— Do. ...	Semi-crystalline small kunkur; some almond color, some geodic. Silicates 17·5 per cent. Slightly hydraulic.
86	Tanjore Taluq—Natani...	No. 5.— Do. ...	Semi-crystalline small kunkur; yellowish, sandy. Silicates 10·2 per cent. Fat.
87	Tanjore Taluq—Allur, Vennar bank.	No. 6.— Do. ...	Semi-crystalline small kunkur; bluish grey, occasionally of clayey appearance. Silicates 12·8 per cent. Fat or slightly hydraulic.
88	Tanjore Taluq—Vadavar, Pulliapullum limits.	No. 7.—Used in Tanjore town.	Semi-crystalline small kunkur; bluish grey, occasionally of clayey appearance. Silicates 12·8 per cent. Fat.

Descriptive List of the Specimens of Limestone sent for examination.—(Continued.)

General No.	Locality.	Summary of description given.	Physical and Chemical character.
		Tanjore District.—(Continued.)	
89	Terumalavaddy, on north bank of Coleroon.	No. 8—Used at Vaduvagady calingulah.	Semi-crystalline kunkur; sandy though somewhat geodic. Silicates 35·6 per cent. Probably good hydraulic.
90	Tanjore Taluq—Thonderampady, Vennar north bank.	No. 9—Used at Kodamurty head works.	Semi-crystalline boulders; multigeodic with granular lining to the cavities. Silicates 20·2 per cent. Probably fair hydraulic.
91	Tanjore Taluq—Gurumundy.	No. 10—Used in Tanjore town.	Semi-crystalline kunkur; occasionally chalky and friable; ochreous color. Silicates 7·7 per cent. Fat.
92	Tanjore Taluq—Vikramanur river.	No. 11—Used in east part of the taluq.	Semi-crystalline small kunkur; bluish grey, occasionally of clayey appearance. Silicates 23·2 per cent. Probably fair hydraulic.
93	Tanjore Taluq—Vennar river east of Road No. 39.	No. 12—Do. do. ...	Semi-crystalline small kunkur gravel size, bluish grey, occasionally of clayey appearance. Silicates 26·2 per cent. Probably fair hydraulic.
94	Tanjore Taluq—Vettu Vakal, east of Road No. 39.	No. 13—Do. do. ...	Semi-crystalline small kunkur; light color, occasionally of clayey appearance; much fissured. Silicates 13·9 per cent. Fat or slightly hydraulic.
95	Combaconum Taluq—Palaram, Vailur village.	No. 14	Semi-crystalline or clayey small kunkur; bluish grey, much fissured. Silicates 21·4 per cent. Slightly hydraulic.
96	Combaconum Taluq—Coleroon river, north bank, Konjakollai village.	No. 15	Semi-crystalline kunkur; some clayey, some sandy, dark grey. Silicates 20·4 per cent. Fat or slightly hydraulic.
97	Combaconum Taluq—Vettar river.	No. 16	Clayey or semi-crystalline small kunkur of gravel size, bluish grey. Silicates 19·1 per cent. Slightly hydraulic.

Descriptive List of the Specimens of Limestone sent for examination.—(Continued.)

General No.	Locality.	Summary of description given.	Physical and Chemical character.
	Tanjore District—(Continued.)		
98	Combaconum Taluq—Malianur.	No. 17	Semi-crystalline small kunkur, of clayey appearance externally; light bluish grey. Silicates 17·9 per cent. Slightly hydraulic.
99	Myaveram Taluq—Bed of the Coleroon about 10 miles below the lower anicut.	No. 18—Cost 1 Anna 3 Pies a parah.	Semi-crystalline small kunkur; dark and sandy. Silicates 42·4 per cent. Hydraulic, perhaps highly so, as it is fairly homogeneous.
100	Tranquebar Coast ...	No. 19—Coral brought as ballast. Cost 8 Annas the parah.	Masses of coral, pumiceous structure. Perfectly fat.
101	Nannilam Taluq—Uthamasholapuram, north bank of Vettar.	No. 20—Cost 2 Annas the parah.	Semi-crystalline small kunkur; contains much foreign matters, hornblende, etc. Silicates 27·6 per cent. Slightly hydraulic.
102	Nannilam Taluq—Terumalrajenar river.	No. 21—Cost 1 Anna 4½ Pies the parah.	Semi-crystalline honeycombed kunkur. Silicates 21·6 per cent. Slightly hydraulic.
103	Nannilam Taluq—Pravadanar river at Thillachery.	No. 22—Cost 1½ Annas the parah.	Semi-crystalline small kunkur; occasionally rather clayey. Silicates 26·3 per cent. Slightly perhaps fairly hydraulic.
104	Nannilam Taluq—Mudikandanar river.	No. 23—Cost 1½ Annas the parah.	Semi-crystalline small kunkur. Silicates 17·6 per cent. Fat.
105	Nannilam Taluq—Vettar river, Otamasholapuram.	No. 24—Cost 2 Annas the parah.	Semi-crystalline small kunkur; variable structure. Silicates 25·2 per cent. Fat or slightly hydraulic.
106	Tiruterapundy Taluq.—Talakandu, Adapur.	No. 25	Amorphous kunkur; friable, buff. Silicates 33·1, rather clayey. Promises to be good hydraulic.

Descriptive List of the Specimens of Limestone sent for examination.—(Continued.)

General No.	Locality.	Summary of description given.	Physical and Chemical character.
	Tanjore District.—(Concluded.)		
107	Tiruterapundy Taluq—Korayar river, Upur and Alengadu.	No. 28...	Small kunkur of variable structure; some compact, some friable and sandy. Silicates 14·4 per cent. Fat.
108	Negapatam Taluq.—Vellayar river, Karungany.	No. 26...	Semi-crystalline or amorphous compact small kunkur. Silicates 17·3 per cent. Fat.
109	Negapatam Taluq—Vellayar river, Velangany.	No. 27...	Amorphous or semi-crystalline small kunkur, variable structure. Silicates 23·6 per cent. Fat or slightly hydraulic.
110	Tranquebar Coast—Coral brought from Paumben.	No. 29 used at Negapatam.	Coral (?) of fibrous laminated structure resembling cattle bone. Perfectly fat.
111	Tranquebar Coast—Shells obtained along the coast.	Nos. 1 and 2 used at Tranquebar and Negapatam, cost 3 Annas the parah.	Various shells. Perfectly fat.
		Madura District.	
112	Madura Taluq—Palanganatham, ½ mile south-east.	No. 1	Amorphous kunkur; friable, white, some of it semi-crystalline (paloday.) Silicates 15·7 per cent. Fat (and magnesian.)
113	Madura Taluq—Puliapoliam, ¼ mile east.	No. 2	Semi-crystalline kunkur; gravel size, dark blue. Silicates 22 per cent. Slightly hydraulic.
114	Madura Taluq—Puteypolliam, 100 yards west.	No. 3	Semi-crystalline kunkur; mostly gravel size, brown. Slightly hydraulic.
115	Madura Taluq—Karumathur, 200 yards east.	No. 4	Semi-crystalline flat honeycombed masses, variegated red. Slightly hydraulic.
116	Madura Taluq—Parapathi, 100 yards north.	No. 5	Semi-crystalline or amorphous kunker, white. Fat or slightly hydraulic.

Descriptive List of the Specimens of Limestone sent for examination.—(Continued.)

General No.	Locality.	Summary of description given.	Physical and Chemical character.
	Madura District.—(Continued.)		
117	Madura Taluq—Karyapathi, ¼ mile west.	No. 6	Semi-crystalline kunkur ; grey, micaceous. Fat.
118	Madura Taluq—Aveyur, ½ mile north-west.	No. 7	Semi-crystalline conglomerate kunkur, red. Fat or slightly hydraulic.
119	Madura Taluq—Arupucotta ¼ mile east.	No. 8	Semi-crystalline kunkur ; some amorphous and coarse, red to grey. Fat or slightly hydraulic.
120	Madura Taluq—Pantalagudy, 1½ miles south.	No. 9	Alabaster marble (calc-spar) ; white, with crystals, of plumbago. Silicates, etc., 2·4 per cent. Perfectly fat.
121	Madura Taluq—Aneyur, ½ mile west.	No. 10...	Semi-crystalline masses, variable structure, grey to red. Fat or slightly hydraulic.
122	Madura Taluq—Nidumathurey, ½ mile east.	No. 12	Semi-crystalline pisolitic conglomerate, red. Fat or slightly hydraulic.
123	Meylur Taluq—(Tripatore Taluq ?) Therukalupathi, 1 mile north.	No. 2A...	Semi-crystalline small kunkur, fawn. Fat or slightly hydraulic.
124	Meylur Taluq—(Tripatore Taluq ?) Kalapur, ¼ mile west.	No. 3A...	Semi-crystalline or amorphous masses, white. Silicates 11 per cent. Fat (and magnesian.)
125	Meylur Taluq—Meylur, 2 miles west.	No. 4A...	Semi-crystalline or coarse amorphous masses, greenish grey. Silicates 50·6 per cent. Promises to be strongly hydraulic.
126	Meylur Taluq—Chunambur ⅛ mile east.	No. 5A...	Semi-crystalline small boulders, variegated red. Fat or slightly hydraulic.
127	Meylur Taluq—Narasinghampathi, 2 miles west.	No. 6A...	Semi-crystalline masses; grey, much decomposed gneiss. Fat or slightly hydraulic.

Descriptive List of the Specimens of Limestone sent for examination.—(Continued.)

General No.	Locality.	Summary of description given.	Physical and Chemical character.
	Madura District.—(Continued.)		
128	Meylur Taluq—Velavalavu, 1 mile west.	No. 8A...	Semi-crystalline masses ; grey, not homogeneous. Fat or slightly hydraulic.
129	Meylur Taluq—Karugalagudy Melampathi, ¾ mile west.	No. 9A...	Do. do.
130	Meylur Taluq—Yarumapathi, 1 mile north-east.	No. 11A	Semi-crystalline kunkur ; grey, micaceous. Fat or slightly hydraulic.
131	Meylur Taluq—Punapathi Kavakundu, ½ mile south.	No. 12A	Amorphous kunkur ; friable, white, some of it semi-crystalline. Silicates 18·4 per cent. Fat (and magnesian)
132	Meylur Taluq—Nagamanglam, ¼ mile west.	No. 13A	Amorphous kunkur ; friable, white, some of it semi-crystalline. Silicates 10·4 per cent. Fat (and magnesian.)
133	Meylur Taluq—Narasinghum, ¼ mile south.	No. 14A	Semi-crystalline masses ; some coarse ; not homogeneous. Fat or slightly hydraulic.
134	Kulakalu Pamben, 2 miles north-east of Pamben near Akalamantapam.	Coral stone	Coral ; large-celled, light, spongy. Perfectly fat.
135	Kulakalu Pamben, 2 miles north-east of Pamben.	Chunam stone... ...	Coral ; porous, close-grained ; heavy, worm-eaten ; apparently fossil. Silicates 9·6 per cent. Fat.
136	Kulakalu Pamben, ¾ mile east of Pamben.	Shell	Shells. Perfectly fat.
137	Kulakalu Pamben, 2 miles north-east of Pamben.	White clay No. II (?)...	Chalky kunkur ; white, very friable. Silicates 23·1 per cent. Fairly hydraulic.

Descriptive List of the Specimens of Limestone sent for examination.—(Continued.)

General No.	Locality.	Summary of description given.	Physical and Chemical character.
		Madura District.—(Continued.)	
138	Dindigul Taluq—Vakampatty.	No. 1	Semi-crystalline or amorphous masses; very hard, almond color (paloday), contains magnesite. Fat.
139	Dindigul Taluq—Matupatty.	No. 2	Same as preceding. Fat.
140	Dindigul Taluq—Palkanuth.	No. 3	Marly mass; amorphous, friable; white to pink. Silicates 8·8 per cent. Fat.
141	Dindigul Taluq—Vagambur.	No. 4	Semi-crystalline masses; very hard, almond or white (paloday.) Fat.
142	Dindigul Taluq—Mathuryakalputty.	No. 5	Semi-crystalline honeycombed masses; semi-tufaceous in parts, grey. Slightly hydraulic.
143 and 144	Palney Taluq—Thopanputty and Thotamanaikenputty.	Nos. 6 and 7 (cannot be distinguished owing to the labels having fallen off).	Semi-crystalline honeycombed conglomerate, reddish. Semi-crystalline boulder kunkur. Both are slightly hydraulic.
145	Palney Taluq—Ayagudy...	No. 8	Semi-crystalline flat masses; very hard, grey. Slightly hydraulic.
146	Palney Taluq—Talayuth.	No. 9	Semi-crystalline boulders; conglomerate structure, very hard, red. Slightly hydraulic.
147	North Periakolam—Anachy.	No. 10...	Semi-crystalline large masses, conglomerate structure; very hard, red. Slightly hydraulic.
148	North Periakolam—Anachy.	No. 12...	Semi-crystalline large honeycombed mass; very hard, red. Slightly hydraulic.

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Descriptive List of the Specimens of Limestone sent for examination.—(Continued.)

General No.	Locality.	Summary of description given.	Physical and Chemical character.
		Madura District.—(Continued.)	
149	North Periakolam—Telandyammal Kovil.	No. 13...	Semi-crystalline or semi-tufaceous masses; hard, rather light, buff. Silicates 45·9 per cent. (clayey.) Promises to be strongly hydraulic.
150	South Periakolam ...	No. 14...	Semi-crystalline large boulders; very hard, almond or white (paloday.) Fat.
151	South Periakolam ...	No. 15...	Semi-crystalline masses; compact, very hard; grey to ochreous or red. Slightly hydraulic.
152	South Periakolam—Kuchanur.	No. 16...	Amorphous masses, (fragments of) very hard, light grey, contains much quartz. Fat or slightly hydraulic.
153	South Periakolam.	No. 17—Clay... ...	Chalky marl, white, soft. Silicates 34·7 per cent. (sandy.) Probably good hydraulic.
154	South Periakolam—Bodinithrapuram.	No. 18...	Semi-crystalline honeycombed kunkur, grey. Fat or slightly hydraulic.
155	South Periakolam—Taleyuth, 3 miles east of Chinamanur.	No. 18A	Chalky (or marly) kunkur laminated, white, friable. Silicates 9 per cent. (sandy.) Fat.
156	South Periakolam—Bothuputty.	No. 19...	Semi-crystalline kunkur, reddish. Fat or slightly hydraulic.
157	South Periakolam—Kombum.	No. 20	Same as 19.
158	Ramnad Zemindary—Villages 1½ miles west of Tondy.	No. 1	Amorphous or clayey geodic kunkur, mixed with gneiss *debris* grey, variegated. Silicates 42 per cent. (sandy.) Probably fair hydraulic.

Descriptive List of the Specimens of Limestone sent for examination.—(Continued.)

General No.	Locality.	Summary of description given.	Physical and Chemical character.
	Madura District.—(Concluded.)		
159	Ramnad Zemindary—Tondy.	Shells	Shells. Perfectly fat.
160	Ramnad Zemindary—Ramnad.	No. 3	Fossilized coral. Perfectly fat.
161	Shivagunga Zemindary—Tirukalapatty on Dindigul road, 7 miles west of Tirapatore.	No. 4	Amorphous or semi-crystalline kunkur; grey, hard or friable. Silicates 8·3 per cent. Fat.
162	Shivagunga Zemindary—Bed of Manimuthar river near Avelikota.	No. 5	Amorphous kunkur; rather friable, white. Fat or slightly hydraulic.
163	Shivagunga Zemindary—1 mile west of Savuganj, ¼ mile north of Road No. 14.	No. 6	Semi-crystalline kunkur; very hard, reddish. Fat or slightly hydraulic.
164	Shivagunga Zemindary—Conjurangal, 1½ miles north of Shivagunga.	No. 7	Amorphous or semi-crystalline kunkur; some rather chalky, variable, salmon color. Fat.
	Tinnevelly District.		
165	Thenkaray Taluq—Madathur.	Nos. 5 and 6	Semi-crystalline honeycombed kunkur; hard, grey to almond. Fat.
166	Ootapedaram Taluq—Puthukota.	No. 7 ... ... This and Nos. 8, 9, 10, yield a very good lime.	Semi-crystalline kunkur; variegated, grey to red. Fat.
167	Ootapedaram Taluq—Puthukota.	Nos. 8 and 9	Semi-crystalline (saccharoid) kunkur, grey. Fat.
168	Thenkaray Taluq—Karungolam.	No. 10...	Semi-crystalline honeycombed conglomerate kunkur, grey to reddish. Fat.

Descriptive List of the Specimens of Limestone sent for examination.—(Continued.)

General No.	Locality.	Summary of description given.	Physical and Chemical character.
	Tinnevelly District.—(Continued.)		
169	Ambasamudram Taluq ...	No. 13...	Semi-crystalline honeycombed kunkur; red, with white (magnesites) nodules. Silicates 15 per cent. Fat.
170	Velamudam	No. 14...	Semi-crystalline or amorphous masses (fragments); grey, variegated. Fat.
171	Streeviliputur Taluq—Chettikolam.	No. 15...	Semi-crystalline small kunkur; grey, variegated. Fat or slightly hydraulic.
172	Streeviliputur Taluq—Malli.	No. 16...	Semi-crystalline small kunkur; geodic, bluish grey. Silicates 21·6 per cent. Fat or slightly hydraulic.
173	Streeviliputur Taluq—Padakinengi.	No. 17...	Semi-crystalline kunkur, light grey. Fat.
174	Streeviliputur Taluq—Odayarputty.	No. 18...	Amorphous or semi-crystalline kunkur; grey to ochreous; friable. Fat or slightly hydraulic.
175	Streeviliputur Taluq—Kunur.	No. 19...	Semi-crystalline kunkur; grey to reddish, variegated. Fat or slightly hydraulic.
176	Streeviliputur Taluq—Marikolam.	No. 20...	Semi-crystalline kunkur, light grey. Fat.
177	Streeviliputur Taluq—Pachaliar.	No. 21...	Semi-crystalline small kunkur; reddish, with black mica. Fat.
178	Sankeranakovil Taluq—Sankeranakovil.	No. 22...	Amorphous stone (fragments); hard, quite white. Silicates 19·4 per cent. (pure silica !) Possibly fair hydraulic.

Descriptive List of the Specimens of Limestone sent for examination.—(Continued.)

General No.	Locality.	Summary of description given.	Physical and Chemical character.
	Tinnevelly District.—(Concluded.)		
179	Sankeranakovil Taluq—Perambatur.	No. 23...	Semi-crystalline kunkur (rolled pebbles); some geodic, others friable and amorphous; grey to reddish. Fat or slightly hydraulic.
180	Sankeranakovil Taluq—Karavanalur.	No. 24...	Semi-crystalline honeycombed conglomerate kunkur; red, with white (magnesian) nodules. Fat.
181	Sankeranakovil Taluq—Sankeranakovil.	No. 25...	Amorphous or semi-cry talline stone (fragments); very hard, light grey. Similar to No. 178.
182	Satur Taluq—Nally ...	No. 27...	Semi-crystalline honeycombed conglomerate small kunkur, grey to reddish. Fat or slightly hydraulic.
183	Satur Taluq—Ecurvatum.	No. 28...	Amorphous or semi-crystalline stone (fragments); very hard, light grey. Silicates 19·9 per cent. (pure silica ?) Possibly fair hydraulic.
184	Satur Taluq—Lervikarampatty.	No. 30...	Like 28. One piece contains some crystals of plumbago.
185	Ootapedarum Taluq—Kytar	No. 33...	Semi-crystalline kunkur (rolled pebbles); red, with black mica. Fat or slightly hydraulic.
	Trichinopoly District.		
186	Trichinopoly Taluq—Erasakanaikenputty.	No. 1	Semi-crystalline stone (fragments); hard, grey, with much black mica and other foreign matters. Fat or slightly hydraulic.
187	Trichinopoly Taluq—Saralaputty.	No. 2	Semi-crystalline or amorphous kunkur; hard, greenish grey, much mica. Fat or slightly hydraulic.

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General No.	Locality.	Summary of description given.	Physical and Chemical character.
	Trichinopoly District.—(Continued.)		
188	Trichinopoly Taluq—Goapu.	No. 3	Semi-crystalline small kunkur; red outside, grey. Fat or slightly hydraulic.
189	Trichinopoly Taluq—Nangaveram.	No. 4	Semi-crystalline small kunkur, red. Fat or slightly hydraulic.
190	Trichinopoly Taluq—Kolathur.	No. 5	Semi-crystalline or amorphous kunkur; slightly geodic and clayey in parts, russet greenish. Silicates 36 per cent. Fair or even good hydraulic.
191	Trichinopoly Taluq—Areamputty.	No. 6	Semi-crystalline kunkur; reddish with black mica. Fat or slightly hydraulic.
192	Trichinopoly Taluq—Alandur.	No. 7	Semi-crystalline kunkur; grey with black mica. Fat or slightly hydraulic.
193	Trichinopoly Taluq—Sungalam.	No. 8	Semi-crystalline rounded kunkur; grey with much black mica. Fat or slightly hydraulic.
194	Trichinopoly Taluq—Gundur.	No. 9	Semi-crystalline honeycombed kunkur; grey, red outside. Fat or slightly hydraulic.
195	Trichinopoly Taluq—Kilakurchy.	No. 10...	Similar to the preceding.
196	Trichinopoly Taluq—Pudur.	No. 11...	Similar to the preceding.
197	Trichinopoly Taluq—Nagamangalam.	No. 12...	Semi-crystalline or amorphous kunkur, much of it rotten. Silicates of the rotten part 40 per cent. On the whole it is slightly hydraulic.
198	Trichinopoly Taluq—Valavandecota.	No. 13...	Similar to the preceding.

Descriptive List of the Specimens of Limestone sent for examination.—(Continued.)

General No.	Locality.	Summary of description given.	Physical and Chemical character.
	Trichinopoly District.—(Continued.)		
199	Lalgudi Taluq—Torriur road, 9th mile.	No. 24...	Semi-crystalline small kunkur, red. Fat or slightly hydraulic.
200	Lalgudi Taluq—Sembangudy.	No. 25...	Amorphous or slightly clayey small kunkur, grey. Silicates 12 per cent. (clayey.) Slightly hydraulic.
201	Lalgudi Taluq—Sengady.	No. 26...	Semi-crystalline kunkur, grey to red. Fat.
202	Lalgudi Taluq—Arasangudi.	No. 27...	Amorphous or semi-crystalline kunkur, grey to ochreous. Fat or slightly hydraulic.
203	Lalgudi Taluq—Vengangudi.	No. 28...	Semi-crystalline small kunkur, light grey. Fat.
204	Lalgudi Taluq—Kalgudi...	No. 29...	Chalky kunkur, but transitional to marble; friable, pure white. Silicates 2·5 per cent. (clayey.) Perfectly fat.
205	Lalgudi Taluq—Vengangudi.	No. 30...	Semi-crystalline small kunkur; loose structure, friable; much debris of gneiss, grey. Fat or slightly hydraulic.
206	Lalgudi Taluq—Pulyadi...	No. 31...	Amorphous kunkur, gravel size; friable loose structure, grey. Fat or slightly hydraulic.
207	Lalgudi Taluq—Kuhur ...	No. 32...	Semi-crystalline small kunkur, some geodic, ochreous grey to red. Silicates 29 per cent. (sand.) Slightly hydraulic.
208	Lalgudi Taluq—Kuthapal.	No. 33...	Semi-crystalline small kunkur, grey. Fat or slightly hydraulic.

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Descriptive List of the Specimens of Limestone sent for examination.—(Continued.)

General No.	Locality.	Summary of description given.	Physical and Chemical character.
	Trichinopoly District.—(Continued.)		
209	Lalgudi Taluq—Sembangudi..	No. 34...	Semi-crystalline kunkur; gravel size, blue outside, grey inside. Slightly hydraulic.
210	Lalgudi Taluq—Virahatur.	No. 35...	Semi-crystalline small kunkur, grey. Slightly hydraulic.
211	Woodiarpaliam Taluq—Kotakadu, bed of Velar river.	No. 49...	Amorphous or semi-crystalline compact stone, yellowish grey. Silicates 8 per cent. Fat.
212	Woodiarpaliam Taluq—Arialur, 3 miles east of village, in the bed of a stream.	No. 50...	Fossilized oyster shells; semi-crystalline structure. Impurities and moisture 2·5 per cent. Perfectly fat.
213	Woodiarpaliam Taluq—Kalapalur.	No. 51...	Semi-crystalline or amorphous kunkur; much large sand, ochreous. Slightly hydraulic.
214	Woodiarpaliam Taluq—Tirumalavady.	No. 52...	Semi-crystalline small kunkur; blue outside, almond inside. Silicates 15 per cent. (clayey.) Slightly hydraulic.
215	Musery Taluq—Kaveraputty.	No. 53...	Amorphous stone (fragments), much black mica. Fat or slightly hydraulic.
216	Musery Taluq—Maikanaikenputty.	No. 54...	Semi-crystalline stone (fragments), much black mica. Fat or slightly hydraulic.
217	Musery Taluq—Thotiam...	No. 55...	Semi-crystalline kunkur; loose structure, much mica, etc., red, variegated. Fat or slightly hydraulic.
218	Musery Taluq—Naivaly...	No. 56...	Semi-crystalline or amorphous honeycombed large kunkur, red. Fat or slightly hydraulic.

Descriptive List of the Specimens of Limestone sent for examination.—(Continued.)

General No.	Locality.	Summary of description given.	Physical and Chemical character.
	Trichinopoly District.—(Continued.)		
219	Musery Taluq—Maruthamputty.	No. 57...	Semi-crystalline kunkur ; dark grey, red outside. Fat or slightly hydraulic.
220	Musery Taluq—Suriamputty.	No. 58...	Semi-crystalline stone (fragments), grey to almond. Fat or slightly hydraulic.
221	Musery Taluq—Road No. 7, 16th mile.	No. 59...	Semi-crystalline kunkur, light grey. Fat.
222	Musery Taluq—Kunkumapuram.	No. 60...	Semi-crystalline kunkur, much black mica. Fat or slightly hydraulic.
223	Musery Taluq—Valavunthy.	No. 61...	Amorphous compact stone, grey to almond. Fat.
224	Musery Taluq—Iythamputty.	No. 62...	Semi-crystalline kunkur ; mostly in fine powder, brown. Lumps gave 43 per cent. of silicates. Strongly hydraulic (?) or simply meagre.
225	Kulitalay Taluq—Kupachiputty.	No. 63...	Semi-crystalline honeycombed kunkur ; coarse and friable. Fat or slightly hydraulic.
226	Kulitalay Taluq—Pulapoliam.	No. 64...	Semi-crystalline honeycombed kunkur ; much black mica, red outside. Fat or slightly hydraulic.
227	Kulitalay Taluq—Thasyamangalam.	No. 65	Semi-crystalline kunkur, mostly in fine powder. Silicates 63 per cent. Possibly a cement stone, but from its excessive friability it is impossible to tell.

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Descriptive List of the Specimens of Limestone sent for examination.—(Continued.)

General No.	Locality.	Summary of description given.	Physical and Chemical character.
	Trichinopoly District.—(Concluded.)		
228	Kulitalay Taluq—Erumputhyputty.	No. 66...	Semi-crystalline kunkur, mostly in fine powder. In the lumps free of sand and dust, the silicates were 16 per cent. Slightly hydraulic.
229	Kulitalay Taluq—Puthur near Katlay.	No. 67...	Amorphous or semi-tufaceous honeycombed kunkur ; light grey. Silicates 16·5 per cent. (sand and mica.) Fat or slightly hydraulic.
230	Kulitalay Taluq—Thogaymalay.	No. 68...	Semi-crystalline kunkur, mostly in powder. Doubtful.
231	Perambalur Taluq—Tondamandorey.	No. 69...	Semi-crystalline kunkur ; grey hard, grey to almond. Fat.
232	Perambalur Taluq—Yesanay.	No. 70...	Semi-crystalline kunkur, grey. Fat.
233	Perambalur Taluq—Manglam.	No. 71...	Semi-crystalline kunkur, grey. Fat.
234	Perambalur Taluq—Vapamthalay.	No. 72...	Marly kunkur, still soft, and passing to semi-crystalline, grey. Silicates 12 per cent. Fat and magnesian.
235	Perambalur Taluq—Tharanay.	No. 73...	Chalky kunkur (rolled) passing to marble (like No. 204.) Silicates 1·6 per cent. Perfectly fat.
236	Iyakondasolapuram Taluq—Kotakadu.	No. 9 in South Arcot list. Used for Pelandorai Anicut Works.	Amorphous compact stone, yellowish. Silicates 15 per cent. (clayey.) Slightly hydraulic.
		South Arcot District.	
237	Tindevanum Taluq—Thylaveram.	No. 1	Marly kunkur ; coarse and friable, white. Silicates 17 per cent. (clayey.) Slightly hydraulic.

Descriptive List of the Specimens of Limestone sent for examination.—(Continued.)

General No.	Locality.	Summary of description given.	Physical and Chemical character.
	South Arcot District.—(Concluded.)		
238	Tindevanum Taluq—Jainkondan.	No. 2	Amorphous to semi-crystalline kunkur ; coarse, grey. Fat.
239	Trinomalay Taluq— Do. Hills.	No. 3	Amorphous kunkur ; sandy, friable. Silicates 28 per cent. (clayey.) Fairly hydraulic.
240	Trinomalay Taluq—Kacharpet.	No. 4	Semi-crystalline honeycombed kunkur, reddish grey. Fat or slightly hydraulic.
241	Trikalur Taluq—Kachigavacham.	No. 5	Semi-crystalline honeycombed kunkur, red outside. Fat.
242	Trikalur Taluq—Kodungal	No. 6	Semi-crystalline kunkur, grey. Fat.
243	Vilapuram Taluq—Wodanpaliam.	No. 7	Semi crystalline honeycombed small kunkur, grey. Fat.
244	Vilapuram Taluq—Valudareddy.	No. 8	Marly kunkur ; grey, coarse. Fat.
245	Unknown...	No. 24	Semi-crystalline honeycombed kunkur. Fat.
246	Unknown...	No. 25	Amorphous stone (hardened marl.) Fat.
		Chingleput District.	
247	Trivellur Taluq—Kupur.	No. 1	Marly kunkur ; coarse, white. Silicates 7·1 per cent. Fat.
247A	Trivellur Taluq—Gudapakam.	No. 2	Amorphous kunkur ; some rather tufaceous, some clayey. Silicates 20 per cent. Probably fair hydraulic.

