

SELECTIONS
FROM
THE RECORDS
OF THE
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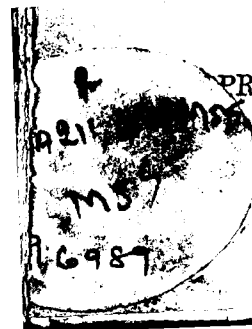
No. XXXIX:
REPORT
UPON THE
GOVERNMENT CENTRAL MUSEUM
AND
THE LOCAL MUSEUMS
IN THE PROVINCES
FOR THE YEAR 1855-56,
WITH APPENDICES

BY
EDWARD BALFOUR,
SURGEON, MADRAS ARMY,

Officer in charge of the Government Central Museum, Madras.

Madras:

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1857.



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GOVERNMENT CENTRAL MUSEUM,
MADRAS, 1st July 1856.

From

SURGEON EDWARD BALFOUR,
Officer in charge of the Government Central Museum.

To

T. PYCROFT, Esq.,
*Chief Secretary to Government,
Fort Saint George.*

SIR,

1. I have the honor to report, to the Right Honorable the Governor in Council, on the transactions of the Government Central Museum and of the Local Museums in the Provinces, during the year 1855-56; and believe that the evidence here afforded of the increasing attractiveness and public utility of this Institution will be satisfactory.

2. Its increasing favor with the public can best be shewn by furnishing a statement of the number of visitors during the past year, and contrasting the same with the numbers in former years, and with the visitors to kindred institutions at Home.

3. The visitors to the Royal Zoological Gardens, in the year 1854, were in number 407,676; to the Kew Gardens in 1855, 318,818,* and to the British Museum, in 1855, the general visitors numbered 347,683,† while the number visiting this Institution during the year ending the 31st June 1856, was 368,873, of whom 127,646 visited it during the second half of the year 1855, and 241,227 from the 1st January to the 31st June 1856: and the following tables will shew the proportions of the races, &c., who have come sight-seeing.

* Annals of Legislature, p. 3.

† Quarterly Review, December 1855, p. 220.

‡ London Athenæum, No. 1,486, April 19th 1856.

VISITORS TO THE GOVERNMENT CENTRAL MUSEUM DURING THE MONTHS OF JULY, AUGUST,
SEPTEMBER, OCTOBER, NOVEMBER AND DECEMBER 1855.

1855.	Signatures made in										Total of signatures.	Unable to sign, but names taken down.	Total Visitors.	Number of		Total Visitors.
	English.	Telooquo.	Tamil.	Hindustani.	Chingalese.	Maharatta.	Nagaree.	Gooserattee.	Canarese.	Chinese.				Males.	Females.	
July.....	1,054	473	2,118	350	0	39	10	6	7	0	4,021	10,148	14,169	8,957	5,212	14,169
August.....	2,004	617	3,769	286	0	28	4	7	0	0	6,715	11,272	17,987	10,699	7,288	17,987
September...	1,840	862	7,572	349	0	43	11	24	0	0	10,701	9,961	20,662	9,050	11,612	20,662
October.....	1,862	1,334	4,663	711	0	32	16	0	5	1	8,624	18,271	26,895	12,310	14,585	26,895
November....	1,636	1,062	3,360	432	0	36	0	6	11	0	6,543	16,068	22,611	12,497	10,114	22,611
December....	3,305	1,021	4,047	573	0	39	3	0	0	0	8,988	16,334	25,322	17,255	8,067	25,322
Total...	11,701	5,333	25,529	2,701	0	217	44	43	23	1	45,592	82,054	127,646	70,768	56,878	127,646

GOVERNMENT CENTRAL MUSEUM

VISITORS TO THE GOVERNMENT CENTRAL MUSEUM DURING THE MONTHS OF
JANUARY, FEBRUARY, MARCH, APRIL, MAY AND JUNE 1856.

Signatures made in										Total of signatures.	Unable to sign, but names taken down.	Total of Visitors.	Number of		Total of Visitors.		
English.	Telooquo.	Tamil.	Hindustani.	Bengalee.	Mahratta.	Nagaree.	Gozerattee.	Canarese.	Chinese.				Chinese.	Males.		Females.	
1856.																	
January ...	3,591	1,403	5,573	599	0	29	10	7	0	4	0	11,216	30,074	41,290	25,327	15,963	41,290
February...	4,061	1,172	5,155	914	0	38	5	4	4	4	0	11,357	27,032	38,389	23,359	15,030	38,389
March.....	4,254	1,271	5,242	687	2	39	8	5	5	0	0	11,513	27,156	38,669	22,985	15,684	38,669
April.....	3,524	1,497	4,838	802	0	34	3	14	6	3	0	10,721	23,267	33,988	20,358	13,630	33,988
May.....	4,482	1,303	5,976	613	5	40	14	7	10	7	0	12,457	25,238	37,695	23,405	14,290	37,695
June	4,467	2,235	7,139	1,547	10	47	25	29	23	0	0	15,522	35,674	51,196	30,623	20,573	51,196
Total...	24,379	8,881	38,923	5,162	17	227	65	66	48	18	0	72,786	168,441	241,227	146,057	95,170	241,227

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GOVERNMENT CENTRAL MUSEUM

Since the origin of the Institution, the visitors have been gradually increasing as follows :

1851; 1st 8 Months,	1852,	1853,	1854,	1855,	1856; 1st 6 Months,	Total Visitors.
530	2,906	20,096	40,316	201,987	241,227	507,062

4. The conduct of this great mass of people has been most exemplary: the few acts of pilfering detected have been amongst school boys, who seem to have thoughtlessly taken things away, merely because they pleased the eye. The numbers of Native women, all of them well dressed, continue to increase, and the intelligence they display and the pleasure they seem to derive, are remarkable.

5. As a further means of judging of the utility of this Institution, I may mention that the total of its current expenses, for the year 1856, reckoning every item of expenditure whatever, may be estimated at about Rupees 10,000, or £1,000; while for the year 1856-57, the sum of £85,643 sterling was voted for the British Museum (with fewer visitors) and in 1854, the Royal Zoological Society paid £3,942 for food alone, and as their visitors for that year were 407,676, their income must have been about £20,000, and probably their expenditure was not much less. These matters are of interest, as affording means of judging the success of the Government Central Museum, the visitors to which in the current year will be about 600,000. Though the number of visitors has been regularly increasing ever since 1851, the very great increase in this, over former years, must have been much owing to the addition made to the Institution of the living animals now forming the Zoological Gardens attached to it: and this will be recognised by examining the tables given above wherein it is shewn that while the visitors in December 1855 numbered only 25,322, the numbers rose, at once, in January 1856, to 41,290, the gathering in of the animals having then commenced.

6. The formation of the Zoological Gardens in connection with this Institution has been the great feature of change, during the bygone year, and the success of our efforts to preserve the living creatures has, compared with other Institutions, been fair considering that at first,

we had not the means of preserving them and that of many we were ignorant of their habits. For instance the Royal Zoological Gardens, which now contain only 1,300 Mammals, Birds and Reptiles, have by purchases and presents, during the 26 years of their existence, received

Quadrupeds.....1,069	Ruminantia.....1,098
Carnivora.....1,409	Marsupialia..... 219
Rodentia.....1,025	Reptilia.....1,861
Pachydermata..... 204	Aves.....7,320

being a total of 14,205 in 26 years, shewing therefore that they have lost $1\frac{1}{2}$ animals per day. But the Madras Zoological Gardens have received and bought in all, 812 animals, and we have now 360 present in the Institution.

7. The mortality has been chiefly the consequence of two causes; one, the difficulty, I might say impossibility, of keeping some animals alive, and the other the injuries which we have found impossible wholly to prevent them inflicting on each other. But greater experience will remove the former and more care and separation will remedy the latter cause. While the liberality of Government in authorising this additional means of amusing the people of this country, may be estimated by recognising that, at least 100,000 visitors will come sight-seeing in 1856, additional to those whom the Museum alone would have attracted. The charge per head, on each visitor to the British Museum is about 3 shillings and sixpence, sixpence is charged for every visitor to the Royal Zoological Gardens: but, in the Government Central Museum, Madras, the whole sum for the year 1856, spread over its estimated 600,000 visitors, makes the Government expend only three pence or about one farthing for each visitor. The visitors on an average remain about two hours in the Institution, and it will be allowed that this gratification to the community is very cheaply furnished. Unlike the Museum of Natural History and of Economic Geology, however, nearly all the 33,732 specimens in which were given gratuitously, the Zoological collection has had to be purchased; and I find that in this country similar fanciful values are put upon animals brought for sale which the Royal Zoological Gardens have had to contend with. That London Institution was asked by a ship Captain £600 for 2 Pythons, but he took £40; an American offered them a grisly Bear for £2,000, and a Walrus for £700, and a Tortoise shell Tom Cat was offered for £250.

Its 1st Rhinoceras cost.....	£1,000
Its 2d do. „	£ 350
Four Giraffes „	£ 700
and their carriage another.....	£ 700
An Elephant and Calf bought in 1851.....	£ 800
Their Hippopotamus was a gift, but its carriage and housing cost.....	£1,000
The Lion Albert.....	£ 160
A Tiger in 1852.....	£ 200
A pair of black-necked Swans.....	£ 80
A „ crowned Pigeons and 2 Malcos.....	£ 60
A „ Victoria do.	£ 35
Four Mandarin Ducks.....	£ 70
Their Lions have ranged from.....	£40 to £ 180
Their Tigers do.	£40 to £ 200

NOTE.—Quarterly Review, December 1855, p. 220. Review of Wolf's Zoological Sketches made for the Zoological Society of London. Also of D. W. Mitchell's popular guide to the Garden of the Zoological Society.

In this Institution I have had to pay Rupees 500 for a Giraffe; have had to refuse two Tortoises, for which Rupees 300 were asked—and the fanciful prices asked for some of the smaller creatures have been as extraordinary. The largest Pythons, however, can be purchased for a rupee, and smaller Snakes of every kind for a few annas each. Connected with the progress and usefulness of the Central Museum of Natural History, and Economic Geology, during the past year, there are several points deserving notice here.

8. Amongst these is the great progress I have made in preparing catalogues of the different departments of the Institution, the catalogue of the Minerals in illustration of systematic Mineralogy, being completely printed. The catalogue of all the specimens relating to systematic Geology, the fossiliferous rocks and their fossils of the non-fossiliferous rocks and of the rocks of igneous origin being likewise complete and will now be all printed in a few weeks. The catalogue of the Molluscan animals in the Museum, the collection embracing the large number of 2,378 species and varieties has also been completed and printed, and I would here wish to acknowledge the valuable assistance which Dr. Trail afforded me in arranging and naming these shells. The catalogue of our books has also been completed and will shortly be printed, and that of

our coins has been completed, though it may require further revision before being printed. The description of the Elliot Marbles, entrusted to the Rev. William Taylor to perform, has likewise been completed and is appended to this report **B**.

9. Amongst other matters which I have endeavoured to make progress in, is the commenced arrangement of the Models and Machinery, for the reception of which the north-wing of the building has been allotted; I have also sent £120 to the Honorable Court* to purchase models of all implements, machines, &c., the introduction of which into this country might aid the productive powers of the people, and I am rendered the more desirous of the speedy arrival of this consignment by witnessing the constant crowding of the visitors to the model room.

10. Amongst my avocations of the past year has been the preparation of a report on the materials procurable in Southern India, used in the arts, for *grinding, sharpening* and *polishing*, my attention having been directed thereto by the requests of the Principal Commissary of Ordnance, the Commissary General and the Military Board. This Report will be found in Appendix A, and seems to me to contain much information of use as well to Government and all desirous of developing the economic resources of the country, as to the several departments of the State using these materials.

11. LITHOGRAPHIC LIMESTONES.—For similar objects and in pursuance of the orders of the Honorable the Court of Directors* and of Government, that the Chief Engineer and myself should jointly prosecute the examination of the Limestones of this country, suited for lithography, I have corresponded with the Chief Engineer and have sent stones for trial. In the last letter received from that officer he wished me to continue the search through the country for rocks suitable for lithography, but I have not thought it necessary to follow out this suggestion, because I have conclusively adopted the opinion that in many places of this country, but particularly in the water-shed of the Kistnah river and its tributaries, from near the debouchure of the Kistnah westward in its own valley and in the valleys of its tributaries the Tumbudra, the Gutpurba and the Malpurba, amongst the whole of the compact Magnesian limestones

* Honorable Court's letter, dated 30th May, No. 31 of 1855, and Extract Minutes Consultation dated 20th July, No. 966 of 1855.

of every colour, which occur there in great beds, destitute of fossils, it would be almost impossible to use a stone not suitable for lithography. All of them capable of being delivered in Madras at a twentieth part of the price that the German stones cost: and, that Government should at once order a discontinuance of the importation of this material. But specimens of the impressions from various stones have been made in order that the Government may have the means of deciding on this point.

12. With a view to record the novelties connected with the physical formation of this country, I may mention that, since my last report, Captain Campbell has discovered, at Ootacamund, on the Neilgherry Hills, the occurrence of the rare mineral Molybdenum which is said not be in the usual form of Sulphuret, but of a Carbonate: a specimen of it sent to the Museum has been submitted to the Chemical Examiner, but his report has not yet been received. Although none of the specimens have, as yet, reached this Institution, I may mention another discovery of importance as a further guide in searching for economic products, which has been made by Major Bisset, in the vicinity of Ghooty; of fossil which, from a casual glance seem to be of the Eocene formation.

Since last report, I have endeavoured to aid General Cullen's search for the tree producing the Gutta Percha, a product which, within a few years has rapidly risen to be of great importance. Aided by Mr. Jaffrey of the Madras Agri-Horticultural Society, I believe it has been satisfactorily ascertained that the tree on the Western Coast is the Isonandra Polyandra and the following is a summary of all the existing information.

No. 198. Letter to T. PIERCE, Esq., Chief Secretary to Government, Fort St. George.

Para. 2. The tree is known in the Travancore forests under the name of "*Pauchontee*," but, in the forest tracts of Cochin it is termed "*Pauly*," and on the cardamom table land "*Thempullay*" or "*Shempullay*." There could perhaps be no better instance than this given to show the little use of Native names towards determining the genera of forest trees; the term "*Pauchontee*" is quite local being confined to Travancore the same tree being known by the term "*Pauly*" in Cochin, and by the term "*Thempullay*" or "*Shempullay*" on the cardamom table land there. General Cullen having sent to me specimens of the fruit, flower and leaf of the tree, I forwarded them to the Professor of Botany at the Medical College, and to Mr. Jaffrey, and it will be observed from Mr. Jaffrey's reply that he has decided the tree to be the Isonandra Polyandra of Dr. Wight, though differing in some respects from the figure in the "*Illustrations*." In the plant received from General Cullen and

submitted to Mr. Jaffrey, the lobes of the corolla were 6 in number; the ovary 6 celled, and the stamens 18; a botanical drawing of the plant and the description of it which Mr. Jaffrey has favored me with, will be found appended to that gentleman's letter. Though two species of Isonandra are found growing on the Koondah Ghauts, the Gutta Percha tree of Malacca, the Isonandra Gutta, as such has not hitherto been discovered to be a native of the forests of Southern India; its capability of being introduced, however, seems to be decided by the experiment of Mr. McIvor who got twenty-four of the plants from Malacca for the Ootacamund Horticultural Gardens; and he considers that the plant is likely to succeed well in many parts of Malabar, as it is of rapid growth and easily cultivated: it appears also from the observations of Mr. Lobb, who was for several years a Botanical Collector in Malacca, that the true Gutta Percha is obtained from one species only, the Isonandra Gutta, but that somewhat similar, though inferior, gums are procured from two other species to mix with it.

3. Whatever value the product discovered in Southern India may ultimately be found to possess, the credit of its discovery is due to General Cullen. In the early part of the past year he sent it for exposition at the Madras Exhibition of 1855, and it was then pronounced by the Jury to bear a strong resemblance to Gutta Percha both in external appearance and mechanical properties. A subsequent sample, sent by General Cullen to the Madras Museum, resembled the crude gum imported from the Straits. Its outer surface was brownish red and presented a mottled appearance, but this depth of color may probably have been given to it by the plantain leaf which it was wrapped in, for a fresh fracture was of a cream yellow, slightly tinged with red. The fracture was smooth but conchoidal and the gum was plastic under the heat of the hand, and a non-conductor of electricity.

4. The tree comes in flower towards the end of January. It has been found to prevail in the forests along the foot of the Ghauts from lat. $8^{\circ} 30'$ to latitude $10^{\circ} 30'$ north in the Cochin Territories, and General Cullen's explorers found it common on the table land of the cardamom hills at an elevation of 3,000 feet above the level of the sea. The tree grows to a height of 70 to 80 and 90 feet, with a diameter of 2 to 3 and 4 feet; it is said to be quick of growth but the timber to be of no value.

5. It may be concluded that the discovery of this gum is interesting in a scientific point of view. Its value in commerce and the arts,

will depend wholly upon the abundance of the tree from which it is obtained, and on the quantity, for it is not a gum, of the milk or sap, to be obtained by tapping, from each tree without injury to the plant. So far as our information at present extends, the trees seem to be rather common in some parts of the tract examined. They were common on the elevated cardamom table land; in the forests of Malliatoor, and at the base of the mountains north-east of Trevandrum.

6. In my former letter (letter dated 21st January, No. 87 of 1856) I enclosed a botanical drawing of the Isonandra Gutta, the true Gutta-Percha tree of Malacca. I have now the honor to enclose a drawing of the fruit, flower and leaf of the Isonandra Polyandra from which this product is obtained; for which as well as for the name of the plant I am indebted to Mr. A. T. JAFFREY.

(Signed) EDWARD BALFOUR,

Officer in Charge.

MUSEUM, 8th March 1856.

From

MR. A. T. JAFFREY,

Supt. Agri and Horticultural Society's Garden.

SIR,

I have the honor to inform you in answer to your communication, dated 26th February, accompanied by specimens of the Pauchontee, gum tree requesting the botanical name of the same. After some labour in dissecting one of the flowers, a rough sketch of which is forwarded, I find that the name is Isonandra Polyandra, though differing in some respects from the figure in Dr. Wight's Illustrations, Vol. 4th, Fig. 1589. In the plant forwarded by you, the lobes of the corolla are 6 in number. The ovary 6 celled, stamens 18. I append a simple description of the plant which may be useful to those interested.

(Signed) A. T. JAFFREY,

Superintendent.

AGRI AND HORTICULTURAL SOCIETY'S GARDEN, 9th September 1856.

ISONANDRA POLYANDRA.—Wight's Illustrations, Vol. 4th, Fig. 1589. Leaves oblong, ovate, pointed, tapering to the base; upper surface bright green, under light green, tinged with pale brown; alternate, somewhat tufted, without stipules, entire, flowers small on short stalks pendulous, axillary, in tufts of from 3 to 4 flowers Corolla Monopetalous, deciduous, its segments equal in number to those of the Calyx

imbricate. Calyx of six segments ovate, obtuse, imbricate in ostivation, persistent, stamens inserted on the Corolla, in number 18, all fertile, stigma one persistent fruit erect pointed. Containing one nut like seed, ovary 6 celled often only one or two seeded by abortion. The outward appearance of the bark is a dull green, though the real color is dull brown, the green arises from a lichen which in a great measure covers the whole tree, there being no less than 4 or 5 distinct lichens and one moss on the specimen before me. The bark when cut is dark brown. The wood is hard of a light brown color (not unlike Mimosa), works well in the carpenters' hands but hardly fit for any thing but house building purposes, posts, &c. There can scarcely be much difficulty in distinguishing this tree from any of the other Isonandrias. The pendulous stalked flowers and erect fruit are a sufficient guide. The flowers of the other species being sessile.

(Signed) A. T. JAFFREY.

Extracts from the correspondence in the Government Central Museum, Madras, on the subject of a product of the Isonandra Polyandra, possessing some of the properties of the Gutta Percha of Commerce.

1856, 29th January. TRICHIOOR.—The Pauchontee tree seems to be partially in flower again, but in places too far off for me to secure good specimens * * * * *; I beg to send you a few of the seed vessels. They a good deal resemble those of the Isonandra Candolliana of Wight's Icones: but they are smooth, not hispid externally, though straited on one side and do not appear to be 5 celled. The inflorescence, however, of Isonandra Candolliana congestive and sessile does not at all correspond with my drawing (if it be a correct one), my drawing answers better to Wight's Isonandra Polyandra * * * *. The tree has not been recognised in these (Trichoor?) forests.—(From Lieutenant General W. CULLEN.)

1856, 5th February. COCHIN.—* * My explorers on the table land of the cardamom hills have just represented to me the discovery of the (Pauchontee) tree there also, at an altitude of 3,000 feet. They saw two trees 80 to 90 feet high by 3 or 4 feet diameter, and the tree was said to be common, though its properties as a gum were not known. The tree was there called (Thempallay?) Shempallay.—(From Lieutenant General CULLEN.)

1856, 8th February. OOTACAMUND.—Mr. Lascelles * thinks that the gum is had from more than one species. I believe this to be the case,

but will be able to speak with certainty on this point when I return. Mr. Lobb, who was several years a Botanical Collector in Malacca, informed me that the real Gutta Percha is produced by one species only, but that two gums somewhat similar but much inferior, are procured from other species to mix with the true article. I also got 24 Gutta Percha plants from Malacca for these (Ootacamund) Gardens, and they are all one species, so I am led to suppose that only one species in the Straits yields the true article, from Mr. McIvor, Ootacamund. Mr. McIvor in another letter (letter dated 21st November 1855) remarks that the Isonandra Gutta or Gutta Percha from the Straits of Malacca is likely to succeed well in many parts of Malabar. It is of rapid growth and easily cultivated. Two species of this gum (Isonandra) occur on the Coondalr Ghauts, but neither of them yield Gutta Percha. The substance discovered by A. Lascellas, Esq., in the Nelamboore jungle is not Gutta Percha but a gum which may prove of some value.

1856, 9th February. ALURE, 12 miles up the river East of Cochin.—I hope to be back to Trivandrum by the 25th, and I shall take an early opportunity of going to the forests to examine the tree. I have parties now up the ———? river some 20 or 30 miles farther east to search for the flowers of the tree which I have ascertained to grow there, and I furnished Mr. Clarke, the Calicut Collector, who was recently at Cochin, with some of the gums and some young plants to take back with him, as a guide to his own enquiries. I have not yet heard of it in the Cochin forests. You say one of my late notes first shewed you the discovery was mine. As far as I can judge from the newspapers, I seem to be the first who has brought a really useful gum to notice and at the same time furnished a drawing with dried specimens of the flowers and leaves and fruit; imperfect certainly, but I have not noticed as much done by others, and every body writes to me for descriptions. I recollect some notice in the papers about the time of the Exhibition, of some discoveries in Wynaad of the Isonandra, but not I think of the flower or gum.—(From Lieutenant General CULLEN.)

1856, 15th February. COCHIN.—* I have despatched to you today by banghy, a small box with some tolerable specimens of the leaf, flowers and fruit of the Pauchontee. Still not sufficient, I feel, for a Botanist; but having just procured them from the forest I sent them. I will try to get better hereafter. One packet is from the Travancore forests east of this; the other from the Cochin forests some miles farther north. The tree in Cochin is called Pauly. We have now established

a tolerably extended habitat. Except in seed vessel, it answers very well to the Isonandra Lanceolata, but the seed is like the Bassia. I thought the stamen 6, but Dr. Waring dissected and thought he had made out 16. Had you not better send the specimens to Dr. Cleghorn† * *.—(From General CULLEN.)

1856, 19th February. CUNDAPOOR IN CANARA.—* I have just ascertained from Dr. Gibson, Conservator of Forests, Bombay, that the Pauchontee gum tree is known in Canara as Halimurra (*Chrysophyllum acuminatum*) and is common throughout the district. I shall lose no time in taking measures for the preservation of such of these trees as are in Government jungles, and will procure and forward a sample of the gum in the course of a few days.—(From W. FISHER, Esq.)

1856, 19th February. CALICUT.—* * I have the honor to forward for your information copies of two letters from Mr. Brook, a merchant at Cochin and a gentleman competent to give an opinion—from T. CLARKE, Esq., 1856, 1st February. COCHIN.—* "I do not think the gum in question is Gutta Percha as it is deficient in toughness and when melted in hotwater is extremely viscid. Gutta Percha on the contrary is similar to India Rubber in its freedom from stickness. The leaves are not like those of the Gutta Percha which is very similar to the India Rubber plant in both form and size.

A sample of a substance similar to that you were kind enough to send me, was exhibited in London about four years ago, but though attracting some attention from its novelty did not appear of any commercial value.—(H. BROOK, Esq., to Mr. CLARKE.)

26th February 1856. TRIVANDRUM.—* * The Pauchontee tree * * is now found to prevail in the forests along the foot of the Ghauts from the latitude 8° 30' North to 10° 30' N. in the Cochin Sircar territories. I sent you from Cochin some of the flowers and seed of the tree in that latitude, though badly dried or prepared, but I yesterday dispatched to you from this place some specimens of the flower, leaf and seed procured from our forests N. E. of Trivandrum. * * * I have also sent some specimens to Dr. Cleghorn. I have also sent therewith the specimens of the flower, seed and leaf of the tree furnishing the handsome redwood, like Mahogany, that I sent to the Madras Exhibition.