Descriptive List of the Specimens of Limestone sent for examination.—(Continued.)

General No.	Locality.	Summary of description given.	Physical and Chemical character.
	Chingleput District.—(Continued.)		
248	Trivellur Taluq—Ulamary	No. 3	Marly kunkur, white. Silicates 4·9 per cent. Perfectly fat.
248A	Sydapet Taluq—Nandanpakam.	No. 4	Semi-crystalline or amorphous kunkur ; much rotten gneiss and mica ; dark grey and greenish. Silicates 21 per cent. Fat or slightly hydraulic.
249	Sydapet Taluq—Madapakam.	No. 5	Amorphous kunkur ; much rotten gneiss, greenish grey. Silicates 19 per cent. in homogenous parts. Meagre rather than hydraulic.
250	Sydapet Taluq—Kolathur.	No. 6	Amorphous kunkur ; much rotten gneiss; grey to greenish, variable. Fat or slightly hydraulic.
251	Sydapet Taluq—Thamarapakam.	.....	Semi-crystalline kunkur ; subgeodic, grey. Silicates 25 per cent. Slightly perhaps fairly hydraulic.
252	Trivellur Taluq—Umanambakam.	.....	Clayey kunkur ; geodic, dark brown clay color. Silicates 26 per cent. (clay and sand) good hydraulic.
253	Sydapet Taluq—Palanjur.	No. 1	Amorphous stone, grey. Fat or slightly hydraulic.
254	Sydapet Taluq—Saragalatlur.	No. 2	Marly kunkur, light grey. Fat.
255	Chingleput Taluq—Trikachur.	.....	Semi-crystalline honeycombed kunkur ; dark grey, red outside. Fat or slightly hydraulic.
256	Chingleput Taluq—Pomadekupam.	.....	Semi-crystalline small kunkur ; light grey, red outside. Fat or slightly hydraulic.
257	Madrantikam Taluq—Sanur.	.....	Semi-crystalline small kunkur, grey. Fat.

Descriptive List of the Specimens of Limestone sent for examination.—(Continued.)

General No.	Locality.	Summary of description given.	Physical and Chemical character.
		Chingleput District.—(Concluded.)	
258	Chingleput Taluq—Kambakal, near Paduvur.	.....	Marly or semi-crystalline small kunkur, white. Fat.
		North Arcot District.	
259	Chendragherry Taluq—Ranigunta.	No. 1	Marly kunkur, grey. Fat.
260	Chendragherry Taluq—Mungapuram.	No. 2	Marly kunkur (branched incrustations), grey or white. Fat.
261	Wallajah Taluq—Vanapady.	No. 3	Chalky marl, grey. Fat.
262	Wallajah Taluq—Kalar...	No. 4	Chalky marl; grey, friable. Silicates 25 per cent. Slightly hydraulic.
263	Karvetnagram Zemindary—Potur.	No. 5	Amorphous stone (fragments), perhaps hardened marl. Fat.
264	Chittoor Taluq—Vendamur.	No. 6	Amorphous honeycomed kunkur, dark grey; much clay adherent. Slightly hydraulic.
265	Gudiatham Taluq—Nagalathur.	No. 7	Semi-crystalline kunkur, white. Fat or slightly hydraulic.
266	Gudiatham Taluq—Kalinjur.	Nos. 8, 11 and 12 ...	Chalky kunkur, white. Fat.
267	Gudiatham Taluq—Amanankupam.	No. 9	Chalky to semi-crystalline kunkur, white. Fat.
268	Palmanair Taluq—Parapully.	No. 10	Chalky to semi-crystalline small kunkur. Fat.
269	Vellore Taluq—Aryur ...	No. 13...	Grey chalk. Silicates 25 per cent. Slightly to fairly hydraulic.

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General No.	Locality.	Summary of description given.	Physical and Chemical character.
		North Arcot District.—(Continued.)	
270	Vellore Taluq—Bothur...	No. 14	Marly kunkur, grey. Fat.
271	Vellore Taluq—Poygey...	No. 15...	Marly kunkur, grey. Fat.
272	Vellore Taluq—Mongadu Sappapeta.	No. 16...	Amorphous or semi-crystalline subgeodic stone (fragments), grey. Silicates 25 per cent. Slightly hydraulic (magnesian.)
273	Vellore Taluq—Thasipuram Sathur.	No. 17	Marly stone (hardened), white. Fat.
274	Vellore Taluq—Mongadu tank.	No. 18	Marly stone (hardened), white. Fat.
275	Vellore Taluq—Panchapondava Malay.	No. 19	Marly stone (hardened), white. Fat.
276	Trinomalai Taluq (South Arcot)—Parkonam.	No. 20...	Semi-crystalline or marly kunkur, grey. Fat.
277	Polur Taluq—Anavady...	No. 21	Semi-crystalline kunkur, grey. Fat.
278	Polur Taluq—Velva Arni.	No. 22...	Marly kunkur, white. Fat.
279	Polur Taluq—Valyanur...	No. 23...	Amorphous kunkur; dark grey, friable. Silicates 12 per cent. Fat.
280	Polur Taluq—Alinagar...	No. 24	Amorphous kunkur; dark grey, friable. Silicates 15 per cent. Fat.
281	Polur Taluq—Parikalpatu	No. 25	Semi-crystalline kunkur, white. Fat.

Descriptive List of the Specimens of Limestone sent for examination —(Continued.)

General No.	Locality.	Summary of description given.	Physical and Chemical character.
	North Arcot District.—(Continued.)		
282	Polur Taluq—Tirumali ...	No. 26...	Mostly friable grey chalk, some semi-crystalline. The friable parts contain 77 per cent. of silicates. This is rather too sandy, but it might possibly yield a meagre cement.
283	Polur Taluq—Malekarikathur.	No. 27...	Semi-crystalline kunkur; hard, white, micaceous. Fat.
284	Polur Taluq—Chetput ...	No. 28...	Semi-crystalline, amorphous or chalky small kunkur. Fat.
285	Polur Taluq—Indravanam	No. 29...	Semi-crystalline, amorphous or chalky small kunkur. Fat.
286	Polur Taluq—Karapatu...	No. 30...	Semi-crystalline kunkur; rather clayey, grey. Silicates 16 per cent, fairly clayey. Slightly to fairly hydraulic.
287	Polur Taluq—Kadalody...	No. 31...	Semi-crystalline or amorphous kunkur, grey. Fat.
288	Polur Taluq—Viralur ...	No. 32...	Semi-crystalline or amorphous kunkur, grey. Fat.
289	Polur Taluq—Gangayeram	No. 33...	Marly kunkur, white. Silicates 8 per cent. Fat (and magnesian.)
290	Polur Taluq—Kutagrampolliem.	No. 34...	Marly kunkur, harder. Fat or slightly hydraulic.
291	Polur Taluq—Kalasamudram.	No. 35...	Amorphous to semi-crystalline kunkur; white; the amorphous friable portions are of tufaceous character and contain 30 per cent. of silicates. They should be fairly hydraulic.

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General No.	Locality.	Summary of description given.	Physical and Chemical character.
	North Arcot District.—(Continued)		
292	Arni Jaghire—Tachur ...	No. 36...	Marly to semi-crystalline kunkur. Fat.
293	Arni Jaghire—Palathuvanam.	No. 37...	Marly to semi-crystalline kunkur. Silicates 9 per cent. Fat.
294	Arni Jaghire—Andipaliam	No. 38...	Amorphous kunkur, rusty grey. Silicates 22 per cent. Fat or slightly hydraulic.
295	Arni Jaghire—Vanamanglam.	No. 39...	Marly kunkur, white. Fat.
296	Arni Jaghire—Nesal ...	No. 40...	Marly to semi-crystalline kunkur, white quartzose. Fat.
297	Arni Jaghire—Chitary ...	No. 41...	Marly kunkur, white. Fat.
298	Arni Jaghire—Ponalapody	No. 42...	Marly to semi-crystalline kunkur, white. Fat.
299	Arni Jaghire—Thandukonathur.	No. 43	Marly kunkur; white, friable. Silicates 16 per cent. Fat or slightly hydraulic.
300	Wandewash Taluq—Thyampoliam.	No. 44...	Amorphous to semi-crystalline micaceous kunkur, grey. Fat or slightly hydraulic.
301	Wandewash Taluq—Maruthadu.	No. 45	Semi-crystalline kunkur; some amorphous and friable; grey. Fat or slightly hydraulic.
302	Wandewash Taluq—Neliankolam.	No. 46...	Semi-crystalline kunkur, grey. Fat.
303	Wandewash Taluq—Arunkonam.	No. 47...	Like No. 301.
304	Wandewash Taluq—Berudur.	No. 48	Like No. 301.

Descriptive List of the Specimens of Limestone sent for examination.—(Continued.)

General No.	Locality.	Summary of description given.	Physical and Chemical character.
	North Arcot District.—(Concluded.)		
305	Wandewash Taluq—Sathamanglam.	No. 49	Amorphous to semi-crystalline kunkur. Slightly hydraulic.
306	Wandewash Taluq—Sathathangal.	No. 50...	Marly to amorphous kunkur, grey. Fat.
307	Wandewash Taluq—Parasur.	No. 51...	Semi-crystalline kunkur, micaceous. Fat or slightly hydraulic.
308	Wandewash Taluq—Nanthiambady.	No. 52	Marly to semi-crystalline kunkur, white. Fat.
309	Wandewash Taluq—Kunambady.	No. 53...	Semi-crystalline micaceous kunkur. Fat or slightly hydraulic.
		Nellore District.	
310	Nellore Taluq—Kotapally	.....	Semi-crystalline kunkur, grey. Fat.
311	Nellore Taluq—Chemudugunta.	.....	Semi-crystalline kunkur, earthy. Fat.
312	Nellore Taluq—Amancherla.	.....	Semi-crystalline honeycombed kunkur, earthy. Fat.
313	Nellore Taluq—Dontah...	.....	Semi-crystalline kunkur, chalky outside. Fat.
314	Nellore Taluq—Ambaparám.	.....	Semi-crystalline honeycombed kunkur; dark, red ext. Fat or slightly hydraulic.
315	Kavaly Taluq—Siripuram	No. 1	Semi-crystalline kunkur. Fat.
	aluq—Siripuram	No. 2	Amorphous mass (fragments), grey. Fat.

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General No.	Locality.	Summary of description given.	Physical and Chemical character.
	Nellore District.—(Concluded.)		
317	Kavaly Taluq—Siripuram.	No. 3	Granitoid semi-crystalline boulder. Fat or slightly hydraulic.
318	Kavaly Taluq—Nagalaveram.	.....	Crystalline kunkur. Fat.
319	Kavaly Taluq—Takapalli Guduru.	.....	Crystalline micaceous kunkur. Fat or slightly hydraulic.
320	Rapuru Taluq—Kondumanaidupally.	Very excellent limestone	Semi-crystalline honeycombed stone, red. Fat.
321	Northern Range—Adanky quarry.	.....	Semi-crystalline kunkur; micaceous, red. Fat.
321A	Northern Range—Madaramita.	.....	Semi-crystalline micaceous stone, white. Fat.
322	Southern Range—Nagalaveram quarry.	.....	Semi-crystalline kunkur; micaceous, grey. Fat.
323	Southern Range—Atlagunta quarry.	.....	Semi-crystalline kunkur; micaceous, grey. Fat.
324	Southern Range—Kotapally quarry.	.....	Semi-crystalline kunkur; micaceous, grey. Fat.
		Vizagapatam District.	
325	Parvatipore Taluq—Parvatipore.	No. 2 of Vizianagram Range.	Semi-crystalline kunkur, subgeodic. Slightly hydraulic.
326	Salur Taluq—Salur ...	No. 5	Semi-crystalline kunkur, subgeodic. Slightly hydraulic.
327	Vizagapatam Taluq—Maduravada.	No. 6	Semi-crystalline kunkur, micaceous. Fat.
328	Ankapilly Taluq—Penduru	No. 9	Semi-crystalline kunkur, micaceous. Fat.

Descriptive List of the Specimens of Limestone sent for examination.—(Continued.)

General No.	Locality.	Summary of description given.	Physical and Chemical character.
	Vizagapatam District.—(Continued.)		
329	Palcondah Taluq—Palcondah.	No. 10	Semi-crystalline kunkur, micaceous. Fat.
330	Bobilli Taluq—Bobilli ...	No. 11	Semi-crystalline kunkur, micaceous. (small) Fat.
331	Ankapilly Taluq—Papiah Rajapalam.	No. 12	Semi-crystalline kunkur, micaceous. Fat.
332	Bimlipatam Taluq—Yalanky.	No. 16	Semi-crystalline kunkur, micaceous. Fat.
332A	Golgonda Taluq—Kanurpalem.	No. 3 of Golgonda Range.	Semi-crystalline kunkur, micaceous. Fat.
333	Ankapilly Taluq—(Golgonda) Vangaly.	No. 4...	Semi-crystalline kunkur, micaceous. Fat.
334	Chodaveram—Woderu ...	No. 6.	Semi-crystalline kunkur, micaceous. Fat.
335	Golgonda Taluq—6th mile, Golgonda road.	No. 7...	Semi-crystalline kunkur, appears sandy; occasionally subgeodic. Slightly to fair hydraulic.
336	Golgonda Taluq—14th mile.	No. 8	Semi-crystalline kunkur. Fat or slightly hydraulic.
337	Golgonda Taluq—4th mile, Kondasuntha road.	No. 12...	Semi-crystalline kunkur (small boulders), subgeodic. Slightly hydraulic.
338	Golgonda Taluq—10th mile, Thalapuram road.	No. 13...	Semi-crystalline kunkur, white inside. Fat.
339	Golgonda Taluq—7th mile, Thalapuram road.	No. 15...	Semi-crystalline kunkur, various. Fat or slightly hydraulic.
340	Golgonda Taluq—6th mile, Kondasuntha road.	No. 16	Perfect geodes of semi-crystalline or clayey kunkur, small. Silicates 22 per cent. (fairly clayey.) Fair to good hydraulic.

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General No.	Locality.	Summary of description given.	Physical and Chemical character.
	Vizagapatam District—(Concluded.)		
341	Survasidy Taluq—Pedapilly.	No. 29—Burns and slakes with difficulty.	Semi-crystalline or amorphous kunkur, of ferruginous sandy appearance. Silicates 28·4 per cent. (fairly clayey.) Fair hydraulic.
342	Survasidy Taluq—Veluchur.	No. 30...	Semi-crystalline small kunkur very ferruginous. Silicates 32·9 per cent. (hematite sand.) Slightly hydraulic.
		Ganjam District.	
343	Berhampore Taluq—Takasanghy, 6 miles south of Gopalpore.	Nos. 1 and 2	Fossil shells. Perfectly fat.
344	Berhampore Taluq—Gopalpore.	No. 3	Sea shells. Perfectly fat.
345	Berhampore Taluq—Mines between Sunapur and Surla, 4 miles east of Doigam road.	No. 5	Fossil shells. Perfectly fat.
346	Berhampore Taluq—Hotezapadu, 18th mile on Doigam road.	No. 6	Semi-crystalline small kunkur, occasionally subgeodic. Slightly hydraulic.
347	Berhampore Taluq—Chengudinagy Hill, 22nd mile on Doigam road.	No. 7	Semi-crystalline small kunkur, occasionally subgeodic. Slightly hydraulic.
348	Berhampore Taluq—Mongachikapada Hill, 17th mile on Doigam road.	No. 8	Semi-crystalline kunkur, dark. Fat or slightly hydraulic.
349	Berhampore Taluq—Palur, 4 miles from Ganjam.	Nos. 12 and 13 ...	Fossil shells. Sea shells. Both perfectly fat.
350	Berhampore Taluq—Korakory nullah between villages of Javajy and Rampully.	No. 14	Semi-crystalline micaceous kunkur, much quartz, etc. Slightly hydraulic.
351	Berhampore Taluq—Four miles from Aska.	No. 16	Semi-crystalline kunkur, occasionally subgeodic. Slightly hydraulic.

Descriptive List of the Specimens of Limestone sent for examination.—(Continued.)

General No.	Locality.	Summary of description given.	Physical and Chemical character.
	Ganjam District.—(Continued.)		
352	Berhampore Taluq—Three miles from 16th mile on Aska and Berhampore road.	No. 17	Semi-crystalline kunkur, some clayey and subgeodic. Slightly hydraulic.
353	Berhampore Taluq—Dimaza nullah near Bodagada.	No. 20	Semi-crystalline small kunkur, gravel size; somewhat clayey and geodic. Fairly hydraulic.
354	Berhampore Taluq—Wunta nullah near Kaoriguda.	No. 21	Semi-crystalline kunkur, sometimes clayey and subgeodic. Slightly to fairly hydraulic.
355	Berhampore Taluq—Sides of hills, near Kaoriguda.	No. 22...	Semi-crystalline kunkur, sometimes subgeodic. Slightly hydraulic.
356	Berhampore Taluq—Jayamanglam nullah, 3rd mile of Jaganadapur road.	No. 24	Semi-crystalline small kunkur. Fat or slightly hydraulic.
357	Berhampore Taluq—Boda nullah, 12th mile of Jaganadapur road.	No. 25	Semi-crystalline small kunkur, rather friable. Fat or slightly hydraulic.
358	Gumsur Taluq—25th mile, Surada road.	No. 28	Semi-crystalline small kunkur (gravel size), subgeodic. Slightly to fairly hydraulic.
359	Gumsur Taluq—25th mile, Surada road.	Nos. 29 and 30 ...	Semi-crystalline kunkur, subgeodic. Slightly hydraulic.
360	Gumsur Taluq—Nullah at 9½ mile on Surada road.	No. 31...	Amorphous kunkur; red, sandy. Slightly hydraulic.
361	Gumsur Taluq—Kukudagay, 13th mile, on Surada road.	No. 32...	Amorphous kunkur; rather clayey and subgeodic. Silicates 18 per cent. magnesian. Slightly hydraulic, but too magnesian.
362	Gumsur Taluq—In nullahs at 26th mile, on Surada road.	No. 33...	Tufaceous sandy kunkur; friable, grey, rather earthy. Silicates 49 per cent. (somewhat magnesian.) Promises to be strongly hydraulic.

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General No.	Locality.	Summary of description given.	Physical and Chemical character.
	Ganjam District.—(Concluded.)		
363	Gumsur Taluq—At 8th mile, on Surada road.	No. 34...	Semi-crystalline geodic kunkur. Fairly hydraulic.
364	Gumsur Taluq—At 22nd mile, on Surada road.	No. 35	Semi-crystalline geodic small kunkur. Slightly to fairly hydraulic.
365	Gumsur Taluq—At 24th mile, on Surada road.	No. 36	Amorphous to semi-crystalline kunkur, subgeodic. Slightly to fairly hydraulic.
366	Gumsur Taluq—At 20th mile, on Surada road.	No. 37	Semi-crystalline somewhat clayey kunkur, subgeodic. Slightly to fairly hydraulic.
367	Gumsur Taluq—Gotademeru at 15th mile south of Surada.	No. 38	Amorphous to semi-crystalline small kunkur, sometimes subgeodic. Slightly hydraulic.
368	Gumsur Taluq—Gotademeru at 15th mile south of Surada.	No. 39	Semi-crystalline rolled kunkur, subgeodic. Slightly hydraulic.
369	Chicacole Taluq—Chicacole	No. II.	Semi-crystalline micaceous small kunkur. Fat or slightly hydraulic.
		Bellary District.	
370	Bellary Taluq—West of 4th mile, Herihal road.	Nos. 1 and 2	Semi-crystalline micaceous kunkur stone; compact, grey. Fat or slightly hydraulic.
371	Bellary Taluq—Honally...	No. 3	Marly to semi-crystalline micaceous kunkur, white. Fat.
372	Bellary Taluq—Honally...	No. 4	Semi-crystalline kunkur. Fat or slightly hydraulic.
373	Bellary Taluq—Honally...	No. 5	Semi-crystalline kunkur. Fat or slightly hydraulic.
374	Raidrug Taluq—Raidrug.	No. 6	Semi-crystalline kunkur. Fat or slightly hydraulic.

Descriptive List of the Specimens of Limestone sent for examination.—(Continued.)

General No.	Locality.	Summary of description given.	Physical and Chemical character.
		Bellary District.—(Continued.)	
375	Raidrug Taluq—Fakirappa's garden.	No. 7	Amorphous kunkur, containing much rotten gneiss. Homogeneity uncertain ; possibly fair hydraulic.
376	Raidrug Taluq—Wodiakolam.	No. 8	Semi-crystalline kunkur, agglomerate honeycombed, red. Slightly hydraulic.
377	Raidrug Taluq—Malapur.	No. 9	Semi-crystalline kunkur stone, agglomerate honeycombed, red. Fat or slightly hydraulic.
378	Ghooty Taluq—Ghooty ...	No. 10	Semi-crystalline kunkur, white. Fat.
379	Ghooty Taluq—Ghooty ...	Nos. 11 and 12 ...	Marly to semi-crystalline kunkur, white. Fat.
380	Ghooty Taluq—Kistnapad.	No. 13	Semi-crystalline kunkur ; honeycombed, red. Slightly hydraulic.
381	Ghooty Taluq—Gundakal.	No. 14	Semi-crystalline kunkur, white. Fat.
382	Anantapur Taluq—Golapully.	No. 15	Semi-crystalline small kunkur, white. Fat.
383	Anantapur Taluq—Anantasagur.	No. 16	Semi-crystalline small kunkur, white. Fat.
384	Anantapur Taluq—Kudair.	No. 17	Semi-crystalline micaceous kunkur, dark. Fat or slightly hydraulic.
385	Anantapur Taluq—Galadinay.	No. 18	Semi-crystalline kunkur, much quartz and gneiss debris, white. Fat or slightly hydraulic.
386	Anantapur Taluq—Ramenpully.	No. 19	Semi-crystalline small kunkur, white. Fat.

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General No.	Locality.	Summary of description given.	Physical and Chemical character.
		Bellary District.—(Continued.)	
387	Anantapur Taluq—Rajampully.	No. 20	Compact semi-crystalline stone approaching splintering rock, light brown. Contains small *helix* shell. Silicates 5 per cent. Perfectly fat.
388	Tadpatri Taluq—Rayalcheruvu.	No. 21	Compact semi-crystalline stone, white. Fat.
389	Tadpatri Taluq—Muchukota.	No. 22	Semi-crystalline kunkur stone, white. Fat (strongly magnesian.)
390	Tadpatri Taluq—Alur ...	No. 23	Semi-crystalline kunkur stone, white. Fat (magnesian.)
391	Penkonda Taluq—Somasapully.	No. 24	Semi-crystalline micaceous kunkur stone. Slightly hydraulic.
392	Penkonda Taluq—Ardakalapully.	No. 25	Semi-crystalline micaceous kunkur stone. Fat or slightly hydraulic.
393	Hadagaly Taluq—Hampasagur.	No. 26	Amorphous or marly kunkur; white, friable. Fat.
394	Hadagaly Taluq—Upanyakanhully.	No. 27	Semi-crystalline kunkur, honeycombed, red. Slightly hydraulic.
395	Hadagaly Taluq—Tumbarhully.	No. 28	Amorphous to semi-crystalline kunkur, friable. Fat or slightly hydraulic.
395A	Kadligi Taluq—Thimalapur.	No. 29	Semi-crystalline subgeodic kunkur. Silghtly hydraulic.
396	Kadligi Taluq—Bundry...	No. 30	Semi-crystalline kunkur, white. Slightly hydraulic.
397	Kadligi Taluq—Kadligi...	No. 31	Semi-crystalline small kunkur. Fat.

Descriptive List of the Specimens of Limestone sent for examination.—(Continued.)

General No.	Locality.	Summary of description given.	Physical and Chemical character.
	Bellary District.—(Continued.)		
398	Kadligi Taluq—Beladu ...	No. 32	Semi-crystalline small kunkur. Fat.
399	Kadligi Taluq—Hegadal.	No. 33	Semi-crystalline kunkur. Fat.
400	Kadligi Taluq—Huchenhully.	No. 34	Semi-crystalline kunkur. Fat.
401	Hospett Taluq—Arupenkota.	No. 35	Semi-crystalline kunkur. Fat.
402	Hospett Taluq—Wudderhully.	No. 36	Semi-crystalline kunkur stone, red. Fat.
403	Hospett Taluq—Jambanathahully.	No. 37	Semi-crystalline compact kunkur stone; quartz and magnesite, red. Fat.
404	Hospett Taluq—Buttahully	No. 38	Semi-crystalline kunkur. Fat.
405	Hospett Taluq—Tirsankalu Vanka.	No. 39	Semi-crystalline kunkur stone, red. Fat.
406	Hospett Taluq—Anantasayangudy.	No. 40	Semi-crystalline small kunkur, reddish. Fat or slightly hydraulic.
407	Hospett Taluq—Devasamudram.	No. 41	Semi-crystalline kunkur stone. Fat.
408	Hospett Taluq—Narsapur.	No. 42	Semi-crystalline kunkur stone. Fat.
409	Hospett Taluq—Hanikara tank.	No. 43	Semi-crystalline kunkur, honeycombed, reddish. Fat or slightly hydraulic.
410	Harpanhully Taluq—Bikykota.	No. 44	Semi-crystalline kunkur. Fat.
411	Harpanhully Taluq—Narayanpur.	No. 45	Amorphous to semi-crystalline kunkur, rather friable. Fat or slightly hydraulic.

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General No.	Locality.	Summary of description given.	Physical and Chemical character.
	Bellary District.—(Continued.)		
412	Harpanhully Taluq—Banihully.	No. 46	Semi-crystalline micaceous small kunkur. Slightly hydraulic.
413	Harpanhully Taluq—Karanhully.	No. 47	Semi-crystalline honeycombed kunkur, reddish. Fat or slightly hydraulic.
414	Harpanhully Taluq—Sringartolu.	No. 48	Semi-crystalline honeycombed kunkur, micaceous. Fat or slightly hydraulic.
415	Harpanhully Taluq—Tilligi	No. 49	Semi-crystalline to clayey kunkur; subgeodic, bluish. Silicates 16 per cent. (clayey.) Fair hydraulic.
416	Harpanhully Taluq—Chigitary.	No. 50	Semi-crystalline honeycombed kunkur, reddish. Fat or slightly hydraulic.
417	Harpanhully Taluq—Nandibagur.	No. 51	Semi-crystalline kunkur, reddish. Fat.
418	Harpanhully Taluq—Nagargudy.	No. 52	Semi-crystalline small kunkur. Fat.
419	Harpanhully Taluq—Mipanachanhully.	No. 53	Semi-crystalline kunkur, white. Fat.
420	Harpanhully Taluq—Jirlahully Dadapura.	No. 54	Amorphous micaceous kunkur. Slightly hydraulic.
421	Harpanhully Taluq—Sigyhully.	No. 55	Marly kunkur, red and white. Fat.
422	Harpanhully Taluq—Darapaukanahully.	No. 56	Semi-crystalline micaceous kunkur. Fat.
423	Harpanhully Taluq—Muthigy.	No. 57	Semi-crystalline micaceous kunkur. Fat or slightly hydraulic.
424	Adony Taluq—Tumbal ...	No. 58	Semi-crystalline kunkur, white. Fat.

Descriptive List of the Specimens of Limestone sent for examination.—Continued)

General No.	Locality.	Summary of description given.	Physical and Chemical character.
	Bellary District.—(Continued.)		
425	Adony Taluq—Tagadona.	No. 59	Semi-crystalline kunkur, white. Fat.
426	Adony Taluq—Erapuram.	No. 61	Semi-crystalline kunkur, white. Fat.
427	Adony Taluq—Danapuram.	No. 63	Amorphous kunkur, red. Fat or slightly hydraulic.
427A	Adony Taluq—Bodibunda.	No. 64	Semi-crystalline kunkur, white. Fat.
428	Adony Taluq—Chenampully.	No. 65	Marly to semi-crystalline kunkur, white. Fat.
429	Adony Taluq—Girzivanka.	No. 66	Semi-crystalline kunkur, white. Fat.
430	Adony Taluq—Sonagal ...	No. 67	Semi-crystalline kunkur, white. Fat.
431	Adony Taluq—Narayanpuram.	No. 68	Semi-crystalline kunkur, white. Fat.
432	Adony Taluq—Jalibench.	No. 69	Semi-crystalline kunkur, white. Fat.
433	Adony Taluq—Basapur ...	No. 70	Semi-crystalline kunkur, white. Fat.
434	Adony Taluq—Kapati ...	No. 71	Semi-crystalline kunkur, white (greenish.) Fat.
435	Adony Taluq—Tarapur ...	No. 73	Semi-crystalline kunkur, white (rather marly.) Fat.
436	Adony Taluq—Osahully...	No. 74	Semi-crystalline kunkur, white. Fat.

Descriptive List of the Specimens of Limestone sent for examination.—(Continued.)

General No.	Locality.	Summary of description given.	Physical and Chemical character.
	Bellary District.—(Continued.)		
437	Adony Taluq—Kamaveram.	No. 75	Semi-crystalline kunkur, white (rather marly.) Fat.
438	Adony Taluq—Kotakal ...	No. 76	Semi-crystalline kunkur, white. Fat.
439	Adony Taluq—Mantriky.	No. 77	Semi-crystalline kunkur, white. Fat.
440	Adony Taluq—Saltanpur.	No. 78	Semi-crystalline kunkur, white (rather marly). Fat.
441	Adony Taluq—Pasalbanda.	No. 79	Semi-crystalline kunkur, white. Fat.
442	Adony Taluq—Chinagonahull.	No. 80	Semi-crystalline kunkur, white. Fat.
443	Adony Taluq—Nagathanhully.	No. 81	Semi-crystalline kunkur, white. Fat.
444	Adony Taluq—Musanahully.	No. 82	Semi-crystalline kunkur, white. Fat.
445	Adony Taluq—Chikaharniana.	No. 83	Semi-crystalline kunkur, white. Fat.
446	Adony Taluq—Chagry ...	No. 84	Semi-crystalline kunkur, white (rather marly.) Fat.
447	Adony Taluq—Ingaladahull.	No. 86	Semi-crystalline kunkur, white. Fat.
448	Adony Taluq—Pedagonahull.	No. 87	Semi-crystalline kunkur, white. Fat.
449	Tadpatri Taluq—Royalchervu.	No. 88	Compact semi-crystalline kunkur stone; approaching splintering rock, light brown. (Like No. 387.) Fat.