I sent you, some days ago, specimens of the milk of the Pauchontee

† This was done.—(Signed) E. B.

from the Cochin forests and from those of Travancore in about the same latitude, and to-day I have despatched to you fresh specimens of the milk from the Cochin forests. I have already told you that the tree of Cochin is called "Pauly."

The Pauly tree of Cochin, like the Pauchontee in Travancore is said to grow to a height of 70 or 80 feet, with a diameter of 2 to 3 feet. The timber of no value but said to be quick of growth. I must now make enquiries as to the best mode of collecting the milk without destruction of the forests. I will send you another chatty of the gum.—(From General CULLEN.)

1856, 10th January. MUNDOKYUM, ALEPPIC.—* * I saw your pamphlet about the Gutta Percha: my hill people have long used the bark in lieu of Arcca nut and call the tree Chemään. The juice flows only I think from the tick bark—and the trees are to be found scattered all through the Travancore or primitive forests of this country. The name in the Resident's letter you could not decipher is "Malliatoor," about 40 miles east of Cochin. I do not think that the present price would repay the collection, but however as that is out of my line, I may be wrong * *.—(From Revd. HENRY BAKER, Junior.)

(Signed) EDWARD BALFOUR,

MUSEUM, 8th March 1856.

Officer in Charge.

The Chemään mentioned above, Mr. Lascelles informs me, is not an Isonandra. The latest information from General Cullen, regarding the Pauchontee or Isonandra Polyandra, is connected with its qualities as a timber tree. He says that in gravity it is not less than lbs. 55 the cubic foot, and that a bar of one inch square, with 18 inches clear of the supports, at each end, broke with a long fibrous fracture, after a weight of 440 lbs. had been imposed, but only after this weight had been suspended for some minutes from the bar: a tenacity equal to that of teak.

General Cullen likewise ascertained the Pauchontee tree when tapped (two taps at every three feet, from the base to 60 feet high, or 40 taps in all) yielded in twelve hours about eight pints or pounds of the sap.

In a conversation with Mr. A. R. W. Lascelles, and from what has appeared in the public papers from him, I learn that he considers the number of species of the Isonandra in the Wynaad forests to be not less than five or six, the native names of which he gives as (1) the black Pali

tree, which he says has a single jet black seed; (2) the Pali kai with an edible fruit, used by the natives; (3) the Chinna pali marm, which last attains a height of 60 feet, and has, he mentioned, a high resemblance to the true Isonandra Gutta, though not so common as the Isonandra acuminata. These are all different from the Pauchontee or Shempullay which likewise grows in the ghauts. Mr. Lascelles mentions that he made his first discovery of these trees towards the end of 1854, and in January 1855 he sent to England samples of the produce per ship *Owen Glendower*. The tree, the produce of which was sent Home, was named by Dr. Lindley as the Isonandra acuminata. This species is common from 150 to 200 feet high and grows straight with clean timber, of the best description. Mr. Lascelles informed me that from 20hs. to 40hs. of sap is procurable from one tree. Mr. Lascelles has obligingly placed the following letter at my disposal, and informs me that he has now sent another and larger consignment Home. The letter, it will be observed, gives a report on the properties of the Isonandra acuminata;

COLLEGE ROAD, Highbury Park, June 18th, 1856.

MESSRS. WILLIAM AND HENRY THOMPSON,

GENTLEMEN,—We have carefully examined the vegetable substance from Madras, the properties of which you desired us to ascertain, and beg to submit to you the following remarks; the results of our observation.

This substance is heavier than water; its floating in that fluid being due to air enclosed in the cavities to be seen in the mass.

It is brittle at ordinary temperature, becoming more so (almost fragile) at low temperatures. It softens by the heat of the hands or mouth and may be moulded between the fingers. By the application of heat it readily melts, emits a somewhat agreeable perfume, and froths up, giving off watery vapour; by the loss of this water, it deepens in colour, may be drawn out into long threads, and is greatly increased in its adhesive properties. In this state it is the most "sticky" substance with which we are acquainted, and retains the stickiness (in the absence of water) for several days probably for a long period of time.

The stickiness is destroyed (gradually) by contact with water with which liquid this substance enters into combination and is thereby hardened.

It is insoluble in water, in solution of caustic, soda and in wood-naphtha; rectified spirits exerts a very slight action upon it.

It breaks down and readily forms a paste with coal tar-naphtha and oil of turpentine.

If heated with sulphur at various temperatures, simple mechanical admixture takes place but apparently no combination. It is the same, if lime be used in lieu of sulphur.

If melted in contact with water it becomes a whitish brown viscid colour, whilst hot, which is "sticky" after cooling, remaining so for many days, but gradually hardening till it resumes its former condition.

From the above properties it is evident that this substance belongs to the class of vegetable products of which Caoutchouc and Gutta Percha are types and that it greatly resembles "bird-lime" in its leading characteristics, but in a higher degree. It is evident that for water-proofing purposes, it is (in its crude state) unfit, for although the coal tar, oil or turpentine paste might be applied to fabrics, as similar solutions of Caoutchouc now are, and a material obtained impervious, for a time, to wet, yet that owing to the capacity of this substance to combine with water and become brittle in consequence at ordinary temperatures, such a water-proofed fabric would become useless very quickly. We do not of course in any way imply that in the hands of some inventors this and other difficulties to its useful application may be overcome. Although unfit for water-proof clothing, moveable tarpauling and its like, yet it might be usefully employed to water-proof fixed sheds, or temporary erections of little cost covered with calico or cheap canvas; but there are already a numerous class of cheap varnishes equally adapted for such a purpose; so that as a water-proofing material it is but advisable for the present to look upon it as useless.

Its perfume when heated might possibly render it of some value to the pastille and incense makers.

Its bird-lime sticky quality might be made available by the game keeper and poacher in this country for taking vermin and small birds: we almost doubt whether a rabbit, hare or pheasant could free itself if hair feathers or feet came in contact with it. We think it might be usefully and more legitimately employed by the trapper, for taking the small fur-bearing animals; turpentine would cleanse the soiled furs. The extensive and practical use, however, in this country to which we at present think it may probably be advantageously applied is as a subaqueous

cement or glue. We beg to forward you some dealwood glued together with this substance melted and applied hot, which we have now kept under water for several days, and two fragments of glass which have been similarly treated. You will observe that the cement has hardened at the edges, but probably without injury to its cementing properties. We have no reason to think that it would rot under water more rapidly than wood does, but experience must be the sole guide here. We have reason to think such a glue or cement would be readily tried and if found good, employed by joiners and others, having been applied some time since, to examine a glue which after application resisted the action of water.

Should any other use for this substance suggest itself to us, we shall have much pleasure in submitting it to your notice.

We remain,

Gentlemen,

Your's respectfully,

(Signed) E. F. TESCHEMACHER,
J. DENHAM SMITH.

Mr. Lascelles mentions that in Wynaad and Coorg "thousands of the trees were annually destroyed in the course of cultivation," and is of opinion that unless Gutta Percha rises very considerably in value, Malabar alone will supply the world for the next quarter century.*

Another interesting discovery has been that of a hot spring in the bed of the upper Godavery, and the following report on its water has been made by the Chemical examiner;

Report on the water taken from a hot spring in the bed of the upper Godavery nearly opposite Riagoodium.

This is sulphuretted water, containing in addition to this foetid gas, with which it is saturated, a copious sediment consisting of sulphuret of iron, silicate of alumina, and organic matter. When first poured out it was nearly clear, but on shaking the bottle and pouring its contents into a glass vessel, it had an inky appearance. The specific gravity of the water was 1.002, one thousand grains of it contained 2.7 grain

* What I formerly printed is appended.

of fixed residue: analysis shewed the presence of the following bases and acids ;

Bases.

Alumina.

Iron.

Lime.

Soda.

Potash (presence inferred.)

*Acids.*Sulphuretted hydrogen, free and
combined with iron.

Silica.

Sulphuric acid.

Chlorine, or Hydrochloric acid.

The results of analysis shew that the water is not fit to be employed internally, the silicates of alumina, the organic matters, &c., present, being opposed to such an idea. The water is so far interesting as it points to the more abundant constituents of the stratum where it arises, and also to chemical actions beneath the surface of the earth still in continuance the temperature as issuing from its bed of sand is stated to be 23° above the surrounding bodies ; probably the use to which the spring is occasionally put by the Natives, is the only one for which it is suitable

(Signed) J. MAYER,
Professor of Chemistry

LOCAL MUSEUMS.—Some of these institutions, those of Cuddalore, Mangalore, Ootacamund and Rajahmundry seem to have made progress ; that of Bellary has only made arrangements for beginning and the Coimbatore one has wholly failed. The Rajahmundry Museum seems to take precedence of all the others, though the progress in the Cuddalore and Mangalore Museums is great and the Ootacamund Institution will probably ere long surpass the whole. I would suggest to Government to remove from the Coimbatore District the sanction accorded in Extract Minutes Consultation, dated 27th April, No. 543 of 1855, and allow from the same date, the same sum of rupees fifty for establishing a Museum at Madura.

REMARKS ON THE GUTTA PERCHA OF SOUTHERN INDIA, NOTICING ALSO
THE HISTORY AND MANUFACTURE OF THE GUTTA PERCHA
OF COMMERCE.

Many of the readers of this will remember that the announcement of the discovery, in the forests on the Western Coast of the Gutta Percha tree, was first made to the public in the columns of the *Athenæum* when publishing the Report of the Jury on the articles in Class IV sent to the Madras Exhibitions. The Jury's remarks regarding it were as follows:—

GUM ELASTICS.—“ From different parts of the Presidency, valuable specimens have been received possessing the useful properties of Caoutchouc and Gutta Percha, in more or less degree. The exhibition of the inspissated gum elastic juice of a number of trees, from different localities, and prepared in different manner, renders it probable that there are a number of similar vegetable productions, which may be advantageously introduced into commerce.

General Cullen has forwarded a drawing and description of a large forest tree, abounding at the foot of the ghauts, N. E. of Trevandrum. The plant delineated is evidently one of the Sapotaceæ, and the Malayalam name is “*pauchonthee*” and the product, of which a good sample is forwarded, on examination bears a strong resemblance to gutta percha, both in external appearance and mechanical properties. It appears to the Jury, that this gum elastic is possessed of valuable properties, and they beg to recommend that a 2d class Medal be awarded.”

I have now an opportunity of furnishing, from the records of the Museum, copy of a letter I have received from General Cullen, dated 2d instant, to the following effect :

“ You have seen I believe, the milky juice and substitute for Gutta Percha: you will probably, also, have seen the drawings of the flower and leaf that I sent to Dr. Cleghorn.

“ I have now ascertained the tree to be rather common, some 1,500 or 2,000 trees, near the base of the mountains north east of this. These have been found also, by Mr. Kohloff, our Conservator of Forests, the forest is —? upon Cochin.

“ I send some pieces of the gum, prepared by him : could you

oblige me with some of the processes for its preparation, in a fit state for the market, and of its market price in the Straits."

The product which General Cullen has sent to the Museum, resembles the best of the crude gum imported from the Straits. Its outer surface is brownish red, and mottled, but this deep tinge may probably have been given to it by the plantain leaf which it was wrapped in, for a fresh fracture has a cream yellow colour, slightly tinged with red. The fracture is smooth but conchoidal, and it is plastic under the heat of the hand. It has been ascertained by myself and Mr. G. Norton, to be a perfect non-conductor and possessing this quality, could be applied to all the uses for which the Malayan Gutta Percha is adapted, for isolating the wires of the Electric Telegraph, &c.

The latest advices shew that, for the crude material, as imported, the London price ranges from 10d. to 1s. per lb. At Singapore by the latest reports, Gutta Percha, was in less request. Sales of good at Sp. D. 20 and inferior Sp. D. 12* to 15 per picul. Imports from April 15th to the 10th instant, 1395 pils; the exports, 547 pils; at this rate the gum was worth from 4½d. to 8d. per lb. at Singapore.

With two thousand trees discovered in one district, it may be assumed that they will be found growing along the whole line of the Western Ghats and I will be happy to find the following extracts of use to those who may direct their attention to the collection of this material.

GUTTA PERCHA.

According to Dr. Montgomerie, this word is a pure Malayan one, *gutta* meaning the gum or concrete juice of a plant, and *percha* the particular tree from which this is procured. The *ch* is not pronounced hard, like a *k*, but like the *ch* in the English word *perch*.

It is the concrete juice of a forest tree, a native of the shores of the Straits of Malacca, Borneo, and the neighbouring countries. The natives had themselves discovered its valuable properties before they became known to Europeans. They constructed whips, buckets, and vessels of various kinds out of the hardened juice, and thus excited the attention of travellers to a substance which has since been applied to a vast variety

* The picul = 133½ lb. The dollar = 4s. 0d.

of domestic and scientific purposes in this country. Their method of proceeding, however, has been of the most destructive kind, especially since the demand of a European market for this substance has had to be met. Instead of economising their treasure, as is done in the case of the caoutchouc, by tapping the tree and allowing its juice to ooze gradually from the incision, they fell the trees at once, and removing strips of bark at intervals, collect indeed a large quantity of sap at one time, but destroy all future supplies from that source. This wholesale destruction of the gutta trees, which are naturally slow of growth, must, if unchecked, necessarily involve the destruction of the traffic which is now so brisk and advantageous in this article. To put any check upon these proceedings is said, moreover, to be extremely difficult; because each set of explorers, in searching after these trees, is more anxious for present profit, than for future benefit, to the trade. A very small quantity, comparatively speaking, is to be obtained by tapping, and it is evidently to the interest of the first comers to get a full supply of sap for themselves, without considering those who come after, and who might very probably cut down the trees if they had been spared previously.

The first accounts which reached us of these trees were given by Dr. Montgomerie, of Bengal, who appears to have been the first person to notice the native use of this substance: this was in 1842. In 1843, Dr. D'Almeida presented a specimen of their inspissated juice to the Royal Society of Arts, and described some of the advantages which would accrue from its use. This communication led to no results; but another, made shortly after by Dr. Montgomerie, was more successful, so that by the united efforts of these gentlemen gutta percha was introduced to public notice, and soon told its own tale to our manufacturers. They could not be blind to the advantages offered by a material possessing many of the properties of caoutchouc, with others in addition essentially its own. The abundance of the supply also encouraged invention, and in a very short time gutta percha was applied to multifarious uses, and became a valuable auxiliary in the arts.

The tree which produces this substance is from sixty to seventy feet high, and three or four feet in diameter. Its foliage is of a pale green on the upper side, and covered with reddish-brown hairs beneath. Specimens of the flowers and fruit are exceedingly difficult to be obtained. The tree flourishes luxuriantly in alluvial tracts, at the foot of hills, and forms in many places the principal part of the jungle in such situations.

From communications of Sir W. J. Hooker to the London Journal of Botany, it appears that numerous well-dried specimens of the gutta percha, though unfortunately without corollas, were sent to this country, by Mr. Lobb, during his botanical mission in the east, accompanied by sections of the wood, which is peculiarly soft, fibrous and spongy, pale-coloured, and traversed by longitudinal receptacles or reservoirs, filled with the gum, forming ebony black lines. Application was then made to Dr. Oxley, of Singapore, for flowering specimens, and these were immediately supplied by him in the most obliging manner, and transmitted to England in a thin box, the top and bottom of which were made of sheets of the gum itself (now deposited in the Museum of the Royal Gardens at Kew). From the more accurate knowledge obtained by means of these specimens, Sir W. J. Hooker was able to refer the plant to Dr. Wright's new genus of Sapotaceæ, called *Isonandra*, and to name the plant *Isonandra gutta*. Fig. 1116 represents a branch of the *I. gutta*, and various portions of the blossom as,—1, the flower scarcely expanded; 2, ditto, with the corolla expanded; 3, the pistil; 4, transverse section of the ovary; 5, vertical section of ditto; 6, the anther; 7, the scarcely matured fruit, natural size; 8, transverse section of the same.

After the natives have cut down the full-grown trees, they make rings in the bark at the distance of every ten or twelve inches, placing under each, as they make it, a cocoa-nut shell, or the spathe of a palm, as a receptacle for the milky sap which begins to flow immediately that the incision is made. The sap is collected in bamboos, taken to their houses, and boiled in order to drive off the watery particles, and inspissate it to the proper consistence. Boiling appears necessary when the juice is collected in large quantity, but when a small quantity is allowed to exude from a freshly-wounded tree, and is collected and moulded by the hand, it consolidates perfectly in a few minutes, and has all the appearance of the prepared article.

Gutta Percha when quite pure is greyish white, but it is generally brought to market of a reddish-brown hue. This is ascribed to chips of the bark, which fall into the sap and give it their colour, but in addition to this there are frequently other matters, such as saw-dust, purposely introduced as adulterants. Dr. Oxley, of Singapore, in an interesting description of this substance, first printed in a Singapore periodical in the year 1847, states that the tree which yields gutta percha was formerly very abundant on that island, but already all the large timber has been felled, and few but very small plants are to be found. "The range of its

growth," he says, "appears to be considerable, it being found all up the Malayan peninsula, as far as Penang, where I have ascertained it to be abundant, although as yet the inhabitants do not seem to be aware of the fact, several of the mercantile houses there having sent down orders to Singapore for supplies of the article, when they have the means of supply close at hand. The tree is also found in Borneo, and I have little doubt is to be found in most of the islands adjacent." Respecting the wholesale destruction of the trees, the same writer observes,—"The quantity of gutta obtained from each tree varies from five to twenty catties, so that, taking the average at ten catties, which is a tolerably liberal one, it will require the destruction of ten trees to produce one picul. Now the quantity exported from Singapore to Great Britain and the Continent, from 1st January 1845 to July 1847, amounts to 6,918 piculs, to obtain which 69,180 trees must have been sacrificed. How much better would it, therefore, be to adopt the method of tapping the tree, practised by the Burmese in obtaining the caoutchouc from the *Ficus elastica*, (viz., to make incisions in the bark, placing bamboos to receive the sap, which runs out freely) than to kill the goose in the manner they are at present doing. True, they would not at first get so much from a single tree, but the ultimate gain would be incalculable, particularly as the tree seems to be one of slow growth, by no means so rapid as the *Ficus elastica*. I should not be surprised if the demand increases, and the present method of extermination be persisted in, to find a sudden cessation of the supply."

The great peculiarity which makes Gutta Percha convenient and valuable for a variety of purposes is, that when plunged into boiling water it becomes so soft and plastic as to be easily moulded into any desired form and this form it permanently retains on cooling. It was the discovery of this fact which first led the Malays to fabricate it into whips, and subsequently into basins, jugs, shoes, traces, &c. The Medical profession soon became aware of its extreme value and applicability in the practice of surgery. Dr. Oxley early discovered it to be "the best and easiest application ever yet discovered in the management of fractures, combining ease and comfort to the patient, and very much lessening the trouble of the Surgeon." He also employed it for bougies, capsules, tubes and syringes, &c."

Gutta Percha tubing has been found extremely useful for water service, and for the conveyance of sound. Its extraordinary strength for the former use in a remarkable degree. A series of interesting experiments were made two or three years ago at the Birmingham wa-

works, to ascertain the strength of tubes of $\frac{3}{4}$ inch diameter, and $\frac{1}{8}$ inch thickness. These were attached to the iron main, and subjected for two months to a pressure of two hundred feet head of water without being in any way deteriorated. In order to ascertain the maximum strength of the tubes, they were connected with the Company's hydraulic proofing pump, the regular load of which is 250 lbs. on the square inch. At this point they are unaffected, and the pump was worked up to 337 lbs., but to the astonishment of every one the tubes still remained perfect. It was then proposed to work the pump up to 500, but it was found that the lever of the valve would bear no more weight. The utmost power of the hydraulic pump, therefore, was ineffectual to burst these tubes.

In the conduction of sound gutta percha is also found remarkably useful. Speaking tubes of this substance for the conveyance of messages are now fitted up in mines, railway stations, prisons, workhouses, hotels, and other large establishments. Partially deaf persons are found to appreciate its value: an ingenious apparatus for their use has been devised, including the distribution of the gutta percha tubing over a church or other large building, so that, by seating themselves at particular parts where these tubes terminate, such persons are able to hear distinctly the sermons or speeches delivered therein.

Gutta percha is also brought to the aid of the architect in the ornamental work of the interior of houses. It appears to be admirably adapted for cornices and centres for ceilings, also for picture-frames, and many other uses to which plaster and papier machie have hitherto been applied. It has likewise been employed for door handles and plates, for knife handles, vases, baskets, &c., for the stopping of decayed teeth and for printing in relief. The clear, sharp impression it receives, and the toughness of the substance, have made it very useful in books for the blind, and in maps embossed for their benefit. In solution this substance is employed in waterproof clothing; mixed with caoutchouc and other substances it is made into a light, porous, spongy material, suited for stuffing or forming the seats of chairs, cushions, and mattresses. Springs of clocks, clasps, belts, garters and string, are prepared from the modification of the above mixture, while moulds and balls of gutta percha are produced of a hardness sufficient to bear turning in the lathe, like wood or ivory. A varnish may also be made in which gutta percha, being the principal ingredient, may be used to give a waterproof covering to other substances.

Gutta percha dissolves at ordinary temperatures, and still better at a higher heat in sulphuret of carbon. The solution leaves behind on a glass plate a thin coating possessing all the properties of gutta percha, unaltered. Pasteboard boxes coated over with this may be made to hold water.

Electrical experiments are aided by the use of gutta percha, for it has been found by Dr. Faraday to possess high insulating power. A letter from this distinguished philosopher, published in the "Philosophical Magazine," in March 1848, gives the following among other particulars:—"A good piece of gutta percha will insulate as well as an equal piece of shell-lac whether it be in a form of a sheet, a rod, or filament; but being tough and flexible when cold, as well as soft when hot, it will serve better than shell-lac, in many cases where the brittleness of the latter is an inconvenience. Thus it makes very good handles for carriers of electricity in experiments on induction, not being liable to fracture; in the form of thin band or string, it makes an excellent insulating suspender; a piece of it in sheet makes a most convenient insulating basis for anything placed on it. It forms excellent insulating plugs for the stems of gold-leaf electrometers, when they pass through sheltering tubes, and larger plugs supply good insulating feet for extemporary electrical arrangements: cylinders of it, half an inch or more in diameter, have great stiffness, and form excellent insulating pillars. Because of its good insulation, it is also an excellent substance for the excitement of negative electricity. It is hardly possible to take one of the soles sold by the shoemakers out of paper, or into the hand, without exciting it to such a degree as to open the leaves of an electrometer one or more inches; or if it be unelectrified, the slightest passage over the hand or face, the clothes, or almost any other substance, gives it an electric state. Some of the gutta percha is sold in very thin sheets, resembling, in appearance, oiled silk; and if a strip of this be drawn through the fingers, it is so electric as to adhere to the hand or attract pieces of paper. The appearance is such as to suggest the making of a thicker sheet of the substance into a plate-electrical machine for the production of negative electricity. Then as to inductive action through the substance, a sheet of it is soon converted into an excellent electrophorus; or it may be coated, and used in place of a Leyden jar, or in any of the many other forms of apparatus dependent on inductive action."

The properties thus noticed could hardly fail to bring this substance into use in telegraphic communication. Being flexible, impervious to water, and possessing insulating power, it is the most efficient of all substances as a coating or tubing for the copper wire of submarine telegraphs. Thus it aids in producing the most marvellous annihilation of time and space our age has yet witnessed. Gutta percha has been analysed by Dr. MacLagan, who obtained as its per centage composition, carbon 86.36; hydrogen 12.15; the remainder 1.49, was most probably oxygen absorbed from the air during the process of purifying it, as the substance whilst heating on the vapour bath acquired a brown colour.

Respecting the purification of gutta percha, Dr. Oxley gives a good hint to manufacturers when he says that gutta ought not to require an elaborate process: the simple boiling in water, and rolling out into sheets, whence all foreign matter can be easily picked off, is the only process he employs, and this he thinks would be generally sufficient, if manufacturers in giving their orders would take the precaution of requiring that the article should be strained through a cloth at the time of its collection, and if they would encourage the natives to do this, by offering a somewhat higher price for gutta percha so prepared. A vast deal of trouble and expense might, in his opinion, be saved in this way, and the various processes rendered unnecessary, which have from time to time been suggested for the purification of gutta percha.