Descriptive List of the Specimens of Limestone sent for examination.—(Continued.)

General No.	Locality.	Summary of description given.	Physical and Chemical character.
	Bellary District.—(Concluded.)		
450	Tadpatri Taluq—Royalchervu.	No. 89	Semi-crystalline kunkur, white. Fat.
451	Tadpatri Taluq—Muchukota.	No. 90	Semi-crystalline kunkur, white or ochreous. Fat or slightly hydraulic.
452	Tadpatri Taluq—Alur ...	No. 91	Tufaceous stone, white, friable. Silicates 12 per cent. Promises to be fairly hydraulic.
453	Tadpatri Taluq—Bogasamudram.	No. 92	Semi-crystalline stone, rather worm-eaten. Fat or slightly hydraulic.
454	Darmaveram Taluq—Gutlur.	No. 93	Semi-crystalline stone quartzose, reddish. Fat.
455	Madakseera Taluq—Bukapatam.	No. 94	Semi-crystalline kunkur; much quartz, red. Meagre or slightly hydraulic.
456	Hindupur Taluq—Hindupur.	No. 95	Semi-crystalline kunkur, subgeodic. Slightly hydraulic.
	Cuddapah District.		
457	Cuddapah Taluq—Bogalatipully.	No. 1	Semi-crystalline red kunkur stone with much magnesite. Fat.
458	Poolivendla Taluq—Chintalapully.	No. 1	Semi-crystalline red kunkur stone with much magnesite. Fat.
459	Jamalmadugu Taluq—Jogapuram.	No. 1	Semi-crystalline micaceous kunkur, loose textured. Fat or slightly hydraulic.
460	Jamalmadugu Taluq—Setivarapully.	No. 2	Semi-crystalline micaceous kunkur. Fat.

Descriptive List of the Specimens of Limestone sent for examination.—(Continued.)

General No.	Locality.	Summary of description given.	Physical and Chemical character.
	Cuddapah District.—(Continued.)		
461	Jamalmadugu Taluq—Degavabrahmanapully.	No. 3	Semi-crystalline red kunkur (magnesian.) Fat.
462	Prodatur Taluq—Nine specimens.	Nos. 1 to 9	All these are very similar; they may be described as honeycombed red kunkur, and are all more or less magnesian. Fat.
463	Poolamputt Taluq—Rajampett.	No. 1	Honeycombed red kunkur. Fat.
464	Poolamputt Taluq—Chitwail.	No. 2	Red kunkur stone with much magnesite. Fat.
465	Badwail Taluq—Eight specimens.	Nos. 1 to 8	All of these are similar; red kunkur stone with much magnesite. Fat.
466	Royachoty Taluq—Five Specimens.	Nos. 1 to 5	All of these are semi-crystalline kunkur, grey (approaching to *paloday*) but friable. They are strongly magnesian. Fat.
467	Royachoty Taluq—Madaveram.	No. 6	Semi-crystalline micaceous kunkur. Fat.
468	Royachoty Taluq—Duragam.	No. 7	Amorphous to semi-crystalline kunkur; grey, friable. Fat.
469	Sidhout Taluq—Eight specimens.	Nos. 1 to 8	All of these are red kunkur stone with more or less magnesite. Fat.
470	Madanapully Taluq—Busankonda.	No. 1	Amorphous kunkur masses, grey; rather friable. Slightly hydraulic.
471	Kadery Taluq—Three specimens.	Nos. 1 to 3	Semi-crystalline kunkur, white. Fat.

Descriptive List of the Specimens of Limestone sent for examination.—(Continued.)

General No.	Locality.	Summary of description given.	Physical and Chemical character.
		Cuddapah District.—(Concluded.)	
472	Voilpad Taluq—Voilpad.	No. 2	Marly kunkur ; friable, white. Fat.
473	Voilpad Taluq—Voilpad.	No. 1	Semi-crystalline kunkur. Fat (or meagre.)
474	Voilpad Taluq—Voilpad.	No. 3	Semi-crystalline kunkur. Fat.
		Kurnool District.	
475	Cumbum Taluq—Cumbum.	No. 1	Honeycombed red kunkur stone, magnesian. Fat.
476	Cumbum Taluq—Ragamangunta, Nandikanama Ghaut.	No. 3	Semi-crystalline white kunkur stone. Fat.
477	Markapur Taluq—Markapur.	No. 4	Like No. 475 (No. 1.)
478	Ravalakota Taluq—Kalur.	No. 5	Splintering rock, light brown. Silicates 29 per cent. Fair hydraulic.
479	Ravalakota Taluq—Dinadevarapad.	No. 7	Semi-crystalline kunkur ; honeycombed agglomerate, magnesian. Fat.
480	Ravalakota Taluq—Ulindakonda.	No. 9	Semi-crystalline kunkur ; white, micaceous. Fat.
481	Nundikotkur Taluq—Jutur.	No. 11...	Semi-crystalline honeycombed kunkur, red. Fat.
482	Nandikotkur Taluq—Nandikotkur.	No. 13...	Amorphous conglomerate ; pebbly, friable, red. Fat (or meagre.)
483	Sirvel Taluq—Arlaguda...	No. 15	Honeycombed red kunkur stone. Fat or slightly hydraulic.

Descriptive List of the Specimens of Limestone sent for examination.—(Continued.)

General No.	Locality.	Summary of description given.	Physical and Chemical character.
		Kurnool District.—(Concluded.)	
484	Koilguntla Taluq—Sangapatam.	No. 17...	Marly kunkur ; friable, grey. Silicates 6 per cent. Fat.
485	Koilguntla Taluq—Perasamala.	No. 18...	Amorphous kunkury masses, pinkish grey. Silicates 7 per cent. Fat.
486	Koilguntla Taluq—Palakur.	No. 19...	Semi-crystalline kunkur stone, grey. Fat.
487	Nandiyal Taluq—Kodithadu.	No. 20...	Honeycombed red kunkur stone. Fat.
488	Nandiyal Taluq—Kondajutur.	No. 21...	Splintering rock, black. Silicates 13 per cent. Slightly hydraulic.
489	Nandiyal Taluq—Kondajutur.	No. 22...	Splintering rock, grey. Silicates 30 per cent. Fair to good hydraulic.
		Kistna District.	
490	Satenapully Taluq and the Palnad.	Black napa stone ...	Compact saccharoid rock of very fine grain, slate color, white when powdered. Silicates 10 per cent. (fine white sand.) Fat.
491	Satenapully Taluq and the Palnad.	White napa stone ...	The same, color slightly greenish white. Silicates 21 per cent. (fine white sand.) Slightly hydraulic.
492	Narsarowpet and other taluqs.	Stone kunkur, Nos. 10 and 11.	Red kunkur stone. Fat.
493	Narsarowpet and other taluqs.	No. 12...	Semi-crystalline micaceous kunkur. Fat.

Descriptive List of the Specimens of Limestone sent for examination.—(Continued.)

General No.	Locality.	Summary of description given.	Physical and Chemical character.
		Godavery District.	
494	Ellore Taluq—Janampet.	No. 1	Semi-crystalline stone with much rotten gneiss and marl. Meagre or slightly hydraulic.
495	Ellore Taluq—Valagalapully.	No. 2	Semi-crystalline stone with some marly lumps. Fat.
496	Pedapur Taluq—Jagampetta.	No. 4	Semi-crystalline stone with some marly lumps. Fat.
497	Rajahmundry Taluq—Katair.	No. 5	Compact amorphous rock, with calcite crystals in some parts, greenish grey with a crimson tinge in one part. Silicates 6 per cent. (clayey.) Fat.
498	Yernagudiam Taluq—Gaoripatnam.	No. 6	Like the preceding, but of looser structure, yellowish grey. Silicates 1 per cent. (red clay.) Fat, magnesian.
499	Yernagudiam Taluq—Gaoripatnam.	No. 7	Like 497 (No. 5).
500	Yernagudiam Taluq—Gaoripatnam.	No. 8	Mass of calcite in foliated crystals; color and appearance that of buffalo horn. Silicates 6·4 per cent. (brown clay.) Fat.
501	Yernagudiam Taluq—Gaoripatnam.	No. 9	Like 498 (No. 6) with large crystals of calcite in some parts. Pink to red. Silicates 1 per cent. (chocolate clay.) Fat.
502	Yernagudiam Taluq—Gaoripatnam.	No. 10...	Like 497 (No. 5) contains masses of fossil shells. Fat.
503	Yernagudiam Taluq—Gaoripatnam.	No. 11...	Mass of foliated horn-like crystals of calcite (like No. 8), nearly black. Silicates 4·6 per cent. (brown clay.) Fat.

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Descriptive List of the Specimens of Limestone sent for examination.—(Concluded.)

General No.	Locality.	Summary of description given.	Physical and Chemical character.
		Godavery District.—(Concluded.)	
504	Rajahmundry Taluq—Katair.	No. 12...	Compact rock, amorphous to semi-crystalline pink. Fat.
505	Upper Godavery—Bhumilanka, 18 miles from Dumagudiam.	No. 1 ... ... In extensive beds and boulders. 19·7 per cent. silicates.	Mixture of white calcite and of black splintering rock. Silicates ... white 2·8 per cent. / black 10·3 ,, The black may be slightly hydraulic.
506	Upper Godavery—Amagaripully opposite Dumagudiam.	No. 2 ... ... Beds of large extent.	Light slate color (mixture of black and white) fracture not so clean as usual in the splintering rock. Silicates 24 per cent. Fair hydraulic.
507	Upper Godavery—Enchampilly below junction of the Indravati.	No. 3 ... ... Extensive beds; graphite found near it at 40 feet depth.	Like the preceding; in highly compressed layers with veins of calcite running through it.
508	Upper Godavery—Bodaigudiam right bank of Godavery, 12 miles above Enchampilly.	No. 4 ... ... Small beds and boulders.	Amorphous rock of clayey appearance, light yellow. Silicates 17 per cent. (clayey.) Fair to good hydraulic.
509	Upper Godavery—Bed of the Godavery, 2 miles above Bodaigudiam.	No. 5 ... ... Extensive beds near and overlying sandstone.	Compact rock, with not very clean fracture, in numerous very thin layers giving a banded appearance; dark brown. Silicates 3 per cent. (black clay). Fat.
510	Upper Godavery—Seroncha, on left bank of the Tranhita a little above its junction.	No. 6 ... ... Very large beds over and underlying sandstone.	Ochreous to purple rock. A sandstone; it contains no limestone.
511	Upper Godavery—Develamary, on left bank of the Tranhita at foot of 3rd Barrier.	No. 7 ... ... Lies in beds over a large area.	Compact splintering rock, black with veins of white calcite. Silicates 14 per cent. Slightly to fair hydraulic.

N. B.—These 511 numbers represent 557 limestones examined.

The term "Fat" in the foregoing description is to be understood as opposed to "hydraulic" rather than to "meagre." A micaceous kunkur, containing 20 per cent. of silicates, may yield a lime which, though strictly speaking, rather meagre, inasmuch as it contains 30 per cent. of inert matter, yet behaves as a fat lime when slaked and does not set under water.

In concluding this report it may be useful to give a specimen of the system of classification adopted by M. Vicat in his Statistical Researches on Limestones. These tables, comprising the results obtained in the examination of 10,000 specimens (made in 1833—45), are drawn up in the following manner:—

Department.	No.	Color.	Texture.	Geological formation.	Insoluble.		Magnesia.	Classification.
					Per cent.	Quality.		
Orne ...	96	Pale yellow ...	Very coarse.	Middle oolite ...	1·5	Clay ...	...	Fat.
Do. ...	93	Milk and Coffee.	Sub compact.	Do. ...	8	Do. ...	...	Slightly hydraulic.
Do. ...	90	Buff ...	Chalky ..	Middle tertiary.	15	Do. ... (carbonaceous)	...	Hydraulic.
Do. ...	99	Do. ...	Do. ...	Middle oolite ...	23·5	Clay ...	...	Intermediate.
Do. ...	91	Earthy yellow ...	Do. ...	Middle tertiary.	26·5	Do. ...	...	Cement or intermediate.
Do. ...	89	Buff ...	Do. ...	Do. ...	31·5	Do. ...	...	Cement.
Do. ...	95	Reddish grey ...	Sub-compact.	Middle oolite ...	22	Sand ...	...	Very meagre.
Do. ...	94	Dirty white ...	Coarse ...	Do. ...	34·5	Sand and a little clay.	...	Valueless.

It has been seen (paragraph 37) that Indian limestones give very different results; 20 per cent. of sand or other more or less inert silicates affect very slightly the "fat" character of the limestone, and the best stones examined have been those containing 40 per cent. and upwards of silica.

BANGALORE,
30*th September* 1874.

(Signed) E. NICHOLSON,
Surgeon-Major, B.M.S.

APPENDIX.

Descriptive List of Limestones sent by the Madras Railway Company and the Madras Irrigation and Canal Company.

No.	Locality.	Summary of description given.	Physical and Chemical character.
		1st Division, South-West Line.	
1	65th mile	No. 1	Rather clayey, marly kunkur. Fair hydraulic.
2	56th mile	No. 2	Marly kunkur, slightly clayey. Slightly hydraulic.
3	53rd mile	No. 3	Marly to semi-crystalline kunkur. Fat or slightly hydraulic.
4	48th mile	No. 4	Semi-crystalline kunkur. Fat or slightly hydraulic.
5	42nd mile...	No. 5	Chalky kunkur. Fat.
6	39th mile	No. 6	Semi-crystalline kunkur, somewhat clayey and sub-geodic. Slightly hydraulic.
7	70th mile, 6th telegraph post.	No. 7	Semi-crystalline kunkur, variable, some chalky, some sandy. Fat or slightly hydraulic.
8	79th mile, 13th telegraph post.	No. 5	Do. (friable and earthy.) Fat or slightly hydraulic.
9	80th mile, 2nd telegraph post.	No. 6	Clay with chalky particles disseminated through it. Too poor to be worth burning.
10	81st mile, 6th telegraph post.	No. 9	Chalky to semi-crystalline kunkur. Fat.
11	82nd mile, 7th telegraph post.	No. 10	Chalky kunkur. Fat.
12	81st mile, 14th telegraph post.	No. 12	Marly to semi-crystalline kunkur, friable, sub-geodic. Slightly hydraulic.

***Descriptive List of Limestones sent by the Madras Railway Company, etc.*—(Contd.)**

No.	Locality.	Summary of description given.	Physical and Chemical character.
	1st Division, South-West Line.—(Concluded)		
13	92nd mile, 1st telegraph post.	No. 17	Chalky to semi-crystalline kunkur. Fat.
14	94th mile, 4th telegraph ost.	No. 19	Marly to semi-crystalline kunkur. Fat.
15	127th mile, 15th telegraph post.	.....	Marly kunkur, grey, friable. Fat.
16	129th mile, 10th telegraph post.	.....	Marly to semi-crystalline kunkur, grey. Fat.
	2nd Division, South-West Line.		
17	135th mile, Salem ...	.....	Semi-crystalline kunkur, honeycombed, earthy in large masses, grey. Slightly hydraulic.
18	137th mile, Salem ...	.....	Semi-crystalline kunkur, red outside. Fat.
19	170th mile, Salem ...	.....	Marly kunkur, grey, hardening. Fat.
20	Bangalore branch, 136th mile.	.....	Marly to semi-crystalline kunkur, white. Fat.
21	Bangalore branch, 137th mile.	.....	Marly kunkur in large mass, white. Fat.
22	Bangalore branch, 141st mile, Salem.	.....	Marly with much rotten gneiss. Fat or slightly hydraulic.
23	Bangalore branch, 142nd mile, Salem.	.....	Chalky kunkur with rotten gneiss, white. Fat.

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***Descriptive List of Limestones sent by the Madras Railway Company, etc.*—(Contd.)**

No.	Locality.	Summary of description given.	Physical and Chemical character.
	2nd Division, South-West Line.—(Concluded.)		
24	Bangalore branch, 148th mile, North Arcot.	.....	Marly to semi-crystalline kunkur, friable, much rotten gneiss, grey. Fat.
25	Bangalore branch, 151st mile, North Arcot.	.....	Marly to semi-crystalline kunkur, grey. Fat.
26	Bangalore branch, 158th mile, North Arcot.	.....	Marly to semi-crystalline kunkur, some sub-geodic, grey. Fat or slightly hydraulic.
27	Bangalore branch, 181st mile, Mysore.	.....	Semi-crystalline kunkur, much of it clayey and geodic, brown. Fair hydraulic, good if picked.
28	Bangalore branch, 203rd mile, Mysore.	.....	Semi-crystalline kunkur, subgeodic, very hard, brown. Slightly to fair hydraulic.
	3rd Division, South-West Line.		
29	180th mile, 8th telegraph post, Bunderchetty putty.	.....	Semi-crystalline kunkur, honeycombed, large, white. Fat.
30	189th mile, 15th telegraph post, Kadamputty.	.....	Amorphous kunkur, micaceous brown. Occasionally magnesian. Fat or slightly hydraulic.
31	190th mile, 1st telegraph post, Morur.	.....	Amorphous kunkur, friable, brown, magnesian. Silicates 44 per cent. (black mica.) Slight to fair hydraulic.
32	190th mile, 15th telegraph post, Kadamputty.	.....	Clayey, kunkur, mostly perfect geodes, brown. Silicates 26·4 per cent. (clayey.) Good hydraulic.
33	191st mile, 20th telegraph post, Ahtur.	.....	Amorphous kunkur, friable, brown. Silicates 44 per cent. (sand, mica and clay.) Fair hydraulic.

***Descriptive List of Limestones sent by the Madras Railway Company, etc.*—(Contd.)**

No.	Locality.	Summary of description given.	Physical and Chemical character.
	3rd Division, South-West Line.—(Concluded.)		
34	199¼ mile	.....	Amorphous to semi-crystalline kunkur, brownish grey. Fat or slightly hydraulic.
35	201½ mile	.....	Marly to semi-crystalline kunkur. Fat or slightly hydraulic.
36	205½ mile	.....	Semi-crystalline kunkur. Fat.
37	211th mile	.....	Amorphous to semi-crystalline kunkur, greenish grey. Slightly hydraulic.
38	212th mile	.....	Amorphous, rather porous, kunkur, grey. Slightly hydraulic.
39	218th mile	.....	Semi-crystalline kunkur, micaceous, mottled. Fat or slightly hydraulic.
40	223rd mile	.....	Semi-crystalline kunkur, variable, rather magnesian in parts. Fat or slightly hydraulic.
41	240th mile	.....	Amorphous honeycombed kunkur, grey. Fat or slightly hydraulic.
42	243rd mile, 6th telegraph post.	.....	Amorphous kunkur, grey. Fat or slightly hydraulic.
43	300th mile, 17th telegraph post.	.....	Red honeycombed kunkur, (*eraloday*) magnesian. Fat.
44	302nd mile	.....	Amorphous kunkur, white, (*tending to eraloday*) magnesian. Fat.

***Descriptive List of Limestones sent by the Madras Railway Company, etc.*—(Contd.)**

No.	Locality.	Summary of description given.	Physical and Chemical character.
	4th Division, South-West Line.		
45	Coimbatore Station cutting, 305th mile.	No. 1	Semi-crystalline kunkur, much honeycombed, in large mass, mottled, yellow outside. Fat or slightly hydraulic.
46	Hills near Kanavapaliam, 8 miles from Coimbatore town.	No. 2	Crystalized limestone (coarse marble), red mottled with grey and with black mica. Perfectly fat.
47	303rd mile cutting, Pothanore.	No. 3	Amorphous red limestone in large mass. Silicates 50 per cent. (red sand) appears meagre rather than hydraulic, yet it may be very fair hydraulic.
48	306th mile cutting, Echanaric.	No. 5	Amorphous honeycombed, red kunkur stone, magnesian. Fat.
49	Hills near Echanaric ...	No. 6	Crystalized limestone, red mottled with grey and black mica, the crystals of calcite very large. Perfectly fat.
50	308th mile cutting, Muddikurry.	No. 7	Amorphous honeycombed conglomerate, red with much magnesia. Fat.
		No. 7	Semi-crystalline, honeycombed kunkur, reddish. Fat or slightly hydraulic.
51	312th mile cutting, Ettanuraday.	No. 8	Amorphous to semi-crystalline kunkur stone, in large compact mass, reddish grey, much quartz and mica. Slightly hydraulic.
52	315th mile cutting, Walliar.	No. 9	Pisolithic conglomerate of red magnesian kunkur. Fat.
	1st Division, North-West Line.		
53	Virapareddypoliam, 67th mile, 13th telegraph post.	No. 4	Marly kunkur, white. Fat.

Descriptive List of Limestones sent by the Madras Railway Company, etc.—(Contd.)

No.	Locality.	Summary of description given.	Physical and Chemical character.
		1st Division, North-West Line.—(Concluded.)	
54	Thaduck, 58th mile, 3rd telegraph post.	No. 5	Semi-crystalline kunkur, grey. Fat.
55	Iyavarkondigy, 64th mile, 3rd telegraph post.	No. 6	Marly to amorphous kunkur, grey. Fat.
56	79th mile, 15th telegraph post.	No. 10	Amorphous to semi-crystalline kunkur, very sandy, some of it sub-geodic, brown. Meagre, perhaps fairly hydraulic.
57	93rd mile, 15th telegraph post.	No. 11	Amorphous kunkur, brown. Slightly hydraulic.
58	81st mile, 2nd telegraph post.	No. 12	Marly kunkur, with rotten gneiss, white. Fat.
59	Asthaveram, 134th mile, 3rd telegraph post.	No. 13	Red magnesian kunkur, honeycombed. Fat.
60	Rajampett, 129th mile, 14th telegraph post.	No. 14	Semi-crystalline kunkur, reddish grey. Fat or slightly hydraulic.
61	Gallapully, 129th mile, 4th telegraph post.	No. 15	Semi-crystalline kunkur, white, red outside. Fat.
62	Cherlopully, 145½ miles ...	No. 19	Semi-crystalline kunkur, white mottled. Fat or slightly hydraulic.
63	Gungavadithamay, 145¼ miles.	No. 20	Semi-crystalline kunkur, white and red. Fat.
64	Palakovadorayanypully, 160th mile, 3rd telegraph post.	No. 21	Red magnesian, kunkur honeycombed. Fat.

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Descriptive List of Limestones sent by the Madras Railway Company, etc.—(Contd.)

No.	Locality.	Summary of description given.	Physical and Chemical character.
		2nd Division, North-West Line.	
65	Bogalapully, 162nd mile...	No. 1	Red kunkur, honeycombed, somewhat magnesian. Fat or slightly hydraulic.
66	Bed of Buga river, 162nd mile, 5th telegraph post.	No. 2	Semi-crystalline kunkur, honeycombed, grey mottled with pink and black. Fat or slightly hydraulic.
67	Bogalapully, 164th mile...	No. 3	Red magnesian kunkur. Fat.
68	Bogalapully, 164th mile ...	No. 4	Red kunkur. Fat.
69	Yerragoontla	No. 5	Compact, imperfectly splintering rock in boulders, purple. Silicates 72 per cent. A calcareous sand stone. It might yield a rather meagre cement.
70	Nurji	No. 6	Compact splintering rock, slate color. Silicates 18 per cent. Fair hydraulic.
71	Chittanarpully, 204th mile, 7th telegraph post.	No. 7	Semi-crystalline kunkur, mottled grey. Fat or slightly hydraulic.
72	Kondapuram, 210th mile, 8th telegraph post.	No. 8	Semi-crystalline kunkur, mottled grey. Fat or slightly hydraulic.
73	Royalcheru, 243rd mile, 9th telegraph post.	.....	Semi-crystalline kunkur, grey to reddish. Fat or slightly hydraulic.
74	Royalcheru, 243rd mile, 10th telegraph post.	No. 10	New compact splintering rock (connecting the semi-crystalline deposited kunkur stone with the old compact splintering rock of a former geological period.) Light slate, shells visible. Fat.

Descriptive List of Limestones sent by the Madras Railway Company, etc.—(Contd.)

No.	Locality.	Summary of description given.	Physical and Chemical character.
		2nd Division, North-West Line.—(Concluded.)	
75	Dayalamadugu, 246th mile, 11th telegraph post.	No. 11	Red magnesian kunkur stone. Fat.
76	Kurnool road crossing near Ghooty, 255th mile, 15th telegraph post.	No. 12	Marly to semi-crystalline kunkur, white. Fat.
77	Pathakalcheru, 265th mile, 8th telegraph post.	No. 13	Semi-crystalline kunkur, mottled with black and red. Fat or slightly hydraulic.
78	Laudygudy, 270th mile, 11th telegraph post.	No. 14	Amorphous or semi-crystalline kunkur, grey. Fat or slightly hydraulic.
79	Dandumitta, 271st mile, 3rd telegraph post.	No. 15	Marly to amorphous kunkur, friable, grey. Fat or slightly hydraulic.
80	Terumalmadigunta, 271st mile, 9th telegraph post.	No. 16	Amorphous kunkur, white, magnesian. Fat.
		3rd Division, North-West Line.	
81	278th mile	.....	Chalky kunkur, with much rotten gneiss, white. Fat.
82	287th mile	.....	Chalky kunkur, more than half is rotten gneiss. Too impure for use, perhaps slightly hydraulic.
83	291st mile	.....	Chalky kunkur, more rotten gneiss than limestone.
84	302nd mile, 2nd telegraph post.	.....	Chalky kunkur, white. Fat.
85	315th mile, 14th telegraph post.	.....	Rotten gneiss cemented by a little chalky kunkur. Worthless for burning.

Description List of Limestones sent by the Madras Railway Company, etc.—(Concld.)

No.	Locality.	Summary of description given.	Physical and Chemical character.
		3rd Division, North-West Line.—(Concluded.)	
86	321st mile, 11th telegraph post.	.....	Semi-crystalline kunkur, grey. Fat or slightly hydraulic.
87	321st mile, 11th telegraph post.	.....	Semi-crystalline kunkur, honeycombed, conglomerate, yellow outside, grey or white inside. Magnesian (paloday). Fat.
...	323rd and 324th miles and others.	.....	Rotten gneiss, no limestone.
88	334th mile, 14th telegraph post.	.....	Chalky kunkur, with rotten gneiss, friable, white. Fat.
89	345th mile, 4th telegraph post.	.....	Clayey kunkur, small, grey. Fair hydraulic.
90	347th mile, 5th telegraph post.	.....	Marly kunkur, white. Fat.
91	349th mile, 1st telegraph post.	.....	Chalky kunkur, buff. Fat.
		Bellary Branch, North-West Line.	
92	Huggry river	.....	Semi-crystalline kunkur, grey in shombic lumps. Fat.

The other specimens from this branch consist mostly of rotten gneiss with a little chalky kunkur.

Remarks.—After rejecting several specimens consisting rather of rotten gneiss than of limestone, there still remained amongst the ninety-two, two or three specimens rather too poor to be worth burning.

The best of the collection are Nos. 1, 27, 28, 32, 33, and 70. These are fair to good hydraulic.

Nos. 33, 47, 56, and 69 are possibly of some value, but it is uncertain whether they are strongly hydraulic or merely meagre.

The remainder are either fat or but slightly hydraulic.

I would observe that amongst the collection there was no specimen of the excellent geodic clayey kunkur which is found all along the lime in Mysore. In no part of the Madras Presidency does there appear to be such good hydraulic limestones as those found between Colar and Bangalore.

Proceedings of the Madras Government, Public Works Department,
10th December 1874.

Limestones from the works of the Madras Irrigation and Canal Company.

One soft white kunkur, Katur—Fat or slightly hydraulic.
One semi-crystalline kunkur, Podur—Slightly hydraulic.
Three specimens of compact splintering rock.
No. 1 dark slate, Nigud, 16 per cent. silicates—Slightly hydraulic.
„ 2 light ochre, Kurnool, 21 „ „ —Fair hydraulic.
Dark slate, Alur, 19 „ „ —Slight to fair hydraulic.

BANGALORE,
30*th September* 1874.

(Signed) E. NICHOLSON, Surgeon-Major, B.M.S.

No. 196. ORDER THEREON, 10th December 1874, No. 3,468.

CIVIL WORKS, No. 12.

HIS Excellency the Governor in Council is much indebted to Surgeon-Major Nicholson for this clear and valuable Report, which will afford to all Executive Officers and members of the Department information, from which it is anticipated that a marked improvement in the selection and preparation of cements and mortars for different descriptions of public works will result. The latter part of paragraph 38 of the Report will be especially deserving of attention whenever it may be desirable or necessary to obtain cement stones for special work, while paragraphs 29 and 30, on the means of revivifying Portland cement, will be of practical utility to all who may require to use this material, though it may be expected that very generally District Officers will find close at hand the means of preparing a cement possessing all the more valuable properties of Portland, and obtainable at a small fraction of its cost.

2. Surgeon-Major Nicholson's previous Reports will be found recorded in the Proceedings as per margin.

No. 1,267, dated 8th May 1873.
„ 427, „ 21st Feb. 1874.

3. The Government consider it desirable that every District Engineer should have a set of the typical limestones to refer to, and 25 sets therefore should be made up under the direction of Dr. Nicholson and sent to the General Superintendent, Public Works Workshops and Stores, for distribution, as opportunity may offer, to the several officers to whom these Proceedings will be communicated.

3. A set will also be supplied to the Madras Museum.

(True Extract.)

Colonel, R.E.,
Secretary to Government.

To Surgeon-Major Nicholson, with twelve printed copies.
To all Superintending Engineers.
„ District Engineers.
To the Chief Engineer for Irrigation.
„ Chief Engineer and Manager of the Madras Irrigation and Canal Company.
„ Consulting Engineer for Railways.
„ Principal, Civil Engineering College.
„ Superintendent, Government Central Museum.
Exd. S. T. Austin.
Exd. E. C. Shunker.
Spare Copies

Concluding report of Experiments on Cements and Limestones.

(13)

Experiments on the relative adhesion of mortars to brick and to stone.

1. In the former series of experiments adhesive strength was tested only with regard to bricks, but I found that these, although of excellent quality often yielded under a strain insufficient to rupture the mortar by which a pair was united. At 300 lbs. to 400 lbs. on the crossed bricks (17 to 22 lbs. per sq. in.) the bricks peel off somewhat at the moment of rupture. Above 400 lbs. the bricks, seasoned by a months immersion in water (often for the second or third time) are liable to break off outside the joint; sometimes the strain will tear a large piece out of one brick, the joint standing perfect. This generally occurs between 500 lbs. and 540 lbs (28 to 30 lbs per sq. in.) Being therefore unable to ascertain the maximum strength of mortars requiring a greater strain that the bricks would stand, I had two dozen pairs of bricks cut out of the burnt stone (gneiss) of Bangalore, and of the same breadth as the clay bricks. With these I was able to test the strength of the best cements. I was somewhat surprised to find that the adhesive strength to stone was invariably greater than to brick; the proportion varied with different compositions but was on the average 1·7 to 1. This rule holds good in the case of the weakest sand mortar as well as in that of the strongest pure or Portland cements.

On the best way of using mortars of sand and fat lime.

2. In para. 14 of my last report I stated that "the hardening of this mortar being entirely due to dessiccation, it is not necessary that the bricks should be soaked in water" as saturation of the bricks is positively detrimental; it is sufficient if they are dipped into water for a few seconds immediately before laying". I have since made some experiments on this point:-

Table I.

Adhesive strength of joints made with mortar of 1 shell-lime paste, 2 sand. Means of 5 trials.

	Breaking weight	lbs per sq. in.
A. Bricks dry; mortar rather stiff	39 lbs	2.1
B. do. mortar rather thin	57 "	3.1
C. do. do. but the bricks dashed with water from a pot	67 "	3.7
D. Bricks soaked 10 seconds, mortar rather stiff	82 "	4.5
E. Bricks soaked 2 hours, do.	56 "	3.1
F. Bricks soaked 2 hours, drained 1 hour, do.	67 "	3.7
G. Stones wetted, do.	136 "	7.2

These experiments show that the opinion I ventured was correct, the best results being given when the bricks were soaked for a few seconds only, the next best when wetted in the fashion usual with careful bricklayers. However bad is the best with mortars of this kind.

On the necessity of keeping hydraulic mortars wet.

3. The former series of experiments included numerous examples of the great advantage obtained by the immediate immersion of joints made with mortars of fat lime and sand: the rule did not hold good in the case of mortars made with moderately hydraulic lime and sand, but it was invariable in the case of fat lime, even when the joint had had the advantage of being made with bricks already saturated with water. The following series illustrates this point, one of considerable importance in practice. The sample of mortar was not a good one, but the relative strength of the series is not affected by this.

Table II.

Adhesive strength of brick joints made with 1 shell-lime paste, 1 sand; after 28 days	lbs per sq. in.
A. Bricks dry, mortar rather thin	1.4
B. Bricks dipped in water 1 minute do	2.3
C. Bricks saturated, do	6.7
D. Same as C but immediately immersed	16.7

Perfect immersion though beneficial, is not absolutely necessary. If the bricks C had been kept moist for a month they would have given results nearly as good as D.

4. I also found that brick joints immersed at once gave better results than those kept 24 hours in air before immersion. Stone joints are not so much affected by dryness; the porosity of stone being so small that the joint retains its moisture much longer. It has frequently happened

that joints kept in air have shown nearly as great strength as the immersed joints; but for once that this happens I have found five times that the dry joints are much weaker than those which were kept immersed.

On the best proportions for mortars of fat lime and surki to be used in masonry & brickwork.

5. In my last report it will be seen that the strength given by different proportions of shell lime paste and of surki from S.M bricks was as follows:—

Table III.

Composition of Cement	Adhesive strength lbs per sq. in.	Tensile strength lbs per sq. in.
A. 1 lime paste, 1½ surki	20·5	62
B. do 2	11·1	91
C. do 3	17 to 27	95
D. do 4	10	114
E. do 5	9	90
F. do 7	5	57
G. do 10	4·4	50

The results obtained with 3 parts of surki were exceptionally good while those given by 1 part and by 2 parts were exceptionally low, hence a discrepancy. I therefore made a fresh series of experiments and found that while the adhesive strength remained very poor with as much as 5 parts of surki, yet that it dimi-

nished with each increase. The tensile strength on the contrary increased with the proportion of surki up to 5 parts. As this question of the best proportion of surki is mixed with that of the substitution or the addition of sand in these surki cements, I give the experiments on both on one table (IV.)

6. The brick joints were immersed at once and tried after 28 days, the bricklets were immersed after one day and also tried at 28 days of age.

Table IV.

Composition of cement.	Neat surki cement.		Cement with equal volume of sand.	
	Adhesion strength lbs per sq. in.	Tensile strength lbs per sq. in.	Adhesion strength lbs per sq. in.	Tensile strength lbs per sq. in.
1 lime paste, 1 surki	32	130	20·8	144
1 do 1½ do	16·9	146	8·9	120
1 do 2 do	18·8	130	7·1	116
1 do 3 do	11·2	125	1·*	156
Mean		132		134

* This is rather low. It may rise to as much as 11·2 lbs (see para 22) but at this point the strength is very (capricious)

From this table it will be seen 1° that adhesive strength, though good with all proportions within rather wide limits, yet decreases with an addition of surki beyond one part. 2° that the adhesive strength of these mixtures diminishes still more rapidly when they are diluted with sand. 3° that for tensile strength the proportion of surki

is immaterial 4° that the tensile strength is on the average fully as good when the cement is diluted with sand as when it is used neat.

2. 7° Another set of experiments showed that a half-part of surkí is too small a proportion, and confirmed the inferences to be drawn from Table IV, that the adhesive strength is affected by the addition of sand in proportion to the quantity of surkí. These experiments were made with a hunkur lime very slightly hydraulic; the joints were tried after 28 days immersion.

Table V.

	Neat lime or sand mortar lbs per sq. in.	Surkí cement		
		Neat, lbs per sq. in.		With equal vol. of sand, lbs per sq. in.
	Brick	Brick	Stone	Brick
Lime paste, neat	3·8	—	—	—
do 1 sand	2·7	—	—	—
do 2 sand	7·8	—	—	—
do ½ surkí	—	18·3	27·6	19·4
do 1 surkí	—	29·3	59·3	15·6

8. From these last two tables the following practical rules may be deduced:

a. The best surkí cement for masonry is made with 1 of surkí to 1 of lime paste (or an equivalent quantity of slaked lime). After 28 days under water it is stronger than the best bricks, and with stone it stands a disruptive force of nearly 60 lbs per square inch.

b. When rapidity of setting is an object the proportion of surkí can be increased to 2 parts; this proportion causes quicker setting, but with some loss of strength.

c. When economy is an object the cement made with 1 of surkí to 1 of lime paste may be diluted with an equal volume (1 ½ parts) of sand; the mortar will be as strong as good bricks.

d. When greater economy is an object, especially in the case of rubble masonry where a great quantity of mortar is used and the work is more of the nature of concrete (requiring tensile rather than adhesive strength) 2 parts of surkí may be used to 1 of lime paste and the cement diluted with an equal volume (2 ½ parts) of sand.

e. Where the rubble masonry is required to be specially good, two proportions may be used—1 lime to 1 surkí for laying the stone; 1 lime, 2 surkí, 2 ½ sand for grouting; the latter of course to be filled in before the jelly is placed in the interstices of the stones.

f. The latter proportion, 1 lime, 2 surkí, diluted with an equal volume (2 ½) of sand may advantageously be employed where the bricks are of inferior quality. It is still much stronger than ordinary country bricks. I prefer throwing in the sand after the lime and surkí have been mixed together in the mill with a full quantity of water.

g. When the lime is more or less hydraulic the

the foregoing proportions still hold good.
There is some advantage in the lime being
2. hydraulic as the adhesive strength of
the Surki-cement while it yields is
less dependent on moisture than is the
case when fat lime is used. For super-
structures a Surki-cement made with
fairly hydraulic lime gives perhaps
the best guarantee of strength.

On the use of Surki-cement for concrete and for plastering.

9. It has been seen that the greatest tensile strength was obtained by the use of 3 or 4 parts of Surki to 1 of lime paste, and that this cement would bear dilution with an equal quantity (3 parts), or even more, of sand not only without loss of tensile strength, but even with positive gain, besides acquiring hardness. I would not however advise greater proportions than 3 of Surki to be used, as beyond this limit the cement becomes soft, nor more than an equal volume (or perhaps a volume and a half) of sand in dilution. The proportions I have mentioned, 1 lime 3 Surki, 3 sand may be taken as the standard when the lime is fairly rich.
When the lime is meagre or slightly hydraulic the proportions of Surki may be reduced to 2 with advantage. The standard proportion gives a tensile strength (after 28 days of which 27 in water) of 327 lbs per square inch according

to the experiments in my last report, or even more in the present series. The mean tensile strength of the four compositions given in Table IV is 134 lbs, the most economical of them being the best. This strength is little inferior to that of Portland cement diluted with an equal volume of sand and far superior to that of the more diluted mixtures ordinarily used.

10. For work in large masses, such as foundations or large blocks of artificial stone, I can see no objection to the use of this Concrete-mortar in any place where the material can be procured. But for thin work such as plastering there is an objection, though not so formidable as one as would at first appear. There is no doubt that Surki-mortar plastering, has a great tendency to crack; this can be in a great measure if not entirely obviated by keeping the surface constantly wet and by good workmanship; yet these precautions are often inapplicable. However I have not found much practical disadvantage in this respect; I admit that cracks are unsightly and impair the water-tightness of walls, but they can generally be avoided in hydraulic works where impermeability is most important as in the interior of buildings; and in work exposed to the sun such as the outer plastering of a building, they are of little consequence and are filled up when the walls are whitewashed or coloured. I have used this mortar in making terrace roofs;

they are lighter than those made with common mortar as only two or three layers of tiles are required, they do not get saturated in wet weather, and much less timber is needed to support them, not only from their lightness but also from their strength. In many cases the timber is principally useful as a centering and could be in great fact removed after three or four weeks. If I may be excused giving my experience on a part of the subject which is hardly within my professional competence I would submit the following examples of work done with this mortar:

A. I made a verandah to a stable, it is 36 feet long 7 feet wide, supported on the outside by four stone posts and bearing on 3 brass summers of jungle wood each 10½ feet between the supports, and of very light scantling (4 inches deep, 3 inches broad) The rafters are bamboo, the rafters jungle wood. The roof is 2 inches thick, composed of 2 layers of flat tiles, the upper layer laid in and covered with the Surki-cement mortar.

B I also made an experimental arch 10 feet in span with 10 inches rise, it is flat above, being 12 inches thick at the haunches and 2 inches at the crown. Its width is 2 feet, it abuts on two piers each of 2 feet square. The middle half of the arch, where it is less than 4 inches thick, is made of mortar alone (1 lime 2 Surki,

3 sand), the remainder of concrete 2 volumes of gravel with one of mortar. Owing to the thinness of the arch, and either to my neglect of protecting it from the sun by a covering of wet sand, or perhaps to some settlement in the piers, two cracks appeared, one across the crown, another at a foot and a half on one side of the first. These cracks were cleaned out to the depth of ½ inch and filled with Portland cement and sand; and a few days afterwards, (one month after the arch was made) the centerings were removed. It was then seen that the cracks extended right through the arch; yet there are no signs of weakness, and it supports a weight of 1000 lbs on the crown.

C The impermeability to wet of plastering made with this mortar is so good that brick in mud walls are perfectly protected by it, even when exposed to constant wet. Small cisterns, in earth, made of brick in mud, lined for a brick thick, and plastered inside with this mortar, can be filled with water within a few hours of the plaster being polished

D For floors and walls of bathrooms this mortar is well adapted; it does not become saturated with water, it is always clean and as floor it lasts much longer than the ordinary mortar.

On the best way of using mortars of sand and hydraulic lime.

11. In the foregoing observations I have referred principally to surkie cements made with fat lime, such as that obtained from shells, from Cuddalore stone, from chalky kunkur &c. (see para 38) There hydraulic limes are procureable there is of course less advantage in the employment of surkie-cement mortar, except from economy, and the use of sand mortar then has advantage in certain circumstances. Sand-mortars of hydraulic lime doubtless deteriorate by keeping and by having to be beaten up again when required for use; though to a less extent than surkie-cement mortars. * Sand mortars also require less moisture during setting, they do not demand such skilled labour or so much supervision. Moreover good hydraulic lime is often procurable very cheap in parts of the country, where good surkie may not be obtainable except at a considerable cost. For these reasons sand mortar is sometimes preferable to surkie-cement mortar, especially for petty works. To give an example, in Bangalore excellent hydraulic lime can be procured, but at a high price, one rupee to one and a half rupee per parah; as surkie can be made very cheaply it will still be economical to use surkie-cement mortar. But twenty miles away, the same lime may cost only half a rupee while it is difficult to ensure good surkie being used, water may have to be brought from a long distance and supervision may necessarily be irregular. In this case there is manifest advantage in using sand-mortar; of course on the understanding that the lime is up to a certain hydraulic standard. This standard I place at the ability to set within 7 days under water when tested by Vicat's needle (B in table VI).

12. But whatever combinations be used in making mortar with hydraulic lime, I would recommend that the usual method of slaking and beating the lime be abandoned. The hydraulic limes from kunkur stone are usually so little homogeneous that the nodules may separate, when slaked, into flakes of fat lime and cores so strongly hydraulic as to be incapable of slaking. The latter are separated by beating and usually rejected as 'kutchy'. I need hardly say that I am supposing the lime to be well burnt; and since paying attention to the subject I have found, as far as my small

* Where the work does not require any very great strength, as in the case of plastering, or of grouting for rubble masonry, surkie-cement mortar may be kept for as much as a week without notable detriment. In this case the mass should be broken up and allowed to dry rather than to set, so that the powder can be beaten up again with water when required.

experience goes, that the Indian lime-burner works very honestly. Any quantity under 10 per cent of carbonate remaining in a lime may be taken as moderate, and I have never found this number exceeded in a Bangalore quick-lime; 4 or 5 per cent is the more usual number. These facts, which I obtained since using the calcimeter regularly on every sample of lime burnt or bought, are in correction of my remarks on the nature of kuppy in para 15 of my former report. The cores, when hydrated and left to the action of the air soon became carbonated and simulate a refuse of badly burnt and very meagre lime-stone

13. The following experiments illustrate the ill-effects of the usual treatment of hydraulic lime. The specimen was the common lime of Bangalore bought from the bazar; it is made from a good clayey kunkur and had in this case the following composition:—

Silicates	40.
Carbonate of lime	8·8
Quick lime	(51·2)

When the lime was slaked and beaten the kuppy was found to contain 10 per cent of carbonate.

Table VI.

	Setting; days. the with 3 coats of mortar			Adhesive strength; mean; lbs per sq. in.
	A	B	C	Bricks 22 days immersed
Lime slaked and beaten free of kuppy	8	13	24	2 lbs per sq. in.
kuppy alone, ground	15/24	2	2¼	25·4 *
Lime slaked and ground with kuppy	8	15	28	2
Lime ground quick and then slaked	3	4	7	19·6
The same as the equal volumes of kuppy and lime	1	2	3	27·6 *

* The bricks broke off at the strain; joints standing good.

14. From these experiments it would appear that the proper way to obtain the full hydraulic properties of the lime is to grind it quick and slake it afterwards. Slaking it and then grinding it yields very poor results; I surmise that the kuppy, when hydrated already is incapable of exercising any influence over the remainder of the lime; but if distributed through the lime before slaking, its full effect is obtained.

15. From some experiments on a large scale I may state that there appears to be no practical objection to this plan of grinding hydraulic lime before slaking. The quick lime is ground in the common lime-mill and sifted through a 12 mesh sieve; it may now be left heaped under cover; it slakes spontaneously without any loss of hydraulic properties and absorbs carbonic acid very slowly. When the sand to be used is dry, I would recommend that the lime thus ground be at once mixed with it (2 or 2½ even parts) and left until required for mixing. One advantage of this plan is that the lime is less liable to be stolen.

16. Absorption of carbonic acid from the air affects a heap of ground quick-lime very slowly; some Bangalore quick-lime ground very fine and left undisturbed in a bucket, was found after four months to contain the following proportions of carbonated lime:—

at the surface	9·2 per cent.
One inch below	5·2 "
In the middle	4·8 "

Some of the same lime kept in a bottle contained 4·6 per cent of carbonate. The lime left in the bucket-head increased in volume by about one half; when reduced to paste it gave out but slight heat, being nearly completely slaked; its hydraulic qualities were present as when it was fresh.

On mixing the materials for surki-cement mortar.

17. If the lime is fat and slakes freely leaving little or no "kuspy" or not foreign matter, it can be slaked and mixed with the surki; the mixture being kept until wanted. The volume of lime after slaking is rather variable and as the paste is taken as the active volume of the lime, it is needful to ascertain how much of it is equal to one part of paste. The following examples show the quantity of slaked lime and paste obtained from some typical limes. All, except the first, were measured grounds; 100 parts quick lime ground are roughly equal to 110 or 120 of it in lumps.

Table VII.

Sp. Gr. in bulk	Kind of Lime.	Quick	Slaked	Paste
1·06	Shell lime (fat not ground and unburnt)	100	200	133
1·05	No 13 (slightly hydraulic)	100	252	132
·91	No 16 (slightly hydraulic)	100	210	144
·91	No 26 (fair hydraulic)	100	200	108
1·04	Bangalore (fair hydraulic)	100	149	100
1·—	No 75 (good hydraulic)	100	112	88
·96	No 24 (very strongly hydraulic)	100	117	63

18. Roughly speaking, the fatter a lime the more slaked lime and paste does it produce. Quick-lime ground gives more slaked lime than when slaked in lumps; but the quantity of paste will be the same.

Fat lime slaked in lumps, 1 paste = 1½ slaked or ⅔ quick

do ground 1 paste = 2 slaked or ⅔ quick

Hydraulic lime slaked ground 1 paste = 1½ slaked or 1 quick

19. If a hydraulic lime is to be made into surki-cement, it may (advantageously, though not necessarily,) be treated in the same way as for sand mortar. The ground lime is mixed with the proper proportion of surki and left heaped under cover until required. If a fairly hydraulic lime, 1 part of ground lime (which is about equal to its volume in paste) is mixed with 2 parts of surki for concrete, rubble masonry or common brickwork, with 1 part if for the best masonry or brickwork. When required, 3 parts of the mixture are placed in the mill and mixed along with a sufficiency of water. (If mortar be required, then) to the mixed cement 2 to 3 parts of sand are added, according to the quality of the work.

20 When the lime is fat and slakes perfectly there is no object in grinding it before slaking; 1 part of slaked lime (equal to 1 of paste) can be mixed with 2 or even 3 of surki if for concrete, with 1 of surki if for fine brickwork or masonry. When required for use 3 parts of this mixture

are taken, mixed in the mill, and sand added if required.

21. I prefer to add the sand after the cement has been mixed. If the mortar is for concrete it is important that it should be as stiff as possible and this stiffness is attained by mixing the cement with sufficient mortar to temper it well and adding the sand afterwards. When the whole of the materials are placed in the mill at once, much more water is required and the mortar is generally too thin for concrete. There is no difference in the strength (tensile) of the concrete whichever way it is made (See next section). When the ground quicklime and surkhi have been kept together as I have suggested, it is advisable to mix them well into paste before adding the sand in order to ensure perfect slaking. I have never found any defects from this possible cause, but it is a reasonable precaution to take. After the sand is added very little more mixing is required.

22. But I have reason to believe that, while tensile strength is not affected by the addition of sand being made before or after the mixing of the cement, or by rough mixing, the adhesive strength is often seriously affected. In carefully conducted experiments on a small scale the effect of sand is often capriciously detrimental to adhesive strength, and on a large scale the risk of reducing it should be avoided as much as possible. In the experiments detailed in para 24 with a sand mortar made

from surki cement containing 3 parts of surkhi to 1 of fat lime the tensile strength was as nearly as possible the same under both conditions of mixture, but there was a considerable difference in the adhesive strength of the mortar. When the sand was added after the mixture of the cement into paste the brick-joints broke at 170, at 240, at 198 lbs. giving a mean of 203 lbs. or 11·2 lbs per square inch. When the sand was added to the dry ingredients the adhesive strength was 120 lbs, 156 lbs, 0. Even eliminating the last as possibly an accident the mean is 138 lbs. or 7·7 lbs. per square inch. I must say that both were good, much better than the standard results given in Table IV. But the effect of sand on adhesive strength appears to be very capricious.

23. The following case in practice illustrates this point. The mortar used in building the additions to the Division Cutcherry at Bangalore was made thus. Baskets of slaked kunkur lime, of broken brick and of sand, in equal numbers, were thrown into a steam mortar mill, along with a sufficiency of water, and, as the mixing was done with great rapidity, in less than five minutes the batch of mortar was taken out, apparently well mixed. The composition of this mixture may be taken as 1 lime-paste, 1½ surkhi, with 1½ or somewhat less than a volume, of sand. The tensile strength of this should be about 116 lbs. per square inch, the adhesive strength at least 9 lbs. per square inch (Table IV). The actual

results obtained were as follows:

Tensile strength, 28 days in air, 247 lbs. or 110 lbs per sq. in.

" " in water 252 lbs. or 112 "

" 118 days in water 333 lbs or 148 "

Adhesive strength 28 days in water 11·6 lbs or 5·5 "

Here the tensile strength is very fair, 112 lbs being a close approximation to the strength given in the standard experiments, showing how little the mode of mixture affects tensile strength; but the adhesive strength 5·5 instead of 7 or more is decidedly poor. In lime, I consider that it is better to added the sand after the lime and Surki cement has been thoroughly incorporated with the requisite quantity of water.

On the proportion of actual strength to the tensile strength obtained with standard briekets of mortar.

24. When using my lever testing-machine I take care that the weight is drawn along the lever at a regular speed, so that the increase of strain is equal; it is generally at the rate of 5 lbs per second perhaps somewhat quicker in very strong specimens. The following experiments were made with briekets of Surki-cement mortar to ascertain what proportion the actual strength of the mortar bore to the breaking weight. The composition of the briekets was:—

Shell-lime slaked 1½ = paste 1 } 3 vol 1 cement

S M brieki surki 2½ }

Sand (vol = vol of mixed cement) 2⅔ vol 1 sand

They were 28 days old of which 27 under water.

First series. Sand added after mixing the cement.

Brieket A. Breaking weight 314 lbs.

B " 293 lbs. } Mean 311 lbs.

C " 326 lbs. } or 138 lbs per sq. in.

The mean breaking weight being divided into tenths, three other briekets were tested by a portion of the strain at first, the remaining tenths being added at intervals of time. The following were the times during which the increasing strains were supported:—

Brieket D stood for 10 minutes, ·5 of the mean breaking weight

" 15 minutes more ·6 " "

" 10 " " ·7 " "

" 15 " " ·8 " "

" 3 " " ·9 " "

Total 53 " when it broke

Brieket E stood for 3 minutes ·75 of the mean breaking weight.

Brieket E stood for 2 minutes ·7 of the mean breaking weight.

" 20 minutes more ·75 " "

" 22 " " ·8 " "

" 13 " " ·85 " "

Total 1 hour 15 minutes when it broke.

Second series. Sand added to dry lime and surki.

Brieket G. Breaking weight 284 lbs.

H. " 317 lbs. } Mean 306 lbs.

I. " 317 lbs. } or 136 lbs per sq. in.

Brick k. J stood for 5 minutes : 6 of the mean breaking weight.
" 18 hours .75 " "
Total 18 hours 5 minutes when it broke.

Brick k. K stood for 1½ hour .6 of the mean breaking weight.
" 1½ " more .75 " "
Total 3 hours when it broke.

25. It would appear from these that the breaking weight being 100 when attained rapidly, 60 could be supported for at least twenty four hours perhaps longer, and 75 for a time varying between 3 minutes and 18 hours. The tenacity appears to be measured by a slow increase of the strain. It is probable that the permanent strength of this mortar would be little short of 50 per cent of its breaking weight.

Experiments with limed Surki mortar.

26. I have not had time to pursue my experiments in cement made with the improved, or limed, surki, but such further experience as I have had shows the value of this pozzolana where quick setting and hardness are required.

A. Surki made from blue clay treated with 20 per cent of lime. A cement made of 1 shell lime paste 2 surki set hard (C needle) in 16 hours. It gave the following results.

Adhesive strength after 1 day immersion 2·2 lbs per sq. in.
" " 28 days " 25 lbs " " (bricks broke)
" Stones " " 48 lbs "
Mixed with equal volume of sand.
Tensile strength after 28 days immersion 156 lbs " "
" " 118 " " 201 lbs " "

B. Surki made from common brick clay treated with 10 per cent of lime.
A cement made with 1 shell lime 1 surki gave an extraordinary rapidity of adhesion.
Adhesive strength after 1 day immersion 5·8 lbs per sq. in.
28 days " bricks broke at 25 lbs.
Mixed with equal volume of sand
Adhesive strength of bricks after 28 days immersion 2·87 (bricks broke)
" Stones " 49·5 lbs per sq. in.

From pressure of time I had to discontinue the experiments.

Experiments with lime and clay (twice-kilned) cement.

27. Further experiments with this cement show that it has no advantage over the surki cements except in quick setting under water. It sets fully (C needle) within 24 hours and in the same time attains an adhesive strength of 4·5 to 4·8 lbs. per sq. in. Its ultimate adhesive strength is not better than that of the surki cements; moreover it has the disadvantage of being unable to bear dilution with sand. It also has a very poor tensile strength neat or mixed with sand. Its quick setting under water is counterbalanced by a loss of strength if bricks immersed at once.

28. I tried the admixture of magnesite before burning, but the results were not encouraging.

On a process for revivifying Portland cement and rendering it quick-setting.

29. Having a large number of broken briquettes of Portland cement (neat) lying about, I burnt some on top of a charge of limestone in my furnace, for different lengths of time between 6 hours and 20 hours. The burnt cement, ground and sifted, was found to be possessed of extraordinary hydraulic energy. While the original cement when new, set in the following times, A 6 hours, B (Vicat's needle) 10 hours, C 16 hours, this reburnt cement set hard in less than 10 minutes. Two months after burning, the weather being also very damp, about 20 minutes were required for setting. I made some briquettes from the reburnt cement when new, not without difficulty, for it set hard before I could tamp it and get it out of the moulds; and I found that the strength, compared with that of Portland cement, was as follows:—

	7 days old (6 under water)	28 days old (6 under water).
London standard	178 lbs per sq. in.	
Original cement	181 "	219 lbs per sq. in.
Reburnt cement	91 "	153 "

It appears that this cement follows the usual rule of quick setting being obtained at the expense of strength; however the strength, though poor at a week old, is very satisfactory after a month. There are many cases where a considerable sacrifice of strength may be made in order to obtain quick setting, for example in tidal works or in stopping springs.

30. It is probable that by using the ashed portions always found on opening casks of Portland cement (which has been estimated as a wastage of 10 per cent.) or cement which has become unserviceable through age, this quick-setting cement could be produced very cheaply. The damaged cement could be mixed with water, made into bricks and burnt in a kiln in the usual way.

I found that specimens burnt for different lengths of time were equally good provided they were not clinkered. The burnt cement grinds easily, no more powerful mills than that for grinding sumbi being required. It should be sifted through a 48 mesh sieve and kept in air tight packages. But it would be well to keep the bricks and burn them only a short time before the cement is required for use.

Results obtained in the Examination of Limestones from the different districts of the Madras Presidency.

31. With a view to concisoness the list (appended to this report) has been drawn up according to a scheme of description giving
1° the physical character of the stone
2° the chemical character
3° the probable or actual character of the lime yielded

32. Of these three heads of description the last is the most important when the character of the stone can be determined by actual experiment on the lime obtained from it. Such a procedure would however demand a heavy outlay of time when several hundreds of stones have to be examined; each stone requiring on the average two or three days work. But experience shows that attention to the physical appearance of the stone with a short chemical examination will give such preliminary information as will render experiment on the burnt stone unnecessary except in the case of specimens promising good results. These are unfortunately but few in number and the information obtained under the first two heads, or even under the first alone, eliminates at least nine out of ten specimens under examination as not being sufficiently promising to repay the labour of burning and practical trial.

Determination of Physical character.

33. The use of the following terms enable the physical description to be given concisely.

Morphism	Consistence	Form of deposit	Hardness	Colour
Crystalline	Compact	Rock	Intensely hard	White
Splintering	Honeycombed	Boulders	Very hard	Buff
Semicrystalline	Mammillated	Massive (irregular)	Hard	Grey
Almond like	Conglomerate	Marly lumps	Friable	Pink
Amorphous	Geodic	Nodules	Soft	Red
Chalky (or marly)	Subgeodic	Incrustations*	Rotten	Greenish
Clayey	Subfaceous			Ochreous
Sandy				Mottled with mica

* Nodules or incrustations when not larger than road metal or large gravel are known as kunkur.

Examination of the numerous specimens sent from all parts of the Presidency show that they may conveniently be referred to the following types.

I. Chalky or marly kunkur.
Sometimes found as soft marl more often as rounded lumps of chalky appearance, or less soft, of amorphous texture. Sometimes this passes to marble having an effloresced and somewhat

crystalline appearance; the marly kind passes to the semicrystalline type. The lime yielded is generally fat.

II. Clayey kunkur.

Nodules or incrustations; mulberry-like or mammillated; with very distinct central cavity (geodic); hard but brittle; grey to dark slate colour; fracture conchoidal, amorphous and dull; the cavity generally lined with a fine granular layer. Yields more or less hydraulic lime according to the degree in which these characters are present.