The preparation of this substance for use is carried on on a large scale in the following manner;—the lumps of gutta as they are received at the factory are first brought within the action of a vertical wheel, on the face of which are fixed three knives, which, as the wheel moves at the rate of two hundred revolutions, per minute, rapidly cut the lumps into thin slices, discovering whatever adulterating materials may be contained therein. The gutta thus torn up is not uniform in colour or texture, but it is rendered so by the subsequent operations. It is first softened by soaking in hotwater (by which also the dirt and other impurities become separated from it) and then thrown into a rotating machine, where it is dragged asunder by jagged teeth and reduced to fragments. These fragments fall into water, which still further tends to purify them, and are then softened into a paste in hotwater, kneaded, and rolled between heated cylinders so that all parts may become thoroughly mixed and uniform. It may be then rolled out into sheets between steel rollers, or passed in the mass through heated iron cylinders, and made into tubes, or converted to the thousand purposes of ornament or use which

we have briefly indicated. In the Great Exhibition gutta percha was seen in a vast variety of forms, but none were more interesting than those which illustrated the successive stages of its manufacture. The original lump, the slices, the shreds, the kneaded mass, the sheets ready for use; all appeared there. A very ingenious adaptation of the substance to making stereotype plates attracted much notice. A mould is taken by pressure of a page of type with woodcuts, in gutta percha; from this mould a cast is obtained on a cylinder of gutta percha, and from this last the printing is carried on. An hour, it is said, suffices to make both mould and cylinder.

EDWARD BALFOUR,

In charge of the Museum.

GOVERNMENT CENTRAL MUSEUM, }
MADRAS, 25th November 1855. }

REPORT ON BELLARY MUSEUM.

From the REVEREND J. MORANT,

*Honj. Secretary of the Govt. Committee
of the Bellary Museum.*

To SURGEON EDWARD BALFOUR, Esq.,

Officer in charge of the Govt. Central Museum.

SIR,

I have the honor, in compliance with your request, to forward to you the Report of the Committee of the Bellary Museum, for 1855 and as far as June 1856.

I have the honor to be, &c.,

BELLARY, 24th June 1856. (Signed) JAMES MORANT.

REPORT.

The Committee of the Bellary Museum much regret that, at present, there is so little of interest on which to draw up a Report.

Owing to the ill health of the late President of the Sub-Committee (who has left the station) and the difficulty of procuring a suitable building, the Committee have not, as yet, formed a collection of objects.

The Institution at Bellary is now thus composed :

C. Pelly, Esq., is President of the General Committee. The Rev. James Morant, President of the Sub-Committee and Honorary Secretary of the General Committee, and Captain Greenlaw, Honorary Secretary and Treasurer of the Sub-Committee.

The south-west angle of one of the wings of the old European Barracks in the Fort is being repaired and put in order, the sanction for its use having been obtained from the General Commanding the Division. An indent has been sent in for cases and furniture, and the sanction has been obtained for the application of the Government allowance from February 1855 : so that the Sub-Committee are prepared to use their best energies towards the collection of objects of interest, and the formation of a Museum. The Committee confidently hope, in their next Report, to be able to state, for the satisfaction of the Museum Committee at Madras and the Government, that a good Museum has been established.

(By order.)

(Signed) JAMES MORANT,

*Honj. Secy. of the General Committee
of the Museum at Bellary.*

COIMBATORE, COLLECTOR'S OFFICE,
CAMP MATOOPOLLIEM, 25th January 1856.

No. 41.

From G. L. MORRIS, Esq.,

Acting Sub Collector, in charge Coimbatore.

To SURGEON EDWARD BALFOUR,

In charge of the Government Central Museum.

SIR,

In reply to your letter, No. 542, of the 20th December 1855, I have the honor to inform you that little could be done towards the formation of a Museum here, till a fit place has been secured for it : no building of any kind has as yet been found available, but the Collector is still in treaty for the Gin House, and progress will be made with as little delay as possible.

I have the honor to be,

Sir,

Your most obedient Servant,

(Signed) G. L. MORRIS,

Acting Sub Collector in charge.

COIMBATORE, 21st March 1856.

No. 127.

From E. B. THOMAS, Esq., T. B. ROUPELL, Esq., AND
GEORGE MACKAY, Esq.

To SURGEON EDWARD BALFOUR,

Secretary to the Central Museum, Madras.

SIR,

In reply to your letter asking for a report of the Local Museum at Coimbatore, we have the honor to inform you, that the want of a suitable building has delayed the commencement of the Museum. Government sanctioned the purchase of the Cotton Gin House here, but it is still doubtful whether it can be safely bought. Under these circumstances, we are inclined to think that it will be better to give all encouragement and assistance to the formation of the Museum at Ootacamund, instead of dividing our efforts and means in the hopes of establishing one at Coimbatore also : should the building referred to, be eventually

REPORT ON COIMBATORE MUSEUM.

procured, it will be required for other public purposes, though a portion of it might be reserved, for a *branch* Museum, when the one on the Hills (also in the District) is fully established. Contributions have already been sent from hence to Ootacamund, and we fear that a second collection would not progress very rapidly at present. In fact it is our opinion, on fuller enquiry, that it is scarcely practicable to obtain contributions for keeping up the two Museums, within 50 miles of each other; the one on the Hills, with Mr. Ross and many other gentlemen at *leisure* to attend to it, gets on but slowly; and at present the two would necessarily and naturally interfere with each other.

We have the honor to be, &c.,

(Signed) E. B. THOMAS,
 „ T. B. ROUPELL,
 „ GEORGE MACKAY, M. D.

COIMBATORE, 30th June 1856.

No. 323.

From E. B. THOMAS, Esq., T. B. ROUPELL, Esq., AND
 G. MACKAY, Esq.,

To SURGEON EDWARD BALFOUR,
Officer in charge of the Government Central Museum.

SIR,

In reply to your letter of the 6th ultimo, No. 317, calling for our Report on the Coimbatore Museum, we beg to refer you to our letter of the 21st March last, No. 129, in which we reported that the want of a suitable building at first delayed the commencement of the Museum, and that we are now led to believe that it will be better to give all encouragement and assistance to the Museum at Ootacamund, instead of dividing our efforts and means, in the hopes of establishing one here, also, at present.

We have the honor to be, &c.,

(Signed) E. B. THOMAS,
 „ T. B. ROUPELL,
 „ G. MACKAY.

From the SECRETARY TO THE GOVERNMENT MUSEUM
 AT CUDDALORE.

To EDWARD BALFOUR, Esq., SURGEON, MADRAS ARMY,
Officer in charge of the Government Central Museum.

SIR,

As you have called for a Report on the progress of the Government Museum established at this place for the half year ending 31st December last, I am instructed by the Committee to express their regret that as yet there is nothing to report except that the collection of specimens is proceeding gradually although slowly.

2. It was not thought hitherto advisable formally to announce the Museum as open to the public, as the paucity of good or interesting specimens might have created an unfavorable impression at first, but it is proposed now that the collection increases more rapidly, to throw it open to the public in a day or two, and the names of all visitors will be registered from the 1st proximo.

3. The Committee expect that the Public Exhibition of agricultural and other produce of this District which will be held here on the 20th proximo, will give them a favorable opportunity of purchasing many articles that may be worthy a place in the Museum.

4. The number of specimens already collected is as follows :

Vegetable products, grains, oils, gums, &c.....	62	specimens
Illustrations of Natural History.....	126	do.
Illustrations of Arts and Manufacture.....	17	do.
Stones and ores.....	110	do.

Total...315

This last includes a well arranged series of characteristic rocks for which the Committee are indebted to Dr. Burrell.

I have the honor to be,

Sir,

Your most obedient servant,

JOHN ARMOUR,

Secretary to the Government Museum, Cuddalore.

GOVERNMENT MUSEUM, CUDDALORE, 12th January 1856.

CUDDALORE, 30th June 1856.

From the SECRETARY TO THE COMMITTEE OF THE
GOVERNMENT MUSEUM AT CUDDALORE.

To EDWARD BALFOUR, ESQ., SURGEON, MADRAS ARMY,
Officer in charge of the Government Central Museum, Madras.

SIR,

As requested by the Committee, I have the honor to report to you, the progress of the Government Museum established at this place, during the 6 months ending this day. In my letter to you of date 12th January last, I had the honor to inform you that it was then proposed to throw open the Museum to the Public in a few days thereafter. This was accordingly done, and a register of the daily number of visitors has been kept since the 1st of February. Accompanying this is a tabular statement shewing the visitors on each day and also the totals of visitors during each of the 5 months embraced in the Report. You will observe that the number of visitors during the month of February (6,827) greatly exceeds that of any subsequent month, but this was to be expected as the Museum ceased to be a novelty: it is hoped however that as the variety and number of articles exhibited gradually increase, there will be a corresponding increase in the number of visitors.

2. The Committee beg to remind you of the hopes originally held out to them, that you might be able occasionally to forward articles of interest, of which you might have specimens to spare from the collection in the Central Museum.

3. Appended to this is a statement of the total expenditure incurred on account of this Museum from its commencement up to this date. The Committee hope to recover the amount expended on account of the furniture (in terms of the original orders of Government on the subject, specifying that furniture would be supplied in addition to the monthly allowance); but they do not propose to apply for the refund of the sum expended for this purpose from the monthly allowance, until some other glass cases, &c. have been made, the number already purchased being fully occupied by specimens, of which we have received many of every variety since the date of my last report.

I have the honor to be, &c.,

(Signed) JOHN ARMOUR,

Secretary to Museum Committee.

STATEMENT

Shewing the total expenditure on account of the Government Museum at Cuddalore, from its commencement to the 30th June 1856.

1. Furniture (glass cases, shelves, &c.).....	Rupees	211	11	0
2. Floor mats, whitewashing and repairing Museum rooms, supplying new door locks, bolts, &c. ...	„	32	7	0
3. Purchasing and preserving specimens of Natural History, &c.....	„	145	9	8
4. Models, Figures, &c.....	„	61	4	0
5. Salary of Servant in charge (up to 31st May)..	„	96	0	0

Total Rupees...546 15 8

Monthly allowance from Government up to 31st May.....	Rupees	818	3	5
Balance in Collector's Treasury to the credit of the Museum on the 30th June.....	„	271	3	9

E. E.

(Signed) JOHN ARMOUR,
Secretary.

STATEMENT OF THE NUMBER OF DAILY VISITORS TO THE GOVERNMENT MUSEUM AT CUDDALORE FOR THE MONTHS OF

1856 FEBRUARY.			1856 MARCH.			1856 APRIL.			1856 MAY.			1856 JUNE.		
Date.	Males.	Females.	Date.	Males.	Females.	Date.	Males.	Females.	Date.	Males.	Females.	Date.	Males.	Females.
1	164	86	1	67	12	1	6	4	1	15	0	1	0	0
2	236	14	2	0	0	2	15	7	2	10	2	2	15	0
3	0	0	3	24	12	3	23	7	3	14	0	3	14	0
4	183	106	4	31	9	4	14	2	4	0	0	4	16	0
5	99	22	5	27	8	5	19	16	5	14	0	5	8	4
6	207	21	6	18	7	6	0	0	6	15	1	6	30	0
7	50	34	7	0	0	7	8	2	7	6	1	7	13	7
8	140	34	8	2	8	8	10	2	8	17	1	8	0	0
9	132	30	9	0	0	9	21	1	9	8	4	9	16	9
10	0	0	10	20	6	10	12	3	10	15	0	10	14	2
11	183	40	11	11	9	11	11	2	11	0	0	11	20	2
12	185	48	12	12	3	12	14	0	12	22	8	12	10	6
13	278	67	13	19	0	13	6	0	13	35	5	13	20	0
14	233	40	14	13	0	14	12	3	14	10	2	14	23	3
15	341	84	15	0	0	15	10	9	15	14	10	15	0	0
16	510	93	16	0	0	16	12	3	16	26	10	16	12	3
17	0	0	17	10	7	17	10	1	17	0	0	17	7	3
18	540	160	18	15	0	18	12	0	18	9	3	18	19	6
19	1,150	352	19	10	3	19	10	5	19	3	3	19	8	8
20	348	90	20	8	3	20	0	0	20	3	0	20	5	6
21	0	0	21	19	31	21	13	2	21	9	6	21	2	4
22	0	0	22	9	3	22	13	2	22	18	10	22	0	0
23	158	127	23	0	0	23	7	5	23	17	0	23	4	0
24	0	0	24	15	0	24	11	4	24	25	0	24	4	0
25	46	33	25	8	2	25	12	4	25	0	0	25	7	1
26	65	30	26	18	0	26	14	3	26	8	3	26	6	0
27	14	11	27	15	7	27	0	0	27	9	3	27	10	0
28	19	4	28	7	3	28	8	4	28	26	4	28	14	0
29	30	0	29	7	5	29	13	2	29	5	7	29	0	0
			30	0	0	30	8	2	30	7	3	30	8	0
			31	9	1				31	17	0			
5,301			1,526			358 139			326 74			377 86		
												305 64		

2d July 1856.

(Signed) JOHN ARMOUR, Secretary.

MANGALORE, 4th January 1856.

To SURGEON E. BALFOUR,

In charge of Government Central Museum, Madras.

SIR,

We have the honor to acknowledge the receipt of your letter of the 20th ultimo, calling for the Report on the Museum at this station for the half year ending the 31st December 1855.

2. As yet our measures are entirely of a preliminary character. During the past half year we have obtained the sanction of the Right Honorable the Governor in Council for the appropriation as a Museum of a very suitable upstairs tiled building, the property of Government, and for the expenditure of the sum required to alter and adapt it for a Museum. The works are now being carried on.

3. We have received information of 240 species of stuffed birds, male and female, and upwards of 100 single birds from Malabar being ready for transmission to this station; also of 230 shells of different species having been despatched from Ceylon. A gentleman in Bombay has kindly undertaken a commission to send us specimens of the most remarkable Geological and other curiosities procurable in the Bombay Presidency and Scinde.

We have the honor to be,

Sir,

Your most obedient servants,

(Signed) F. ANDERSON, } *Members of the local*
 „ W. FISHER, } *Committee in Canara.*

MANGALORE, 30th June 1856.

From

JOHN BRETT, Esq., M. D.,

Secretary to the Canara Museum.

To

SURGEON E. BALFOUR,

In charge of Government Central Museum, Madras.

SIR,

I have the honor, with reference to your letter No. 321, dated 6th

May 1856, to submit the following Report of the Mangalore Museum, for the half year ending June 30th 1856.

I have the honor to be,
Sir,

Your most obedient servant,

(Signed) JOHN BRETT, M. D.,
Secretary to the Canara Museum.

REPORT.

1. The building appropriated as the Mangalore Museum has been undergoing repairs and alterations to adapt it for its intended use.
2. On carrying out the work according to the first estimate sanctioned by Government, 5th September 1855, it was found that the repairs, &c. required would, from the decayed state of timbers both of roof and flooring, be of a more extended character than originally supposed.
3. A second small estimate was therefore submitted with the recommendation in addition that the walls of the room should be increased in height about 2 feet, and that two more windows should be made on either side of the portico to throw light upon the entrance room.
4. It had also been discovered that some of the beams required renewing in the lower story and which had not been included in the first estimate.
5. This additional estimate was sanctioned by Government on the 8th March 1856.
6. The work set in force agreeably to the sanctioned estimates has not yet been completed owing to the early setting in of the rains. The walls have however been raised, the timbers repaired, the roof nearly tiled, and the unfinished portion (temporarily protected from the weather) will be finished on the first favorable opportunity. The other parts of the work that were in progress when the monsoon commenced, such as the windows, portico, &c. will, it is hoped, be early completed when a break in the weather ensues.
7. As regards additional collections for the Museum :
 - i. There are two boxes of stuffed birds containing a considerable variety (both male and female) in all 240 species; couples, and 100

single specimens; many of these were named by F. Anderson, Esq., before his departure for Madras.

ii. A valuable collection of shells received from Ceylon.

iii. A case of Mineralogical specimens was lately forwarded to this station per H. C. Steamer "Assaye," but owing probably to the monsoon, the Commander did not touch on the coast. A letter has been addressed to him at Bombay requesting that the box may be forwarded upon the first opportunity after the monsoon.

iv. The case of Geological, &c. specimens alluded to in the last half yearly Report of the Committee, dated 4th January 1856, as being promised from a gentleman at Bombay, has, by mistake, been forwarded to the former President of the Mangalore Museum Committee at Madras.

A few sundries consisting of gold coins, native oils, and medicines, &c.

8. It has been proposed that the furniture required for the Museum room should be made from the different woods of the Canara district, to test their respective value as regards durability, lightness, colour, grain, and capability of polish. No cases for specimens have yet been made.

The Account Current of Receipts and Expenditure is annexed.

(Signed) JOHN BRETT, M. D.,
Secretary to the Canara Museum.

MANGALORE, 30th June 1856.

REPORT ON MANGALORE MUSEUM.

Dr.		Rs. A. P.		Rs. A. P.	
1856	To amount of monthly allowance sanctioned for the Museum—	Rs.	A. P.	1855	By amount paid for the purchase of 10 dozens mill-board boxes.....
June 30th				June 15th	" Purchase of blackwood for preparing furniture.....
	From March to June 1855, @ 50 Rupees per month under authority, dated 16th February 1855.....	200	0 0	July..... 6th	" Expended for the purchase of stuffed birds.....
	From July 1855 to May 1856, @ 55 Rupees per month, under ditto 31st August 1855....	605	0 0	1856	
				February 1st	" Remittance to Ceylon for a supply of shells, &c.....
				"	" Ditto to Dr. Wilson at Bombay for Geological, &c. specimens.....
				June 7th	" Remittance to Dr. Balfour at Madras for a set of Lecturer's collections.....
				30th	" Amount paid for duplicates of such of the collections for the Madras Exhibition as were retained for the use of the Museum.....
					101 8 9
					<u>635 5 5</u>
					<u>169 10 7</u>
					805 0 0
					Balance on hand.....
					<u>Company's Rupees...</u>
					805 0 0

(Signed) JOHN BRETT, M. D.,
Secretary to the Canara Museum.

MANGALORE,
30th June 1856.

OOTACAMUND MUSEUM, 12th July 1856.

TO EDWARD BALFOUR, Esq.,

In charge of the Central Museum, Madras.

SIR,

In conformity with your request, under date the 6th of May last, I am instructed by the Committee of the Museum here to report as follows regarding it, viz. :

That it was formally opened on Monday the 19th of May, in presence of the Lord Bishop of Madras, and several of the leading members of the Society here, when the Secretary read an address detailing the objects of the Government in founding and supporting such Institutions, and he also gave a lecture introductory to a course, on Mineralogy and Geology, on Saturday last, the 5th instant, which will be followed by lectures twice a month on these subjects, and also on Botany by the Superintendent of the Government Gardens here.

We have lately received a complete Lecturer's collection of Mineralogical and Geological specimens from Germany, but they cannot be publicly exhibited, until we have the long promised glass cases to put them in, for without them we are completely brought to a stand, both in regard to these specimens, and a vast number of others, which are promised to us, as soon as we have proper depositories for such curiosities. On this subject I have repeatedly urged compliance with the Minute of Consultation, under date the 19th of December last, and I subjoin an Extract from my last letter to you relative to it.

We have already a considerable collection of minerals, shells, woods, and various stuffed and preserved animals, besides other curiosities (a catalogue of which shall be sent shortly), and we can rely on considerable additions, as soon as we have proper cases, in which to deposit them.

The visitors since the opening of the Museum, on the 19th of May last, were 197 in that month, and in June 270, and we have every reason to believe this Museum will prove a source of attraction, amusement, and instruction, as soon as it is fully established.

I have the honor to be, &c.,

(Signed) D. ROSS,

*Honorary Secretary to the Committee
of the Ootacamund Museum*

Extract of a letter addressed to the Superintendent of the Central Museum, under date the 13th of June last, but not fully replied to.

"We beg to be informed when the so very long promised pattern case, and glass for the whole twelve cases is likely to be forwarded to us, for by these cases being withheld, we are deprived not only of the benefit of the newly arrived Minerals, but of a vast number of curiosities which would otherwise be presented to the Museum, in fact we are completely at a stand for want of them, therefore I am instructed to request you will say positively whether or not there is any probability of the orders of Government, under date the 19th of December 1855 being complied with, otherwise we must not any longer delay taking measures to supply the deficiency, for without proper cases the Museum cannot succeed, nor in any way answer the expectation of the Right Honorable the Governor in Council."

HALF YEARLY REPORT UPON THE GOVERNMENT MUSEUM AT
RAJAHMUNDRY, FOR THE HALF YEAR ENDING
31ST DECEMBER 1855.

1. In the last Report furnished, it was intimated that certain steps had been taken to organise the Institution. Since that period, but little progress has been made, the opening of the Institution being dependent upon the receipt of the specimen, &c. ordered from England and which were despatched by the ship *Essex* in November last, and may consequently be expected to reach this about March next.

2. The Committee at a meeting held on the 4th instant have decided that a temporary building be immediately erected so that the Museum may be opened on their arrival.

3. But although the Committee sanction the erection of a temporary building so as to ensure the opening of the Museum on the receipt of the consignment of specimens from England, they still think it highly desirable that steps be taken to commence a permanent building.

Mr. Faulkner has kindly prepared a plan and estimate which the Committee approve of and which they would wish to adopt.

4. A grant-in-aid is however necessary to enable them to commence the desirable work and the plan, &c. is therefore forwarded for the information of the Officer in charge of the Central Museum who is requested to lay the Committee's application for a grant of money before Government.

5. The estimated cost of the building is 4,000 Rupees.

6. The fund raised by private subscription the Committee regret to say has fallen far short of what was anticipated and it is doubtful if more than 2,000 Rupees will be collected, of this 100£ has to be placed to the credit of the goods ordered from England so that they cannot pledge themselves to contribute more than 1,000 rupees towards the building fund, and consequently they have to solicit a grant from Government of rupees (3,000) to cover the estimated cost of the building.

7. The Committee regret that up to the present time their applications for contributions have not been generally responded to, only a few specimens of rocks and minerals from the upper Godavery district having been presented by Messrs. Tuke and Grove.

8. An abstract statement of the accounts of the Institution is appended for the information of the Officer in charge of the Central Museum.

(Signed) J. L. RANKING,

RAJAHMUNDRY, 6th January 1856. *Honorary Secretary Local Museum.*

The plan and estimate alluded to in the above report is not quite ready for transmission, but will be forwarded immediately.

(Signed) J. L. RANKING.

Abstract account of the actual Disbursements of the Rajahmundry Local Museum from February to 31st December 1855.

1855			Rs.	A.	P.	Rs.	A.	P.
July ...	3rd	By amount remitted to Messrs. Richardson and Brothers of London for £50, at the current exchange of 2s. 4d. per Rupee...	494	13	6			
		By amount paid to writer as his salary						
		For Feb. from 16th to 28th	4	9	4			
		For March.....	10	0	0			
		For April.....	10	0	0			
		For May.....	10	0	0			
		For June.....	10	0	0			
		For July.....	10	0	0			
		For August.....	10	0	0			
		For September.....	10	0	0			
		For October.....	10	0	0			
		For November.....	10	0	0			
		Paid for writing Papers.....	94	9	4			
		Paid for a Paste Board cover book	3	0	0			
		Post Paid.....	1	4	0			
		Papers, Flour, &c. for making 250 Trays.....	1	1	0			
		Mootchee's cooly, for making do..	4	12	6			
		25 small trays from Mootchee Thothiah.....	14	5	9			
		By amount remitted to Mr. Blackland, Vizagapatam, for printing 150 copies of distribution Circulars.....	1	0	0			
		Long Cloth, Green Tape, Copper Nails, Teakwood frames, cooly, &c. for the Tables received from Madras.....	4	5	6			
		2 coolies paid on account of bringing a box of rocks from Lieut. Grove, Narsapoor.....	11	14	0			
		Paid to a cooly from Vellah.....	1	8	0			
			0	4	0			
						632	13	7

RAJAHMUNDY, }
1st January 1856. }

Abstract shewing the allowance received from Government, and the Subscriptions collected from February to 31st December 1855.

	Rs.	A.	P.	Rs.	A.	P.
By amount drawn from the Collector's treasury:						
Government allowance for						
February from 16th.	23	3	5			
Do. do. March 1855	50	0	0			
Do. do. April.....	50	0	0			
Do. do. May.....	50	0	0			
Do. do. June.....	50	0	0			
Do. do. July.....	50	0	0			
Do. do. August.....	50	0	0			
Do. do. September.	55	0	0			
Do. do. October. ...	55	0	0			
Do. do. November.	55	0	0			
	488	3	5			
By amount of Subscriptions received from						
J. H. Master, Esq.....	30	0	0			
F. Copleston, Esq.....	200	0	0			
G. N. Taylor, Esq.....	100	0	0			
C. G. Master, Esq.....	20	0	0			
R. E. Master, Esq.....	50	0	0			
A. Purvis, Esq.....	250	0	0			
Lieutenant Goddard....	20	0	0			
	670	0	0			
Caupaverum Talook Amildar.....	10	0	0			
Toonee do. do...	8	0	0			
Coringa do. do...	3	0	0			
Peddupoor do. do...	12	0	0			
Amalapoor do. do...	25	8	0			
Raulee do. do...	2	0	0			
	60	8	0			
				1,218	11	5
Deduct as per disbursement.....				632	13	7
Balance carried into the account current.....				585	13	10

(Signed) J. L. RANKING,
Honorary Secretary Local Museum.