III. Tufaceous stone.

Irregular masses; of loose and pumiceous texture; perfectly amorphous; light and friable; white or buff colour. When the silicates amount to upwards of 30 per cent, as is frequently the case in this type of stone, the lime yielded is of strongly hydraulic character, only differing from a true cement by its comparative slowness in setting.

IV. Semitufaceous stone.

Similar to the preceding but the characters, especially the lightness, less marked. Tends to the semicrystalline type. Quality depends on the amount of silicates present, but if these be the same as in the preceding type the lime yielded is equally good.

V. Amorphous compact stone.

Generally large boulders or masses of dull granitoid fracture. Rarely homogenous, and yielding usually a lime which is fat or but slightly hydraulic. Sometimes it is of rotten structure, not to be confounded with the friability of tufaceous stone.

VI. Semicrystalline kunkur, boulders or masses of stone.

Generally honeycombed, mammillated or conglomerate; occasionally geodic; of more or less semicrystalline structure. Colour various, often dark grey or red. Contains much quartz, felspar, decomposed gneiss and blackmica. Garnets, chlorite, asbestos or lepidolite (golden mica) often present. The lime yielded is generally fat or only slightly hydraulic. As a rule no quantity of silicates less than 20 per cent gives it the slightest hydraulic properties.

VII. Almond-like magnesian stone; Paloday.

In boulders or compact masses. Intensely hard; fracture dull and almond-like; colour yellowish white, frequently with patches of white magnesite visible. Always more or less magnesian. Yields fat lime devoid of hydraulic properties. Called in Tamil

paladay from its milky or creamy colour.

VIII. Semicrystalline splintering rock.

In large compact masses or slabs (Cuddapah stone) Intensely hard, splintering with a clean fracture, grey to bluish black. Usually yields a fat lime, and, if much silicates (30 per cent) be present, a meagre rather than a hydraulic lime.

IX Napa stone.

This is the name (Telugu?) given to a variety of the preceding; it has a rather smooth feel and fibrous texture. Yields fat lime.

IX. Marble.

The marble of Southern India is a kind of calcspar, resembling alabaster rather than statuary (saccharoid) marble. It is pure and yields a perfectly fat lime.

XI Shells or Coral.

Yields a perfectly fat lime.

34. I consider that all these, with the exception of the last, are forms of carbonate of lime deposited from rainwater. The carbonate of lime (and of magnesia) dissolved by rain water out of weathered gneiss rocks and other metamorphic is deposited in the lower part of valleys. The marly deposits harden and assume in time a crystalline form varying according to the following circumstances:

a. if pure they may crystallize into marble

b. if magnesian, they assume the almond appearance of paladay

c. if mixed with mica and the debris of gneiss they become semicrystalline limestone

d. if mixed with clay, they shrink in drying and form the rounded septarian nodules of clayey limestone.

Chemical Examination.

35. The analysis of a limestone is an operation requiring a well appointed laboratory and skill in chemical manipulation. Even when a complete analysis is not required, when we only want to know the amount of silicates and of magnesia present, the operation, by ordinary good methods is difficult and tedious.* Or even the simplest kind of information, the determination of the amount of silicates (and sand) remaining after solution of the limestone in muriatic acid, is too long for performance in an extended series of investigations. I have devised a method by which a complete analysis can be done in little more than the time usually required for the determination of silicates; and when the percentage of silicates is alone required, I do it indirectly by means of the Calcimeter; the process takes

* In every treatise on limestones with which I am acquainted the analytical processes laid down are very inaccurate, without any compensation in simplicity or in rapidity of execution. The authors are not responsible for this, the chapter on analysis being generally quoted, or contributed by other persons who does not find an opportunity of testing the processes as to their applicability to the special character of the investigations

but a few minutes and is of considerable accuracy.
The original form of the instrument was de-
vised by a German chemist, Mr Schiebler,
for the determination of carbonate of lime
in the spent bone-black of sugar refineries;
31. it was a rather complicated piece of ap-
paratus, but I have simplified it consider-
ably, indeed so much that I constructed two
instruments with the aid of a carpenter and
such materials as are ordinarily found in
32 laboratories.

36. I purpose taking an early opportunity of giving
a full description of the Calimeter and its use
in the examination of limestones and limes, in
accordance with the intimation conveyed in
G.O. 5th August 1874 No. 2,156; it will be
sufficient at present to state the principle
of its action. If the carbonic acid gas be
expelled from a carbonate by the action of
muriatic acid, and the quantity of gas be
measured, the equivalent amount of carbonate
of lime can be ascertained. Now, if we operate,
first on a weighed quantity of pure carbonate
of lime, then on an equal quantity of lime-
stone or other impure carbonate, any deficie-
ency in the quantity of gas evolved from
the latter (as compared with the quantity
evolved in the standard experiment) must
evidently be owing to the presence of impurities

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and be proportionate to their quantity. The
character of the silicates can be approximately
judged by the appearance of the insoluble
residue. They may be sand, mica, clay, silica &c.
The percentage amounts of silicates given in
the descriptive list were usually obtained by
the Calcimeter. They were frequently checked
by other processes and found to be accurate.

Determination of the character of the lime yielded by a specimen of limestone.

37. Great mistakes would be made if the lime-
stones of Southern India were judged solely
by their chemical composition. Most of them
are anything but homogeneous and specimens
containing as much as 20 or 30 per cent of
silicates may yield a limeslaking with all
the energy of fat lime and totally devoid
of hydraulic properties. The reason of this is
that few of them contain clay, the silicates
being, the ~~the~~ more or less fine débris of metamorphic
rocks. Yet on the other hand it is found that
specimens equally devoid of clay but contain-
ing a quantity of silicates (of very sandy
appearance) which would theoretically
render them quite meagre, furnish excellent
hydraulic lime, even cement; e.g. the tufa-
ceous stones.

Good hydraulics	Sandy kunkur	Containing 20 to 50 per cent of silicates	
	Clayey kunkur	Containing 20 to 30 per cent	
	Tufaceous stone	do.	
Strongly hydraulics to Cement	Clayey kunkur	Containing upwards of 30 per cent of silicates	
	Tufaceous stone		

It may be said that with the exception of some few sandy kunkurs, the only limestones giving really good results belong exclusively to two or three types, viz:— geodic clayey kunkur (analogous to the septaria from which the so-called Roman cement is made) and the tufaceous and semi-tufaceous stones containing a large percentage of silicates. I may however mention that other types of hydraulic stone may possibly be found hereafter, but it is probable that the specimens sent to me would only exceptionally include any found not to yield a slaking lime. The few really good stones which I have found have been sent to me with remarks that they are bad or inferior, and I should not be surprised if a large number of cements stones were discovered if bad limestones were especially required from the Indian subordinates who possess a knowledge of local mineral products.

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39. When the physical characters of a limestone, or its physical character combined with the amount of silicates, indicated that it possessed hydraulic properties in a notable degree, the specimen was burnt. Where numerous investigations are carried on, an assay furnace with a muffle would be very useful for burning a number of small specimens at a time, but under the circumstances of the present experiments I found a furnace of the following construction to answer well.

40. The furnace was 13 inches square in horizontal section and 2 ft. 8 in. high from the firebars to the top, exclusive of the cast pot. It was closed by a lid of iron, faced with clay and provided with a knob, working on hinges, and readily lifted by means of a pully overhead, and a counterpoise. At 8 inches above the firebars the furnace was divided vertically and equally into a back grate for the reception of limestone and into a front firespace. The floor of the grate was formed by iron bars or a perforated fireclay plate, the front by a grating of half inch square iron bars; these require renewal after about a dozen burnings. The grate was 1 ft. 4 inches high; just above it was the flue. By this contrivance the limestone

could be kept in its place while subjected to a red heat for any length of time.

The fuel used was coke and charcoal, loaded at the top. The fire was usually lit at 5. p.m. and kept low all night; in the morning it was allowed to burn well till 5. p.m. when it was let down; next morning the kiln was cool enough for the lime to be drawn.

I usually worked two furnaces; in each were three specimens of limestones separated from one another and from the walls by terrace tiles; above the limestone specimens of puzzolana could be burnt.

41. When the lime was drawn, a sample was tested by the calcimeter, and if it contained not more than 5 per cent. of carbonate, was considered well burnt. It was powdered in an iron mortar, passed through a sieve of 30 meshes to the inch, slaked and finally reduced to paste. A portion of the paste was pressed into a small pat (of 2 inches diameter) and immersed in water. The remainder was mixed with an equal volume of sand, and with this mortar pairs of bricks were joined and standard briquets moulded. If the specimen was obviously a cement stone, its adhesive strength was tested without sand being used.

42. The tests for setting were made by means of loaded needles

A. a needle of ⅛ inch diameter at the point loaded with ¼ lb

B Vicat's needle ⅛ inch do do 10 ozs.

C a needle of ⅛ inch do do 1 lb

The first and third were very useful for limes showing an extreme of fatness or of hydraulic energy, and were found to give results consonant with those of Vicat's needle. Thus a lime disappearing Vicat's needle after 6 days' immersion would usually support needle A in 3 days and needle C in 9 days.

43. The adhesive strength test was also of great practical value. The pairs of bricks joined with a mortar of lime paste and sand in equal parts were immersed at once and tried after 4 weeks; and after 1 week if strongly hydraulic. I found that the addition of an equal quantity of sand obviated some failures in adhesion; while it did not detract perceptibly from the strength attained in 4 weeks. It was not however necessary in those limes which contained so much silicates as to be natural cements.

44. The system on which limes were divided by Vicat according to their rapidity of setting

under water, requires some modification before it can be applied to the case of Indian limes. The following table shows the division I have found most applicable.

Quality	Slaking	Setting under water Vicat's needle	Adhesive strength lbs per sq. inch. after		
			1 day	1 week	1 month.
Fat	Energetic, volume increases to 2 at least; vol. of paste 1½ to 1½	Never sets and will be washed away in time if the water is renewed	—	—	
Meagre	Energetic, but the volume increases to not more than 1½	Never satisfactory	—	—	
Slightly hydraulic	Energetic, volume increases to 1½ or 2.	15 to 30 days	—	2 lbs	5 lbs
Fairly hydraulic	do	10 to 15 days	—	2–5 lbs	5–10 lbs
Good hydraulic	Languid, volume increases not more than 1½, produces lumps.	5 to 10 days	2 lbs	5–10 lbs	10–20 lbs
Strongly hydraulic	Heard by slakes unless powdered previously. Does not heat much.	2 to 5 days	2–3 lbs	10–15 lbs	20–30 lbs equal to the best bricks
Cement	Little or no heat even when powdered	less than 1 day	3–5 lbs	do	do

It should be observed that a lime may be meagre and yet hydraulic; the meagreness arises from a large quantity of inert silicates besides the small quantity which are active.

End of Part I

E. Blanford Calcutta

Summarized description of the limestones examined.

Coimbatore District.

45. The Pollegal limestones, 12 in number, comprised 1 good hydraulic limestone and 2 cement stones. Rather extended examinations of these and of the limes which they yield, having been made, the results may be given as illustrative of some of the general results of the chemical examinations of limestones.

46. The good hydraulic limestone is that numbered 1 in the detailed description appended.

Assay by the Calcimeter.

Carbonates 73·2

Poor 26·8

Analysis (by the short assay method)

Moisture	2·6	18.
Sand and Clay	25·8	
Carbonate of magnesia	18·9	equivalent to carb. lime 21·1
Carbonate of lime	52·2	52·2
	99·5	

The limestone when burnt yielded a lime of the following composition

	By analysis	Composition deduced from that of the limestone	
Insoluble silicates (in acid)	25·6		
Silica	13·9		40·3
Alumina and ferric oxide	6·0		
Magnesia	12·6		14·0
Lime	42·5		45·7
Carbonic acid	0·4		
	100·1		

Considering the difficulty in obtaining a perfectly fair sample of the stone which has actually burnt the composition of the lime deduced from the unburnt stone corresponds fairly with that obtained by analysis of the lime.

The lime set with needle A in 3 days, needle B (Vicat's) in 5 days, needle C in 8 days. Though setting quickly, the adhesive strength was not so good as might have been expected. It was as follows:—

Neat lime	8 days immersion,	10·8 lbs per sq. in.
do	28 "	"	13·6 "
1 lime 1 sand	28 "	"	11·3 "

This is fair, but yet unsatisfactory. I regret that I had no more materials in order to find out the cause of the adhesion progressing so slowly after the 8th day.

The cement stones are those from Sipperam, numbered 11 and 12. 48.

* Sut limes sometimes yield a large amount of silicates if washed with water or even with acid. The following are the quantities of silicates contained in the lime yielded by limestones of various degrees of impurity:

Percentage of silicates in limestone	Percentage of Silicates in burnt stone
5	8·6
10	16·5
20	30·7
30	43·4
40	54·3
50	64·1

As 100 Carbonate of lime yield 56 lime, the percentage of silicates in the lime obtained by burning a stone of known composition is thus found: $\frac{\text{Silicates} \times 100}{(\text{Carbonate} \times 56) + \text{Silicates}} = \text{Silicates in the lime}$

The silicates in the burnt lime are always more or less attacked by acid, as seen in the case of the specimen described above.

They are of the bituminous type and about equally good. The cement produced from № 12 gave the following composition on analysis.

Insoluble silicates and sand	39·5	53·9
Soluble alumina and ferric oxide	14·4	
Magnesia	11·7	
Lime	31·2	
Carbonic acid	1·0	
Alkalies, water and loss	2·2	
	100·0	

Both set with A needle in 1 day
B (Vicat's) do in 3 days
C do in 5 days

The adhesive strength shown by the two cements were as follows.

	Best bricks			Stone
	1 day in water lbs per sq. in.	7 days in water lbs per sq. in.	28 days in water lbs per sq. in.	28 days in water lbs per sq. in.
№ 11 neat	...	15·1 lbs.	31 lbs. (bricks broke)	46 lbs.
№ 12 neat.	3·2 lbs.	12·9 lbs.	26 lbs. (bricks broke)	34·3 lbs.
№ 11, with 1 sand	...	...	23·7 lbs.	...

I am informed by Mr Lennon, who was Superintendent in the College Range when the limestones were first recorded, that the deposits of these two cement stones are very extensive.

49. The stones from Coimbatore taluq, from Erode, Kodumudy and Caroor are either fat or only slightly hydraulic.

One of these, from Kodumudy (№ 17) deserves notice as it is the type of a very common lime-stone. It is known by the name of Palodey in Tamil, from its milky ~~white~~ appearance. This specimen was found to contain.

Silicates	2·5
Carb. of magnesia	37·1
Carb. of lime	61·4
	101·0

I examined it (and other similar specimens) with care in view of the disputed point as to the alleged properties of magnesia in rendering fat lime hydraulic. I found that although this lime at first appeared to set rapidly, supporting the needle A in 2 days, any subsequent setting was very slow; after 17 days the set with Vicat's needle was barely obtained and no subsequent improvement was observed. The adhesive strength was that of a slightly hydraulic lime viz. 3·5 lbs per sq. in., after a months immersion.

Of the 4 limestones sent from Metaspolliam in this district by the District Engineer, Nilgiris, one was found to be of considerable value. This (№ 24) is from Podur and Mangalkerry; it is a semi-tufaceous stone containing 31·4 per cent of silicates. The lime which it yielded, did not slake when powdered, it heated but did not swell or steam. It set in the following time:- 50.

65

With A needle in 2 days
with B (Vicat's) needle in 4 days
with C needle in 7 days

The adhesive strength of the neat cement was:— after 7 days immersion 10·2 lbs per sq. in. after one month the bricks broke off at a strain of 26·2 lbs per sq. in.

It is evidently little inferior to the Aspurans cements.

51. Of the limestones sent from the Bhowany valley by Mr. Sordmann one presented in an eminent degree the character of the tufaceous type. It was the specimen from Kotamang I am convinced to be incapable of slaking and is in fact a cement similar to the cements from Collegal already described. I think it must have been sent by mistake, for the description accompanying it stated that it was "very pure, burns and slakes freely" and a further supply sent to me at my request from the same locality is a common slightly hydraulic kunkur, described as "the best according to the kiln-burners and yielding the greatest quantity of powder when slacked." Now the specimen originally sent would not slake at all when burnt. I would suggest, as I have before mentioned,

that the lime burners be especially asked for the bad stones, those which yield a lime incapable of slaking. The stone now described is so valuable that it would be well worth searching for. It is of a loose sandy structure, and of a light brown colour.

Malabar district

The ten limestones sent are from the neighbourhood of Palghat; they are only slightly hydraulic. 52.

Salem district.

The limestones sent from the Namkal range are mostly either fat or only slightly hydraulic. 53.
Nos 54 from Valavendy and Nos 44 from Vallisipetty are the most promising. Several specimens of magnesite (carbonate of magnesia) were sent from the Shola Malai hills in this range. This substance contains only 7½ per cent. of impurities and being very plentiful it would be very desirable to find a use for it. The magnesia which it yields on burning at a low temperature sets very quickly under water but apparently with an amount of expansion which disturbs adhesive strength. When pairs of bricks joined with magnesia paste were immersed, it was found 24 hours afterwards that the magnesia had become perfectly hard but without the the slightest adhesion; a strong plate of

hydrated magnesia lay loose between the bricks. When the bricks were not immersed, adhesion was very good, attaining a strength of 22·4 lbs per square inch after 28 days (perhaps much sooner). The tensile strength of the magnesia was very poor.

54. The limestones of the Cosoor range were mostly fat or slightly hydraulic. No 65 was good hydraulic stone. The lime mixed with sand and mortar gave an adhesion of 6·3 lbs per sq in. after one week and 13·3 lbs after eight weeks immersion. It may be remarked that this stone contains only 7·3 per cent. of silicates but it belongs to the good bituminous type. It set in 6 days to Vicat's needle. No 71 is a white marble.

Tanjore district.

55. The limestones from Tanjore include several specimens of clayey kunkur, very small in size, which promise to yield good hydraulic lime. Nos 89, 90, 92, 93, 99, 106 may be noted. The remainder are fat or slightly hydraulic.

Madura district.

56. Of the 53 specimens examined, the greater part were either fat or only slightly hydraulic. Five only were note worthy:—
No 137, a Chalky kunkur containing 23 per cent of silicates
No 113, a clayey kunkur containing 22 " "
No 126, a semi crystalline or amorphous stone containing 50 " "
No 158, an amorphous kunkur containing 42 " "

These promise to give fair or good hydraulic lime
No 149, a light-semitubaceous stone containing 45·9 per cent.
This promises to give a cement.

Vimicielly district.

Of the 23 specimens examined only 3 are perhaps 57.
good – Nos 178, 181, 183. These are of the amorphous
compact type containing only 19 to 20 per cent.
of silicates, but this is remarkable as being
not sandy as usual, but rather pure silica
very finely divided. I had not enough of these
to burn, but they promise perhaps good results.

Trichinopoly district.

Of the 51 specimens examined, the following 58.
are perhaps worthy of notice.
No 196, a somewhat clay-stone promising fair or even
good hydraulic properties.
Nos 197, 198 are not homogeneous; some parts
are rotten, like weathered gneiss, and would
possibly yield hydraulic lime.
Nos 224 and 227 arrived in powder, so that their
character is doubtful. They appear to be
friable and mixed with a good deal of clay
and sand. Further examination of them
is desirable.
No 204 and 235 are remarkable as being transitional
between chalky limestone and marble. They are
perfectly soft.
No 212 is fossilized oyster shell.

South Arcot District

59. The 10 specimens examined were all fat or
only slightly hydraulic, with the exception
perhaps of No 239, which is somewhat
superior.

Chingleput District

60 Of the 14 specimens examined, there were one,
No 252. (from Ilmanambakum), which is a
perfect specimen of clayey limestone and
should give good hydraulic lime. No 247a
and 251 are apparently of poor hydraulic
quality. The rest are all fat or only slightly
hydraulic.

North Arcot District

61. The 53 limestones from this district belong
for the most part to the chalky or marly
type. The marl is more or less hardened
and is sometimes sandy, but is rarely more
than slightly hydraulic generally fat.
Some of the stones from the Polur range
are rather sandy at least in parts.
Nos. 282, 286, 291 are perhaps more or
less hydraulic.

Nellore District

62. The 16 specimens are all semicrystalline mica-
ceous stones yielding fat or slightly hydraulic
lime.

Vizagapatam District

63. The 19 specimens from this District are semi-
crystalline small limestones yielding with a

few exceptions fair or slightly hydraulic lime.
The best of these is No 340 a geodic clayey limestone promising a fair good hydraulic lime.
Nos 325, 335, 337, 341, 342 also appear better than the rest.

Gunjam District.

64. Of the 30 specimens from this District those from the Berhampore taluq were either shell (perfectly fat) or semicrystalline limestone of but slightly hydraulic character. Nos 353 and 354 are somewhat better than the rest.
In the Gumsur taluq, the limestones were somewhat clayey and subgeodic promising better than the preceding. Nos 361, 362, 363, 366 are the best. Of these No 362 is a tufaceous stone containing 49 per cent. of silicates; it promises to yield a strongly hydraulic lime, if not a cement.

Bellary District.

65. There was a remarkable uniformity of inferior hydraulic character in the 91 specimens from this District. With few exceptions they were the common semicrystalline limestone derived from hardened marly chalk. The only specimens promising to yield at all hydraulic lime are Nos 415 and 452. The former is a poor clayey stone; the latter, though only containing 12 per cent. of silicates, is yet of the good tufaceous type.
No 387 is remarkable for its resemblance

to the splintering rock of Kadapa and Karnul. No 449 also approaches this type and is a link in the series connecting recent chalky marl with the old rocks of former geological periods

Cuddapah District.

66. The 46 specimens examined belong nearly without exception to two common types:—
The semicrystalline or amorphous limestones.
The red honeycombed limestones.
In both cases they are so very magnesian that any hydraulic character derived from the silicates is considerably neutralized.
No splintering rock among the specimens.

Kurnool District.

67. Of the 15 limestones examined, 3 were specimens of the compact splintering rock commonly known as Kadapa stone. This rock varies in character; it sometimes contains pure white Calcite, at other times it is black, slate-blue, or nearly white; its fracture varies from a somewhat fibrous texture to the cleanest splintering. It may be almost pure carbonate of lime or contain as much as 30 per cent of Silicates.
These may be either pure white silica or clay of various colours. In some cases the colour is variable and appears to have been

derived from contact with purple shale overlying the limestone.

When the quantity of silicates amounts to 68.
15 per cent, the stone is of a more or less hydraulic character. The lime produced slakes perfectly well and has all the appearance of a perfectly fat lime, but it has a fair adhesive strength when joints made with it are immersed. I burnt specimens from the Cuddapah District (Chegair river) and found the hydraulic character to be as follows.

No	Silicates per cent.	Adhesive strength lbs per sq in. 28 days in air	28 days in water	Tensile strength 8 days in air 20 — in water
A	82	7·2	3·7	67 lbs
B	79	—	7	64 lbs
C	84	—	11·8	20 lbs?

The tensile strength was very poor in every case and the setting under water unsatisfactory.

Kistna District.

Amongst the few limestones from this District 69.
examined, were two specimens of Nagpore stone. This is a compact limestone resembling the splintering rock (kadapastone) but often with a much less clean fracture. It contains from 10 to 20 per cent of silicates and mineralogically it differs but little

from the compact splintering rock.* Like the latter it gives a lime which is generally fat and sets under water very imperfectly; yet it has fair adhesive power when the quantity of silicates exceeds 10 or 15 per cent.

Godavery District.

70. Of the 18 specimens from this District there were 3 kunkurs from Ellore and Pedapur talugs; 8 specimens of rock from the neighbourhood of Rajahmundry, and 7 from the Upper Godavery. The Rajahmundry stones are amorphous rock or calcite both very pure, the Upper Godavery stones are either of the same character or compact splintering rock.

* Never having been in the districts yielding these stones I could only appreciate their mineralogical similarity to stones clearly formed from chalky marl. But after being pointed out the Indian Geological Survey has pointed out to me that the Nagpur stone belongs to strata of the Palæozoic period while the splintering rocks of Yernagudiam (Godavery) are Lower Eocene Whatever may be the geological age of these various specimens I consider that there is little mineralogical difference between those of quite recent formation and those of ancient strata. In the course of these examinations of limestones I have come across some specimen in which the transformation from chalky marl was plainly visible in stone which I should certainly have taken to be identical with napa stone or the splintering rock of the Kistna-Godavery upper country.

Abstract of Limestones examined

District	Perfectly fat	Fat or slightly hydraulic	Fairly good hydraulic	Strong hydraulic	Total
Coimbatore		36	1	4	41
Madura		2			2
Salem	7	31	3		41
Tanjore	3	22	6		31
Madura	8	41	4	1	54
Tinnevelly	1	18	3		21
Trichinopoly	3	45	1	(2?)	51
South Arcot	—	9	1	—	10
Chingleput	1	11	2		14
North Arcot	—	50	3	—	53
Nellore	—	16	—	—	16
Vizagapatam	—	18	1	—	19
Ganjam	6	18	5	1	30
Bellary	1	88	2	—	91
Cuddapah	—	46	—	—	46
Kurnool	—	13	2	—	15
Kistna	—	3	1	—	4
Godavery	—	17	1	—	18
Total	29	484	36	8	557

Thus out of 557 limestones only 44 or about 8 per cent promised to be more than slightly hydraulic.

Descriptive List of the specimens of Limestone sent for examination

General No.	Locality	Summary of description given	Physical and Chemical Characters
	Coimbatore District		
1.	Collegal range N. of the Honally stream near Collegal.	No 1. Found in the bed of the stream, also 2 feet under alluvial soil.	Clayey texture, multigenic, dark bluish grey. Silicates 26.8 per cent. Yields good hydraulic lime.
2.	Collegal range Attur.	No 2. Found near the surface in sandy soil.	Chalky texture, ~~mixed with~~ mixed gneiss gravel contained in it, white. Silicates 33.2 per cent. Very slightly hydraulic; sets only from the quantity of burnt silicates acting as a puzzolana.
3.	Collegal range. Pollium 6 miles N.E. of Collegal.	No 3. Near the surface, at a hill; considered good and hydraulic.	Semicrystalline texture; geodic; reddish. Silicates 24.4 per cent. Very slightly hydraulic.
4.	Collegal range. Madavanhilly 3 miles E of Collegal.	No 4. That most used in the range.	Semicrystalline texture; but of somewhat clayey appearance; greenish white. Silicates 23.6 per cent. Fairly hydraulic.
5.	Collegal range. Chanhilly, 16 miles S.E. of Collegal.	No 5. On the surface in red soil; scanty.	Chalky texture. Silicates 13.4 per cent. Fat; perhaps slightly hydraulic.

General No.	Locality	Summary of description given	Physical and Chemical characters
6.	Collegal range.— Anur.	No 6. Is stony ground considered good.	Semicrystalline masses Silicates 7.8 per cent. Fat.
7.	Collegal range.— Madavanthully	No 7.	Semicrystalline kunkur. Silicates 21.1 per cent. Perhaps slightly hydraulic.
8.	Collegal range.— Tiganaray, 4 miles from Jahady	No 8. Believed to possess considerable hydraulic properties.	Semicrystalline kunkur, much honeycombed Silicates 17.1 per cent. Perhaps slightly hydraulic.
9.	Collegal range.— Seeragacully jungle between Jahady and Tallamalla.	No 9 Believed to be hydraulic.	Semicrystalline kunkur Silicates 27.5 per cent. Slightly hydraulic
10.	Collegal range— Between Abgalipuram and Jahady.	No 10. Considered good ordinary.	Semi-crystalline kunkur. Silicates 23.9 per cent. Slightly hydraulic.
11.	Collegal range.— Ajjipuram	No 11. A very poor kind.	Semi-tufaceous masses; white hard. Silicates 37.4 per cent Strongly hydraulic; only differing from a cement stone by the slow setting of the burnt stone.
12.	Collegal range— Ajjipuram	No 12. — do	Tufaceous masses, light and friable, white. Contain fossil shells Silicates 45.8 per cent Strongly hydraulic; a little inferior to the preceding.

General No.	Locality	Summary of description given	Physical and Chemical characters
13.	Erode.	No I. Found 1 yard below the surface, under No II. Not in Mr Neighbour's hand.	Amorphous granitoid boulder. Silicates 23 per cent. Very slightly hydraulic
14.	Erode	No II. Found very near the surface.	Semi-crystalline kunkur, highly marmillated. Silicates 21.3 per cent. Perhaps slightly hydraulic.
15.	Chengapilly	On the trunk road near the railway, between Avenashy and Perundorey stations.	Semi-crystallized large honeycombed masses. Silicates 22.4 per cent. Perhaps slightly hydraulic
16.	Kunatur	Burns quickly, lime very inferior	Chalky kunkur, some of it is rather tufaceous. Silicates 26.0 per cent Slightly hydraulic.
17.	Kodumudy (on the Cauvery below Erode)	Palodey, 1st quality found in white soil, 100 measures give 320 of lime (slaked)	Semi-crystalline boulders of [illegible] milky [illegible] like appearance Silicate 2.5 Carb. magnesia 37.1 A fat magnesian limestone, very hydraulic.
18.	Kodumudy	Palodey 2nd quality	Semicrystalline boulders of almond appearance but marked May be preceding. Silicates 13.4 per cent. A fat magnesian limestone, very hydraulic.

No.	Locality	Summary of description given	Physical and Chemical Characters
19.	Kolumudy	Mavoday	Semi-crystalline small boulders (water-worn?) Silicates 16.5 per cent. Perhaps slightly hydraulic.
20.	Kolumudy	Nimily oday	Semi-crystalline honeycombed masses; ochreous outside. Silicates 17.5 per cent. Fat.
21.	Kolumudy	Eral oday	Semi-crystalline honeycombed flattened masses; reddish. Silicates 17.2 per cent. Fat.
22.	Kolumudy	Sengaral oday	Semi-crystalline honeycombed masses; flattened, reddish. Silicates 25.8 per cent. Fat.
23.	Metapolliam Karamudy, 3 mile, S by W. of Metapolliam	No I. In succession lages 4 inches thick for a depth of 1 or 2 yards with imperfect granular soil yielding nitre.	Semi-crystalline masses; honeycombed. Silicates 19.7 per cent. Fat.
24.	Metapolliam Podur and Mangalcherry 4 mile SW. of Metapolliam.	No II. In succession lages 4 inches thick for a depth of 1 or 2 yards. Light red soil yielding nitre.	Semi-tufaceous masses, white. Silicates 31.4 per cent Yields strongly hydraulic limestone equal to a cement though setting slowly.

No.	Locality	Summary of description	Physical and Chemical characters
25.	Metapolliam, Yeranapolliam, 4 miles SE of Metapolliam.	No III. As No I.	Semi-crystalline honeycombed masses. Silicates 13.4 per cent. Fat.
26.	Metapolliam, Dodabani 3½ miles E of Metapolliam	No IV As No I.	Semi-crystalline honeycombed flattened masses. Silicates 24.6 per cent. Slightly hydraulic
27.	Coimbatore. 2nd mile on the road to Sirudaiyamuthur	No I. found in cubes of 162 feet at a depth of 4½ feet below the surface.	Amorphous or semi-crystalline conglomerate masses; grey. Silicates 12 per cent Fat.
28.	Coimbatore. 1st mile of the road to Metapolliam.	No II As No I	Like No I Silicates 19.7 per cent. Fat.
29.	Coimbatore. 2nd mile of the road to Annur	No III. Found in cubes of 3.64 feet at a depth of 1.65 feet below the surface.	Honeycombed conglomerate masses of various appearance from semi-tufaceous to semi-crystalline with much gneiss débris. Silicates 22.5 Fat
30.	Caroor At the 6th mile on the road to Madura	No I. At the 6th mile out	Semi-crystalline limestone Silicates 19.6 Slightly hydraulic.
31.	Caroor At the 9th mile on the road to Erode.	No II.	Semi-crystalline limestone in mulberry nodules, with admixed lithomarge. Silicates 5.2 per cent A fat magnesian limestone.

No.	Locality	Summary of description given	Physical and Chemical character
32.	Caroor.— At the 8th mile on the road to Aravakurchy.	No III	Semi-crystalline limestone, highly honeycombed and water worn. (resembles laterite ironstone) Silicates 11.3 per cent. Fat.
33.	Bhowany.— Velamondy, 12 miles N.E. of Natapollium	A. Found near the surface in red soil.	Semi-crystalline boulders, grey. Silicates 16.6 per cent. Fat.
34.	Bhowany.— Danaikenkota	B. Same as A.	Semi-crystalline flattened honeycombed masses. Silicates 20.8 per cent. Fat.
35	Bhowany.— Kotwelly 5 miles E of Satyamungalum.	C. More hydraulic than A or B	Semi-crystalline honeycombed masses. Silicates 32.3 Slightly hydraulic.
36.	Bhowany:— Satyamungalum	D. Found in Black clayey soil; very little hydraulic.	Semi-crystalline honeycombed masses. Silicates 17.2 per cent. Fat.
37.	Bhowany.— Kotamungalum. a mile below the junction of the Moyar and Bhowany rivers.	E. Found in black clayey soil considered unfit for building purposes	Tufaceous masses, light friable, of a light brown colour Silicates 60.9 per cent. The lime yielded only differs from cement in its slow setting.
38.	Bhowany.— From fields at the 2nd mile on the road to Koundapady.	A. Eraloday. Found 1 foot below the surface, in red soil. Not much valued.	Semi-crystalline boulders; variegated red colours; forms handsome marble when polished. Much quartz, magnesite, chlorite, asbestos &c. Worthless for burning.

No.	Locality	Summary of description given	Physical and Chemical character
39.	Bhowany.— at the same place.	B. Velgoday Found on the surface or 1 foot below. Considered superior to the other kind.	Amorphous honeycombed masses containing nodules of magnesite. Silicates 18.4 per cent. A fat magnesian limestone.
40.	Bhowany.— at the same place.	C. Nir oday. Abundant on the surface, considered inferior to B. but useful.	Amorphous conglomerate masses containing much foreign matter. Grey, friable. Silicates 25.8 per cent Fat.
41.	Bhowany.— At the same place.	D. Karu oday Found near the surface; not much esteemed.	Semi-crystalline honeycombed masses. Silicates 9 per cent Fat.

Malabar district.

No.	Locality	Summary of description given	Physical and Chemical character
42.	Palghat.— Wallier.	Found 3 feet below the surface in white clayey soil, somewhat salt.	Amorphous masses grey. Silicates 19.7 per cent. Slightly hydraulic.
42a	Palghat.— Modalamaday, 17 miles SE on the Pattambra road.		Hardly different from the Wallier stone.

Salem district.

No.	Locality	Summary of description given	Physical and Chemical character
43	Namkul range— Kosavumpitty 1½ mile E of Namkul		Amorphous compact masses; grey Silicates 22.5 Slightly hydraulic

No.	Locality	Summary of description given	Physical and Chemical character
43a	Do. Namkal range — Aveyandi Uthu; a spring 4 miles SW of Namkal		Amorphous or semi-crystalline mass; grey with much black mica. Silicates 27·2 per cent. Slightly hydraulic
43b	Do. Namkal range — Andapuram, 12 miles SE of Namkal		Semicrystalline homogeneous mass; grey Silicates 26·2 per cent. Slightly hydraulic
44.	Do. Namkal range — Palliaputty, 8 miles S of Namkal		Semicrystalline mass, with occasional semi-fucaceous portions. Silicates 22·4 Probably hydraulic; the most promising of the Namkal series.
45.	Do. Namkal range — Valvathur, 11 miles S of Namkal		Semicrystalline homogeneous mass Appears fat or but slightly hydraulic
46	Do. Namkal range — Moraputty, 24 miles SE of Namkal		Amorphous masses; grey. Silicates 23·7 Slightly hydraulic
47	Do. Namkal range — Thalagaray, 12 miles NE of Namkal		Amorphous or semi-crystalline masses; much black mica Silicates 17·2 Fat.
48	Do. Namkal range — Maravapollian, 1 mile S. of Paramathy		Amorphous masses Silicates 20·7 per cent Slightly hydraulic

No.	Locality	Summary of description	Physical and Chemical character
49	Do. Namkal range — Thatiyengarpet, 21 miles SE of Namkal		Semicrystalline limestone Fat or slightly hydraulic
50	Do. Namkal range — Mahadevy, 20 miles SE of Namkal		Semicrystalline limestone Fat or slightly hydraulic.
51	Do. Namkal range — Kuduchetty, 9 miles N of Namkal		Semicrystalline mass with almond-like nodules (Saloday) Silicates 4·3 per cent Carb. mag. 55 A fat magnesian limestone
52.	Do. Namkal range — Kerambur, 6 miles from Namkal		Semicrystalline compact mass Fat or slightly hydraulic
53	Do. Namkal range — Mal Sathambur, 7 miles N of Paramathy		Semi crystalline mass Fat or slightly hydraulic
54	Do. Namkal range — Valavendy, 7 miles SE of Paramathy		Fucaceous masses, partly semi-crystalline Silicates 10 per cent Fat or slightly hydraulic
55	Do. Namkal range — Sembumaday 20 miles SE of Namkal		Semi-crystalline almond like mass (saloday) Fat magnesian stone
56	Do. Namkal range — Karaguby, 21 miles SE of Namkal		Semi-crystalline mass. Fat or slightly hydraulic
57	Do. Namkal range — Komarapollian 9 miles N of Paramathy		Semicrystalline mass Fat or slightly hydraulic.

No.	Locality	Summary of description given	Physical and Chemical character
58	do. Nanthal range.— Anatharamian Spur, 1½ mile S of Nanthal.		Semi-crystalline mass. Fat or slightly hydraulic.
59	do. Nanthal range.— Arakaray, 19 miles SE of Nanthal		Semi crystalline mass, of somewhat almond like appearance. A fat magnesian stone.
60	do. Nanthal range.— Kurpamputty, 22 miles SE of Nanthal		Semi-crystalline mass. Fat or slightly hydraulic.
61.	do. Nanthal range.— Pudamaleyputti, 23 miles SE of Nanthal		Semi-crystalline mass Fat or slightly hydraulic.
62.	do. Nanthal range.— Thillay Mullay hills, 12 miles SE of Nanthal.		Several specimens of magnesite Contains 1.3 per cent of silica 6.1 " of carbonate of lime
63.	Darmapury taluq.— Woriaputty, near Topur.	No 1.	Semi-crystalline masses Silicates 1.7 per cent Very fat.
64.	do. Darmapury taluq.— Woraputty near Topur	No 2.	Semi crystalline mass Silicates 4.7 per cent. Very fat.
65.	do. Darmapury taluq.— Samichettiputty.	No 3.	Subcrystalline masses friable yellowish. Silicates 7.3 per cent. Fat. Good hydraulic
66	do. Darmapury taluq.— Sembodytupur.	No 4.	Calcareous gravel, bluish grey, and occasionally of clayey appearance with minute geode. Silicates 26 per cent. Probably hydraulic

No.	Locality	Summary of descriptions given	Physical and Chemical character
67.	do. Darmapury taluq.— Erraputty.	No 5	Amorphous or semi-crystalline masses. Silicates 13.1 per cent. Fat.
68	do. Darmapury taluq.— Karimunglem.	No 6	Semi-crystalline masses, occasionally semi-fusaceous. Silicates 9.6 per cent. Fat.
69	Kistnagherry taluq.— Jagadabu, Kaveriputnum taraf (2 very towards Kaveriputnum).	No 1	Semi-crystalline masses, occasionally semi-fusaceous. Silicates 4.3 per cent. Very fat.—
70	do. Kistnagherry taluq.— Motur, Kaveriputnum taraf (2 very towards Kaveriputnum).	No 2.	Semi crystalline kunkur, red. Silicates 33.9 per cent Fairly hydraulic
71	do. Kistnagherry taluq.— Kondaraputty, Motur taraf.	No 3.	Marble, or rather alabaster, some pure white, but mostly with a blue tinge from black mica Silicates 1 per cent in the white part Very fat.
72	do. Kistnagherry taluq.— Nullavaidy gundanur, Motur taraf.	No 4.	Semi crystalline massive Silicates 8.7 per cent. Fat.
73.	do. Kistnagherry taluq.— Chikiliputty, Motur taraf.	No 5.	Semi-crystalline masses Silicates 3.2 per cent Very fat.
74	do. Kistnagherry taluq.— Burgur	No 6	Semicrystalline small kunkur. Silicates 10.7 per cent Fat.

No.	Locality	Summary of description given	Physical and Chemical character
75.	Do. Kistnapperry taluq — Maharajaguda.	No 7	Semicrystalline small kunkur sometime, rather clayey and gerdie; blueish grey. Silicates 33·3 per cent Good hydraulic.
76	Do. Kistnapperry taluq — Dowlatabad, near Kistnapperry	No 8	Semicrystalline marses. Silicates 21·9 Fat or slightly hydraulic.
77.	Dosoor taluq — Kutalapilly, near Kumaramangalam.	No 1	Semicrystalline small kunkur. Silicates 32·6 per cent. Probably hydraulic
78.	Do. Dosoor taluq — Nayttony, near Kilaminglum.	No 2	Semicrystalline kunkur, reddish. Silicates 26·4 per cent Slightly hydraulic
79	Do. Dosoor taluq — Anasonah, near Kilaminglum.	No 3.	Semicrystalline kunkur; red. Silicates 38·6 per cent. Fairly hydraulic
80	Do. Dosoor taluq — Obaypollium, near Komayapilly	No 4.	Semicrystalline small kunkur; variegated, sandy, Silicates 30 per cent Slightly hydraulic
81	Do. Dosoor taluq — Komayapilly	No 5.	Semicrystalline kunkur; variegated, sandy. Silicates 31·3 Slightly hydraulic

No.	Locality	Summary of description	Physical and Chemical character
	Tanjore district		
82	Trichinopoly taluq — Kariamanikam	No 1. Used at upper anicut works.	Semicrystalline or amorphous kunkur; micaceous, red externally Silicates 22 Fat or slightly hydraulic
83	Trichinopoly taluq — Vaingur; Kovalay channel.	No 2. Used at the Vennar head works.	Semicrystalline kunkur; almond colour Silicates 17 Fat.
84	Tanjore taluq — Nagathi	No 3. Used at the Vettar head work.	Semicrystalline kunkur; gravel; blueish grey or almond colour. Silicates 20 Fat; somewhat magnesian
85	Do. Tanjore Taluq — Ovathur	No 4. do.	Semicrystalline small kunkur; some almond colour, some gerdie. Silicates 17·5 Slightly hydraulic
86	Do. Tanjore Taluq — Natam	No 5. do.	Semicrystalline small kunkur; yellowish, sandy. Silicates 10·2 Fat.
87	Do. Tanjore taluq — Allur, Vennar bank	No 6. do	Semicrystalline small kunkur; blueish grey; occasionally pelagey appearance Silicates 12·8 Fat or slightly hydraulic

No.	Locality	Summary of description given	Physical and Chemical character
88	Do. Tanjore taluq — Vadavar, Valliapullium limits.	No 7. Used in Tanjore town.	Semicrystalline small kunkurs; blush grey, and occasionally of clayey appearance Silicates 12.8 Fat.
89.	Jerumalaveddy, on N. bank of Coleroon river.	No 8. Used at Vadivagady Calingula.	Semicrystalline kunkur; sandy throughout and argillaceous. Silicates 35.6 Probably good hydraulic.
90	Tanjore taluq — Mondarampady, Vennar N. bank.	No 9. Used at Kodamurty lead works	Semicrystalline boulders; multigerous with granular lining to the cavities. Silicates 20.2 Probably fair hydraulic.
91	Do. Tanjore taluq — Gurumundy.	No 10. Used in Tanjore town.	Semicrystalline kunkurs; occasionally chalky and friable; ochreous stains. Silicates 7.7 Fat.
92	Do. Tanjore taluq — Vikramanur river.	No 11. Used in E part of the taluq.	Semicrystalline small kunkur blush grey occasionally of clayey appearance. Silicates 23.2 Probably fair hydraulic.
93	Do. Tanjore taluq — Vennar river. E of road No 39.	No 12. do	Semicrystalline small kunkur; gravel size; blush grey occasionally of clayey appearance. Silicates 26.2 Probably fair hydraulic.

No.	Locality	Summary of description given	Physical and Chemical character
94	Do. Tanjore taluq — Vettu Vakal, E of road No 39.	No 13. do	Semicrystalline small kunkurs; lighter colour, occasionally of clayey appearance; much fissured. Silicates 13.9 Fat or slightly hydraulic.
95	Kombakonum taluq — Palavam, Vailur village.	No 14.	Semicrystalline or clayey small kunkur; blush grey; much fissured Silicates 21.6 Slightly hydraulic.
96	Do. Kombakonum taluq — Coleroon river, N. bank, Konjakollai village.	No 15.	Semicrystalline kunkurs; some clayey, some sandy; dark grey. Silicates 20.4 Fat or slightly hydraulic
97	Do. Kombakonum taluq — Vettar river.	No 16.	Clayey or semicrystalline small kunkur of gravel size; blush grey. Silicates 19.1 Slightly hydraulic
98	Do. Kombakonum taluq — Malianur.	No 17.	Semicrystalline small kunkur; of clayey appearance externally; light blush grey. Silicates 17.9 Slightly hydraulic.
99	Myaveram taluq — Bed of the Coleroon about 10 miles below the lower anicut	No 18. Cot 1 a 32. a parah.	Semicrystalline small kunkurs; dark and sandy Silicates 42.4 Hydraulic, perhaps highly so, as it is fairly homogeneous.

No.	Locality	Summary of description given	Physical and Chemical character
100	Tranquebar coast	No 19. Coral brought as ballast, Cost 8 as. the parah	Masses of coral; pumiceous structure. Perfectly fat.
101	Nunnilam talug — Uthamasholapuram N. bank of Vettar.	No 20. Cost 2 as. the parah	Semicrystalline small kunkur; contains much foreign matter, hornblende &c. Silicates 27.6 Slightly hydraulic
102	Do. Nunnilam talug — Tirumalrajanar river.	No 21. Cost 1a. 4½ pie the parah	Semicrystalline honeycombed kunkur. Silicates 21.6 Slightly hydraulic
103	Do. Nunnilam talug — Pravadanar river at Tillachery.	No 22. Cost ½ anna the parah.	Semicrystalline small kunkur occasionally rather clayey. Silicates 26.3 Slightly perhaps fairly hydraulic
104	Do. Nunnilam talug — Mudikandanar river.	No 23. Cost 1½ anna the parah.	Semicrystalline small kunkur. Silicates 17.6 Fat.
105	Do. Nunnilam talug — Vettar river, Otamasholapuram	No 24 Cost 2 as the parah	Semicrystalline small kunkur, variable structure Silicates 25.2 Fat or slightly hydraulic
106	Tiruturaipundy talug — Talakandu, Adapur	No 25	Amorphous kunkur; friable, buff Silicates 33.1 rather clayey Promises to be good hydraulic.

No.	Locality	Summary of description	Physical and Chemical character
107	Tiruturaipundy talug — Koraiyar river, Upur and Alengadu.	No 28	Small kunkur, of variable structure, some compact, some friable and sandy. Silicates 16.4 per cent. Fat.
108	Negapatam talug — Vellayar river, Katungany	No 26	Semicrystalline or amorphous compact small kunkur. Silicates 17.3 per cent. Fat.
109	Negapatam talug — Vellayar river, Velangany	No 27	Amorphous or semicrystalline small kunkur; variable structure. Silicates 23.6 per cent. Fat or slightly hydraulic
110	Tranquebar coast — Coral brought from Paumben	No 29 Used at Negapatam	Coral (?) of laminated fibrous structure resembling cattle bone. Perfectly fat
111	Tranquebar coast — Shells obtained along the coast	Nos 1 & 2. Used at Tranquebar and Negapatam Cost 3 as. the parah.	Various shells Perfectly fat

Madura District.

112	Madura talug — Palanganatham ½ mile SE.	No 9	Amorphous kunkur; friable, white, some of it semicrystalline (shelly) Silicates 15.7 per cent. Fat (and magnesian)
113	Do. Madura talug — Puliapoliam ¼ mile E.	No 2	Semicrystalline kunkur, granular size, dark blue. Silicates 22 per cent, Slightly hydraulic

No.	Locality	Summary of description given	Physical and Chemical character
114	Do. Madura talug— Puteyppoliam, 100 yards W.	No 3	Semicrystalline kunkur; mostly gravel size, brown. Slightly hydraulic
115	Do. Madura talug— Karumathur, 200 yards E.	No 4	Semicrystalline flat lenticular masses; variegated red. Slightly hydraulic.
116	Do. Madura talug— Parapathi, 100 yards N.	No 5	Semicrystalline or amorphous kunkur; white Fat or slightly hydraulic
117	Do. Madura talug— Karyapathi, ¼ mile W.	No 6	Semicrystalline kunkur; grey micaceous. Fat.
118	Do. Madura talug— Aveyur, ½ mile NW.	No 7	Semicrystalline conglomerate kunkur; red Fat or slightly hydraulic.
119	Do. Madura talug— Arupucotta ¼ mile E	No 8	Semicrystalline kunkur, some amorphous and coarse, red to grey. Fat or slightly hydraulic
120	Do. Madura talug— Pantalaguady, ½ mile S.	No 9	Alabaster marble (calc-spar); white, with crystal of plumbago. Silicates & 2.4 per cent. Perfectly fat

No.	Locality	Summary of description given	Physical and Chemical character
121	Do. Madura talug— Aneyur, ½ mile W.	No 10	Semicrystalline massive; coarse structure; grey to red Fat or slightly hydraulic
122	Do. Madura talug— Nidumathurey ½ mile E.	No 12	Semicrystalline pisolitic conglomerate red. Fat or slightly hydraulic
123	Meylur talug— (Tripatore talug?) Therukalupathi, 1 mile N.	No 2 A	Semicrystalline small kunkur; porous Fat or slightly hydraulic
124	Do. Meylur talug— (Tripatore talug?) Kalapur, ¼ mile W.	No 3 A	Semicrystalline or amorphous masses; white Silicates 11 per cent Fat (and magnesian)
125	Do. Meylur talug— Meylur, 2 miles W.	No 4 A	Semicrystalline or coarse amorphous masses; greenish grey Silicates 50.6 per cent Promises to be strongly hydraulic.
126	Do. Meylur talug— Chinnambur ½ mile E	No 5 A	Semicrystalline small boulders variegated red. Fat or slightly hydraulic
127	Do. Meylur talug— Narasinghampatti 2 miles W.	No 6 A	Semicrystalline masses; grey, much decomposed gneiss. Fat or slightly hydraulic

No.	Locality	Summary of description	Physical and Chemical character
128	Do. Aleyelur taluq — Velavalavu, 1 mile W.	№ 8 A	Semicrystalline masses; grey, not homogeneous Fat or slightly hydraulic
129	Do. Aleyelur taluq — Karagalegudy Malampatty, ¾ mile W.	№ 9 A	Do
130	Do. Aleyelur taluq — Yarumapatty 1 mile NE.	№ 11 A	Semicrystalline Kunkur; grey, micaceous Fat or slightly hydraulic
131	Do. Aleyelur taluq — Punapatty Karaikudy ½ mile S.	№ 12 A	Amorphous Kunkur; friable, white; some of it semicrystalline. Silicates 18.4 per cent. Fat (and magnesian)
132	Do. Aleyelur taluq — Naganangalam ¼ mile W.	№ 13 A	Amorphous kunkur, friable, white; some of it semicrystalline. Silicates 10.4 per cent. Fat (and magnesian)
133	Do. Aleyelur taluq — Narasinghum ¼ mile S.	№ 14 A	Semicrystalline masses; some coarse; not homogeneous Fat or slightly hydraulic
134	Kulakalu Pamben 2 miles NE of Pamben near Akalamantapam	Coral stone	Coral; large-celled, light, spongy Perfectly fat

No.	Locality	Summary of description	Physical and Chemical character
135	Kulakalu Pamben 2 miles NE of Pamben	Chunam stone	Coral; porous, close grained; heavy, worm-eaten; apparently fossil. Silicates 9.6 per cent ~~Perfectly~~ Fat
136	Kulakalu Pamben. ¾ mile E of Pamben.	Shell	Shells Perfectly fat.
137	Kulakalu Pamben 2 mile NE of Pamben.	White clay № II (?)	Chalky Kunkur; white, very friable. Silicates 23.1 Fairly hydraulic
138	Dindigul taluq — Vakampatty.	№ 1	Semicrystalline or amorphous masses; very hard; almond colour (haloday) contains magnesite Fat
139	Do. Dindigul taluq — Mallupatty	№ 2	Same as preceding Fat
140	Do. Dindigul taluq — Palkanuth.	№ 3	Marly mass; amorphous, friable; white to pink Silicates 88 Fat
141	Do. Dindigul taluq — Pagambur	№ 4	Semicrystalline masses; very hard; almond or white (haloday) Fat

No.	No.	Locality	Summary of description given	Physical and Chemical character
75	142	do. Dividigal taluq— Mathuryakalputty.	No 5	Semicrystalline honeycombed masses; semisurfaceous in part; grey. Slightly hydraulic
7	143 and 144	Palney taluq— Thopanputty and Tholamanaickenputty	No 6 and 7 (cannot be distinguished owing to the label having fallen off)	Semicrystalline honeycombed conglomerate; reddish Semicrystalline boulder kunkur Both are slightly hydraulic
	145	Palney taluq— Ayagudy	No 8	Semicrystalline flat masses; very hard, grey. Slightly hydraulic
	146	Palney taluq— Talayūtt	No 9	Semicrystalline boulders; conglomerate structure; very hard; red. Slightly hydraulic
	147	N. Periakolam, Anachy	No 10	Semicrystalline large masses conglomerate structure; very hard, red. Slightly hydraulic
	148	N. Periakolam Anachy	No 12	Semicrystalline large honeycombed mass; very hard, red Slightly hydraulic
	149	N. Periakolam Selandyammal Kovil	No 13	Semicrystalline or semisurfaceous masses; hard, rather light; buff. Silicates 45.9 Clayey Promises to be strongly hydraulic

No.	Locality	Summary of description given	Physical and Chemical character
150	South Periakolam	No 14	Semicrystalline large boulders; very hard; almond or white (paloday) Fat
151	South Periakolam	No 15	Semicrystalline masses; compact, very hard; grey to ochreous or red. Slightly hydraulic
152	South Periakolam, Kuchanur	No 16	Amorphous masses (fragments) very hard, light grey, contain minute quartz. Fat or slightly hydraulic
153	South Periakolam	No 17 Clay	Chalky marl, white, ~~30 ft~~ Silicates 34.7 (sandy) Probably good hydraulic
154	South Periakolam, Bodinitthrapuram	No 18	Semicrystalline honeycombed kunkur, grey. Fat or slightly hydraulic.
155	South Periakolam Taleyūtt, 3 miles E of Chinnamanur	No 18 A	Chalky (or marly) kunkur laminated, white, friable. Silicates 9 per cent (sandy) Fat
156	South Periakolam, Bothuputty	No 19	Semicrystalline kunkur, reddish Fat or slightly hydraulic
157	South Periakolam Kunkum	No 20	Same as 19

No.	Locality	Summary of description given	Physical and Chemical character
158	Rāmnād zemindary— village 1½ mile W. of Tondy.	No 7	Amorphous or clayey geodic Kunkur, mixed with gneiss débris Grey, variegated Silicates 42 per cent (sandy) Probably fair hydraulic
159	Rāmnād zemindary— Tondy	Shells	Shells Perfectly fat
160	Rāmnād zemindary— Rāmnād	No 3	Fossilized coral Perfectly fat
161	Shivaganga zemindary— Sirukalapatty, on Madigul road, 7 miles W. of Sivagatore	No 4	Amorphous or semicrystalline Kunkur; grey; hard or friable. Silicates 8·3 per cent. Fat
162	Shivaganga zemindary— Bed of Manimūttar River near Avelikota	No 5	Amorphous Kunkur; rather friable, white. Fat or slightly hydraulic
163	Shivaganga zemindary— 1 mile W. of Sarugany ¼ mile N. of Road No 14	No 6	Semicrystalline Kunkur; very hard; reddish Fat or slightly hydraulic
164	Shivaganga zemindary— Conjurangal, 1½ mile N of Shivaganga	No 7	Amorphous or semicrystalline Kunkur; some rather chalky, variable, salmon colour. Fat

No.	Locality	Summary of description	Physical and Chemical character
	Tinnevelly District		
165	Thenkarai taluq— Madathur.	No 5 & 6	Semicrystalline honeycombed Kunkur; hard; grey to almond Fat
166	Ottapidaram taluq— Puthukota	No 7 This and No 8, 9, 10 yield a very good lime.	Semicrystalline Kunkur; variegated grey to red Fat
167	do	No 8 & 9	Semicrystalline (saccharoid) Kunkur; grey. Fat.
168	Thenkarai taluq— Karungolam.	No 10	Semicrystalline honeycombed conglomerate Kunkur; grey to reddish Fat.
169	Aruvasamudram taluq—	No 13	Semicrystalline honeycombed Kunkur; red, with white (magnesia) nodules Silicates 15 per cent. Fat
170	Velamūdem	No 14	Semicrystalline or amorphous massive (fragments) grey, variegated Fat
171	Sivanipatti taluq— Chettikolam.	No 15	Semicrystalline small Kunkur; grey, variegated Fat or slightly hydraulic
172	do Sivanipatti taluq— Malli	No 16	Semicrystalline small Kunkur; gravel; white grey Silicates 24·6 per cent. Fat or slightly hydraulic

No.	Locality	Summary of description given	Physical and Chemical character.
173	Do. Sirinilipatur taluq — Padakinengi	No 17	Semicryst. kunkur; light grey Fat
174	Do. Sirinilipatur taluq — Odyarputty	No 18	Amorphous or semicryst. kunkur; grey to ochreous; friable Fat or slightly hydraulic
175	Do. Sirinilipatur taluq — Kunur	No 19	Semicryst. kunkur; grey to reddish; variegated. Fat or slightly hydraulic
176	Do. Sirinilipatur taluq — Marikolam	No 20	Semicryst. kunkur; light grey Fat.
177	Do. Sirinilipatur taluq — Pachalur	No 21	Semicryst. small kunkur; reddish, with black mica Fat.
178	Sankeranakovil taluq — Sankeranakovil	No 22	Amorphous stone (fragments); hard; white Silicates 19.4 per cent. (some silica?) Possibly fair hydraulic.
179	Do. Sankeranakovil taluq — Perambatur	No 23	Semicryst. kunkur (rolled pebbles); some geodic; others friable and amorphous; grey to reddish. Fat or slightly hydraulic.
180	Do. Sankeranakovil taluq — Karavanalur	No 24	Semicryst. homogeneous conglomerate kunkur; red, with white (magnesian) nodules. Fat.

No.	Locality	Summary of description given	Physical and Chemical character.
181	Do. Sankerenakovil taluq — Sankerenakovil	No 25	Amorphous or semicryst. stone (fragments); very hard; light grey. = Silicates to No 178.
182	Satur taluq — Nally.	No 27	Semicryst. homogeneous conglomerate; small kunkur; grey to reddish. Fat or slightly hydraulic
183	Do. Latur taluq — Eturvatam	No 28	Amorphous or semicryst. stone (fragments); very hard; light grey. Silicates 19.9 per cent (pure silica?) Possibly fair hydraulic.
184	Do. Satur taluq — Lerrikarampatty	No 30	Like 28. Has pale green stone crystals of plumbago.
185	Do. Tapidaram taluq — Kytan	No 33	Semicryst. kunkur (rolled pebbles), red, with black mica Fat or slightly hydraulic

Trichinopoly District.