REPORT UPON THE RAJAHMUNDY MUSEUM,
FOR THE HALF YEAR ENDING
30TH JUNE 1856.

The Museum at length bears something more than a name. The articles so long expected from England have arrived and a shed as a very temporary building has been erected, in which they are now being duly arranged and the Institution will be formally opened on the 7th instant. The Committee have already in their letters from their Secretary given a list of the articles which were ordered to form a nucleus for the Institution.

The glass cases in which to arrange the Geological and Mineralogical specimens are much needed and the pattern one which the Military Board was requested to furnish has not been received. The Committee therefore have decided to make them up on the spot, a measure which will perhaps be more economical as well as more expeditious.

The shed above alluded to is 60 feet long by 31 wide and was erected at a cost of 157 Rupees, including some rough lath and plaister tables.

The Committee have been disappointed in not receiving the plans and estimates of a pukka building alluded to in the last half yearly report. It certainly is desirable that a suitable building be immediately commenced. The sum of 1,000 Rupees will be available as mentioned in the last report from the funds collected by private subscriptions and the Committee would be glad of some definite information as to the probability of a grant-in-aid of the erection of a suitable building being sanctioned by the Government.

The Civil Engineer has now been requested to furnish plans and estimates for submission to you and on their receipt the Committee trust that the subject of the above-mentioned grant may be laid before Government.

An abstract of the accounts of the Institution is forwarded.

(Signed) J. L. RANKING,
Hony. Secy. Local Museum.

RAJAHMUNDY MUSEUM, 1st July 1856.

Abstract account of the actual Disbursements of the Rajahmundry Local Museum from 1st January to 30th June 1856.

		Rs. A. P.			Rs. A. P.		
1856							
Jan....	7th	Balance brought.....					
Feb....	4th	By amount paid to writer as his salary for December 1855.....					
March..	4th	10	0	0			
April .	5th	10	0	0			
May ...	14th	10	0	0			
June...	28th	10	0	0			
Feb....	2d	10	0	0			
		By amount paid for Postage Stamps.....					
		1	0	0	60	0	0
		Do. for Letter Paper ... as batta to 2 smiths.....					
		1	0	0			
		from Yrranagoodim with Ironstone.....					
		0	8	0			
		Do. to 2 Coolies from do. ...					
		0	4	0			
		Do. to Dowleswarum canal.....					
		1	0	0			
		Boat for 3 cases received from England.....					
		1	0	0			
		Do. 5 Coolies employed for conveying the above cases to Rajahmundry					
		0	10	0			
		Do. to a Bandy for do.					
		0	6	0			
		Do. for erecting temporary shed					
		120	0	0			
		Do. for 4 windows for do.					
		16	0	0			
		Do. for erecting rough lath plaster tables.....					
		21	0	0			
		Do. Purchased Postage Stamps					
		1	8	0			
		Do. Baskets, Pots, &c. for sweep-er.....					
		0	3	0			
		Do. Papers, Flour and Arsenic for trays.....					
		0	11	4			
		Do. to a Peon proceeded to Cananda and other villages for collecting subscription.....					
		1	0	0			
		Total Company's Rupees.....					
					165	2	4
					225	2	4

RAJAHMUNDRY, }
1st July 1856. }

Abstract shewing the allowance received from Government, and the Subscriptions collected from 1st January to 30th June 1856.

			R ^s .	A.	P.	R ^s .	A.	P.
		Balance brought from last half yearly account current.....				585	13	10
		By amount drawn from the Collector's treasury.						
1856								
Jan....	7th	Government allowance for December 1855.....	55	0	0			
Feb....	4th	Do. do. for January 1856.....	55	0	0			
March.	4th	Do. do. for February 1856....	55	0	0			
April .	5th	Do. do. for March 1856.	55	0	0			
May ...	6th	Do. do. for April 1856.....	55	0	0	275	0	0
		By amount of subscriptions received from						
		Captain C. Taylor.....	25	0	0			
		J. McGregor, Esq.....	25	0	0			
		Civil Court Servants.....	50	4	0	100	4	0
		Total.....				961	1	10
		Deduct as per Disbursements.....				225	2	4
		Balance carried into account current.....				735	15	6
N. B.—The allowance for May not having been yet received is not accounted for in this abstract.								

(Signed) J. L. RANKING,
Honorary Secretary Local Museum.

NOTICE ON SAUGOR MUSEUM.

CIRCULAR, No. 250 OF 1856.

From GEORGE WIGGINS, Esq.,

*Secretary L. C. P. I. Saugor.*To E. BALFOUR, Esq., SURGEON, MADRAS ARMY,
Government Central Museum, Madras.

Dated SAUGOR, the 28th July 1856.

SIR,

I have the honor to forward for your information copy of the Prospectus of a Museum of Economic Geology, established in connection with the Saugor Government Institution, and to solicit the favour of your giving it such assistance and support as may be in your power.

2. I regret to say that there are no funds attached to the Saugor Museum and it must therefore depend entirely at present on the bounty of its liberal contributors for its supplies. In isolated instances, of an assortment of rare Minerals, Fossils, and other Metalliferous deposits of a District being forwarded of the size of a cubic inch each, their postage will be paid here from private sources.

I have the honor to be, &c.,

(Signed) GEORGE WIGGINS,

Secretary L. C. P. I.

SAUGOR, GOVT. SCHOOL, the 28th July 1856.

PROSPECTUS.

In a country so advantageously formed for Geological and Mineralogical research as Saugor, the establishment of a small Museum of Economic Geology readily suggests itself to the mind. Two gentlemen from the Geological Survey of India arrived here the other day. The existence of such a Museum would materially have assisted their labours in this part of the District. There is a Museum at Jubbulpoor, but it is not available on account of its distance for the purpose of conveying instruction or information to the pupils of the Saugor Government Institution, who are forward to the time when service in the Railway and Mining operations about to be undertaken in these Districts, will be offered them, and for which service they ought to be prepared. It is proposed therefore to open a small Museum (open to the residents of the station) in connection with the Government Institution: specimens of Minerals and

fossils, will be thankfully received by the undersigned. Those gentlemen who may present specimens will be pleased to state the name of the locality in which they were picked up, with any other particulars connected with them. The undersigned is prepared to present a hundred specimens principally from the Himalaya and Aravulli ranges of mountains from Nynce Tal and Almorah, situated in the former range, and from Ajmere situated in the latter, as a commencement of this Museum. Those interested in the Geology of the country must have discovered that the sloping valley now used as the parade ground was once the bed of a lake. Walking over it of a morning or evening, light, chunam-looking stones may be picked up. These on close examination prove to be freshwater petrifications and indicate the existence of a lake. On ascending from the parade ground to the hills surrounding the valley petrifications of palm trees and other tropical plants which grow abundantly only on the shore of the sea of Saugor are to be found. But all this knowledge of separate inquiries ought to be collected and digested, and no place, I would humbly suggest is fitted so well in all respects for such a purpose as the Government Institution, where the specimens can be assorted, described and laid out in shelves

(Signed) GEORGE WIGGINS.

SAUGOR, GOVT. SCHOOL, the 19th December 1855.

NAMES OF CONTRIBUTORS.	No. OF SPECIMENS CONTRIBUTED.

GOVERNMENT CENTRAL MUSEUM,
MADRAS, 24th May 1856.

From

SURGEON EDWARD BALFOUR,

Officer in charge of the Govt. Central Museum.

To

T. PYCROFT, Esq.

Chief Secretary to Government,

Fort St. George.

SIR,

1. I have the honor to submit, for the orders of the Right Honorable the Governor in Council, a description of Materials procurable in the Madras Presidency, useful as aids in grinding, polishing and sharpening the metallic and mineral substances used in the arts; and I likewise submit Extracts from the most recent publications on such substances and their application.

2. The preparation of them has been one of my occupations in the Museum during the bye-gone year, but I was induced to commence it by receiving from the Arsenal and Commissary General requests for information, and I append correspondence thereon by which it will be seen that the Commissary General, the Military Board, the Arsenal, and the Committee now enquiring into the Products of this country, all think favorably of the value to this country and its people, of the informations in this report on the materials procurable in the Madras Presidency useful for grinding, sharpening and polishing.

3. As it is more of a report than a catalogue (though the first part is really a catalogue) I submit it for the orders of the Right Honorable the Governor in Council as to printing it or not.

I have the honor to be,

Sir,

Your most obedient servant,

EDWARD BALFOUR,

Officer in charge of the Govt. C. Museum.

FROM THE COMMITTEE ON THE PRODUCE AND RESOURCES
OF INDIA, AS REGARDS THE REQUIREMENTS OF THE
PUBLIC SERVICE;

To

SURGEON EDWARD BALFOUR, M. D.,

Officer in charge Government Central Museum, Madras.

SIR,

In returning the papers on the polishing, sharpening and grinding minerals produced in India, which you so kindly placed at the disposal of the Committee, I am desirous to offer you their thanks for the valuable assistance you have afforded them in their enquiries, and to state that the information supplied having been condensed into a form suitable for the immediate purpose of the Committee, they would strongly recommend that it be printed, as the best means of making known the substances therein shewn, as equal if not superior to the English kinds. The Committee consider that the memorandum is generally very suggestive of the application of little known substances to manufacturing purposes, and would be of great value to the Government and industrial classes.

The Committee consider it due to you to forward the extracts* which they have taken from your manuscript that you may see to what extent they are indebted to your valuable work.

I have the honor to be,

Sir,

Your most obedient servant,

H. C. CLEGHORN,

Member of the Committee.

COMMITTEE OFFICE, FORT ST. GEORGE, 26th April 1856.

* To be returned.

No. 63.

FROM THE COMMITTEE ON THE PRODUCE AND RESOURCES
OF INDIA, AS REGARDS THE REQUIREMENTS OF THE
PUBLIC SERVICE;

To

SURGEON EDWARD BALFOUR, M. D.,

Officer in charge Government Central Museum, Madras.

SIR,

In reply to your communication, dated 28th ultimo, I am desired to express the Committee's regret, that their former letter should have left any doubt on your mind, as to their opinion of the value of your report on the grinding, sharpening and polishing materials, procurable in this country.

Though for the present objects of the Committee, only certain portions of your report were required to be extracted by them, the Committee instruct me to say that the report with its appendices, being, as was before remarked, "generally very suggestive of little known substances to manufacturing purposes, it would be of great value to the Government and industrial classes;" and the Committee hope that the Right Honorable the Governor in Council will sanction its being printed.

In the belief that this will be sanctioned, the Committee would defer extracting from your report until it appears in print, and thus obviate any difficulty on the point about which you are solicitous, viz. the setting forth of your own views.

I have the honor to be,

Sir,

Your most obedient servant,

H. C. CLEGHORN, M. D.,

Member of the Committee.

COMMITTEE OFFICE, FORT ST. GEORGE, 8th May 1856.

EXTRACTS FROM APPENDICES.

As the correspondence appended has been carried on, over a year, and is voluminous, the following extracts from it are given :—

A.

Extract of a letter from the Military Board, dated 12th March, No. 7993 of 1855.

"The main object of the enquiry is not so much to supply the Madras Arsenal with grindstones, as it is probable that these article may be sent from England and landed at Madras as cheaply as they could be supplied in India."

B.

Extract of a letter from the Commissary General, Madras, dated 25th July, No. 1296 of 1855.

"I have the honor to acknowledge the receipt of your letter forwarding a summary of the existing information Dated 12th May 1855. "on the subject of grindstones, hones, &c. and "in returning you my thanks for the varied, interesting, and valuable information therein contained, I beg to inform you that a copy will be taken and the original returned to you in a few days: owing to a press of business the book has been delayed a longer time than it would otherwise have been, and I trust the delay has not caused you any inconvenience."

C.

Extract of a letter from the Commissary General, Madras, dated 4th August, No. 1493 of 1855.

" I have the honor to return, with many thanks, the summary of information on the subject of grindstones, hones, &c. forwarded with your letter, after making a copy of the same. Dated 12th May 1855. " and as it contains a good deal of valuable information likely to be of use to this Department, I will take into consideration the propriety of having it printed and circulated to the Officers of the Commissariat.

D.

Extract of a letter from the Committee on the Produce and Resources of India, as regards the requirements of the Public Service, dated 26th April, No. 62 of 1856.

" The Committee consider that Memorandum is generally very suggestive of the application of little known substances to manufacturing purposes, and would be of great value to the Government and industrial classes.

E.

Extract of a letter from the Committee on the Produce and Resources of India, as regards the requirements of the Public Service, dated 8th May, No. 63 of 1856.

" The Committee instruct me to say that the report with its appendices, being, as was before remarked, 'generally very suggestive of little known substances to manufacturing purposes, it would be of great value to the Government and industrial classes,' and the Committee hope that the Right Honorable the Governor in Council will sanction its being printed."

EDWARD BALFOUR,
Officer in charge of the Government Central Museum.

No. 26.

Letter to COLONEL F. BLUNDELL, C. B.,

Principal Commissary of Ordnance.

SIR,

I have the honor to mention in reply to your communication as per

No. 203 ORDNANCE DEPARTMENT.

FROM COLONEL F. BLUNDELL, C. B.,

Principal Commissary of Ordnance.

TO SURGEON BALFOUR,

In charge of Central Museum, Madras.

SIR,

With reference to Extract of a letter from the Military Board, No. 6032, of the 4th January 1855, noted in the margin, I have the honor to request, you will have the goodness to inform me, if a good substitute sufficiently large for grindstones 30 inches in diameter, has been found in this country; and if so, I shall feel obliged, if specimens could be procured, and sent to the Arsenal for trial.

I have the honor to be, &c.

(Signed) F. BLUNDELL, COLONEL.

Principal Commissary of Ordnance.

ARSENAL, FORT ST. GEORGE, }

29th January 1855.

The grindstones which the Board allude to have been known and used in this country from time immemorial and various modifications of them have been adopted in Europe. They are composed of some soft material for a base or paste mixed up with emery or corundum powder. In this country the base or paste is the lac, which is melted and the powder stirred into it and moulded into a circular form, but in our own country, where they are termed emery-stones, the manufacturers generally employ, as the paste, various proportions of stone-bridge clay: though many other substances, such as slate, and Yorkshire gritstone, are used, as the basis, and in this way the hardness and cut of the emery-stone is much improved. I think you will find that these emery-stones are used in the Arsenal and in the Medical Stores, but they are only made into disks and laps suitable to grinding, cutting, and polishing glass, enamels, metals and other hard substances. I never have heard or seen any of this composition grindstones exceeding 8 or 10 inches of diameter, never of the vast size of thirty inches which you seek for, for

margin, that the Military Board and your Department, are there-in alluding to two different kinds of grindstones, used for quite different purposes; but I will endeavour to furnish, in the following remarks, all the information that I have on the subject.

GOVERNMENT CENTRAL MUSEUM

grinding-stones, although, if of any use to you of such dimensions, there would be no difficulty of making them.

What you allude to, however, does not seem to be the emery grindstones of England or the corundum grindstones of India, spoken of by the Military Board, but to be the grindstones formed from sandstones or other silicious rocks. Major Simpson, while Commissary of Ordnance, favored me with a portion of one of your broken grindstones, which is lodged in the Museum, and from its examination I was not prepared to learn, from the Board, that these are expensive articles, because it does not differ from any of the many sandstones of this country. I have not specially turned my attention to this point of enquiry, but if the Board wish it, I do not doubt that I could in the course of a month or two produce many sandstones superior to those of which the portion I received was a specimen. You are no doubt, however, aware that there are a very large variety of sandstone grits used in the manufacture of this implement, amongst which I may name, in England, those of Newcastle, Bilston, Devonshire, Yorkshire, Congleton, Sheffield and Wickersley, all of these having different qualities; the very best grindstones contain small vesicular cavities, which constantly come upon the surface as the stone wears down, and thus keep it rough; while the smooth sandstones, such as those I have seen with you, for this purpose require to have their surface picked from time to time.

I send you sample of a sandstone from the neighbourhood of Tripetty in North-Arcot which is used *dry* by the Nalbunds of this place to give an edge to their large cutting knives: I see no difficulty in employing it as a substitute for implements, brought from England for similar purposes. It may be too soft for a grindstone to be used wet, such as your circular ones require to be. Captain Campbell while at Saugor sent me a specimen of sandstone which has been largely introduced in Bengal as a grindstone.

In conclusion, I beg of you to mention to the Board what I have alluded to above, as to the existence of extensive beds of sandstone rocks, in various parts of this country, many of which would doubtless be well suited for the grindstones you want, and the best way of getting information regarding them is to make them a subject of special enquiry which the Board could either do themselves or I will gladly undertake the duty of, if they think my position would enable me to obtain the required information sooner or better, and I would wish you to add that the manufacture of the emery and corundum grindstone disks or laps

to which the extract given me from the Board's letter refers, is very simple and is well known and daily resorted to in Madras and many other parts of Southern India.

I have the honor to be, &c.,

(Signed) EDWARD BALFOUR,

MUSEUM, 31st January 1855.

In charge.

No. 89.

From

SURGEON EDWARD BALFOUR,
Government Central Museum.

To

LIEUTENANT COLONEL A. McCALLY,
Commissary General.

SIR,

I have the honor to acknowledge your letter of the 24th instant No. 7455, and will very gladly give all the assistance in my power towards discovering a material in this country suitable for grindstones.

You will have observed from my letter to the Principal Commissary of Ordnance, 31st January, No. 26 of 1855, that there has appeared to me some difference in the objects that the Board and the Arsenal have in view; and I would suggest that the search, now to be instituted by your Department, should be made upon a basis sufficiently broad to secure the fullest results: I think that this would best be attained by requesting each of the Officers of your Department to forward by Banghy direct to the Museum or to yourself for me, samples of all the sandstones in his neighbourhood, whether made any use of or not by the people of his district, in order that an opinion may be formed as to their fitness for grindstones.

Excepting the composite grindstones made from lac, emery, &c. as explained in my letter to the Principal Commissary of Ordnance, of which you have a copy, quartzose sandstone of different kinds is the only rock from which manufacturers form the grindstones that are used (wet or, like scythe stones, dry) for sharpening the larger and rougher tools of the trades, and I think that the Officers of your Department may find abundance of them, in several of the collectorates and territories of Southern India.

H

While this is the case with grindstones, it may be proper to add that the various mineral substances used for fine sharpening, called "Hone;" "Honestones;" "Whetstones;" "Whetslates;" "Oilstones;" Ragstones; Turkeystones; Polishing slates, &c. &c. &c. &c. all possess very remarkable analogies and all appear to be "altered" or metamorphic slates or schists of the Palæozoic period or that remote age of the earth when the rocks belonging to it contained no fossil remains. Your own Officers are doubtless aware of these facts and of the difference in the material used for sharpening the rougher and finer tools, but as it would be wrong of us to expect the Natives of this country to possess the minuteness of information which is requisite for us to ascertain definitely the existence of materials for grindstones (for they probably are unable to distinguish one sharpening material from another), I venture to suggest that each of your Officers, should not restrict his enquiry to grindstones but might now send a sample of each stone to be found in his neighbourhood or used by the people for sharpening tools, &c. I will shortly have the pleasure of sending you a summary of all the information on this subject in my possession, and as the enquiry is an important one; as it is desirable to have it carried out as well and as rapidly as possible, if you deem it advisable, my former letter and this one could now be printed and circulated to all whom you may think likely to furnish you with information, and the summary which I will shortly send could be similarly treated hereafter.

NAME OF DISTRICTS.	PROBABILITY OF OBTAINING IN THE DISTRICTS Sandstones suitable for grindstones, &c. &c.	Schistose rocks suitable for hones, &c. &c.
ARCOT, NORTHERN DIVISION	Sandstones to be had on the eastern and northern parts of the Collectorate, where it joins Chingleput and Cuddapah. That from Triputtty is used by the Nalabunds.	Metamorphic Schistose rocks, as clay slates and limestones occur in the greatest abundance on the eastern & northern frontier.
DO. SOUTHERN do.	Probably between Pondicherry and Trichinopoly.....	?
BELLARY	Good probability	In great abundance.
BURMAH	?	?
CANARA	Great probability.....	Great probability.
CHINGLEPUT	Sandstones occur in several places	?
COCHIN	A garnet sand now used by the Jewellers for polishing metals.....	?
COIMBATORE	Ask Mr. Ross and Captain Campbell.....	?
CUDDAPOH	Very abundant.....	Very abundant.
CUTTACK	Probable.....	Probable.
GANJAM	Do.....	Do.
GUNTOOR	Very abundant.....	In very great abundance.

I have information in the Museum that I could now give, but I think you would prefer my preparing for you a general report

NAME OF DISTRICTS.	PROBABILITY OF OBTAINING IN THE DISTRICTS Sandstones suitable for grindstones, &c. &c.	Schistose rocks suitable for hones, &c. &c.
HYDERABAD	May probably be met with abundantly on the borders, east, north, south and west	?
INDORE	?	?
KURNOOL	Abundant	In great abundance.
MADRAS	The people of Madras such as Ma-chies, Chucklers, Nalabunds, Zeengars, &c. &c. use smooth rolled pieces of Basalt from Vellore; angite rock and binary granites from Palmanair, sandstones from the south of Chingleput and Triputtty—but the composite corundum laps and bars, made in Mysore are fast superseding all other materials. In the Arsenal and the European and large Native manufactories, the Europe grindstones and hones, &c. are used and the Stone Masons and Architects used as "grit" a Nodular sandstone found in the Marine Lagoon at Ennore.	?
MADURA	Ask the Rev. Mr. Muzzy.....	?
MAHARATTA COUNTRY, SOUTHERN.....	Probable.....	In great abundance around Kulladghree.
MALACCA	Very probable	?
MASULIPATAM	Possible towards the west	Abundant towards the western part of this district.
MYSOORE	?	?
NAGPORE	Perhaps towards the east and west. The Rev. Mr. Hyslop could tell this	?
NAGPORE	Sandstones abundant through the District.....	?
PEGUE	?	?
PENANG	?	?
RAJAHMUNDRY	?	?
SAUGOR	Sandstones used as grindstones.....	?
SINGAPORE	?	?
TANJORE	?	?
TENASSERIM PROV.....	?	?
TRIVANDRUM	Genl. Cullen could tell this.....	?
TINNEVELLY	Very probable	?
VIZAGAPATAM	?	?
VIZIANAGRAM	?	?

on the subject when all the available information comes to our hands, and in the meantime I place on the margin the names of the several districts of Southern India, with remarks to shew the probability of obtaining the rocks now sought for.

I have the honor to be, &c.,

(Signed) EDWARD BALFOUR,

MUSEUM, 29th March 1855.

In charge.

ORDNANCE DEPARTMENT.

No. 479.

From

COLONEL F. BLUNDELL, C. B.,
Principal Commissary of Ordnance.

To

THE SECRETARY MILITARY BOARD,

SIR,

1. I have the honor to forward copies of letters from the Commissary General and Dr. Balfour, numbers and dates as per margin, with specimens of stones forwarded by them. Dr. Hunter has not yet favoured me with a reply to my letter to him, on the subject: but as soon as received, it shall be communicated to the Board.

Letter from the Commissary General to the Principal Commissary of Ordnance, No. 6854, dated 22d February 1855.

Letter from Dr. Balfour to the Principal Commissary of Ordnance, No. 26, dated 31st January 1855.

2. The specimens furnished by the Commissary General, and labelled Vayera Munnell Cul and Curoonkul are very hard and perfectly unsuited for grindstones, to sharpen tools upon, and are very dear.

3. The specimen furnished by Dr. Balfour (numbered 47) appears to be too soft for a grindstone; but might prove a good substitute for the ragstone, which is received from England for sharpening Laboratory and Chucklers' knives upon. I would however suggest, that the Commissariat Department be instructed to supply a grindstone of the description of stone furnished by Dr. Balfour: but of a less size than those usually received from England, say 24 inches in diameter, and 3 inches thick which could then be proved by trial: as it is important to obtain grindstones if possible in the country.

I have, &c.,

(Signed) F. BLUNDELL, COLONEL,
Principal Commissary of Ordnance.

ARSENAL, FORT ST. GEORGE, 9th March 1855.

(True Copy)

(Signed) A. H. HOPE,
Secretary.

No. 173

Letter to LIEUTENANT COLONEL A. McCALLY,

Commissary General.

SIR,

In accordance with the promise in my letter to your address, dated 29th March 1855, and in continuation of my letter to the Principal Commissary of Ordnance, dated 31st January 1855, of which a copy was furnished to you, I have now the honor to forward a summary of the existing information on the subject of grindstones, hones, &c. whether made of stone, or of corundum, or emery mixed with lac.

I have prepared the summary in accordance with my usual custom of keeping together all the observations met with, which bear on the subject I may be investigating, and I would not have printed it on my own account as grindstones and hones do not much interest me; but, if you think this summary can be of any use to your Department, you are welcome to take a copy of it; or if you consider it of sufficient value to be printed for distribution among the Officers of your Department, you are equally welcome to do so, either by yourself or, if you deem it preferable, I can solicit the permission of the Right Honorable the Governor in Council to have it done, from the Museum.