186	Trichinopoly taluq — Erasakanaikenputty	No 1	Semicryst. stone (fragments); hard, grey, with much black mica and other foreign matter Fat or slightly hydraulic
187	Do. Trichinopoly taluq — Saralaputty	No 2	Semicrystalline amorphous kunkur; hard; greenish grey; much mica. Fat or slightly hydraulic.
188	Do. Trichinopoly taluq — Goapu	No 3	Semicryst. small kunkur; red outside; grey Fat or slightly hydraulic

No.	Locality	Summary of description given	Physical and Chemical character
189	Do. Trichinopoly taluq— Nangaveram	No 4	Semicryst. small Kunkur, red. Fat or slightly hydraulic.
190	Do. Trichinopoly taluq— Kolathur	No 5	Semicryst. & amorphous Kunkur; slightly gritic and clayey in part, ~~mass~~ russet greenish. Silicate 36 per cent Fair or even good hydraulic.
191	Do. Trichinopoly taluq— Areamputty	No 6	Semicryst. Kunkur; reddish with black mica Fat or slightly hydraulic
192	Do. Trichinopoly taluq— Alandur	No 7	Semicryst. Kunkur; grey with black mica Fat or slightly hydraulic
193	Do. Trichinopoly taluq— Sungalam	No 8	Semicryst. rounded Kunkur; grey with much black mica Fat or slightly hydraulic
194	Do. Trichinopoly taluq— Gundur	No 9	Semicryst. honeycombed Kunkur; grey; reddened in parts Fat or slightly hydraulic.
195	Do. Trichinopoly taluq— Kilakurchy	No 10	Similar to the preceding
196	Do. Trichinopoly taluq— Pudur	No 11	Similar to the preceding
197	Do. Trichinopoly taluq— Nagamanglam	No 12	Semicryst. or amorphous Kunkur, ~~the~~ much of it rotten Silicate if the rotten part 40 per cent. On the whole it is slightly hydraulic
198	Do. Trichinopoly taluq— Valavandikota	No 13	Similar to the preceding

No.	Locality	Summary of description	Physical and Chemical character
199	Lalgudi taluq Torriyur road, 9½ mile.	No 24	Semicryst. small Kunkur, red Fat or slightly hydraulic
200	Do. Lalgudi taluq— Sembangudy	No 25	Amorphous slightly clayey small Kunkur; grey. Silicate 12 per cent (clayey) Slightly hydraulic
201	Do. Lalgudi taluq— Sengaty	No 26	Semicryst. Kunkur; grey to red. Fat.
202	Do. Lalgudi taluq— Arasangudi	No 27	Amorphous & semicryst. Kunkur; grey to ochreous. Fat or slightly hydraulic
203	Do. Lalgudi taluq— Vengangudi	No 28	Semicryst. small Kunkur; light grey. Fat.
204	Do. Lalgudi taluq— Kalgudi	No 29	Chalky Kunkur, but transitional to marly; friable, pure white Silicates 2.5 per cent (clayey) Perfectly fat
205	Do. Lalgudi taluq— Vengangudi	No 30	Semicryst. small Kunkur; loose texture friable, much detrital mica, grey. Fat or slightly hydraulic
206	Do. Lalgudi taluq— Pulyadi	No 31	Amorphous Kunkur, pearl oyster; friable loose structure; grey Fat or slightly hydraulic
207	Do. Lalgudi taluq— Kulkur	No 32	Semicryst. small Kunkur; some gritic; ochreous grey to red. Silicate 29 per cent (sand) Slightly hydraulic.
208	Do. Lalgudi taluq— Kuttapal	No 33	Semicryst. small Kunkur; grey Fat or slightly hydraulic

No.	Locality	Summary of description given	Physical and Chemical character
209	Do. Lalgudi taluq — Sembangudi	No 34	Semicryst. kunkur; gravel layer; blue outside; grey inside. Slightly hydraulic
210	Do. Lalgudi taluq — Kirshalur	No 35	Semicryst. small kunkur; grey Slightly hydraulic
211	Kudiarpalliam taluq Kotakadu, bed of Velar River	No 49	Amorphous or semicryst. compact stone; yellowish grey Silicate 8 per cent Fat
212	Do. Kudiarpalliam taluq — Arialur, 3 miles E of village, in the bed of a stream	No 50	Fossilized oyster shells; semicryst. structure. Impurities and moisture 2·5 per cent Perfectly fat
213	Do. Kudiarpalliam taluq — Kalapalur	No 51	Semicryst. & amorphous kunkur; most large sized: ochreous Slightly hydraulic
214	Do. Kudiarpalliam taluq — Sirumelurady	No 52	Semicryst. small kunkur; blue outside dunned inside. Silicates 15 per cent (clayey) Slightly hydraulic
215	Mursery taluq — Kuvereputty	No 53	Amorphous stone (fragments); much black mica. Fat or slightly hydraulic
216	Do. Mursery taluq — Maikanackenputty	No 54	Semicryst. stone (fragments) much black mica Fat or slightly hydraulic
217	Do. Mursery taluq — Nottiam	No 55	Semicryst. kunkur: loose structure much mica &c; red variegated Fat or slightly hydraulic

No.	Locality	Summary of description given	Physical and Chemical character
218	Do. Mursery taluq — Naivaly	No 56	Semicrystalline or amorphous honeycombed large kunkur; red Fat or slightly hydraulic
219	Do. Mursery taluq — Maruthamputty	No 57	Semicryst. kunkur; ~~red outside~~ dark grey ~~red~~ outside Fat or slightly hydraulic
220	Do. Mursery taluq — Suriamputty	No 58	Semicryst. stone (fragments) grey to almond. Fat or slightly hydraulic
221	Do. Mursery taluq — Road No 7; 16½ mile.	No 59	Semicryst. kunkur; light grey Fat
222	Do. Mursery taluq — Kunkumapuram	No 60	Semicryst. kunkur; much black mica Fat or slightly hydraulic
223	Do. Mursery taluq — Valaveurthy	No 61	Amorphous compact stone; grey to almond. Fat.
224	Do. Mursery taluq — Jythamputty	No 62	Semicryst. kunkur; mostly in fine powder. Brown. Some absolutely capable of being obtained
225	Kulitalay taluq — Kupachipitty	No 63	Semicryst. honeycombed kunkur; coarse and friable Fat or slightly hydraulic
226	Do. Kulitalay taluq — Palekoliam	No 64	Semicryst. honeycombed kunkur; much black mica; red outside Fat or slightly hydraulic
227	Do. Kulitalay taluq — Thanjavanagleem	No 65	Semicryst. kunkur, mostly in fine powder Silicates 63 per cent. Possibly a cement stone, but from its appearance probably it is impossible to tell.

No.	Locality	Summary of description given	Physical and Chemical character
228	do Kulitalay taluq — Erumpathypatty	No 66	do do Calcareous per cent and test. the silicate here 16 per cent. Slightly hydraulic
229	do Kulitalay taluq — Puthur near Katlay	No 67	Amorphous or semi-crystaceous homogeneous Kunkur. Light grey. Silicates 16.6 (sand and mica) Fat or slightly hydraulic
230	do Kulitalay taluq — Thozaymalay	No 68	Semicrystl. Kunkur, mostly in powder. Doubtful
231	Perambalur taluq — Jondamandoray	No 69	Semicrystl. Kunkur; grey hard; grey to almond. Fat
232	do Perambalur taluq — Yesanay	No 70	Semicrystl. Kunkur; grey. Fat.
233	do Perambalur taluq — Manglam	No 71	do
234	do Perambalur taluq — Vapamthalay	No 72	Marly Kunkur, still soft, and easily to semicrystalline; grey Silicates 12 per cent Fat, and magnesian.
235	do Perambalur taluq — Thavanay	No 73	Chalky Kunkur (rolled) passing to marble (like No 204) Silicates 1.6 per cent Perfectly fat
236	Jyakondasolapuram taluq — Kolakadu	No 9 in South arcot list. used for Pelandorey ancient works.	Amorphous compact stone, yellow. Silicates 15 per cent (clayey) Slightly hydraulic

No.	Locality	Summary of description given	Physical and Chemical character
	South Arcot District		
237	Tindivanam taluq — Thylaveram	No 1	Marly Kunkur; coarse and friable; white Silicates 17 per cent. (clayey) Slightly hydraulic
238	Tindivanam taluq — Jainkondan	No 2	Amorphous to semicrystl. Kunkur; coarse, grey. Fat
239	Irimonalay taluq — do Hill.	No 3	Amorphous Kunkur; sandy; friable Silicates 28 per cent (clayey) Fairly hydraulic.
240	Irimonalay taluq — Kacharpet	No 4	Semicrystl. homogeneous Kunkur; reddish grey. Fat or slightly hydraulic
241	Irikalur taluq — Kachigavacham	No 5	Semicrystl. homogeneous Kunkur; red outside. Fat.
242	Irikalur taluq — Kodungal	No 6	Semicrystl. Kunkur; grey. Fat.
243	Vilapuram taluq — Modampaliam	No 7	Semicrystl. homogeneous small Kunkur; grey. Fat.
244	Vilapuram taluq — Valudareddy	No 8	Marly Kunkur; grey, coarse. Fat
245	Unknown	No 24	Semicrystl. homogeneous Kunkur. Fat.
246	do	No 25	Amorphous stone (hardened marl) Fat.

No.	Locality	Summary of description given	Physical and Chemical character
	Chingleput District		
247a	Trivelur taluq—Kupur	No 1	Marly kunkur; coarse, white. Silicates 7·1 per cent. Fat
247a	Do. Trivelur taluq—Gudapakam	No 2	Amorphous kunkur; some nature some tufaceous some clayey. Silicates 20 per cent. Probably fair hydraulic
248	Do. Trivelur taluq—Illamary	No 3	Marly kunkur; white Silicates 4·9 per cent. Perfectly fat.
248a	Sydapet taluq—Nandampakam	No 4	Semicrystl. amorphous kunkur; much rotten gneiss and mica. dark grey and greenish. Silicates 21 per cent. Fat or slightly hydraulic
249	Do. Sydapet taluq—Madapakam	No 5	Amorphous kunkur; much rotten gneiss; greenish grey. Silicates 19 per cent in homogeneous lot Meagre rather than hydraulic
250	Do. Sydapet taluq—Kolathur	No 6	Amorphous kunkur; much rotten gneiss; grey to greenish, variable Fat or slightly hydraulic
251	Do. Sydapet taluq—Shamarpakam		Semicrystl. kunkur; subgeodic; grey. Silicates 25 per cent. Slightly perhaps fairly hydraulic
252	Trivelur taluq—Amanambakam		Clayey kunkur; geodic; dark brown clay colour. Silicates 26 per cent. (clay and sand) Good hydraulic

No.	Locality	Summary of description given	Physical and Chemical character
253	Sydapet taluq—Palanjur	No 1	Amorphous stone; grey Fat or slightly hydraulic
254	Do. Sydapet taluq—Saragalatur	No 2	Marly kunkur; light grey. Fat.
255	Chingleput taluq—Trikachur		Semicryst. honeycombed kunkur; dark grey; red outside Fat or slightly hydraulic
256	Do. Chingleput taluq—Pomadekupam		Semicryst. small kunkur; light grey; red outside Fat or slightly hydraulic
257	Madrantakam taluq—Sanur		Semicryst. small kunkur; grey Fat.
258	Chingleput taluq—Kambakal, near Padiyur		Marly or semicryst. small kunkur; white Fat.
	North Arcot District		
259	Chendragherry taluq—Ranigunta	No 1	Marly kunkur; grey. Fat.
260	Do. Chendragherry taluq—Mungapuram	No 2	Marly kunkur (branched encrustations) grey or white Fat.
261	Wallajah taluq—Vanapady	No 3	Chalky marl; grey Fat.
262	Do. Wallajah taluq—Kalar	No 4	Chalky marl; grey, friable Silicate 25 per cent Slightly hydraulic
263	Karvet Nagram Zemindary—Totur	No 5	Amorphous stone (fragments) perhaps hardened marl Fat

No.	Locality	Summary of description given	Physical and Chemical character
264	Chittoor taluq — Vendamūr	No 6	Amorphous concretionated kunkur; dark grey; much clay & breccia. Slightly hydraulic
265	Gudiātham taluq — Nagalapūr	No 7	Semicrypt. kunkur; white Fat or slightly hydraulic
266	Do. Gudiātham taluq — Kalinjūr	Nos 8, 11 and 12	Chalky kunkur; white. Fat
267	Do. Gudiātham taluq — Annanankūpam	No 9	Chalky to semicrypt. kunkur; white Fat.
268	Palmanēr taluq — Parapully	No 10	Chalky to semicrypt. small kunkur. Fat.
269	Vellore taluq — Arcyūr	No 13	Gypsey chalk Silicate 25 per cent Slightly & fairly hydraulic
270	Do. Vellore taluq — Bothūr	No 14	Marly kunkur; grey Fat
271	Do. Vellore taluq — Poygey	No 15	Do
272	Do. Arcot taluq — Pongalūr Sappaytu	No 16	Amorphous or semicrypt. pudgeon stone (fragments); grey Silicate 25 per cent Slightly hydraulic (magnesian)
273	Do. Arcot taluq — Thasipuram Sattūr	No 17	Marly stone (hardens) white. Fat
274	Do. Arcot taluq — Moragalū tank	No 18	Do
275	Do. Arcot taluq — Panchapandava Malay	No 19	Do

No.	Locality	Summary of description	Physical and Chemical character
276	Trinomalai taluq (South Arcot) — Parkonam	No 20	Semicrypt. or marly kunkur; grey Fat.
277	Polūr taluq — Aviavady	No 21	Semicrypt. kunkur; grey Fat.
278	Do. Polūr taluq — Velva ūmi	No 22	Marly kunkur; white Fat.
279	Do. Polūr taluq — Valyanūr	No 23	Amorphous kunkur; dark grey; friable Silicate 12 per cent Fat
280	Do. Polūr taluq — Alinagar	No 24	Do. Silicate 15 per cent Fat
281	Do. Polūr taluq — Parikalpatu	No 25	Semicrypt. kunkur; white Fat.
282	Do. Polūr taluq — Sirumalai	No 26	Mostly friable grey chalk; some semicrypt. The friable part contains 77 per cent. of silicate. This is rather too much, but it might possibly yield a moderate cement.
283	Do. Polūr taluq — Malikarikathūr	No 27	Semicrypt. kunkur; hard; white, micaceous Fat.
284	Do. Polūr taluq — Chetpat	No 28	Semicrypt. amorphous or chalky small kunkur Fat.
285	Do. Polūr taluq — Indravanam	No 29	Do.
286	Do. Polūr taluq — Karapatu	No 30	Semicrypt. kunkur; rather clayey; grey. Silicate 16 per cent.; fairly clayey Slightly & fairly hydraulic
287	Do. Polūr taluq — Kadalody	No 31	Semicrypt. or amorphous kunkur; grey. Fat.
288	Do. Polūr taluq — Viralūr	No 32	Do

90 92 No.	Locality	Summary of description given	Physical and Chemical character
289	Do. taluq — Gangavaram	No 33	Marly Kunkur; white Silicates 8 per cent Fat (and magnesian)
290	Do. taluq — Kutagrampallam	No 34	Do harder Fat or slightly hydraulic
291	Do. taluq — Kalasamudram	No 35	Amorphous to semicryst. Kunkur; white the amorphous friable portions are of superior character and contain 30 per cent. silicates they should be fairly hydraulic
292	Do. jaghir — Jachur	No 36	Marly to semicryst. Kunkur Fat.
293	Do. do. — Palathuvanam	No 37	Do Silicates 9 per cent. Fat.
294	Do. do. — Andipaliam	No 38	Amorphous Kunkur; rusty grey Silicates 22 per cent. Fat or slightly hydraulic
295	Do. do. — Janamanglam	No 39	Marly Kunkur; white Fat
296	Do. do. — Nedal	No 40	Marly to semicryst. Kunkur; white calcareous Fat.
297	Do. do. — Chitary	No 41	Marly Kunkur; white Fat.
298	Do. do. — Pinalapaty	No 42	Marly to semicryst. Kunkur; white Fat.
299	Do. do. — Jhandu Konattur	No 43	Marly Kunkur; white; friable Silicates 16 per cent Fat or slightly hydraulic
300	Wandiwash taluq — Thyampaliam	No 44	Amorphous to semicryst. micaceous Kunkur; grey Fat or slightly hydraulic

No.	Locality	Summary of description given	Physical and Chemical character
301	Do. Wandiwash taluq — Manukadu	No 45	Semicryst. Kunkur; some amorphous and friable; grey Fat or slightly hydraulic
302	Do. Wandiwash taluq — Neliankolam	No 46	Semicryst Kunkur; grey Fat
303	Do. Wandiwash taluq — Arunkonam	No 47	Like No 301
304	Do. Wandiwash taluq — Berudur	No 48	Do
305	Do. Wandiwash taluq — Sathamanglam	No 49	Amorphous to semicryst. Kunkur Slightly hydraulic
306	Do. Wandiwash taluq — Sattathangal	No 50	Marly to amorphous Kunkur; grey Fat
307	Do. Wandiwash taluq — Tarasur	No 51	Semicryst. Kunkur; micaceous Fat or slightly hydraulic
308.	Do. Wandiwash taluq — Nanthiambady	No 52	Marly to semicryst. Kunkur; white Fat
309	Do. Wandiwash taluq — Kunambady	No 53	Semicryst. micaceous Kunkur. Fat or slightly hydraulic

Nellore District

310	Nellore taluq — Kotapally		Semicryst. Kunkur; grey Fat.
311	do. taluq — Chennuguntu		do earthy Fat.
312	do taluq — Amancherla		do honeycombed, earthy Fat.
313	do taluq — Dontali		do chalky outside Fat.

No.	Locality	Summary of description given	Physical and Chemical Character
314	do taluq — Ambaparam		Semicryst. homogeneous kunkur, destroyed ext. Fat or slightly hydraulic
315	Kavaly taluq — Sirupuram	No 1	Semicryst. kunkur. Fat.
316	do do	No 2	Amorphous mass (fragments) grey Fat.
317	do do	No 3	Granular semicryst. boulder Fat or slightly hydraulic
318	Kavaly taluq — Nagalaveram		Cryst. kunkur. Fat.
319	do taluq — Takapalli Gudiem		Semicryst. micaceous kunkur Fat or slightly hydraulic
320	Rapuru taluq — Kondumanaidupally	Very excellent limestone	Semicryst. homogeneous stone, red Fat.
321	Northern Range Adauky quarry		Semicryst. kunkur; micaceous red Fat.
321a	Northern Range Madaramba		Semicryst. micaceous stone; white Fat.
322	Southern Range Nagalaveram quarry		Semicryst. homogeneous kunkur; micaceous grey Fat.
323	do range Allaguntu quarry		do
324	do range Kotapally quarry		do

No.	Locality	Summary of description given	Physical and Chemical Character
	Vizagapatam District		
325	Parvatipore taluq — Parvatipore	No 2 of Vizianagram range	Semicryst. kunkur, subgeode Slightly hydraulic
326	Salūr taluq — Salūr	No 5	Do. Do.
327	Vizagapatam taluq — Maduravada	No 6	Semicryst. kunkur, micaceous Fat.
328	Ankapilly taluq — Pendurū	No 9	Do. Do.
329	Palconda taluq — Palconda	No 70	Do. Do.
330	Bobilly taluq — Bobbily	No 71	Do. Do. (small)
331	Ankapilly taluq — Papiah Rajupalam	No 12	Do. Do.
332	Bimlipatam taluq — Yalanky	No 76	Do. Do.
332a	Golugonda taluq — Kamispalem	No 3 of Golugonda range	Do. Do.
333	Ankapilly taluq — Golugunda Vangaly	No 4	Do. Do.
334	Chodavaram — Modavū	No 6	Do. Do.
335	Golugonda taluq — 8th mile Golugonda road	No 7	Semicryst. kunkur, appearance; occasionally subgeodic Slightly to fair hydraulic

No	Locality	Summary of description given	Physical and Chemical Character
336	Do 16th mile.	No 8	Semicryst. kunkur. Fat or slightly hydraulic
337	Golugonda tatug 4th mile Kondasimtha road	No 72	Semicryst. kunkur (small boulders); subgeodic Slightly hydraulic
338	Do. tatug 10th mile Thalapuram road	No 73	Semicryst. kunkur; subcircular Fat.
339	Do. tatug 7th mile do. road.	No 75	Semicryst. kunkur, various Fat or slightly hydraulic.
340	Do. tatug 6th mile Kondasimtha road	No 76	Perfect geode of semicryst or clayey kunkur. Small. Silicate 22 per cent (fairly clayey) Fair to good hydraulic
341	Suvvasidy tatug— Pedapilly	No 29 Burns and slakes with difficulty	Semicryst. or amorphous kunkur; of ferruginous sandy appearance Silicates 28·4 (fairly clayey) Fair hydraulic
342	Do. tatug. Velichur	No 30.	Semicryst. small kunkur; very ferruginous Silicates 32·9 (hematite sand) Slightly hydraulic

Ganjam District

No	Locality	Summary of description given	Physical and Chemical Character
343	Berhampore tatug— Zakasanghy, 6 miles S of Gopalapore	Nos 1 & 2	Fossil shell Perfectly fat—
344	Do. tatug Gopalpore	No 3	Sea shell Perfectly fat—

No	Locality	Summary of description given	Physical and Chemical Character
345	Do. tatug— Nimo between Simapur and Surla, 4 miles E of Goigam road	No 5	Fossil shells Perfectly fat—
346	Do. tatug— Hotezapeta, 18th mile on Goigam road.	No 6	Semicryst. small kunkur; occasionally subgeodic Slightly hydraulic
347	Do. tatug— Chenguidinagy hill, 22nd mile on Goigam road	No 7	Do. Do.
348	Do. tatug— Mongachikapadi hill, 17th mile do.	No 8	Semicryst. kunkur, dark. Fat or slightly hydraulic.
349	Do tatug— Patiur, 4 miles from Ganjam	No 12 ~~No 10~~ No 13	~~Fossil~~ Fossil shells Sea shells Both perfectly fat.
350	Do. tatug— Kogatory mullah between village of Javagy and Rampulty	No 14	Semicryst. siliceous kunkur; most gritty to Slightly hydraulic
351	Do. tatug— 4 miles from Aska	No 16	Semicryst. kunkur; occasionally subgeodic Slightly hydraulic
352	Do tatug— 3 miles from 11th mile on Aska and Berhampore road	No 17	Semicryst kunkur; some clayey and subgeodic Slightly hydraulic
353	Do. tatug— Simaza mulla near Bodagada	No 20	Semicryst. small kunkur, gradation somewhat clayey and geodic Fairly hydraulic
354	Do. tatug— Mainta mullah near Kaoriguda	No 21	Semicryst. kunkur, sometimes clayey and subgeodic Slightly to fairly hydraulic

No.	Locality	Summary of description given	Physical and Chemical Character
355	Do. taluq — S.E. of hills near Kaorigúda	No 22	Semicrystl. Kunkur, sometimes subgeotic. Slightly hydraulic
356	Do. taluq — Jagamanglam nullah, 3rd mile of Jagannadapúr road.	No 24	Semicrystl. small Kunkur. Fat or slightly hydraulic.
357	Do. taluq — Boda nullah, 12th mile of Jagannadapúr road.	No 25	Semicrystl. small Kunkur, rather friable. Fat or slightly hydraulic
358	Gúmsúr taluq — 25th mile Surada road.	No 28	Semicrystl. small Kunkur (granular) subgeotic. Slightly to fairly hydraulic
359	Do. Do.	No 29 & 30	Semicrystl. Kunkur, subgeotic. Slightly hydraulic
360	Do. taluq — Nullah at 9th mile on Surada road	No 31	Amorphous Kunkur; red, sandy. Slightly hydraulic
361	Do. taluq — Kukudagay, 13th mile do.	No 32	Amorphous Kunkur, rather clayey and subgeotic. Silicates 18 per cent. Magnesian. Slightly hydraulic, but too magnesian.
362	Do. taluq — In nullahs at 26th mile do.	No 33	Subacetous sandy Kunkur; friable, grey; rather earthy. Silicates 14 per cent (somewhat magnesian) Pronounced to be strongly hydraulic
363	Do. taluq — at 8th mile do.	No 34	Semicrystl. gerbi Kunkur. Fairly hydraulic
364	Do. taluq — at 22nd mile do.	No 35	Semicrystl. gerbi small Kunkur. Slightly to fairly hydraulic

No.	Locality	Summary of description given	Physical and Chemical Character
365	Do. taluq — at 24th mile do.	No 36	Amorphous to semicrystl. Kunkur. Subgeotic. Slightly to fairly hydraulic.
366	Do. taluq — at 20th mile do.	No 37	Semicrystl. somewhat clayey Kunkur; subgeotic. Slightly to fairly hydraulic.
367	Do. taluq — Gotademeru, at 15th mile S. of Surada	No 38	Amorphous to semicrystl. small Kunkur, sometimes subgeotic. Slightly hydraulic.
368	Do. taluq — Do	No 39	Semicrystl. rolled Kunkur; subgeotic. Slightly hydraulic.
369	Chicacole taluq — Chicacole	No II	Semicrystl. micaceous small Kunkur. Fat or slightly hydraulic.

Bellary District.

370	Bellary taluq — N.W. of 4th mile Hérihal road	No 82	Semicrystl. micaceous Kunkur stone compact stone; compact, grey. Fat or slightly hydraulic
371	Do. taluq — Honally	No 3	Marly to semicrystl. micaceous Kunkur. White. Fat.
372	Do taluq — Honally	No 4	Semicrystl. Kunkur Fat or slightly hydraulic
373	Do taluq — Honally	No 5	Do Do
374	Raidrug taluq — Raidrug	No 6	Do Do

No.	Locality	Summary of description given	Physical and Chemical Character
375	Raidrug taluq — Takiappa's garden	No 7	Amorphous kunkur, containing much rotten gneiss. ~~Compact~~ Homogeneity in mass; possibly fair hydraulic
376	Do. taluq — Modiakolem	No 8	Semicryst. kunkur; agglomerate honeycombed, red. Slightly hydraulic
377	Do. taluq — Malapur	No 9	Semicryst. kunkur stone, agglomerate honeycombed, red. Fat or slightly hydraulic.
378	Gooty taluq — Gooty	No 70	Semicryst. kunkur; white. Fat.
379	Do taluq — Do	No 71 & 72	Marly to semicryst. kunkur, white. Fat
380	Do taluq — Kistnapad	No 73	Semicryst. kunkur: homogeneous red. Slightly hydraulic
381	Do taluq — Gundakal	No 74	Semicryst. kunkur, white Fat
382	Anantapur taluq — Golapally	No 75	Semicryst. small kunkur: white Fat.
383	Do. taluq — Anantapur	No 76	Do. Do
384	Do. taluq — Kudair	No 77	Semicryst. micaceous kunkur dark. Fat or slightly hydraulic
385	Do. taluq — Galadinay	No 78	Semicryst. kunkur, much quartz and gneiss debris; white Fat or slightly hydraulic.

No.	Locality	Summary of description given	Physical and Chemical Character
386	Do. taluq — Ramenpully	No 19	Semicryst. small kunkur; white. Fat.
387	Do. taluq — Rajampully	No 20	Compact semicryst. stone approaching siliceous rock; light brown. Contains small lake shell. Silicates 5 per cent. Perfectly fat
388	Jadpatoi taluq — Rayalcherumu	No 21	Compact semicryst. stone white. Fat
389	Do. taluq — Nuchikota	No 22	Semicryst. kunkur stone white. Fat (strongly magnesian)
390	Do. taluq — Atur	No 23	Do Fat (magnesian)
391	Pentonda taluq — Tomasapully	No 24	Semicryst. micaceous kunkur stone ~~Fat~~ Slightly hydraulic
392	Do. taluq — Ardakelapally	No 25	Do Fat or slightly hydraulic
393	Hadagaly taluq — Kampasagur	No 26	Amorphous or marly kunkur, white friable. Fat.
394	Do. taluq — Kpangakenhully	No 27	Semicryst. kunkur, homogeneous red. Slightly hydraulic.
395	Do. taluq — Tumbarhully	No 28	Amorphous to semicryst. kunkur; friable. Fat or slightly hydraulic

No	Locality	Summary of description given	Physical and Chemical Character
395a	Kadligi taluq — Thimalapur.	No 29	Semicryst. subgeodic Kunkur. Slightly hydraulic.
396	Do. taluq — Bundry	No 30	Semicryst. Kunkur; white. Slightly hydraulic.
397	Do. taluq — Kadligi	No 31	Semicryst small Kunkur Fat.
398	Do. taluq — Beladu	No 32	Do. Fat.
399	Do taluq — Hegadal	No 33	Semicryst Kunkur. Fat.
400	Do. taluq — Kuchenhully	No 34	Do. Fat.
401	Hospett taluq — Anupenkota	No 35	Do. Fat.
402	Do taluq — Mudderhully	No 36	Semicryst. Kunkur stone. Red. Fat.
403	Do taluq — Jambenathahully	No 37	Semicryst compact Kunkur stone quartz and magnesite, Red. Fat.
404	Do. taluq — Buttahully	No 38	Semicryst. Kunkur. Fat.
405	Do. taluq — Tirsankalu Vanka	No 39	Semicryst Kunkur stone red. Fat.
406	Do. taluq — Anantasayanguddy	No 40	Semicryst. small Kunkur reddish Fat or slightly hydraulic
407	Do. taluq — Devasamudram	No 41	Semicryst. Kunkur stone Fat.
408	Do taluq — Narsapur	No 42	Do Fat.

No.	Locality	Summary of description given	Physical and Chemical Character
409	Do. taluq — Hanikara tank.	No 43	Semicryst. Kunkur; homogeneous reddish. Fat or slightly hydraulic
410	Harpanhully taluq — Bittykota	No 44	Semicryst. Kunkur Fat.
411	Do. taluq — Narayanpur	No 45	Amorphous to semicryst. Kunkur rather friable. Fat or slightly hydraulic.
412	Do. taluq — Banihully	No 46	Semicryst. micaceous small Kunkur. Slightly hydraulic
413	Do. taluq — Karanhully	No 47	Semicryst. homogeneous Kunkur reddish. Fat or slightly hydraulic
414	Do. taluq — Sringartota	No 48	Semicryst. homogeneous Kunkur, micaceous. Fat or slightly hydraulic
415	Do. taluq — Jilligi	No 49	Semicryst. to clayey Kunkur; subgeodic; bluish. Silicates 16 per cent (clayey) Fair hydraulic
416	Do. taluq — Chigitary	No 50	Semicryst. homogeneous Kunkur; reddish. Fat or slightly hydraulic.
417	Do. taluq — Nandibagur	No 51	Semicryst. Kunkur; reddish. Fat.
418	Do. taluq — Nagargudy	No 52	Semicryst. small Kunkur. Fat.
419	Do. taluq — Alipanachanhully	No 53	Semicryst. Kunkur; white. Fat.
420	Do. taluq — Jirlahully Jadapur	No 54	Amorphous micaceous Kunkur Slightly hydraulic.