As I have not retained a copy of the summary, I beg that it may be returned to me when no longer required by you.

I have the honor to be, &c.,

(Signed) EDWARD BALFOUR,

MUSEUM, 12th May 1855.

In charge.

No. 306.

Letter to LIEUTENANT COLONEL HAMOND,

Principal Commissary of Ordnance.

SIR,

After the issue of the Military Board's latest orders, regarding grindstones, I received from the Commissary General, also, a letter on the subject, and in reply I gave the names of localities and suggested the samples of their sandstones should be sent to me, for report. I have the honor to mention that in accordance with that suggestion some varieties of sandstones and other rocks have been forwarded to me, but of such a character as to leave the impression that better success would attend the Board's inquiries, if samples of the sandstones, whets, &c. which you use, were sent as specimens of the material being searched for.

I would therefore suggest that all the old broken-useless grindstones, whets, oilstones, &c. &c. lying in the Arsenal, be sent to me with any note you can give regarding them, and I will break them up into suitable pieces and have them distributed all over the country. I would further suggest that the Ordnance Officers be instructed to distribute, within their ranges, portions of any of the broken implements, for which search is now being made by me and your Department, with instructions to send to you whatever stone of a similar character their search may bring forth.

I have the honor to be, &c.,

(Signed) EDWARD BALFOUR,

MUSEUM, 16th August 1855.

In charge.

COMMISSARY GENERAL'S OFFICE, MADRAS, 24th March 1855.

No. 7455.

From LIEUTENANT COLONEL A. McCALLY,

Commissary General.

To SURGEON E. BALFOUR,

In Charge of the Government Central Museum, Madras.

SIR,

The Military Board have favored me with a copy of your letter to the Principal Commissary of Ordnance on the subject of obtaining a good substitute for the grindstones usually imported from England, and have led me to hope that you will afford me your valuable aid in the procurement of such substitutes; I have the honor consequently to assure you that I shall feel greatly obliged to you for any information which your experience may enable you to give me, or any advice that you may be able to offer in assisting me to carry out the wishes of the Military Board on this subject.

The Officers of the Commissariat shall be addressed and requested in communication with the Ordnance Officer of the station where they are located to give their attention to the procurement of the proper materials for grindstone which may be found in their neighbourhood.

I have the honor to be, &c.,

(Signed) A. McCALLY,

Commissary General.

Letter to CAPTAIN A. H. HOPE,

Secretary Military Board.

SIR,

Amongst a few samples of imported articles, presented to the Museum on the 21st August last, by the Principal Commissary of Ordnance, were those described on the margin; but as they seem to me to be mere ordinary limestones, and therefore of greatly inferior money value to Turkey oilstones, which they have been sent to represent, I have the honor to suggest that the Board send one sealed and authenticated to the Chemical Examiner, asking him to analyse it quantitatively, to ascertain its composition, the Turkey hones or oilstones being composed as per margin.

Stones oil,	{	Used with oil for putting a fine edge on tools.
Turkey		
small pieces 8		
fore of greatly inferior m		
Alumina.....	3	3 3
Silicia.....	72	0 0
Lime.....	13	3 3
Carbonic Acid.....	10	3 3
Total.....	99	0 0

I have the honor to be, &c.,

(Signed) EDWARD BALFOUR,

MUSEUM, 12th December 1855.

In Charge.

ORDNANCE DEPARTMENT.

No. 4820.

Extract from the Proceedings of the Military Board, under date 15th December 1855.

Read letter from the Officer in charge Government Museum.

(Here enter No. 510, dated 12th December 1855.)

Resolved to forward a copy of the above report to Dr. Mayer, Professor of Chemistry, and to state that the Board will feel much obliged if he could find leisure to give some approximate description of the stones so as to enable the Board to enter into further enquiries.

The Board do not wish to entail on the Professor the labor of a strict analysis, as the question is not yet in a stage deserving of such minute enquiries, but they will be glad to receive such information as will enable them to express an opinion on the stones.

The Principal Commissary of Ordnance will be requested to send

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specimens of the stones now in the Arsenal and also to procure from any source a real *Turkey stone* and also send it to the Professor.

The Board believe that stones fully equal to those now sent from England can be obtained in India, and the Board will feel much obliged to Dr. Balfour if he will assist in pointing out the localities where such stones might be found to enable the Commissary General to obtain specimens.

(True Extract,)

(Signed) A. H. HOPE,
Secretary.

FROM THE COMMITTEE ON THE PRODUCE AND RESOURCES OF
INDIA WITH REGARD TO THE REQUIREMENTS OF THE
PUBLIC SERVICE;

To EDWARD BALFOUR, Esq., SURGEON,
In charge Government Museum, Madras.

SIR,

The Committee in furtherance of their enquiries being desirous of obtaining the fullest and most trustworthy information on the subject of the resources of India, and its capabilities of supplying the requirements of Government, will be obliged by your furnishing them with such information as the Museum, aided particularly by your own enquiries and researches may have enabled you to collect.

2. The objects for which the Committee are assembled are of so important a nature, and so momentous to the future welfare and improvement of India that they feel they need hardly apologize to you for the trouble their present enquiry may occasion.

3. As regards the products of India, every information will be of value, but more particularly so in those peculiar products which are immediately applicable to the Public Service and they desire your opinion as to the practicability of substituting India produce for many articles which are now only procurable from England, because their manufacture is solely of materials procurable in England or adjacent countries; thus canvas of hemp, rope, twine, potashes, alkalies, grindstones, hones, &c., may possibly be replaced by Indian produce, equally fitting for their manufacture and as durable and useful for Government purposes.

4. With regard to the metals and minerals of India, the Committee are desirous of obtaining every information, not only as regards their quality, but the source of supply. You have already shewn that iron, steel and marbles may be procured in large quantities, and of good quality, but the Committee are desirous of being able to classify the sources of supply that they may be able to remark upon the situation of the best iron districts with relation to the out-station arsenals.

5. With regard to the tin, copper and lead products of India, and the Eastern Archipelago, the Committee are anxious to obtain information to enable them to ascertain how far these metals may be depended upon for future supply. Many valuable mines of tin and copper are probably to be found in Pegu and the Straits, but how far they may be looked upon as a certain source of supply, the Committee are ignorant and would be obliged for all the information you can furnish on these points.

6. The drugs of India are also important subjects of enquiry and all information regarding them, and probability of purifying and preparing them for medical purposes, will be most acceptable to the Committee.

I have the honor to be,

Sir,

Your obedient servant,

(Signed) P. ANSTRUTHER, Col., c. b.,
Senior Member of the Committee.

COMMITTEE OFFICE, FORT ST. GEORGE, 18th January 1856.

No. 302.

LETTER TO THE COMMITTEE ON THE PRODUCE AND RESOURCES
OF INDIA, AS REGARDS THE REQUIREMENTS OF THE
PUBLIC SERVICE.

GENTLEMEN,

1. I have had the honor of receiving your communication of the 26th instant, No. 62, and while I learned therefrom that the samples had been examined, I hasten to mention that it would be more agreeable to me, if you could accept or recommend my MSS in its integrity; or could extract, verbally any portion thereof; or could allow me to condense it, for you: and I ask any one of these favors because while anxi-

ous, in every way, to promote the objects you have in view, I am no less desirous that, whatever may seem to go forth under my name, shall indeed be without doubt my own; and in the "*extracts*" I observe some matters stated which, though perhaps quite correct, I nevertheless am not able to concur in.

2. Though the report contains the recommendation as per margin, and your Committee consider that

"As there is much valuable information in the reports, and Surg. Balfour has taken the trouble of collecting the most useful valuable papers bearing on the subject, I propose that they be published entire, for the use of the artificers and workmen employed in the different departments of the Service."

"the memorandum is generally very suggestive of little known substances to manufacturing purposes and would be of great value to the Government and industrial classes," your letter under acknowledgment does not expressly recommend its being printed, either in whole or in part, and I would beg of you to favour me with your views on this point, for submission to Government.

3. If you now recommend its being printed and you, at the same time, feel yourselves constrained to adhere to your own extracting, may I beg the favor of your deferring to print until my own views be before the Public, immediately on which you will have my freest consent to use all I have written, in any way you may consider most conducive to the advancement of the objects, we in common have in view.

I have the honor to be, &c.,

(Signed) EDWARD BALFOUR,

Officer in charge.

MUSEUM, 28th April 1856.

(True Copies,)

E. BALFOUR,

Officer in Charge of the Government Central Museum.

APPENDIX.

APPENDIX **A.**

GRINDING, SHARPENING AND POLISHING MATERIALS IN USE IN THE ARSENAL OF FORT ST. GEORGE AND IN THE WORKSHOPS OF THE JEWELLERS, SILVERSMITHS AND STONEMASONS OF MADRAS.

1,¹ Is a *coarsely granular sandstone* of a reddish hair brown color mottled with dark spots : rough to the touch. A portion of the ordinary grindstones of the Arsenal used with water for grinding and sharpening tools.

1,² Is a *sandstone, finer grained than the above 1,¹*, of a reddish brown color, rough to the touch ; a portion of the ordinary grindstones of the Arsenal used with water for sharpening tools.

1,³ Is a *faintly brownish grey sandstone*, composed of somewhat loosely aggregated grains with streaks of a metallic looking substance : finely grained but hard and harsh to the touch : a portion of the better kind of grindstones in use in the Arsenal, used with water for sharpening tools : approaches in its character to the next described.

1,⁴ Is a *faintly brownish grey sandstone*, composed of somewhat loosely aggregated grains with streaks of a metallic looking substance ; rough and harsh to the touch but finely grained : a portion of the better kind of grindstones in use in the Arsenal : used with water for sharpening tools.

19. *Sandstone*, tinged red with iron ; used by Mr. Law for giving form to marble : said to be a product of the Madras Presidency : is admirably suited for grindstones.

23, *Loose silicious brown sandstone*, is fine grained and imparts a
23, 25. rough sensation to the touch. Is used by Mr. Ostheider's people for sharpening their tools on ; brought from England.

24. *Hard purplish colored silicious sandstone*, and fine grained ; a portion of an English grindstone in Mr. Cranston's shoemaker's possession, by whom it is used as a dry whet for his leather-cutting knives.

1,⁵ Is a *bluish grey silicious stone* containing lime, rough to the touch

and contains minute portions of black mica: issued as a ragstone by the Arsenal and used dry for sharpening laboratory and chucklers' knives on.

2 & 21. *Grit, Snake: Grit: Ayrstone: Scotchstone*—Is much in use by the marble polishers of Madras as well as by the silversmiths and jewellers by whom it is called grit; snake grit, and Ayrstone. It is a well known material from Ayr in Scotland, known by polishers in Europe as "snakestone."

22. *Ennore grit* used by stone cutters for grinding the first rough surface of their marbles, &c. It occurs in hard, amorphous and nodular masses of a bluish ash grey color, containing points of some black material and imbedding shells. It closely resembles the finer silicious sandstones and is rough and harsh to the touch; it effervesces very freely with acids and seems to consist of minute grains of quartz in a base of lime; it is found in the bed of the Pulicat marine lagoon, imbedded in the mud at the bottom.

1,⁶. Are small pieces of *deep black limestones* called *Turkey oilstones* and used in the Arsenal with oil, for putting a fine edge on tools. These, however, contain so much lime that they cannot be the true Turkey oilstones in which only a small per centage of lime is found.

1,⁷. A piece of *black limestone*, said to have been brought from Tripooty; is somewhat harder than the above so called Turkey oilstones 1,⁶, for which, however, it is admirably suited; seems indeed, except in its hardness, almost identical with that from the Arsenal. This article is sold in the bazaars of Madras to the Native barbers who use it for sharpening their razors on.

1,⁸. *A garnet*, sold in the bazaar and used as corundum.

GRINDING AND SHARPENING MATERIALS FOUND IN USE AMONGST THE NATIVE SADDLERS, SHOEMAKERS, HORSE-SHOERS, CUTLERS, &c.

15, 16. *Basalt* from Vellore, formerly used by horse-shoers, but they now use *sills* made in Mysore, of corundum and lac.

1. *Basalt*, rolled fragment used by the shoemakers of Madras, for sharpening their knives on. It is called by them *Sanakul*, lit: sharpening stone. All the shoemakers of Madras are said to use the same material. These basalts are found in a stream near Chetput five days' journey from Madras, near Trinamullay and three days' journey this side of Arnee.

2. *Basalt* used by saddlers for sharpening their awls and knives on.

3. *Basalt* used by saddlers for sharpening their awls and knives on.

4. *Hornblendic rock, (greenstone,)* rolled fragment, used by horse-shoers as a whet for sharpening the large hoof-cutter.

12. *Quartzose sandstone* nodule, of greenish color, from Vellore, formerly used by horse-shoers, but they now use *sills* made in Mysore of corundum and lac.

13. *Quartzose sandstone* nodule, of a reddish color from Vellore, formerly used by horse-shoers, but they now use the corundum whets, *sills*, made in Mysore of corundum and lac.

14. *Fine grained yellow sandstone*, said to be from Woodiagherry in Nellore: cutlers were accustomed formerly to use this stone, for giving a first edge to swords, daggers, and their own implements: but it has now been almost wholly superceded by the corundum whets from Mysore. It is hard and rough and admirably suited for hard grindstones.

9. *Fine grained, red silicious sandstone*—Saddlers use it for sharpening awls. It is rough and harsh to the touch.

17, 18. *Reddish yellow quartz* from Vellore, formerly used by horse-shoers, but they now use *sills* made in Mysore of corundum and lac.

8. *White quartz* used by shoemakers for sharpening awls on.

5. *Binary granite*, rolled fragment used as a whet by horse-shoers for sharpening the large hoof cutter.

6. *Binary Granite* used by shoemakers for sharpening awls on.

10. Red binary granite used by saddlers for sharpening all their large and small implements on.

11. Nodule of *fine grained reddish quartzose rock* used by saddlers who say they do not know its origin.

7. *Porphyritic grey granite* used by shoemakers for awls and leather-cutter knife.

a. *A hone* purchased in the Madras bazaar, formed from a silicious rock; its structure arranged in a somewhat fibrous manner, effervesces so feebly that it can contain only a trace of lime, admirably suited for a ragstone. Probably from Cuddapah, or Guntoor, or Nellore.

b. *A hone* purchased in the Madras bazaar, formed of a finely crystalline bluish grey marble; effervesces freely with acids.

c. *A hone* purchased in the Madras bazaar formed from a blue clay slate: probably from Cuddapah.

d, d. *A hone* purchased in the bazaar formed of a liver-colored clay slate, smooth and homogenous, well suited for ordinary hones.

e. A portion of *a hone*, purchased in the bazaar, formed from blue clay slate not well adapted for hones.

2,¹⁰. *English grit*, is a hard but fine grained sandstone, imported from England and used by the stone-mason for the rougher surfaces.

3,¹¹. Are *water worn weathered masses of garnets* sold in the bazaar under the name of *corundum* and *emery*: they are used by the stone cutter and by the Native cutter for purposes to which emery is applied in England; they are found all over the country.

1,¹². Two *irregularly crystallized garnets*: were forwarded to the Museum two years ago by the Commissary General as emery, and his letter mentioned that they are procurable at Callistry and in the vicinity of Naggery at Naglapoorum and the surrounding hills.

1,⁹. *Steel filings*, by the stone cutter is used under the name of steel dust for the first process of rubbing down the coarser rocks, and I presume they may be had in abundance in this country.

3,¹³. *Pumice of Europe*.

2. *Sand paper*.

4,¹⁵. *Jumus country*, is a red carbonate of iron used for polishing.

5,¹⁶. *Washed emery*.

6,¹⁷. *Crocus*.

6,¹⁸. *Putty or oxide of tin*.

7,¹⁹. *Rotten stone*.

8,²⁰. *Tripoli*.

1,¹⁴. *Rouge or red stuff a per carbonate of iron* imported from England and used for polishing jewellery.

MATERIALS FROM THE PROVINCES OF THE MADRAS PRESIDENCY SUITED FOR GRINDING, SHARPENING, AND POLISHING.

A MATERIALS FOR GRINDSTONES.

SANDSTONES.

CORUNDUMS.

GARNETS.

EMERY.

B MATERIALS FOR SHARPENING.

HONESTONES.

RAGSTONES.

WHETS.

C MATERIALS FOR POLISHING.

ARCOT—NORTHERN DIVISION.

$\frac{2}{3}$. *A white, hard and very finely granular quartzose rock* from the Paliaghat range. It is probably the unweathered rock of Nos. 8 and 10.

Though harder and finer than any of the sandstones in the Arsenal, it is rough to the touch and, for sharpening the finer tools, capable of being employed as a grindstone, and also as a ragstone: its presence also indicates the probable existence of other rocks that would be suitable for grinding material.

$\frac{1}{6}$. Is rough to the touch; has small picked-like cavities, and may be found suitable for grindstones. It is from Kurse Mungalum in the vicinity of Vellore where it is called *Muddy Sagapoo Cullo*. This hand specimen is not of sufficient size to admit of the character of the rock being decided on. It may be a conglomerate rock with a basis of calcareous limestone

K

74 MATERIALS FROM THE PROVINCES, MADRAS PRESIDENCY.

and portions of red felspar, silix, &c., &c., mixed up with it or it may be a porphyritic volcanic product. It looks like the rock of which $\frac{1}{2}$ is a weathered specimen. It merits further investigation.

$\frac{1}{6}$. Is a deep, brown and red rock: in its present form as a hand specimen looks like a steatitic sandstone, with portions of felspar, &c., mixed up. It is rough to the touch, and has a picked like structure. It is from *Lattary Malay* in the vicinity of Vellore, where it is called *Yellum Sagapoo Culloo*. It might be tried as a grindstone. It is probably, however, a weathered specimen of the rock No. $\frac{1}{6}$.

No. $\frac{1}{6}$. Is a hard granular quartzose somewhat rough rock taken from the Doorham Hill, South West of the Village of Callistree.

It is too hard for the ordinary grindstones—but might be found useful as a grindstone for the finer tools and perhaps, also, as ragstone. Its site might be further examined.

$\frac{1}{5}$. A greyish chert from Balapullay, in North Arcot, too hard and not sufficiently granular for grindstone: the neighbourhood might be further examined.

$\frac{2}{10}$. A hard quartzose rock from Cumbaucum Droog, in North Arcot; too hard for grindstones; but indicating the presence of other silicious rocks, which might be found suitable (See Nos. 8 and 10 next).

$\frac{3}{10}$. A rough, harsh white, and finely granular sandstone from the Paliaghat range, in North Arcot. It is a weathered sample from the surface and consequently soft and crumbly; the harder rock is probably well suited for grindstone. The site should be examined.

$\frac{4}{11}$. A granular micaceous red sandstone from the Comarasawmy Hill East of Callistree; even if it be found massive and not arranged in small layers or lamina, it would not suit as a grindstone. In connection with the other silicious rocks in the neighbourhood, it indicates the existence of rocks that might be found suitable for grindstone, and the locality deserves to be examined.

42. A brownish grey sandstone from Trichoor, in Arnee, rough and hard to the touch; seems suited for some kinds of grindstones or shoemakers' knives. This small slab would sell for $\frac{1}{2}$ a rupee in Madras.

43. Bluish grey sandstone, could be used dry or wet for all shoemakers' implements: might also be tried as a grindstone material. It is hard and rough and is from *Madavoor*, in Arnee. This would sell in Madras for $\frac{1}{2}$ a rupee.

The following specimens, viz. Nos. 44, 45, 46, 47 and 48 are from Tripputty, in North Arcot, and the letter regarding them is as follows:—

No. 3.

SIR,—With reference to the Deputy Commissary General's Circular, No. 7665, dated 11th April 1855, I

Specimens No.	Dimensions		Price.
	in Diameter	in the Width	
	F. I.	F. I.	R. A. P.
1...	3 0	0 6	14 0 0
" 2...	3 0	0 4	10 8 0
" 3...	3 0	0 3	8 12 0
" 4...	2 0	0 3	7 0 0
" 5...	1 6	0 3	5 4 0

have the honor to inform you that I have despatched this day to the Presidency by a public bearer, 5 specimens of sandstone which I procured from Tripputty, in North Arcot. I beg to enclose an original Tamil letter received from a merchant of that place together with its English

translation. On each of the specimens, a Tamil memo., as per margin, also translated, are attached.

(Signed) C. W. S. YOUNG, S. A. C. G. Vellore.

COMMISSARIAT OFFICE, C. D. VELLORE, 3d May 1855.

Translation of a Tamil letter from Goorrum Veerasawmy Chetty and his workman, Deevetty Ramen, of Tripputty, dated 26th April 1855, to the Sub Assistant Commissary General at Vellore.

" Agreeably to your instructions along with the Peon and bearer we proceeded to those parts of the Hills which abound with sandstone; and inspected the strata from which stones have been already removed. Five descriptions of stones were discovered. These have been sorted; the dimensions they can be cut, and the prices at which they will be obtained are shewn on the labels pasted on the specimens sent.

" Should stones of a larger size be required, they will not be procurable from the strata from which the small specimens now sent were obtained. It will be necessary to explore the neighbouring Hills. Should any favorable spot be found, then the jungles will have to be cut, and the harder stones removed, and when pits are made of 2 or 3 men's height in depth, the sandstone will appear, which must be cut into such shapes as are necessary. Large expense will attend this laborious work. Considering that the demand is made by Government, we have made a just estimation of the prices. It will be difficult to procure stones of larger sizes than those mentioned on the samples. If sandstones of 3 feet in diameter and 1 foot in thickness be procured (the dimensions mentioned to us by the bearer and Peon) and an increased price allowed for the same, our labour will be compensated.

" We received one rupee for 2 days' cooly hire for the 5 samples now sent. The coolies were promised batta, but it was not afterwards given."

(Signed) C. W. S. YOUNG.

26th April 1855.

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The following describes the characters of the five samples thus alluded to:—

$\frac{3}{4}$. Soft micaceous, purplish coloured sandstones—rough to the touch but fine grained; marked from Tripputty, in North Arcot; might be used dry as a whet for the smaller tools of shoemakers, &c., &c., and No. $\frac{3}{4}$ is marked as from Vellore, but it too is from Tripputty.

$\frac{2}{8}$. Samples of flesh-coloured micaceous sandstone—harder than the above, grained, marked from Vellore, but these also are from Tripputty; suited for dry whets for shoemakers' knives and awls. Each of these slabs would sell in Madras for $\frac{3}{4}$ of a rupee. The report as above states that a grindstone 10 inches thick, 2 feet diameter, would cost about 15 Rupees, but this seems excessive.

46 A nodule of rough hard yellow sandstone from near Kurkumbady; deserves examination in position.

ARCOT.—SOUTHERN DIVISION.

From the extensive tracts of fossiliferous rocks met with in South Arcot; this district will probably be found capable of furnishing from it sandstone and schistose strata, materials suitable for grindstones and hones. There has not, however, been received into the Museum any promising rock specimen and I can only mention that "immense beds of rock" are said to "occur at Verdachellum near Cuddalore, and to be quarried by the natives for rice-mills, and grindstones, while, Sadras is said to possess one of the finest quarries in the Madras Presidency, the grindstones made in which are reported to be quite equal to those imported from England."—See *Juries' Reports, Madras Exhibitions*, page 126.

BELLARY

In the Bellary District there are limestone, clay and chlorite slates, and sandstone strata of the Palæozoic? period, with solitary hills of granite rocks rising abruptly from the level country, and dykes of greenstone traversing the whole in an easterly and westerly direction.

No. $\frac{21}{8}$. Is a dark reddish brown finely granular sandstone, rough and harsh to the touch and cuts glass readily: procurable in digging about knee-deep a short distance to the southward of the village of *Neerdacherla*, and in other parts near the said village. It is employed by the people there, as a grindstone, for grinding sandalwood on, and if it can be found sufficiently massive is suited for a dry whet for the shoemakers and leather cutters' implements; might also be tried for grindstones.

$\frac{6}{8}$. Is a brick red, very finely granular sandstone, harsh to the touch, marked "from Bellary"; scratches glass freely; suited for a dry stone; might be tried as a wet grindstone.

$\frac{2}{8}$. Is similar to No. $\frac{6}{8}$, but of liver-red color. It is rough to the touch and scratches glass: is compact and not crumbly; suited for a dry stone; might also serve as a wet one: well deserves attention.

$\frac{1}{8}$. A white fine grained sandstone from Ghooty; it nearly approaches the texture of 1*, of the Arsenal grindstones, is only a little harder: well merits attention as a material well suited for grindstones.

$\frac{3}{8}$. This hand specimen of rock is rough and hard and granular, but is of insufficient size to allow a definite opinion being given as to its character. It may be a red sandstone, rendered pinny by the presence of other minerals, quartz, felspar, garnets, &c. or it may be a portion of a granitic rock. It is from a rock near *Herrial*, Bellary, and if found to be a sandstone, by examining it in position, it merits attention as a grindstone material.

$\frac{1}{8}$. A micaceous sandstone of a brick red color, from Bellary: would scarcely serve even as an inferior scythe stone or for sharpening sickles, and it is noticed here chiefly as affording indication of other rocks existing in its vicinity of a more suitable character.

$\frac{6}{11}$. A greyish brown micaceous sandstone from Bellary: may not be found useful as a dry stone or as a whet, but is an indication of more suitable rocks existing in its neighbourhood.

$\frac{2}{8}$. A hard schistose-looking silicious sandstone—found in the rivulets near Bellary. If it can be found massive it would serve for grindstones. The imperfect specimen received has a resemblance to the grindstone 1*, of the Arsenal.

$\frac{2}{8}$. A slab of yellowish grey limestone from Bellary, well suited for hones or oilstones and for lithography.

$\frac{2}{4}$. A slab of yellowish grey limestone from Bellary; well suited for hones or oilstones and for lithography.

$\frac{2}{8}$. A slab of serpentinous limestone from Bellary; suited for hones.

$\frac{2}{8}$. A slab of serpentinous limestone from Bellary; suited for hones.

$\frac{2}{4}$. A slab of blue limestone from Bellary; suited for hones, oilstones.

20. A brick red sandstone; fine grained; marked from Bellary; might be tried as a dry whet or as a sickle or scythe stone: also merits examination in position; the locality of the district not given.

13 Rough very fine grained sandstone from Bellary; merits attention.

78 MATERIALS FROM THE PROVINCES, MADRAS PRESIDENCY,

CHINGLEPUT.

One part, perhaps the greater portion, of this district consists of plutonic rocks, and another, to the north and west, around Streepermatoor, of sedimentary strata.

No. $\frac{4}{81}$. Is a conglomerate with a base of lime from Cootharampollum in the Conjeveram Talook of Chingleput. Its appearance is that of a coarse gritty sandstone, but it effervesces with acids: it would probably be found suited for dry coarse grindstones and as a grit for marble cutters; but it is mentioned here, principally because a suitable material may probably be obtained from the lateral continuation of the stratum of which this is a portion.

$\frac{2}{82}$. Is a reddish color grit, massive and solid, but of an unequal degree of coarseness in its several parts, some parts being composed of coarse round grains, others finely granular and some almost flinty like. It is from Ootramaloor, in the Chingleput Talook of the Chingleput District; other parts of the same rock might be got, suited for grinding purposes.

$\frac{3}{87}$. This hand specimen looks as if it had formed part of a conglomerate rock: it is from Chingleput and merits attention and further examination as a material for grindstones.

CUDDAPAH.

Nearly the whole of the district of Cuddapah consists of Palæozoic? rocks, clayslates, &c., the prevailing color of which is blue; limestones compact and granular, and sandstones capping the highest hills. There are very few specimens of these rocks in the Museum, but it may be stated, generally, that honestones may be had almost throughout this large district. From the few hand specimens in our possession, however, the only two that I can indicate with precision are as follows:

No. $\frac{1}{78}$. A greyish-brown, schistose-looking granular sandstone from near Chellamcoor, Cuddapah. If it be found massive might be employed for grindstones.

$\frac{2}{79}$. A bluish grey, hard, compact, magnesian limestone, from Cuddapah; suited for the very finest of sharpening stones.

32. A fine grained schistose sandstone, from Woontamitta; might be tried as a ragstone.

GANJAM.

No. $\frac{8}{159}$. A deep liver-brown colored sandstone with white streaks: quarried abundantly in large amorphous masses close to Chutterpore in Ganjam, where it is met with from 6 to 8 feet below the surface, but

it is also to be had plentifully close to the village of Nowgaum, 2 miles further away. Like other sandstones, it hardens somewhat by exposure to the air and when freshly broken it is described as having a dark violet tinge—but it has now a deep liver-brown color with a somewhat resinous lustre. It may be called dark-red colored grit; but the granules of which it is composed seem more or less water worn and minutely comminuted portions of garnet, which cut glass like a diamond.

It would form one of the most powerful of grindstones, not for sharpening but for giving form.

$\frac{1}{92}$. A granular rock from Chutterpore; rough to the touch and scratches glass; but the hand specimen is insufficient in size for an opinion to be given from it as to whether it be a granitic or a sedimentary rock indurated. If the latter, portions of the stratum may be found suitable for grindstones.

$\frac{5}{82}$. A finely granular reddish white sandstone from Ganjam: hard and rough to the touch; cuts glass freely and is well suited for grindstones.

$\frac{2}{83}$. A finely granular reddish white sandstone, from Ganjam; well suited for grindstones.

$\frac{4}{84}$. A pale flesh red sandstone from Ganjam; somewhat coarsely gritty and rather loosely aggregated. Suited for coarser grindstones.

$\frac{2}{85}$. A steatitic gneiss, from Ganjam of a granular texture; could be tried as a grindstone, if much pressed.

$\frac{3}{92}$. Small samples of hard granitic quartzose rock presenting a highly silicious appearance and rough to the touch; from Russelcondah, where these rocks are used by carpenters and others as sharpening hones. They are both well suited for dry scythe whets, and wet grindstones, and merit attention.

GUNTOOR.

Most of the specimens in the Museum from this district consist of sedimentary rocks, limestones, clay slates, and sandstones; many of the limestones are compact, some of them ornamental and fit to be used as marbles; some promise to answer as honestones, and some as lithographic stones.

HONESTONES.

Nos. $\frac{2}{144}$ $\frac{2}{145}$ $\frac{2}{146}$ $\frac{2}{147}$ Black compact limestones, suited for oilstones.

Nos. $\frac{3}{146}$ $\frac{3}{147}$ Greenish yellow colored clay slates; might be tried as hones.

Nos. $\frac{34}{148}$
 $\frac{34}{149}$
 $\frac{34}{149}a$
 $\frac{38}{151}$
 $\frac{30}{153}$
 $\frac{30}{153}$
 $\frac{40}{153}$

Lilac colored clay slates; might all be tried for honestones.

LITHOGRAPHY.

No. $\frac{68}{154}$. *Homogenous dark grey limestone*, suited for honestones and for lithographic slabs, from the compact whitish limestone rock at the south east of the village of Gottenookoola in Palnaud.

No. $\frac{51}{155}$. *Whitish grey homogenous limestone*, admirably adapted for lithographic stones and suitable for honestones; from a Hill near Dyda, in Palnaud.

POLISHING.

No. $\frac{18}{162}$. *An aluminous schistose looking rock*, seemingly decaying, and merits further examination; from Coppoonooroo in the Toomalgoodoo Talook.

No. $\frac{4}{176}$. *Grey clay slate* from Koopookoonda, 8 miles west of Vinacandah; strongly resembles the Ayrstone or snakestone used for polishing metals.

GRINDSTONES.

No. $\frac{100}{166}c$. *A rough silicious sandstone*, of a whitish colour consisting of small grains of quartz with minute striæ of hard pellucid quartz; it is hard and rough and cuts glass readily. It is described as from the Hill of Icooroo or Icoonor. The portion in the Museum is very small, but if obtainable in masses it seems admirably suited for the finer grindstones.

No. $\frac{37}{167}$. *A rough micaceous sandstone*; cuts glass readily; may be found suitable for fine grindstones; marked from Kakatee Talook.

No. $\frac{20}{168}$. *Rough hard siliceous sandstone* glistening with mica and cuts glass readily; seemingly of a schistose character and too small for an opinion to be formed of all its capabilities; it promises to be well suited for ragstone; found in a plain below Singnal pond south of Kopoocondah village.

Nos. $\frac{20}{168}$
 $\frac{20}{168}$
 $\frac{20}{168}$
 $\frac{27}{167}$
Hard semi-vetrified grits, of a yellow brick red and liver red colors, composed of a basis with particles and grains of quartz and other minerals of various sizes: these grits are apparently different portions of the same stratum or formation, perhaps all from Nullamada near Pasoomurroo in the Martoor Talook in Guntoor; they cut glass readily and well deserve further attention as a grindstone material.

No. $\frac{11}{168}$. *Homogenous fine grained clay slate*; found in slabs of a large size; abundant, $\frac{1}{2}$ a mile N. of Malepana West of Ugnigoonsala.

No. $\frac{30}{169}$. *Schistose silicious sandstone from Matoor Hill*; may be found suited for ragstone.

Nos. $\frac{20}{171}$
 $\frac{27}{172}$
Rough micaceous quartzose rocks; deserve a trial for ragstones No. 29 described as from Koopoocondah village and No. 17 from Guntoor.

No. 19 & 20 $\frac{173}{173}$ *Reddish brown hard grit* containing small cavities like millstone grit with portions of quartz of irregular size: cuts glass readily; deserves attention as material for grindstones. It is found at Yagenla or Soodapilly near Chabrole 8 miles south of Guntoor. Carvings in this stone in high relief though long exposed are very perfect.

HYDERABAD.

This large kingdom in Southern India consists partly of fossiliferous strata and of a great volcanic and a plutonic tract. The following brief notices of its sandstones and corundums are all the Museum can furnish:—

No. 3. *A brownish white very fine grained sandstone*, rough and hard; marked "*sandstone with seed vessel*;" locality in Hyderabad unknown; probably from near the Godavery river bed, received from General Fraser.

49. *Quartose rock* granular, very hard, and somewhat rough; could be used in the form of laps by the cutler or the lapidary: the portion sent is very small; the rock deserves examination in mass. The letter referring to the above specimen is as follows:—

No. 473.

TO THE COMMISSARY GENERAL OF THE ARMY, MADRAS.

SIR,

Sandstone exists in the Gawilghur range of hills close to Ellichpore. It also might be found at Kotah, where the late Dr. Bell Dated 11th April 1855. was digging for coal. Near Ellichpore it may be obtained in any quantity, and I beg to forward a specimen which I obtained from Dr. Riddell late of the Nizam's Service.

(Signed) E. WEBBE, A. C. General.

COMMISSARIAT OFFICE, Secunderabad, 21st April 1855.

KURNOOL.

The prevailing rocks in this small district are compact limestones, sandstones and clay stones, occurring in thick strata and possibly of the Palæozoic period. The whole country could furnish slaty slabs more or less suitable for honestones.

82 MATERIALS FROM THE PROVINCES, MADRAS PRESIDENCY,

$\frac{8}{80}$. A compact buff-colored magnesian limestone, from Kurnool, encrusted with arborescent-shaped manganese, suited for honestones and lithography.

MADURA.

The hand specimens in the Museum of sandstones from this district are all too small to allow of a decided opinion being offered regarding them as grindstone materials; but the following rocks presented by the Rev. Mr. Muzzy merit further attention.

No. $\frac{1}{135}$. *Granitic sandstone*, from *Varde purtty*; is a large grained quartose sandstone with black mica and portions of red garnets; the locality where this is procured might be further examined.

2. *A granitic sandstone*, decaying, from *Tovaruncoorchee*; the locality might be further examined.

3. *Granitic sandstone*, from *Catehakut*; consists of fine grains of quartz stained red with iron, with small portions of black mica; is rough and harsh to the touch and cuts glass; the locality might be further examined.

4. *A grey granitic sandstone*, from *Passumalie*; the locality might be further examined.

6. *A rough brownish micaceous sandstone*, from *Allagur covil*; the locality might be further examined.

8. *Irony sandstone*, from *Sittampurty*; the locality might be further examined.

$\frac{105}{88}$. Is described by Mr. Muzzy as *Euphotide rock*, from *Allagur covil* in Madura; it might, in want of others, be found useful as a grindstone material.

$\frac{125}{88}$. Is described by the Rev. Mr. Muzzy, as a *striped felspathic granite*. It is from *Manapara*, in the Madura district, and might, in want of others, suit as a grindstone material. Is rough to the touch and hard. Is evidently of igneous origin.

MOULMEIN.

From what is known of the Geological structure of the whole Malayan Peninsula it may be safely predicated that many sandstones will be discovered there suited to form grindstones. The remoteness of these countries, however, has only admitted of a few specimens being received from them and further search will be required for better materials than the Museum as yet possesses. I give however a brief notice of all the sandstones from that locality to guide enquirers.

Nos. 7 & 10. *Yellowish white silicious sandstone*, found in the *Tsin-goon-gee* (Island). It is hard, imparts a rough sensation to the touch; seems homogenous and well suited to form grindstones with.

$\frac{1}{37}$. *A fine grained whitish yellow sandstone*; rough and hard to the touch, from the *Tsin-goon-gee* (Island); suited for grindstones.

46. *Is a micaceous sandstone*; harsh and rough to the touch, seemingly containing iron and stealite; the locality merits attention. It is from *Thun-h-ton-don* (mountain).

52. *Coarse grit or conglomerate sandstone*, found in the *Thun-lyat-ghom* (Island).

29 & 44. *Decaying yellow sandstone*, found on the *Thun-h-ton-don* (mountain).

36. *Red micaceous sandstone*, found in the *Nhat-thike-don* (mountain).

1. A nodule of *rough hard sandstone*, with crystals of quartz; from the bed of the *Salween river*.

2. *Whitish grey sandstone*, hard and rough; admirably suited for grindstones; from Moulmein.

12. *Rough coarse white sandstone*, from near the rocky hill at the back of *Trocklah* river Salween, in which the cave is situated; if found to be homogenous and not slatey, will suit for grindstones.

25. *Soft, white sandstone*, from *Martaban hill*, Moulmein, decaying. A proper unweathered specimen would be required to judge from.

26. *Soft white sandstone*, unweathered, from *Damathat hill*, Moulmein; full of seams and thus useless for any grinding purposes.

27. *Soft white sandstone*, from *McCallay Pettah hill*, Moulmein.

28. *Soft white sandstone*, from *Taminis hill*, Moulmein.

29. *Soft white sandstone*, from *Gungo hill*, Moulmein.

30. *Soft white sandstone*, from *Amherst hill*, Moulmein.

MYSORE.

No. 6. *A quartzose rock*, from *Nugger*, composed of small grains of quartz with minute portions of black mica, called there *Kausee kull*; might be examined, in situ, to ascertain whether it be a plutonic or sedimentary rock.

12. *A coarse hard red grit*, from *Nugger*, in Mysore; well suited for grindstone. It is there used for grinding colors on, and Brahmins rub sandal-

wood on it into a powder with which to smear themselves and it is there called *Sanee kull*.

9. A fine grained yellow sandstone, rough and harsh to the touch; scratches glass readily; suited for dry whets; from Nuggur.

NAGPORE.

The sedimentary fossiliferous rocks of this district are all of the supra-cretaceous groups, and do not promise to furnish materials for grindstones. The following rocks however merit attention:—

Nos. 33 & 41. *A yellowish brown colored, hard, silicious rock*, containing portions of mica, garnets, and felspar mixed with small round grains of quartz; are more or less rough to the touch and well suited for dry whets, for scythes, &c., also for rougher tools; might also be tried as grindstones. From 10 and 15 miles west of Kamptee.

35 & 39. *Pink colored sandstone*, 6 miles west of Kamptee; useful as a dry whet for the smaller tools: might be tried as wet grindstones, for which however they do not seem suited, being somewhat soft to the touch.

40. *Sandstone yellowish white*, 6 miles west of Kamptee, softer than 35 and 39: might be found useful for dry whets, for the finer tools of the saddler, &c.

34, 36, 37 & 38. *Whitish, somewhat loosely aggregated sandstones*, 5 and 6 miles west of Kamptee; might be found useful for the finer knives of the saddler.

NELLORE.

No. $\frac{3}{8}$. *A greenish colored silicious rock*, rough and hard, from Nellore; perhaps a little too hard for grindstones; but deserves further examination.

$\frac{1}{8}$. *A fine grained reddish colored sandstone*, rough to the touch and hard; suited for grindstones.

$\frac{1}{8}$. *A fine grained reddish colored sandstone*; suited for grindstones.

$\frac{1}{8}$. *A fine grained reddish colored sandstone*; suited for grindstones.

$\frac{1}{8}$. *A fine grained reddish colored sandstone*, may be found suited for grindstones, but this hand specimen has a schistose appearance and it is, altogether too small to allow a decided opinion being formed regarding its character as a grindstone material.

$\frac{1}{8}$. *Fine grained sandstone*, mottled with small black points of another mineral: rough and suited for grindstones, for the finer implements.

$\frac{1}{8}$. *A fine grained reddish colored sandstone*, from Podily Talook, Nellore, contains silvery mica: also a yellowish colored sandstone from Podily division; suited for grindstones.

NELLORE.—Pamoor Division.

No. 104. *A granular reddish yellow rock*, from Peddy redy pully in Pamoor Division. It is rough and hard and deserves examination in its position to ascertain whether it be a plutonic or sedimentary rock, which point this hand specimen is not of sufficient size to determine.

105. *A coarse aventurine looking sandstone*, from Peddy redy pully, in Pamoor Division: deserves further examination on the spot.

106. *A coarse aventurine looking sandstone*, decaying, from Peddy redy pully in Pamoor Division; deserves examination on the spot.

107. *Decaying sandstone*, from Pamoor Division: deserves further attention.

108. *Decaying sandstone*, from Pamoor Division: deserves further attention.

109. *Flesh colored, very finely grained micaceous sandstone*, from Goomma-lumpaudo in Pamoor division.

113. *Weathered nodule of quartzose rock*, from Pamoor division; seems to be a micaceous sandstone; merits further examination.

114. *White colored sandstone*, rock decaying, and too much weathered to form an opinion. From Pamoor division.

115. *Very finely grained sandstone rock*, of a reddish grey color, mixed with particles of black mica compact and massive; from Lutchoonaucka pullay in Googoolapullay division. This specimen of sandstone by reason of the abundance of mica it contains is little adhesive and crumbly, but its vicinity might be examined.

116. *Very fine grained compact quartzose rock*, with faint black striæ, from Outlacindy pulley, in Googoola pullay: is rough and hard and seems suited for grindstones of the finer kind, but this sample is weathered and the rock would be required to be examined in position.

118. *A mottled pinny looking sandstone*, from Poonoogoontaralla pullay; deserves attention.

119. *A fine grained quartzose rock*, rough, spotted with black spots from Salamoontum, Podilay division. This rock might perhaps be found suitable for grindstone, but this specimen is weathered and decayed.

121. *Soft, fine grained, micaceous sandstone*, from Poodilay division, seems a little crumbly, but it scratches glass freely: deserves examination in position, as it might be found suited for grindstones. ●

122. *Soft, fine grained, micaceous sandstone*, from Poodilay division, seems a little crumbly, but it scratches glass readily and might be found suitable for grindstones: deserves examination.

123. *A red colored sandstone*, very fine grained: is soft and crumbly, and seems to be decaying: deserves further attention as it would perhaps be found suited for grindstones or for dry whets. From Conconama, in Poodilay division.

124. *A white very fine grained sandstone*, rough to the touch and hard; suited for the finer grindstones; from Contragoondul, in Podily division.

125. *A hard silicious sandstone*, rough and granular; well deserves attention as a grindstone material; from Contragoomah, in Podily division.

126. *A dark reddish grey sandstone*, rough and hard to the feel, but looks crumbly, being interspersed with portions of black mica; from Mahamanadapoorum, in Podily division; merits attention as rocks in its quartz may be found suited for grindstone.

127. *A whitish grey colored sandstone*, from Yetcalagoonda, in Podily division; finely grained; rough and hard: suited for grindstones.

128. *A brownish grey colored sandstone*, sparkling with fine white mica, rough and hard, almost silicious; grains fine, scarcely distinguishable, nevertheless cuts glass freely; from Podily division; merits attention for grindstones for finest implements.

129. *A decaying quartzose rock*, from Lingumpullay, in Googoolapullay division, mixed with much mica and grains of siliceous, loosely aggregated: deserves examination in situ.

130. *A fine grained streaked reddish sandstone*, from Pullaybootoo, in Choondy division, mixed with black mica but rough and hard: scratches glass; is suited for grindstones.

131. *A decaying sandstone*, loosely aggregated; mixed with black and white mica and portions of garnets decaying. From Coonootalabaloo, in Choondy division: should be examined in position.

132. *A reddish colored sandstone*, hard, but soft to the touch, probably owing to white mica being interspersed: from Mamagoontalun, in Choondy division. Is mentioned here that the locality may be examined.

133. *A greyish colored rough and hard sandstone*, composed of somewhat large grains of white quartz with much black mica and garnets, decaying; cuts glass freely; from Canootolaconda in Choondy division.

134. *Reddish colored rough coarsely granular sandstone*, mixed with black mica and small portions of garnetic sand; cuts glass readily; is suited for grindstones; from Pullybuddoo in Choondy division.

135. *A fine grained whitish grey quartzose rock*, mixed with white mica; rough and harsh to the touch; admirably suited for grindstones; cuts glass easily. It is from Woorapullen Sydapoorum Talook: merits attention.

136. *A hard very fine grain flesh red sandstone*; rough to the touch and well suited for very fine grindstones. It is labelled as procurable in the quarry north of the way of Aukullum, part of Gottaguttoo.

RAJAHMUNDRY.

No. $\frac{42}{156}$. *Fine grained, somewhat loose, reddish colored sandstone*; might be found suited for filters; from Rajahmundry.

$\frac{83}{167}$. LXXXIII. *Steatitic gneiss*, from Vizagapatam, used as a building material; but might be, on emergency, employed for grindstones.

SAUGOR AND NERBUDDA TERRITORIES.

No. $\frac{86}{166}$. *Is a lilac colored fine grained sandstone*, harsh to the feel and hard, and looks equal to the best sandstones used for grindstones. It is from Saugor in Central India.

SINGAPORE.

No. $\frac{3}{1}$. This hand specimen looks like a sandstone, which it indeed probably is. It is reddish, mottled, variegated. This hand specimen seems well suited for grindstones. It is from the mouth of the Singapore river in front of the saluting battery, where it is covered at high water.

CORUNDUM.

The corundums in the Madras Presidency are not unworthy of notice. Their applications, as grinding and polishing materials, are well known to the people who use them in mass or mixed in lac. The implements prepared by the latter process are in the form of discs for laps, or wheel grindstones; used by cutlers, &c., also in the form of whets and hones and ragstones for sharpening the finer and coarser cutting implements used by farriers, &c. The Native workmen cutlers, &c., often do not distinguish garnets from corundums calling both of these emery, though the differences between the three minerals are so marked, it is difficult to understand how they can be confounded.

The corundums of Southern India are the more deserving of notice, because they seem to replace the emery of other countries; at least I am not aware that any author has alluded to the occurrence of emery in Southern India, and the Museum does not contain any substance that Merchants would regard as identical with the Turkish or Grecian emery of commerce.

The meaning or origin of the word is not very apparent; the Mahomedans call it "corund" or "coruny" stone, and the Hindoos know it by a somewhat similar name. The first specimens sent to Europe were forwarded by the late Mr. Anderson to Mr. Berry, a lapidary in Edinburgh, as the substance used by the people of India to polish masses of stone, crystal and all other gems, except the diamond, and it was then examined by the celebrated Dr. Black who from its hardness named it adamantine spar.

Sapphire, corundum, and emery are only surpassed in hardness by the diamond. They belong to the same class of minerals, and the emery of commerce which is so extensively used in Europe and imported into this country for grinding and polishing metals, glass, &c., is supposed to be a mere variety of corundum, a mixed granular corundum; a mechanical mixture of corundum

No.	Localities.	Effective Hardness Sapphire 100.	Specific Gravity.	Chemical Composition.						
				Water.	Alumina	Oxide of Iron.	Lime.	Silica	Total.	
1	Kulah	57	4.28	1.90	63.50	33.25	0.92	1.61	101.18	
2	Samos	56	3.98	2.10	70.10	22.21	0.62	4.00	99.08	
3	Nicaria	56	3.75	2.53	71.06	20.82	1.40	4.12	99.43	
4	Kulah	53	4.02	2.36	63.00	30.12	0.50	2.36	98.34	
5	Gumuch	47	3.82	3.11	77.82	8.62	1.80	8.13	99.48	
6	Naxos	46	3.75	4.72	68.53	24.10	0.66	3.10	101.31	
7	Nicaria	46	3.74	3.10	75.12	13.06	0.72	6.88	98.86	
8	Naxos	44	3.87	5.47	69.46	19.08	2.81	2.41	99.23	
9	Gumuch	42	4.31	5.62	60.10	33.20	0.48	1.80	101.20	
10	Kulah	40	3.89	2.00	61.05	27.15	1.80	3.68	101.13	

and oxide of iron, the iron in some of the varieties amounting to 33 per cent. In the mixed corundums of Greece and Turkey the iron seems equably diffused through the mass imparting to it a bluish grey colour; but in the specimens which have reached the Museum, the corundum and ore of iron, though occur-

ring together are not mixed, but remain apart, segregated, and the corundum forming one side of a mineral and the oxide of iron, in a lump or lumps on the other side; and all of such masses are magnetic and possess polarity.

Of the different varieties of emery used in the arts that of Naxos is still preferred, as it is more uniform in its quality than that from Pulah and Gumuch: but it is believed that if the best qualities of Nicarian emery be found in abundance and such only sent to the market, they will prove equal, if not superior, to the emery of Naxos. That from Naxos is of a dark grey colour with a mottled surface and with small points of a micaceous mineral disseminated in the mass. It frequently contains bluish specks or streaks which are easily recognised as being pure corundum. When reduced to powder it varies in colour from dark grey to black, but the colour of its powder affords no indication of its commercial value. The powder of emery examined under the microscope shows the distinct existence of the two minerals, corundum and oxide of iron.