No.	Locality	Summary of description given	Physical and Chemical Character
421	Do. taluq Sigapully	No 55	Marly Kunkur; red and white Fat.
422	Do. taluq — Darapankanahully	No 56	Semicryst. micaceous Kunkur. Fat
423	Do. taluq — Muthigy	No 57	Do Fat or slightly hydraulic.
424	Adony taluq — Tulimbal	No 58	Semicryst. Kunkur white Fat.
425	Do. taluq — Tagadoma	No 59	Do Fat. Do
426	Do. taluq Erepuram	No 61	Do Fat.
427	Do. taluq. ~~Nagapuram~~ Danapuram	No 63	Amorphous Kunkur; red: Fat or slightly hydraulic.
427a	Do. taluq — Bodibanda	No 64	Semicryst. Kunkur; white Fat.
428	Do. taluq — Chenampully	No 65	Marly to semicryst. Kunkur; white Fat.
429	Do. taluq — Gorjivanka	No 66	Semicryst. Kunkur; white Fat.
430	Do. taluq Sonagal	No 67	Do. Fat.
431	Do. taluq — Narayanpuram	No 68	Do. Fat
432	Do. taluq — Jalibench	No 69	Do. Fat.
433	Do. taluq — Basapur	No 70	Do Fat

No.	Locality	Summary of description given	Physical and Chemical Character
434	Do. taluq — Kapati	No 71	Do. (greenish) Fat.
435	Do. taluq — Tarapur	No 73	Do. (rather marly) Fat.
436	Do taluq — Osahully	No 74	Do Fat.
437	Do. taluq — Kamaveram	No 75	Do (rather marly) Fat.
438	Do. taluq — Kotakal	No 76	Do Fat.
439	Do. taluq — Mantrisky	No 77	Do Fat.
440	Do. taluq — Sultanpur	No 78	Do (rather marly) Fat.
441	Do taluq — Pasalbanda	No 79	Do. Fat.
442	Do. taluq — Chinagonahull	No 80	Do. Fat.
443	Do. taluq — Nagathankully	No 81	Do. Fat
444	Do. taluq — Musanahully	No 82	Do. Fat.
445	Do. taluq — Chikaharniana	No 83	Do. Fat.
446	Do. taluq — Chagry	No 84	Do. (rather marly) Fat
447	Do. taluq — Ingaladahull	No 86	Do. Fat.
448	Do. taluq — Pedagonahull	No 87	Do. Fat.

No.	Locality	Summary of description given	Physical and Chemical Character
449	Tadpatri taluq — Rayalcheruvu	No 88	Compact semicryst. ~~stone~~ kunkur stone; approaching splintery rock; light brown (like No 367) ~~Fat.~~
450	Do. taluq — Rayalcheruvu	No 89	Semicryst. kunkur, white Fat.
451	Do. taluq — Muchukota	No 90	Semicryst kunkur, white & reddish Fat or slightly hydraulic
452	Do. taluq — Alur	No 91	Infusorous stone; white, friable Silicates 12 per cent. Fat Hydraulic
453	Do. taluq — Bogasamudram	No 92	Semicryst. ~~stone~~; rather worn and rotten Fat or slightly hydraulic
454	Darmaveram taluq — Gutlur	No 93	Semicryst. stone greenish grey, reddish Fat.
455	Madakasira taluq — Bukkapatam	No 94	Semicryst. ~~kunkur much~~ quartz, red. Meagre or slightly hydraulic
456	Hindupur taluq — Hindupur	No 95	Semicryst. kunkur; rotten Slightly hydraulic

Cuddapah District.

No.	Locality	Summary of description given	Physical and Chemical Character
457	Cuddapah taluq — Bogalatipully	No 1	Semicryst. red kunkur stone with much magnesite. Fat.
458	Pullivandla taluq — Chintalapully	No 1	Do Fat.
459	Jamalmadugu taluq — Jogipuram	No 1	Semicryst micaceous kunkur stone detrital. Fat or slightly hydraulic
460	Do. taluq — Setivarapully	No 2	Semicryst micaceous kunkur Fat.
461	Do. taluq — Degarabrahmanapully	No 3	Semicryst. red ~~kunkur~~ (magnesian) Fat.
462	Prodatur taluq — 9 specimens	No 1 to 9	All these are very similar; they may be described as Honeycombed red kunkur and are all more or less magnesian Fat.
463	Porlamputt taluq — Rajampett	No 1	Honeycombed red kunkur Fat
464	Do taluq — Chittrail	No 2	Red kunkur stone with much magnesite Fat.
465	Badvail taluq — 8 specimens	No 1 to 8	All of these are similar: — Red kunkur stone with much magnesite Fat.
466	Rayachoty taluq — ~~5 specimens~~ 5 specimens	No 1 to 5	All of these are semicrystalline ~~kunkur~~ kunkur, grey (approaching to paleday) but friable. They are strongly magnesian Fat.
467	Do. taluq — Madaveram	No 6	Semicryst. micaceous kunkur Fat.
468	Do. taluq. Duragam	No 7	Amorphous & semicryst. kunkur, grey, friable Fat.
469	Sidhout taluq — 8 specimens	No 1-8	All of these are red kunkur stone with more or less magnesite. Fat

No	Locality	Summary of description given	Physical and Chemical Character
470	Madanapully taluq — Busankonda	No 7	Amorphous kunkur masses grey; rather friable Slightly hydraulic
471	Kadery taluq — 3 Heermen	No 963	Semicryst. kunkur, white. Fat.
472	Voilpad taluq — Voilpad	No 2	Marly kunkur, friable, white. Fat
473	Do	No 1	Semicryst. kunkur Fat (or meagre)
474	Do	No 3	Do Fat.

Kurnool District

475	Kambam taluq — Kambam	No 1	Honeycombed red kunkur stone magnesian Fat.
476	Do. taluq — Ragamanguntu, Nandikanama ghat.	No 3	Semicryst. white kunkur stone Fat.
477	Markapur taluq — Markapur	No 4	Like No 475 (No 1).
478	Ravalakota taluq — Kalur.	No 5	Splintery rock, light brown. Silicates 29 per cent Fair hydraulic
479	Do taluq — Dinaderavapad	No 7	Semicryst. kunkur; honeycombed, agglomerate magnesian Fat.
480	Do. taluq — Mundatorida	No 9	Semicryst kunkur; white, nucleus Fat

No	Locality	Summary of description given	Physical and Chemical Character
481	Nandikotkur taluq — Jutur.	No 11	Semicryst. honeycombed kunkur red. Fat.
482	Do. taluq — Nandikotkur.	No 13	Amorphous conglomerate; partly friable, red. Fat (or meagre)
483	Sirvel taluq — Arlagudu	No 15	Honeycombed red kunkur stone Fat or slightly hydraulic
484	Koilagumtla taluq — Sangapatnam	No 17	Marly kunkur, friable, grey Silicates 6 per cent Fat
485	Do. taluq — Perasamala	No 18	Amorphous kunkury masses pinkish grey. Silicates 7 per cent Fat
486	Do. taluq — Palakur	No 19	Semicryst. kunkur stone, grey Fat.
487	Nandyal taluq — Kotimadu.	No 20	Honeycombed red kunkur stone Fat.
488	Do taluq — Kondajuttur	No 21	Splintery rock, black. Silicates 18 per cent Slightly hydraulic
489	Do Do	No 22	Splintery rock, grey. Silicates 30 per cent Fair to good hydraulic

Kistna District

490	Satenapully taluq and the Palnad	Black napa stone	Compact saccharoid rock very fine grain; slate colour white when powdered Silicates 10 per cent (fine white sand) Fat

No.	Locality	Summary of description given	Physical and Chemical Character
491	do	White napa stone	Resame colour slightly granular white. Silicates 21 per cent (fine white sand) ~~Fat~~ Slightly hydraulic
492	Narsaraopet & other talugs.	Stone kunkur No 10 & 11	Red limestone stone Fat.
493	do	No 12	Semicryst. micaceous kunkur Fat.
	Godavery District		
494	Ellore talug — Jaggampet	No 1	Semicryst. stone with much rotten gneiss and marl ~~Nyare~~ or slightly hydraulic
495	do. talug — Palagalapully	No 2	Semicryst stone with some-merly limps. Fat.
496	Pedapur talug — Jagampetta	No 4	do Fat.
497	Rajemaundry talug — Katair	No 5	Compact amorphous rock, with calcite crystals in some parts greenish grey with a pretty rose tinge in one part. Silicates 6 per cent (clayey) Fat.
498	Yernagudiam talug — Gantipatnam	No 6	Like the preceding but of loose structure; yellowish grey. Silicates 1 per cent (red clay Fat, magnesian
499	do	No 7	Like 497 (No 5).

No.	Locality	Summary of description given	Physical and Chemical Character
500	do	No 8	Mass of calcite in foliated crystals; colour and appearance that of buffalo horn. Silicates 6·4 per cent (brown clay) Fat.
501	do	No 9	Like 498 (No 6) with large crystals of calcite in some part. Pink tones. Silicates 11 per cent (chocolate clay) Fat.
502	do	No 10	Like 497 (No 5) Contains masses of fossil shells. Fat.
503	do	No 11	Mass of foliated horn-like crystals of calcite (like No 8). nearly black Silicates 4·6 (brown clay) Fat.
504	Rajamundry talug — Katair	No 12	Compact rock, amorphous bremicryst. Pink. Fat.
505	Upper Godavery. Bhimdanka 18 miles from Dumagudiam	No 1 In extensive bed and boulders. 19·7 p% silicates	Mixture of white calcite and of black splintering rock Silicates { white 2·8 per cent black 10·3 The black may be slightly hydraulic
506	Upper Godaveny Amagaripully opposite Dumagudiam	No 2 Bed of large extent	Light slate colour (mixture of black and white) fracture not so clean as in the splintering rock Silicates 24 per cent Fair hydraulic.

No.	Locality	Summary of description given	Physical and Chemical Character
507	Upper Godavery. Enchampilly, below junction of the Indravati	No 3 Extensive beds; graphite found near it, at 40 feet depth.	Like the preceding; in highly compressed layers with veining calcite running through it.
508	Upper Godavery. Bidaigudiam; right bank of Godavery 12 miles above Enchampilly	No 4 Small beds and boulders	Amorphous rock, clayey appearance light yellow. Silicates 17 per cent (clayey) Fair to good hydraulic.
509	Upper Godavery. Bed of the Godavery, 2 miles above Bodaigudiem	No 5 Extensive beds near and overlying sandstone	Compact rock, with not very clean fracture, in numerous very thin layers giving a banded appearance. Dark brown. Silicates 3 per cent (Black clay) Fat.
510	Upper Godavery. Seronchia; on left bank of the Pranhita a little above its junction	No 6 Very large beds over and underlying sandstone.	Ochreous to purple rock. A sandstone; it contains no limestone.
511	Upper Godavery. Develamiry; on left bank of the Pranhita, about 3rd Barrier.	No 7 Lies in beds over a large area	Compact splintery rock; black with veins of white calcite. Silicates 14 per cent. Slightly to fair hydraulic

N.B. These 511 Nos. represent 557 limestones examined.

The term 'Fat' in the foregoing description is to be understood as opposed to 'hydraulic' rather than to 'meagre' A micaceous limestone containing 20 per cent. of silicates may yield a lime, which, though strictly speaking rather meagre inasmuch as it contains 30 per cent of inert matter, yet behaves as a fat lime when slaked and does not set under water.

In concluding this report it may be useful to give a specimen of the system of classification adopted by M. Vicat in his Statistical Researches on Limestones. Real tables, comprising the results obtained in the examination of ten thousand specimens (made in 1833-45) are drawn up in the following manner:—

Department	No	Colour	Texture	Geological formation	Insoluble %	Insoluble Quality	Magnesia	Classification
Orne	96	Pale yellow	Very coarse	Middle oolite	1·5	Clay	0	Fat
do.	92	Milk & coffee	Sub-compact	do.	8	do.	0	Slightly hydraulic
do.	90	Buff	Chalky	Middle tertiary	15	do. Carbonaceous	0	Hydraulic
do.	99	do.	do.	Middle oolite	23·5	Clay	0	Intermediate
do.	91	Earthy yellow	do.	Middle tertiary	26·5	do.	0	Cement or intermediate
do.	89	Buff	do.	do.	31·5	do	0	Cement
do.	95	Reddish grey	Sub-compact	Middle oolite	22	sand	0	Very meagre
do.	96	Dirty white	Coarse	do.	33·5	sand and a little clay	0	Valueless

(para. 37)

It has been seen that Indian limestones give very different results: 20 per cent of sand or more or less inert silicates affect very slightly the 'fat' character of the limestone, and the best stones examined have been those containing 40 per cent and upwards of silica.

Bangalore
30th Sept 1874

Edward Nicholson
Surgeon Major B.M.S.

Report
of Cement Experiments
and of the Examination of
Limestones
"I, (Conclusion)

Report of cement
Experiments and of the
Examination of Limestones
conclusion

"Remarks by Secretary.
These had better be
printed, in continuation of
the former sets, before they
are sent to the Joint Secy
for disposal" 5-10-74

This is the part 2 which was missing
I have already mentioned
the appendix to be printed said which
is to hand with this if forthcoming - I send
also a disposal to the Values can be disposed
of at once. Lt. 4/11/74

Asst Engr Duty D. F. W.

Report

experiments

examination of

No. 88

Bangalore 26th August 1874.

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From

Surgeon E. Nicholson B. M. S.
on Special Duty D. P. W.

To

The Chief Engineer and Secretary to Govt.
Public Works Department.

Sir

I have the honour to forward this day by packet-mail a part of my concluding report on limestones and cements. The remainder (the descriptive list of limestones) will be finished by the 31st inst. and forwarded without delay, but I have thought it advisable to send the first part at once and to state that the work will be concluded on the 31st inst., the date fixed by order of Government.

I have the honour to be
Sir
Your most obdt. Servant

Edward Nicholson
Surgeon B. M. S.
on Special Duty D. P. W.

Appendix.

Descriptive list of Limestones sent by the Madras Railway Company and the Madras Irrigation and Canal Company.

No.	Locality	Summary of description given	Physical and Chemical Character
		1st Division, S. W. Line	
1	65th mile	No 7	Rather clayey marly kunkur Fair hydraulic
2	56th mile	No 2	Marly kunkur, slightly clayey Slightly hydraulic
3	53rd mile	No 3	Marly to semicrystl. kunkur Fat or slightly hydraulic.
4	48th mile	No 4	Semicrystl. kunkur Fat or slightly hydraulic.
5	42nd mile	No 5.	Chalky kunkur Fat.
6	39th mile	No 6.	Semicrystl. kunkur, somewhat clayey and subgeodic. Slightly hydraulic.
7	70th mile / 6th telegraph post	No 7	Semicrystl. kunkur, variable; some chalky some sandy Fat or slightly hydraulic
8	79th mile / 13	No 5	Do (friable and earthy) Fat or slightly hydraulic
9	80th mile / 2	No 1	Clay with chalky particles disseminated through it. Too poor to be worth burning.
10	81st mile / 6	No 9	Chalky to semicrystl. kunkur Fat.
11	82nd mile / 1	No 10	Chalky kunkur Fat.

No.	Locality	description given	Summary of description given	Physical and Chemical Characters
12	81/14 mile	No 72	Marly to semicrypt. kunkur; friable, subgeotic.	Slightly hydraulic
13	92nd mile / 1	No 77	Chalky to semicrypt. kunkur	Fat.
14	94th mile / 4	No 79	Marly to semicrypt. kunkur	Fat.
15	127th mile / 15		Marly kunkur; grey, friable	Fat.
16	129th mile / 10		Marly to semicrypt. kunkur, grey	Fat.
	2nd Division S.W. Line.			
17	135th mile Salem.		Semicrypt. kunkur; homogeneous, earthy; in large masses; grey	Slightly hydraulic.
18	137th mile Salem		Semicrypt. kunkur, adventitious	Fat.
19	170th mile Salem		Marly kunkur; grey, hardening	Fat.
20	Bangalore branch 136th mile		Marly to semicrypt. kunkur, white.	Fat.
23	Do. 142nd mile Salem		Chalky kunkur, with rotten gneiss; white	Fat (23)
24	Do. 148th mile N. Arcot		Marly to semicrypt. kunkur, friable, much rotten gneiss, grey	Fat
25	Do. 157th mile, N. Arcot		Marly to semicrypt. kunkur, grey	Fat.
26	Do. 158th mile, N. Arcot		Marly to semicrypt. kunkur, some subgeotic, grey	Fat or slightly hydraulic
27	Do. 187th mile, Mysore		Semicrypt. kunkur, much of it clayey and geotic; brown	Fair hydraulic; good if picked.
28	Do. 203rd mile, Mysore		Semicrypt. kunkur, subgeotic, very hard, brown.	Slightly to fair hydraulic.
	3rd Division S.W. Line.			
29	180th mile / 6 T.P. Bunder chetty putty		Semicrypt. kunkur, homogeneous large; white.	Fat.
30	189th mile / 15 T.P. Kadamputty.		Amorphous kunkur; micaceous brown. Occasionally magnesian	Fat or slightly hydraulic
31	190th mile / 1 T.P. Morur		Amorphous kunkur; friable brown. Magnesian Silicates 44 per cent (Blastomica)	Slight to fair hydraulic
32	190th mile / 15 T.P. Kadamputty		Clayey kunkur; mostly pellet geodes; brown. Silicates 26·4 per cent (clayey)	Good hydraulic
33	191st mile / 20 T.P. Ahtur		Amorphous kunkur, friable brown. Silicates 44 per cent (sand, mica and clay)	Fair hydraulic

No.	Locality	Summary of description given	Physical and Chemical Character
34	199½ mile		Amorphous to semicryst. kunkur brown & grey. Fat or slightly hydraulic
35	204½ mile		Marly to semicryst. kunkur Fat or slightly hydraulic.
36	205½ mile		Semicryst. kunkur Fat.
37	211th mile		Amorphous to semicryst. kunkur greenish grey Slightly hydraulic
38	212th mile		Amorphous, rather porous, kunkur grey. Slightly hydraulic
39	218th mile		Semicryst. kunkur, micaceous, mottled. Fat or slightly hydraulic
40	223rd mile		Semicryst. kunkur, variable, [illegible] magnesian in parts. Fat or slightly hydraulic
41	240th mile		Amorphous honeycombed kunkur grey. Fat or slightly hydraulic
42	249th mile / 6 T.P.		Amorphous kunkur, grey. Fat or slightly hydraulic.
43	300th mile / 17 T.P.		Red honeycombed kunkur (eralolay) magnesian. Fat.
44	302nd mile		Amorphous kunkur with [illegible] to eralolay) magnesian. Fat.

No.	Locality	Summary of description given	Physical and Chemical Character
	4th Division S.W. Line		
45	Coimbatore station cutting 306th mile	No 1	Semicryst. kunkur, much honeycombed; in large mass; mottled; yellow outside. Fat or slightly hydraulic.
46	Hills near Kanavapolium 8 miles from Coimbatore town	No 2	Crystalliged limestone (coarse marble) red mottled with grey and with black mica. Perfectly fat.
47	303rd mile cutting Pothanore	No 3	Amorphous red limestone in large mass. Silicates 50 per cent (red sand) appears meagre rather than hydraulic, yet it may be very fair hydraulic.
48	306th mile cutting Cobanerie	No 5	Amorphous honeycombed red kunkurstone; ~~red~~ magnesian. Fat.
49	Hills near Cobanerie	No 6	Crystalliged limestone, red mottled with grey and black mica. Receptacles of calcite very large. Perfectly fat
50	308th mile cutting Muddikurry	No 7	Amorphous honeycombed conglomerate, red with much magnesia Fat.
		do	Semicryst honeycombed kunkur reddish Fat or slightly hydraulic.
51	312th mile cutting Ettanuraday	No 8	Amorphous to semicryst. kunkurstone, ~~[illegible]~~ large compact mass; reddish grey, much quartz and mica Slightly hydraulic
52	315th mile cutting Wallian	No 9	Pisolithic conglomerate of red magnesian kunkur Fat.

No.	Locality	Summary of description given	Physical and Chemical Character.
		1st Division N.W. Line	
53	Viraparetty Poliam 67th mile 13 T.P.	No 4	Marly Kunkur. white Fat.
54	Thaduck 58/3	No 5	Semicrypt. Kunkur, grey Fat.
55	Iyavarkoulgy 64/3	No 6	Marly to amorphous kunkur, grey Fat.
56	79th mile 15	No 70	Amorphous Semicrypt. kunkur very sandy, some of it nutgeodic, brown Meagre perhaps fairly hydraulic
57	93rd mile 15	No 71	Amorphous kunkur; brown Slightly hydraulic
58	87th mile 2	No 12	Marly kunkur, with rotten grains white. Fat.
59	Ashaveram 134/3	No 13	Red magnesian kunkur, homogeneous Fat.
60	Rajampett 129/14	No 14	Semicrypt. kunkur; reddish grey Fat or slightly hydraulic.
61	Gallapully 129/4	No 15	Semicrypt. Kunkur; white, red outside Fat.
62	Cherlopully 145¼	No 19	Semicrypt. kunkur, white, mottled Fat or slightly hydraulic.
63	Gungaradithamay 145¼	No 20	Semicrypt. Kunkur, white and red. Fat.

No.	Locality	Summary of description given	Physical and Chemical Character
64	Palatovadiayampully 160/3	No 21	Red magnesian kunkur homogeneous Fat.
		2nd Division N.W. Line.	
65	Bogalapully 162nd mile	No 7	~~Kunkur~~ Red kunkur, homogeneous ~~clay~~ somewhat magnesian Fat or slightly hydraulic
66	Bed of Buga river 162/5	No 2	Semicrypt. Kunkur, homogeneous, grey mottled with pink and black. Fat or slightly hydraulic
67	Bogalapully 164th mile	No 3	Red magnesian kunkur. Fat
68	Do	No 4	Red Kunkur Fat.
69	Yerraguntla	No 5	Compact imperfectly splintering rock in boulders. Purple Silicates 72 per cent. A calcareous sandstone. It might yield a better meagre cement.
70	Narji	No 6	Compact splintering rock slate colour. Silicates 18 per cent Fair hydraulic
71	Chitanarpully 204th mile 7	No 7	Semicrypt. Kunkur, mottled grey Fat or slightly hydraulic
72	Kondapuram 210th mile 8	No 8	Do Do
73	Royalcheru 263rd mile 9		Semicrypt. Kunkur; grey to reddish Fat or slightly hydraulic

No.	Locality	Summary of description given	Physical and Chemical Character
74	Rayalcheruvu 268 mile 10	No 10	New compact splintering rock (connecting the semicrystl. deposited kunkurstone with the old compact splintering rock of former geological period.) Light slate, shells visible. Fat.
75	Dayalemadigu 246 mile 11	No 11	Red magnesian kunkur stone Fat.
76	Kannul road crossing near Koota 255 mile 15	No 12	Marly to semicrystl. kunkur, white Fat.
77	Pathakalcheruvu 265 mile 5	No 13	Semicrystl. kunkur, mottled with black & red Fat or slightly hydraulic.
78	Landyguda 270 mile 11	No 14	Amorphous or semicrystl. kunkur grey. Fat or slightly hydraulic
79	Dandumitta 271 mile 3	No 15	Marly to amorphous kunkur, friable, grey, Fat or slightly hydraulic
80	Jeremalavadigunta 271 9	No 16	Amorphous, kunkur; white, magnesian. Fat.
	3rd Division N.W. Line.		
81	278 mile		Chalky kunkur with much rotten gneiss, white. Fat.
82	287 mile		Chalky kunkur; more than half is rotten gneiss. Too impure for use, perhaps slightly hydraulic

No.	Locality	Summary of description given	Physical and Chemical Character
			(107) 28
83	291 mile		Do. Rare rotten gneiss than limestone
84	302 mile 2		Chalky kunkur, white. Fat.
85	315 mile 14		Rotten gneiss cemented by a little chalky kunkur Not fit for burning
86	321 mile 11		Semicrystl. kunkur, grey Fat or slightly hydraulic
87	Do		Semicrystl. kunkur, honey combed conglomerate, yellow outside, grey or white inside. Magnesian (Kaladgy) Fat.
	323rd, 326 mile and 8 others		Rotten gneiss, no limestone
88	334 mile 14		Chalky kunkur, with rotten gneiss friable, white. Fat.
89	345 mile 4		Clayey kunkur, small, grey. Fair hydraulic
90	347 mile 5		Marly kunkur, white. Fat.
91	349 mile 1		Chalky kunkur, buff Fat

No.	Locality	Summary of description given	Physical and Chemical Character
3		Bellary Branch N.W. line	
92	Huggry river		Semicrystt kunkur, grey in ~~matrix~~ chambic limp. Fat.
	The other specimens from this branch ~~are~~ consist mostly of trotten gneiss with a little chalky kunkur.		

Remarks.

After rejecting several specimens consisting rather of rotten gneiss than of limestone, there still remained amongst the 92, a two or three specimens rather too poor to be worth burning.

The best of the collection are Nos 1, 27, 28, 32, 33, 70. These are fair to good hydraulic.

Nos 33, 47, 56, 69 are possibly of some value, but it is uncertain whether they are strongly hydraulic or merely meagre.

The remainder are either fat or but slightly hydraulic.

I would observe that amongst the collection there was no specimen of the excellent geodic clayey kunkur which is found all along the Line in Mysore. In no part of the Madras Presidency does there appear to be such good hydraulic limestones as those found between Kolar and Bangalore.

Limestones from the Works of the Madras Irrigation and Canal Company.

One soft white kunkur, Kalur — Fat or slightly hydraulic
One semicrystalline kunkur, Podur — Slightly hydraulic
Three specimens of compact splintering rock
No 1 Dark slate Nijūd, 16 per cent silicates Slightly hydraulic
No 2 Light yellow Karnul, 21 " " Fair hydraulic
— Dark slate Alūr, 19 " " Slight to fair hydraulic

Bangalore
30th Sept 1874

Edward Nicholson
Surgeon Major B.M.S.

No 91 Bangalore 30th September 1872

From

Surgeon Major E. Nicholson British Med. Service

To

The Chief Engineer and Secretary to Government P.W.D.

Sir

1. I have the honour to submit the last part of my concluding report; the part containing the last experiments on limes and cement stone already been forwarded, that now despatched* contains the detailed examination of the specimens of limestones sent from various parts of the Presidency.

* by packet post

2. I have thought that some of these specimens might be advantageously kept for record — and have accordingly prepared two boxes containing.

I. A series of typical limestones

II. A series illustrating the development of the various kinds of recent limestones.

I have forwarded these to the District Engineer, Bangalore, for favour of transmission to you.

3. Thinking that possibly it might be useful for District Engineers to have in their offices a case of typical limestones for comparison with those found in their Districts, I have prepared ten (10) similar cases, which can be

Rec'd 1/11/72

Appendix
to Report of Experiments
on Cements and its Examination
&c &c &c

Rec'd Dec 1872
Lr No 1872
Bangalore

made available for distribution as far as they go. Should further series be required they can be made up from surplus specimens without trouble at a cost of about 8s 4d each for the cases.

I have the honour to be
Sir
Your most obedt Servant
Chas. J. Nicholson
Surgeon Major British Med! Service

P. W. 1874 Dept.
No: 6648

From

Surgeon-Major E. Nicholson
British Med. Service

To

The Chief Engineer
and Secretary to Government
Public Works Department

Bangalore 30th September 1874
Rec'd 23rd October "
No. 91

Forwarding
Last part of Consulting
Report on Limestone
+ Cements.

195.

Rec'd Book 23rd Oct 1874

Fwd

10

Proceedings of the Madras Government.

Read the following papers

From Surgeon Major E. Nicholson - H.S. No. 88 - dated 26th August 1874 -

" " " " - H.S. No. 91 - dated 30th Septr 1874 -

3468

His Excellency the Governor in Council is much indebted to Surgeon Major Nicholson for this clear and valuable report, which will afford to all Executive Officers and Inspectors of the Department information from which it is anticipated that a marked improvement in the selection and preparation of cements and mortars for different descriptions of

of Public works will result - The latter part of para 38 of the report will be especially deserving of attention whenever it may be desirable or necessary to obtain cement stones for special work, while paras 29 & 30 on the means of rendering Portland cement will be of practical utility to all who may require to use this material. I think it may be expected that very generally District Officers will find close at hand the means of preparing a cement possessing all the more valuable properties of Portland, and obtainable at a small fraction of its cost.

2. Surgeon Major Nicholson's previous reports will be found recorded in the Proceedings as per margin.

3 It Government consider it desirable that every District Engineer should have a set of the typical limestones to refer to, and 25 sets therefore should be made up and sent to the General Superintendent P.W. Workshops & Store for distribution, as opportunity may offer, to the several officers to whom these Proceedings will be communicated. 4 sets will also be supplied to the Madras Museum

GWW

Surgeon Major Nicholson 12 printed copies ✓
All Supg Engrs ✓
Chief Engr for Brs ✓
Chief Engr for Hyd ✓
Principal C.E. ✓
Exec Engr Nundidrug ✓
Supdt Govt Central Museum ✓
Superintendent all 12/12/74.

No 1267 dated 8th May 73.
No 427 - 21 February 1874.

The Proceedings

Chief Engr

350
90

W. 16/10/74

A. Cyphir dispatched 15/12/74

3148

PUBLIC WORKS.

Surgeon Major Nicholson

Ewal.

10 Dec. No. 03468