The specific gravity of emery is about 4, but its hardness is its most important property in its application to the arts; and those emeries which contain the least water, every thing else being alike, are the hardest. The silica is usually in combination with alumina, or the oxide of iron, or both, so that the quantity of alumina must not be regarded as an indication of the quantity of corundum in the emery.

In addition to the component substances of emery, others, as titanitic acid, oxide of manganese, oxide of zirconium, and sulphur, occur in some of the emeries, but in very minute quantities.

These remarks have been made with the hope that the corundums of this country may be found suitable for all the purposes to which emery is now applied. The only difference in corundum seems to be its freedom from oxide of iron, but there does not seem to be any quality given to the mineral by its presence in emery, essential to its value in the arts. This is a point however that I write with diffidence on.

In Europe where machinery is so available, there could be no difficulty in preparing corundum powders of the requisite degrees of fineness, and its preparation in this country would perhaps be the only difficulty to be overcome.* There can be no question of the great cheapness of corundum. Emery at the end of the last century was selling at from £7 to £8-10 per ton and between the year 1820 and 1835 it fell to even less than this; but a monopoly being allowed, it rose in 1846 and 1847 to £30 a ton. The discovery of other mines however at Gumuchdagh near Ephesus has caused a great reduction since then, and the selling price in London has been from £10 to £15 a ton;

* A description of the modes of preparing emery for use is appended.

what prices the several corundums of this country might bring in the London market it is difficult to say. There is no reason why the picked corundums should sell for less than the finest emeries, and Captain Newbold mentions that the corundums near Gram, when sorted into the three sorts known in commerce, viz. the *red*, the *white*, and the *scraps* of these two, are sold to the Arab merchants at Mangalore and Tellicherry at prices from twelve to fifteen or thirty rupees the candy equal to £4, £6, and £12 a ton.

Corundum seems to occur in abundance in several parts of the peninsula of India, in North Arcot, Cuttack, Coimbatore, Guntoor, Mysore, Salem and Hyderabad. The authority for its existence in North Arcot, is a specimen in the Museum of the clove-brown variety, labelled from Naggery, and for its occurring in Cuttack and Coimbatore, the statement of the late Captain Newbold, who mentions Gudjelhutti and Chennimully as the places where it is found in Coimbatore, but does not specify the locality in Cuttack. The occurrence of corundum in the Guntoor Collectorate, was first made known to the community generally by the Madras Exhibition of 1855, and Mr. Rohde, who exhibited the specimens, remarked on them as follows :—

"I am desirous that the attention of the Agency Houses should be called to the specimens of red corundum, I send. If I mistake not, experienced jewellers would pick out stones suited for common jewellery from it and the refuse cannot be worth less than £15 and £20 a ton at home."

The other district which the Madras Exhibition of 1855 showed to be producing corundum was the kingdom of Hyderabad, from which was received a very excellent sample of picked stones, possessing an irregularly crystalline structure.

Salem and the Mysore country, however, have been the longest known as containing corundum sites, some of which were described at some length by the late Captain Newbold, who mentions its occurrence in the neighbourhood of Gram, a village and fort in the Mysore country about ninety-eight miles westerly from Bangalore and lying between the latter place and the Western Ghats. The mines which Captain Newbold named, being about forty-five miles north by west from Seringapatam and about seven or eight east by north from the fort of Gram.

But judging from the specimens in the Museum there have been some other sites discovered since then, and the following places may be named as sites in Mysore where corundum occurs :—

FRENCH ROCKS.—Captain Loudon in Museum.

Golhushully, in the division of Nooghully, Newbold.

Kulkairi, in the division of Chinrayapatam.

Barkunhully, in the division of Chinrayapatam, Newbold.

Kundee, in the division of Chinrayapatam, Newbold.
Yedgunkul, in the division of Chinrayapatam, Newbold.
Norhik, in the division of Narsipur, Newbold.
Deysani Carbonhully, in the division of Banawaram, Newbold.
Appianhully, in the division of Harnally, Newbold.
Nullapardy, on the road to Bangalore, Museum.
Mundium, in the Astagram division, Museum.
Cuddoor, in the Nuggur division, Museum.
Nuggur, in the Nuggur division, Museum.

Professor Thomson is quoted by Captain Newbold as mentioning (Outlines of Mineralogy, volume 1, p. 213) that "the corundum occurs in imbedded crystals in a rock which consists, according to Count Bournon, of indianite, and contains felspar, fibrolite, several varieties of augite, and also octohedral iron ore; the hair brown or reddish brown varieties are called adamantine spar. They occur with fibrolite and octohedral iron ore in a sort of granite containing no quartz." And again (p. 256) he states, that "fibrolite is a mineral found accompanying crystals of corundum in the Carnatic, and that it is a component part of the granite, which is the matrix of the corundum of China." Professor Jameson, in his Geognosy of Peninsular India (Ed. Cab. Lib. No. VIII, pp. 349-50) gives a summary of what is known regarding the corundum of Southern India, and states that it occurs embedded in granite, and sienite in the district of Salem, in the Madras Presidency, among the mountains of Carnatic, and in other parts of the Peninsula, associated with cleavelandite, indianite, and fibrolite; but near Gram at Golhushully and Kulkairi, at which the best corundum is said to be obtained, the mineral was found to occur in decomposed beds of a talcose slate, to which gneiss is subordinate, associated with nodules of indurated talc, and of a poor quartz iron ore; asbestos, chlorite, actinolite, and schorl were found in the talcose slate.

The formation around Gram, continues Newbold, is gneiss, p. 18, line 8 down to page 22, line 3, Hari Ram.

SALEM CORUNDUM.

In the Salem district also Newbold mentions that this mineral occurs embedded in gneiss and a greyish earth resulting in part from the disintegration of that rock. The places named by that enquirer and the sites from which the specimens in the Museum have been received, are as follows :—

Nammaul. } On the north bank of the Cauvery, in the Permutty talook.
Viralmodos. } —Neub.

Sholasigamany.* Trichingode Talook, near the village in a low hill in great abundance.—Neub.

* Probably Scholaserameny.

CORUNDUMS, EMERIES AND GARNETS.

Caronell, Aupore, Mallapollye and at various localities up the river Cauvery as far as Corcorambodi, when it is dug by the natives in the fields, and there are remains of many ancient excavations still to be traced.—Newbold.

Gopaulchetty pollium, 50 miles north of Salem Museum.

Yalaneeerry Museum.

Coundapady Museum.

Captain Newbold also mentions that fine rubies have from time to time been discovered in many of the corundum localities just enumerated, associated with this gem, particularly in the gneiss at Viralimodos and Sholasiramany, and the natives informed him that it occurs in the Trichingode talook and at Mallapollye, though comparatively speaking rare.

NORTH ARCOT.

34. *Iron garnets from Naggery hills*: sold in Madras as emery.

$\frac{1}{12}$. *Clove brown corundum* of good quality, said to be from *Naggery hills*. This does not possess the granular structure of emery, but in color it *resembles* emery more than any other of the corundums in the Museum.

No. 2. *Cockineal red garnet*, from *Naggery hills*.

MYSORE.

$\frac{1}{16}$. *Tabular corundum* of good quality, from Mysore.

$\frac{1}{17}$. *Tabular corundum* from *Nullapardy* in *Mysore*: on the road to Bangalore the corundum and iron ore separate layers, the ore magnetic; a good sample of the segregation in this country.

$\frac{6}{31}$. *Corundum of a dark grey color*, from *Mundium*, Astagram division of Mysore.

$\frac{5}{34}$. *Corundum in irregularly hexagonal crystals*, from near Cuddoor in Nuggur division of Mysore.

$\frac{5}{26}$. *A nucleus of corundum*, enclosed in portions of schorl, &c.; from Cuddoor.

$\frac{5}{26}$. *Hexagonal crystals of grey corundum*; from Cuddoor.

$\frac{5}{27}$. *Amorphous masses of blue corundum*; from Cuddoor with schorl.

$\frac{1}{18}$. *Corundum of a cubical form*; from Cuddoor.

$\frac{1}{18}$. *Massive corundum*; from near Cuddoor.

$\frac{1}{18}$. *Dark colored irregularly formed corundum*; from Cuddoor.

$\frac{1}{32}$. Long irregularly formed spinel-like crystals called *Butel kull*, from Nuggur; used there for brightening and polishing arms.

$\frac{2}{33}$. Coarse corundum called *Koorung kul*, from Nuggur; used there for cleaning and brightening metals.

NUGGUR DIVISION OF MYSORE.

$\frac{2}{32}$. *Corundum in large amorphous and semi-crystalline masses*; from Cuddoor.

$\frac{2}{33}$. *The corundum associated with lime* and having schorl interspersed; from Cuddoor.

b. *Massive granular corundum* from Cuddoor in Nuggur; imbedding also small portions of a dark colored mineral, either darker corundum or emery; if the latter: it does not resemble the emery of commerce.

a. *Massive corundum with lines* crossing and arranging into small cubes fracturing on its laminæ; from Cuddoor in Nuggur.

No. 21. From *Aroomully* in *Kaukumhully Talook*: *irregularly crystallized masses of corundum*, of a bluish color.

18. From *Mundium*; a *cubical mass of bluish grey corundum*.

19. From Cuddoor; irregularly shaped masses of a bluish grey corundum.

Nos. 23 & 24. From *French rocks*.—An irregular amorphous mass of a reddish pink corundum, also a grey corundum with reddish reflections united to a portion of bluish black glistening mineral resembling the Turkey emery which seems to be a magnetic iron ore, with polarity. A good instance of the segregation which occurs in this country of the two minerals.

1. From French rocks; two amorphous masses of common corundum stone.

SALEM.

$\frac{3}{8}$. *Tabular corundum*, of second quality, from Salem.

$\frac{7}{7}$. *Tabular corundum*, of third quality, from Salem; not granular but of the color emery.

$\frac{8}{8}$. *Granular corundum*, in tabular masses, inferior quality, from Salem.

$\frac{10}{9}$. *Magnetic iron ore, imbedding corundum* of good quality, from Salem.

$\frac{10}{10}$. *Mixed red corundum*, mixed with lime, from Salem.

$\frac{11}{11}$. *Corundums mixed with lime*, from Salem.

$\frac{11}{11}$. *Corundum from Salem*, in seams in tabular masses of inferior quality.

$\frac{12}{12}$. *Red corundum* of good quality from Salem.

4. Samples of *Scholaseramanie corundum*, of a dark grey color; seemingly picked and mostly in the form of hexagonal crystals.

2. *Corundum stones*, from *Scholaseramanie*; the crystalline character of which is less marked; unpicked.

$\frac{2.3.3}{3.1}$. Blue hexagonal corundum from *Scholaseramanie*; 40 miles south-west of Salem; cleaned.

$\frac{2.3.1}{1.9}$. *Corundum* smeared with lime, from *Gopaulchetty pollium*; 50 miles south west of Salem.

$\frac{2.3.2}{3.0}$. *Red hexagonal corundum*, from hills near Salem.

3. *Small portions of corundums*, from Yalaneeberry.

$\frac{2}{3.7}$. *Corundum* in small transverse sections of hexagonal crystals, many of them assuming the green color of beryl, from Yalaneeberry, Salem.

$\frac{1}{3.6}$. *Amorphous masses of corundum*, from *Coundapady*.

5. *Small irregularly formed portions of Coundapady corundum*.

No. 1. *Corundum stones* unpicked; of an irregular hexagonal crystal; from *Coundapady*.

TRAVANCORE.

$\frac{1}{1.6}$. *Corundum of good quality* in limestone, from Travancore.

GARNETS.

The garnet is classed amongst gems, but only one variety is of value, and inferior kinds are so plentiful, that, in some parts of Germany, they are even employed as a flux in smelting iron.

In Southern India they are almost universally employed by the cutler, the stonemason, and others, as a substitute for emery, under which name the coarser garnets are sold in the bazaars. Unlike corundum, however, the hardness of which is only inferior to the diamond, and ranks ninth in the scale of hardness, the garnet is only 6.5 to 7.5 in degree.

Garnets are of various colors, a circumstance due to the varying proportions and combinations of the three or four silicates of alumina, lime, iron and magnesia, of which they are composed. The precious garnets are of a clear, deep red, and on account of their depth of color are cut by the jeweller quite thin. It is this thin stone which is now termed the carbuncle and it is supposed to be identical with the hyacinth or essonite or hessonite.

The varieties of garnet are as follows:—

1. Almandine or noble garnet.
2. Grossular garnet.

3. Cinnamon stone, hessonite or kaneel stone; romanzonite; hyacinth.

4. Common lime garnet.

5. Magnesia garnet.

6. Iron garnets.

7. Common iron garnet; rothoffite; allocorite.

8. Melanite; pyreneite.

9. Colophonite.

10. Uwarowite.

11. Pyrope, almandine, hexahedral garnet.

12. Helvine or tetrahedral garnet.

13. Idocrase or pyramidal garnet.

Garnets are very abundant in many parts of Southern India. From the samples in the Museum, it may, I think, be confidently stated, that they occur chiefly in the mica schists. Captain Newbold indeed mentions its geognostic position to be the hypogene or metamorphic schists, more particularly near the line of junction with the plutonic rocks or trap dykes; and he mentions the crystalline and metaliferous areas of Salem and Nellore as the localities whence the finest crystals are procured and sold by the Native merchants at an insignificant price.

At Sankerrydroog, in the Salem district, green garnet is found in considerable quantities, associated with other green crystals in quartz veins penetrating hornblende schist. The latter is associated with gneiss, garnet rock, actinolite schist, and altered limestone, thrown into disorder by the intrusion of a porphyritic granite.

The same author mentions that colophonite, a variety of this mineral, is not uncommon in these tracts, as also in Mysore, the Neilgherries, the Carnatic and other provinces of Southern India, where, he says, it usually occurs in the granite associated with the hypogene schists. He, likewise, mentions that cinnamon stone or essonite, a beautiful variety of dodecahedral garnet, has been discovered by Dr. Benza near the seven Cairres hill on the Neilgherries, in the hypogene hornblende rock, where then number is such that entire portions of the rock are formed almost exclusively of them.

In the Hyderabad dominions, at Gharliput, about 8 miles south of Palm-sah, a mine of precious garnet occurs in the detritus of a granitic rock penetrated by trap dykes and composed of mica, garnets, kyanite quartz and felspar. Dr. Voysey states (*Asiatic Journal of Bengal*, volume II, para. 404) that the precious garnets are found in the alluvium at the foot of the rock, at the depth of eight or ten feet, and that the garnets when collected are gently pounded and the

bad ones broken, those which survive the blows being reckoned of good quality; garnets of a very coarse kind were strewed in great profusion over the surface of the rock and soil

MYSORE.

- 26. Garnets from near Mysore.
- 25. Garnets from near Mysore.

CANARA.

- 9. Garnets in mica schist from Kootherymoog mountain.
 - 3. Mica schist containing garnets from the Yalaneeer ghat, two thousand feet high.
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APPENDIX B.

ON ABRASIVE AND GRINDING MATERIALS BEING EXTRACTS FROM HOLT-ZAPFFEL, VOL. III ON ABRASIVE AND MISCELLANEOUS PROCESSES WHICH CANNOT BE ACCOMPLISHED BY CUTTING TOOLS.

On examination of the various abrasive processes, and of which grinding for the production of form, and polishing for the production of surface may be considered as the extremes, it will be seen there are in every case of abrasion three distinct points to be considered:

First. The substances that are to be ground or polished.

Secondly. The materials or abrasive powders by the successive employment of which different substances are polished.

Thirdly. The tools or apparatus by the agency of which abrasive substances are applied to the objects to be ground or polished.

Much variety necessarily exists under all three of these heads, and some times the very same substance may be referred to all of them; for example, glass is frequently polished, as in plate glass, cut glass, and lenses. Glass is frequently used as a polishing material when pulverized and glued upon paper; and glass is also frequently used by watchmakers and some other artizans, as a tool or rubber through the medium of which, some of the polishing powders are applied to metal works in the act of polishing them.

The same thing may be observed of iron. This metal in its various metallic forms is continually ground and polished. An iron disk is used with diamond powder under the name of a skive, as the lap whereby diamonds for jewellery are polished, and iron when reduced to the form of the peroxide or crocus, is used for very many purposes in the arts, and amongst others for polishing the specula of reflecting telescopes.

The grinding and polishing materials used in the arts will be found principally to consist of carbon, alumina, and silex, in various degrees of crystallization and admixture, and usually combined with the oxide of iron and some other substances as may be seen by their comparative analyses given in the annexed:

TABLE OF THE ANALYSES POLISHING MATERIALS.

	Car- bon.	Alumi- na.	Silex.	Lime.	Iron.	Authorities, &c.
(1) Diamond.....	100					
(2) Sapphire.....		98.5				
Ruby.....		90.0	7.0	0.5	1.0	Klaproth.
Corundum.....		86.5	7.0		1.2	Chenevix.
Emery of Naxos.....		86.5	3.0		4.0	Chenevix.
Emery of Jersey.....		53.83	12.66	1.66	4.0	Tennant.
Rottenstone.....	100	86.0	4.0		24.66	Vanquelin.
(3) Flint.....		02.5	98.0	0.5		R. Phillips.●
Tripoli.....		10.0	90.0		0.25	Water 1.0; Klaproth.
Tripoli.....		1.5	81.0		8.0	Trace of iron and lime.
Polishing slate.....		4.0	83.5	8.5	1.6	Water, &c., Sulph. 8.5; Bucholz.
Polishing slate.....		7.0	66.5	1.25	2.5	Water 9.0; Bucholz.
Bohemian stone.....		1.0	79.0	1.0		Water 19. Magnesia 1.5; Klaproth.
Turkey hone.....		3.33	72.0	13.33	4.0	Water 140; Bucholz.
Pumice stone.....		16.0	70.0	2.5	0.5	Carbonic acid 10.33; Hon.
(4) Oxide of iron.....					69.22	Potash 6.5 water 3.0; Berthier.
Oxide of tin.....						Oxygen 30.78; Berzelius.
Chalk.....				56.5		Tin. 78.34, oxygen 21.66; J. Davy.
						Carbonic acid 43.0, water 0.5; Bucholz.

and moulded into form; wax and crocus similarly mixed are used in optical works amongst ourselves; and of late years emery has been reunited into factitious stones. But metal, wood, paper, leather, cloth or bristles, are the more common implements or vehicles, by aid of which the several powders are applied in a variety of ways; after the powders have been carefully separated into grains of similar magnitude, the sizes of which must be proportioned to the perfection of the surface to be produced, and with a gradual transition from coarse to fine. This succession is adopted upon the same principle as that in filing; a coarse file is first used, because it may be made to act rapidly; but as the form of the work becomes gradually developed, a second cut file, a smooth, and lastly a superfine file is used, and which progressive mode of action is in no case more distinctly seen in works of polishing, than in the manufacture of a highly finished razor, which is described under the head cutlery in the following catalogue.

The polishing the harder metals and mineral substances. Alumina when

decomposed, is the basis of most of the clays and loams some of which under different names, are likewise used in abrasive processes. It is fortunate for the mechanical arts, that emery, which is nearly the hardest and most useful of all abrasive substances, is also found in sufficient abundance to serve for every required application.

Silex, in its crystalline form, and variously coloured, assumes the names of quartz, amethyst, rock crystal, flint, agate, and when in a disintegrated state, that of sand. Silex, with the addition of a little alumina and foreign matters, constitutes also the major part of the abrasive materials known as grit or grindstones, rubstones, hones and slaty stones, pumice stone, tripoli, and some others, all of which are softer than those mineral substances which are composed principally of alumina.

Of the siliceous abrasives, the gritty and slaty stones are very largely employed in the formation and sharpening of tools; pumice-stone, tripoli, and others for polishing metallic and other substances softer than those which, from their superior hardness, require the employment of emery and rottenstone, abrasives that have alumina for their common base.

To those abrasive materials of which carbon, alumina, and silex form the base, may be added the oxide of iron used under the names of crocus and rouge, and the oxides of tin and lead, or putty powders; these are artificially prepared; and a few mineral substances of no great importance as abrasives are used without any preparation, such as lime and chalk.

Thirdly. On the tools or apparatus, by the agency of which abrasive substances are applied to the objects to be ground or polished.

Some of the abrasive substances are employed in the solid forms in which they are first obtained, as the grindstone, oilstone, hones, charcoal, Dutch rush, and fish-skin; a few are pulverized and mixed with various cements: thus the effective grindstone and razor hone of the Hindoo or corundum mixed with melted gum lac and carbon in its purest and most crystalline form constitutes the diamond, the hardest substance in nature, and which in the pulverized state is variously employed; as, for example, in the polishing of diamonds for jewellery; in the configuration of the rubies and sapphires used for the pivot holes of watches and chronometers; diamond powder is also used by the lapidary in slitting all stones; of course including even those which admit of being polished by abrasive powders of inferior hardness to the diamond. Carbon, in another of its conditions, also constitutes charcoal, and which, probably from the minute particles of silex disseminated throughout its substance, is employed in polishing copper and others of the softer metals.

Alumina when highly crystallized is the basis of the ruby, sapphire, and other gems which are next in hardness to the diamond. This earth, with the

addition of a little silex and iron, constitutes the principal part of corundum, emery, and rottenstone; abrasive materials that are largely employed in grinding and polishing. The grinding powder is of course always harder than the substance to be ground, whereas the implement or grinding tool is softer and generally agrees in form with the analogous cutting or moulding tools, used for producing work of corresponding shapes in other substances, as practised in different branches of the mechanical arts. Thus turned works are often polished with blunt factitious turning tools of wood supplied with the powders; flat works require artificial saws, files, and planes; a convex surface requires a concave grinding tool, and so on.

ALUMINA.—In a compact or crystalline form is the base of some very hard mineral substances used in the arts, namely, emery, corundum, sapphire and ruby, of which it constitutes from $86\frac{1}{2}$ to 98 per cent: these are only exceeded in hardness by the diamond.—*See the table, page 1029.*

BLOODSTONE.—In a very hard, compact variety of hæmatite iron ore, which when reduced to a suitable form, fixed into a handle, and well polished, forms the best description of burnisher for producing a higher lustre on gilt coat-buttons, which is performed in the turning lathe by the Birmingham manufacturers. The gold on Chinaware is burnished by its means. Burnishers are likewise formed of agate and flint; the former substance is preferred by book-binders, and the latter for gilding on wood, as picture-frames, &c.—*Knight.*

BOB.—A familiar name used at Birmingham, for small leather-polishing wheels, with rounded edges, each made entirely of a thick piece of bull-neck, or sea-cow leather, perforated to receive the spindle, and used in polishing the inside of the bowels of spoons and other articles.—*See Wheels, Article 52.*

BOULDERING-STONE.—This name is applied by the Sheffield cutlers to the smooth translucent flint pebbles, found in gravel pits, with which they smooth down the faces of buff and wooden wheels, by abrading any large grains of emery, or other powder contained on their surfaces.—*See Wheels, Articles 43 and 44.* The bouldering-stones are usually selected of about the size of a hen's or pigeon's egg, and of a flattened form; and the flat side becomes gradually worn down and smooth from its continual application. The term appears to be derived from the provincial use of the word boulder, to denote the round stones used in paving, whence, also, boulder-setter or pavior.

Metal laps are "bouldered down;" first, they are supplied with a little emery and oil, which is spread with the fingers, and then pressed into the metal and worn down fine and smooth with the bouldering-stone, and wood laps are first anointed with flour emery or fine flour emery; they are then well bouldered, and are, lastly, waxed by holding a small piece of wax against the revolving wheel; these processes greatly reduce the cut of the powders, and

unless the bouldering-stone is plentifully applied, the colour or high gloss cannot be produced on the works.

CLOTH.—Is extensively used as a vehicle for polishing powders of all kinds; woollen and felted cloths are the most in requisition; some of the felted cloths used for marble, glass, &c., and which are called nap, are upwards of half an inch thick. Thinner cloths, such as the stout cloths used for great coats and for the blankets of printing presses, are also employed especially when discarded from their original purposes, and also ordinary woollen cloth, including the list, or selvages and so on.

Old worsted stockings are used in many trades; linen and cotton cloths and rags are also employed, but, from being thinner, are less generally used than woollen cloths.

BRUSH WHEELS.—Circular revolving brushes are used with various polishing materials.—*See Wheels, Articles 65 and 66.* Hand polishing brushes are also used, which are made almost like nail brushes, but many of them are longer, narrower, and also softer, especially such as are used by watchmakers, jewellers and others.

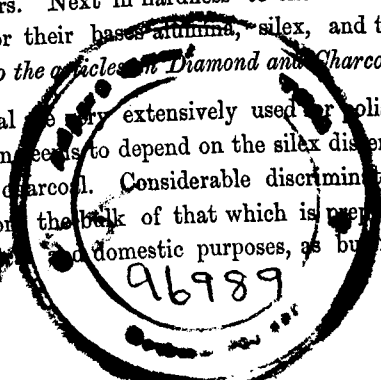
BUFF LEATHER.—Is used in various ways for polishing; it is glued on the circular edges or plane surfaces of wooden polishing wheels and used with coarse emery, crocus, rottenstone and other powders.—*See Wheels, Article 5.*

BUFF STICKS.—Are parallel rods of deal upon which strips of buff leather are fixed, either by means of glue, or by folding the leather around the ends, and securing it by iron tacks. The buff sticks are principally used with crocus and rottenstone, both with or without oil, and for most of the metals as well as various other substances; in some few cases the buff stick is moistened with water.—*See Tortoiseshell.*

CAP.—A term used by many of the Sheffield cutlers to designate wooden wheels, capped or surrounded with a ring of metal to constitute laps, the edges only of which are used.—*See Wheels, Articles 37 to 47, where their construction and application are described.*

CARBON.—When highly crystallized, as in the diamond, is the hardest substance in nature, and cuts all others. Next in hardness to the diamond are those mineral substances having for their bases alumina, silex, and the metallic oxides of iron and tin.—*See also the articles on Diamond and Charcoal.*

CHARCOAL.—Sticks of this material are very extensively used for polishing several of the metals, and the action seems to depend on the silex disseminated throughout the substance of the charcoal. Considerable discrimination is required in the selection of pieces from the bulk of that which is prepared for domestic purposes, as but few from small green wood for metallurgical purposes.



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pieces possess the requisite cutting quality; the workmen generally try it either on the teeth or finger nail.

The stick of charcoal is applied at an angle of about 40 or 50 degrees to the work, the position best suited to every piece being found by trial. Some pieces will cut rapidly and coarsely with water, others more slowly and smoothly with oil, and pieces of good quality are very highly prized by workmen. Some artizans conceive that charcoal cuts more greedily when moistened with vinegar, but which fluid is objectionable as it stains the metals.

In the course of polishing, the charcoal picks up the abraded particles of metal; they sometimes enter its pores, and would scratch the work if allowed to remain on the charcoal; consequently two pieces are mostly used; the one merely to clean, the other by rubbing them together at their ends in the same manner that the painter rubs two lumps of pumice-stone together to clean their surfaces. In finishing delicate works and laying the grain, abundance of oil or water should be used, so as to float off the minute particles of metal removed in the process.

The charcoal prepared from the wood of elder appears to have the decided preference especially for polishing the steel and copper plates used by engravers, both in their first preparation, and in the removal of the burrs thrown up by the graver. To ensure the possession of the true sort, it is recommended to obtain the waste pieces of elder from the rule-maker, to cut them into short pieces, and then to burn them in a crucible filled with sand, in order to exclude the air, otherwise the entire substance of the wood may be burned to ashes; the kitchen or forge fire may be used, and the crucible should be allowed to cool in the embers.

The charcoal made from willow truncheons, is described as being much in esteem by the manufacturers of copper plates for engravers; and elm wood is also stated by Mr. Thomas Gill as being suitable for making the charcoal for polishing.—*See Tech. Repos., Vol. II, p. 264.*

DUTCH RUSH, or the *equisetum hyemale*, is said to be a native of Scotland, and to thrive best in the marshy places in mountainous districts; it is gathered in pieces two or three feet long, which are intersected by knots at distances of four to six inches. The rush is usually of the size of a writing quill, of a greenish-grey colour, with a groovy surface that feels rough like fine glass paper, from the quantity of *silex* disseminated throughout its exterior surface, and upon which circumstance depends its suitability to polishing hard woods, alabaster, marbles, and some other substances. According to the analysis of Sprengel, Dutch Rush, when dry, contains rather more than 13 per cent of ashes, viz. *silex*, 6.38, carb. lime, 5.51, potash salts 79, and alumina 46.

For the application of Dutch Rush, see Wood, Article 5, and Alabaster, Article 1.

FAYRER'S SWING HONE.—This is a flat and parallel slip of brass, in form like a hone, but with pivots at the ends by which it is suspended in two notches, so that this metal lap or factitious hone, may accommodate itself to the angle at which the razor or other instrument is applied to it; the one side of the brass is first used with fine oilstone powder and oil, afterwards the second side with pulverised water of Ayrstone and oil, and the razor strop is afterwards resorted to.—*See Trans. Soc. of Arts, Vol. 48, p. 248.*

DIAMOND.—This remarkable and most useful gem has been considered at some length in the first volume, pages 175-180; first as regards the processes of splitting, cutting, and polishing diamonds for jewellery; then its use in the hands of the glass-cutter and glazier; and, lastly, several of the uses of the diamond as tools, and which applications include the formation of the jewelled holes of ruby and sapphire for watches and chronometers, every process of which requires the intervention of the diamond.

In this place it is proposed to describe the three different modes in which the diamond powder is prepared for the use of various artizans, as the subsequent chapters will treat of its practical application by the lapidary gem, engraver, and others.

DIAMOND POWDER FOR LAPIDARIES' USE.—Lapidaries generally purchase small imperfect diamonds, and the fragments removed by splitting or cleavage, in preparing stones for jewellery. These fragments are crushed in a hardened steel mortar with a cylindrical hole about half an inch diameter, and nearly two inches deep; the bottom of the cavity is hemispherical or constitutes perhaps the third part only of the circle; the pestle almost fits the aperture of the mortar and is curved to the same degree; there is also a cover that fits a recess in the mortar to prevent the escape of any of the valuable dust.

The pestle is struck a few blows with a light hammer, and is twisted round between each blow; this readily crushes the diamond, which, although so incomparably hard, is brittle from its crystalline structure. The fragments are carefully collected, and mixed with a little of the oil of brick, in a small cup or any convenient vessel which should have a cover to keep the prepared diamond from being wasted. When not wanted for immediate use, the prepared diamond is kept in a pasty condition between two very small watch glasses, cemented with soft wax around their edges.

2. DIAMOND POWDER FOR SEAL ENGRAVERS.—This is required to be much more finely pulverised than for lapidary work; therefore having been crushed as above, the fragments are ground into a thick paste, with a few drops of olive oil; in another pestle and mortar of hardened steel, the surfaces of which are both exactly spherical with a curvature of from one to two inches radius; this mortar has a tin cover that it may serve as the recipient for the powder which

has been ground. Sometimes for reducing the powder after it has been crushed, flat grinders of hardened steel are employed, but these are less generally used than the spherical form. Rough diamonds of a dark steely colour are generally selected by the seal engravers, as these are considered the hardest stones.

3. **DIAMOND POWDER FOR WATCH JEWELLERS.**—These artizans who use much larger quantities of diamond powder than the above, for cutting as well as for polishing rubies, sapphires, and topazes, pursue a different method. They purchase the fine dust, or diamond bort, that is rubbed off stones, used for jewelry in the act of cutting them into facets, in which process two diamonds are operated upon at once, and caused mutually to abrade each other in forming the one facet on each stone.—*See Vol. 1, page 176.* The diamond bort is usually washed for its separation into two or three sizes, exactly after the manner of washing emery, except that the process is carried on upon a very much smaller scale, and the finest olive oil is used instead of water; the diamond powder is generally laid by under a stratum of oil to prevent waste; oil is employed because of its viscosity; it does not allow the diamond to subside so quickly as water, and it is, moreover, the fluid always employed in the using and preservation of the diamond by these artizans.

4. The application of diamond powder to the splitting or sawing of minerals will be described in Chapter xxxiv, on lapidary work. The coarser diamond powder used for grinding or cutting is generally burnished into the surface of the iron lap or skive of the diamond worker, and frequently also into the iron, copper, or other laps used by different artizans. In cutting sapphires the lapidary works the diamond powder into the copper lap, with a smooth piece of agate applied with gentle pressure. The finer diamond powder used for polishing, is simply applied on the surface of the tools with the finger, or a small flattened wire used as a spatula. The gem engraver puts the diamond in minute hollowed disks of tin, two of which in fact are soldered to a strip of tin and worn on the forefinger of the left hand as a ring; the one disk, of half an inch diameter, contains the mixed diamond paste; the other disk, one or two drops of the oil of brick, with which the tool is frequently lubricated.

5. **FICTITIOUS DIAMONDS.**—The white sapphire is sometimes used in jewellery as a substitute for the diamond, and the zircon is said also to be so employed when deprived of its colour by heat: the so-called Bristol diamonds are crystals of quartz cut and polished, but those imitations which are considered to come the nearest to real diamonds, in point of luster or colour, though not in hardness, are met with amongst the pastes of the first quality, which are made artificially, and polished on pewter wheels with rottenstone, and not on copper wheels, like most of the hard gems.

CORUNDUM—Includes very dissimilar minerals, all consisting almost en-

tirely of highly crystalline alumina, namely, precious corundum, or the sapphire and ruby, common corundum and emery. The last two are the common abrasives of the Asiatics and Europeans respectively; and all are separately described under their respective heads in this catalogue.

1. *Common corundum*, says Phillips, probably from its texture, has received the name of imperfect corundum; and from its hardness, and from its occasional pearly lustre, adamantine spar: it occurs everywhere from China to Bengal, and is met with of various colours, but more often of a greyish or greenish tint. Corundum is much used in India for corundum wheels and rubbers, the methods of constructing which are described in the following articles.

2. *Corundum wheel*.—"This kind of lapidaries' wheel is called in the Tamil language corundum-sane. It is composed of corundum, more or less finely powdered, cemented together by lac-resin; the proportions, by volume, consisting of two-thirds of powdered corundum, and one-third of lac-resin. The corundum powder is put into an earthen vessel, and heated over a clear fire; and when of a sufficient heat (which is ascertained by a small piece of the resin readily fusing), the resin is added in portions, carefully stirring at the time, to form an intimate mixture. When made into a mass, it is put upon a smooth slab of stone, and kneaded by beating it with a pestle; it is then rolled upon a stick, re-heated several times, continually kneading it until the mixture is perfectly uniform. It is afterwards separated from the stick, laid again upon a stone table which has been previously covered with very fine corundum powder, and flattened into the form of a wheel by an iron rolling pin. The wheel is then polished by a plate of iron and corundum powder, and, finally, a hole is made through the middle of it by a heated rod of copper or iron." "The wheels are made with a grain more or less fine, as the coarser perform the first rough work, and the finer cut the stone. They are mounted on a horizontal axis, and the workman, sitting on the ground, makes them revolve with a spring bow, which he moves with his right hand, at the same time holding the stone with his left against the wheel, the latter being, from time to time, carefully moistened and sprinkled with corundum powder. The polish is given by wheels of lead and very fine corundum powder."

3. *Corundum Rubbers*.—"The proportion generally used in making the corundum rubbers are, for the coarse, lac 8, corundum 1; for the medium, lac 12 to 16, and corundum 1, by weight. The fine rubber is made by mixing the grindings of agates, cornelians, and the like with lac; and as the lapidary's wheels, upon which they are ground, are made of corundum and lac also, the grindings must contain a portion of those materials; their proportion, in composition, must vary according to the nature of the stone from which they are ground; but 6 of lac to 1 of grindings, may be considered a good proportion generally.

"The lac is first melted, and the corundum, after it has been reduced to a powder, mixed intimately with it. The composition is then moulded in the shape of a brick about $6 \times 4 \times 1\frac{1}{2}$ inch, with a handle of wood about 6 inches at one end, having a rise of about 30 degrees for the convenience of working it.

Some dentists employ old files thinly coated with a cement of emery and shell lac, in finishing the enamel or mineral teeth. The incorporation of the materials is greatly assisted when the emery or corundum is heated to the melting point of the gum-resin.

EMERY.—1. Ordinary Preparation of Emery.—The following is the manufacturer's ordinary process; the lumps of emery stone are broken up precisely after the manner of stone for repairing macadamized roads, and into lumps of similar size. The lumps are then crushed under stampers such as are used for pounding metallic ores, and driven by water or steam power; the stampers are considered to leave the particles more angular than they would be if ground under runners, a mode sometimes employed. The coarse powder is then sifted through sieves of wire cloth, which are generally cylindrical, like the bolting cylinders of corn mills, but the sieves are covered with wire cloth, having in general about 90 to 16 wires to the inch. The following table shows the number of wires usually contained in sieves, and the names of the kinds respectively produced by them:

16. Corn emery.	60. Coarse flour emery.
24. Coarse grinding.	70. Flour.
36. Grinding.	80. Fine flour.
46. Fine grinding.	90. Superfine flour.
53. Super grinding.	

No. 16. Sieve gives emery of about the size of mustard seed; and coarser fragments extending nearly to the size of pepper corns, are also occasionally prepared for the use of Engineers.

The sieves have sometimes as many as 120 wires in the inch; the very fine sizes of emery are, however, more commonly sifted through lawn sieves; but the finest emery that is obtained from the manufacturers, is that which floats in the atmosphere of the stamping room, and is deposited on the beams and shelves, from which it is occasionally collected.

The manufacturers rarely or never wash the emery, which is mostly done by the glass workers, opticians, and such others as require a greater degree of precision than can be obtained by sifting.

2. *Washing emery by hand.*—Washing-over or elutriation, as the process is called by chemists, is a valuable application of the law of gravity to the chemical, metallurgical and mechanical arts. Thus the alluvial deposits of some of the tropical rivers are washed for the separation of the particles of gold they

contain. A small portion of the mud of the river is stirred in a large quantity of water contained in a broad shallow basin, the gold being several times as heavy as the earthy particles quickly subsides, and the mud which remains suspended for a long period in the water, is removed by pouring off the water from the valuable sediment.

In a similar manner the particles of emery and other powders may be separated according to their magnitudes, in a more accurate manner than can be accomplished by sieves. A portion of emery powder of uncertain size is thoroughly well mixed in a large quantity of water, as in a common wash-hand basin, and at the end of 10 seconds the liquid is poured off from the sediment which has fallen down in that period; the sediment is laid aside in a separate vessel. The bulk is again stirred and poured off at 10 seconds, and this second sediment added to the first, and which process is repeated until no further sediment is deposited in the period of 10 seconds; the process requires watchfulness and a steady hand. A fresh deposit is similarly collected from the residue after a longer period of rest, say 20 seconds, until the whole quantity of emery is divided into grains of so many sizes, as may be required for the particular branch of manufacture for which it is intended; thus—

3. *Emery for the construction of Mechanism.*—The author has been for many years in the habit of employing emery of twelve degrees of fineness, part of them prepared by himself by washing over, namely:

No.	1. Corn emery of commerce prepared by sifting.
"	2. Grinding "
"	3. Fine grinding "
"	4. Superfine grinding "
"	5. Deposited at the end of 2 seconds.
"	6. " 5 "
"	7. " 10 "
"	8. " 20 "
"	9. " 60 "
"	10. " 3 minutes.
"	11. " 15 "
"	12. " 60 "

The emeries of the sizes 5 to 12 are preserved in glass bottles, to prevent them from becoming accidentally mixed or contaminated with foreign substances.

4. *Emery for optical purposes.*—Mr. Ross mixes four pounds of the flour emery of commerce, with one ounce of powdered gum arabic, and then throws the powder into 2 gallons of clean water. He collects deposits, as above described, at the end of 10 seconds, 30 seconds, 2 minutes, 10, 20 and 60 minutes, and that which is not deposited by one hour's subsidence is thrown away as useless for grinding lenses. The use of the gum arabic, which renders the water slightly

viscid, was recommended by Dr. Green for preparing red oxide of iron, for polishing specula.—*See Trans. Soc. of Arts, Vol. L, p. 152.*

5. *Washing emery in the large way.*—Washing emery by hand as above explained is far too tedious for those who require very large quantities of emery, such as the manufacturers of plate, glass and some others, who generally adopt the following mode. Twelve or more cylinders of sheet copper, of the common height of about two feet, and varying from about 3, 5, 8 to 30 or 40 inches in diameter, are placed exactly level and communicating at their upper edges, each to the next, by small troughs or channels; the largest vessel has also a waste pipe near the top.

At the commencement of the process, the cylinders are all filled to the brim with clean water; the pulverised emery is then churned up, with abundance of water in another vessel, and allowed to run into the smallest or the three-inch cylinder, through a tube opposite the gutter leading to the second cylinder. The water during its short passage across the three-inch cylinder, deposits in that vessel, such of the coarsest emery as will not bear suspension for that limited time; the particles next finer, are deposited in the second or the five-inch cylinder, during the somewhat longer time the mixed stream takes in passing the brim of that vessel and so on. Eventually the water forms a very languid eddy in the largest cylinder, and deposits therein the very fine particles that have remained in suspension until this period, and the water, lastly, escapes by the waste pipe nearly or entirely free from emery.

In this simple yet elegant arrangement, time is also the measure of the particles respectively deposited in the 12 or more vessels, their number being determined by the quantity of sizes respectively required in the manufacture to which the emery is applied. When the vessels are to a certain degree filled with emery, the process is stopped, they are emptied, the emery is carefully dried and laid by, and the process is recommenced.

6. *Emery paper* is prepared like glass paper, and of about six degrees of coarseness. The powders sifted through the sieves with 30 and 90 meshes per linear inch being in general the coarsest and finest sizes employed. When used by artisans the emery paper is commonly wrapped around a file or a slip of wood, and applied just like a file, with or without oil, according to circumstances. The emery paper cuts more smoothly with oil, but leaves the work dull.

7. *Emery cloth* only differs from emery paper in the employment of thin cotton cloth instead of paper, as the material upon which the emery is fixed by means of glue. The emery cloth, when folded around a file, does not ply so readily to it as emery paper, and is apt to unroll, therefore smiths, engineers, and others, give the preference to the emery paper and emery sticks; but for household and other purposes, where the hand alone is used, the greater dura-

bility of the cloth is advantageous. Edward's patent for emery cloth was taken out in December 1830.

8. *Emery sticks*, are rods of deal about 8 to 12 inches long, planed up square, or with one side rounded like the half round file. Nails are driven into each end of the sticks, as temporary handles; they are then brushed over one at a time, with thin glue, and dabbed at all parts in a heap of emery powder, and knocked on one end to shake off the excess; two coats of glue and emery are generally used. The emery sticks are much more economical than emery paper wrapped on a file, which is liable to be torn.

9. *Emery cake* consists of emery mixed with a little suet chopped small, rendered down, and mixed with a very little bees' wax, so as to constitute a solid lump, with which to dress the edges of buff and glaze wheels. The ingredients should be thoroughly incorporated by stirring the mixture whilst fluid, after which it is frequently poured into water, and thoroughly kneaded with the hands, and rolled into lumps before it has time to cool. The emery cake is sometimes applied to the wheels whilst they are revolving; but the more usual course is to stop the wheel and rub in the emery cake by hand: it is afterwards smoothed down with the thumb.

10. *Emery paper or Edward's patent razor strop paper*, is a new article in which fine emery and glass are mixed with the paper pulp, and made into sheets as in making ordinary paper. The emery and glass are said to constitute together 60 per cent of the weight of the paper, which resembles drawing paper, except that it has a delicate fawn colour. This emery paper is directed to be pasted or glued upon a piece of wood, and when rubbed with a little oil to be used as a razor strop, of which it is by far the least expensive of any previously in use. The patent for this invention was granted to the Rev. Mr. Edward in November 1843, and he was rewarded for the same by the Society of Arts, in June 1846.

11. *Barclay's artificial emery stone.*—The numerous articles already given on emery, and various ways in which it is prepared and used will be concluded by a description of the invention of a Mr. Henry Barclay, who took out letters patent in August 1842, for a very efficient mode of combining powdered emery into disks and laps of different kinds, suitable to grinding, cutting, and polishing glass, enamels, metals, and other hard substances. The process of manufacture is as follows:—

Coarse emery powder is mixed with about half its weight of pulverized stourbridge loam, and a little water or other liquid, to make a thick paste; this is pressed into a metallic mould by means of a screw press, and after having been thoroughly dried, is baked or burned in a crucible, muffle, or close receiver within a furnace, at a temperature considerably above a "red heat," and below the "full white heat."

In this case the clay or alumina serves as a bond, and unites the particles very completely in a solid substance, called artificial emery stone, which cuts very greedily, and yet seems hardly to suffer perceptible wear or destruction. Superfine grinding emery is formed into wheels exactly in the same manner as the above, but the proportion of loam is then only one-fourth, instead of one-half that of the emery; these emery stones, which are of medium fineness, cut less quickly but more smoothly than the above.

Flour emery, when manufactured into artificial stones, requires no uniting substance, but the moistened flour emery is alone forced into the metal mould and fired, as some portions of the alumina present seem abundantly to suffice to unite the remainder. These fine wheels render the works submitted to them exceedingly smooth, but they do not produce a high polish on account of the comparative coarseness of the flour emery.

Stourbridge loam is by no means the only ingredient used in uniting the particles of emery, as many other substances answer as well; such as slate, Yorkshire gritstone, crocus, &c., and in this way the hardness and cut of the emery stone may be varied to a great extent.

Most of the grinders made of the emery stone are formed with central holes, so as to admit of being attached to the lathe upon appropriate chucks or spindles; and the substance is so porous as to absorb much water, which is gradually thrown to the surface by the centrifugal motion so as to keep the edge conveniently moist, or with excessive velocity, the water is thrown off as in trundling a mop. Mr. Barclay has made the disks of various diameters from $\frac{1}{4}$ inch to 8 or 10 inches diameter, but the difficulty increases with the size, as the large ones are liable to warp and crack in the firing.

When the emery stone laps are required to have plane surfaces, angular or convex edges, &c. that could not be readily moulded, the composition is partially fired at a low heat, then turned in a lathe to the specific form, and the firing at a nearly white-heat completes the manufacture.

The coarse emery stone has been tried in cutting glass, and is reported then to fulfil in itself the offices, first, of the iron disk fed with sand used in roughing, and secondly, of the Lancashire fine grit stone used in smoothing; as when of proper consistence, the artificial emery stone cuts as quickly as the former, and as smoothly as the latter, and has the advantage of maintaining its form in an eminent degree.

Small fragments of these disks, spoiled in the firing, have been successfully used in scrubbing off the rough sand coat of door plates, mouldings, &c. cast in brass, &c., and indeed the patent emery stone eminently deserves more extended use than it has, up to the present time, attained.

It remains to be observed that Mr. Barclay took up the subject of the artificial emery stone from necessity, as in his professional employment of mak-

ing artificial teeth and gums of a kind of hard porcelain, he found the small grindstones (tediously prepared by rubbing down waste flakes of the Yorkshire stone used for paving into flat plates, and which are afterwards drilled and turned to the requisite forms) wore out amazingly quick, even when assisted by coarse sand and water, but the present scheme fulfils the office of the grindstone in an admirable manner; and some small artificial stones made as above have been in almost daily use for 3 or 4 years.

The project bears an evident analogy to Mr. Prosser's patent for making buttons, various articles, and even fire bricks, out of dry clay in powder compressed in a mould and afterwards burned, and it offers certain advantages over the corundum wheels used in India, and described under the head corundum.

FELT, or felted cloth, is very much used for polishing, especially for marble.—*See cloth and marble.*

FISH SKIN is the skin of the dog-fish, and some others which is dried as its only preparation. The scales of the skin are hard and pointed and stand up obliquely, so that they cut or abrade very effectually in the one direction, but not in the other. Fish-skin is more durable but less generally convenient than glass paper, to which it probably gave rise. It is however now but little used in polishing, although in clearing off rounded and irregular works, as in pattern making, from the fish-skin being somewhat rigid when bent round the finger it may be almost used as a file, and it has the further advantage of leaving nothing behind it, whereas glass paper commonly deposits some of the particles of glass in the surface of the wood, to the detriment of any tools subsequently employed. The fins should be selected for fine works.

FLINT.—Flint is employed in the mechanical arts, as the "bouldering-stone" for rubbing down to a smooth face the laps, buffs and glaze wheels of the cutler, and pulverized flint has also obtained the employment described in the succeeding article.

Flint; the late Mr. Larkin in finishing his beautiful wood models of crystals, employed calcined flint pulverized and glued upon wooden-face wheels, as more fully described under the heads glass paper, and wheels, article 59.

FLANDER'S BRICKS.—These which are now equally or better known as bath bricks, are made in large quantities of a clay found at Bridgewater, and which contains a considerable proportion of fine sand. Besides the extensive employment of these bricks for domestic purposes, and in making founders' cores, they are sometimes employed when rubbed to powder, in polishing bone, ivory, and soft metals; and also in dressing cutlers' dry buff wheels, boards for cleaning table knives, &c. Trent sand is preferable when it can be procured.

GLASS.—Glass is used as a vehicle for polishing powders by watch-makers, watch jewellers, and some others.—*See Brass, Article 6, and Machinery, Article 13.*

GLASS PAPER.—In making this useful article, the fragments of broken wine bottles are carefully washed to remove all dirt; the glass is then crushed under a runner, and sifted into about six sizes as in manufacturing emery. The paper is brushed over with thin glue, and the pulverized glass is then dusted over it from a sieve, which completes the process. Sometimes two coats of glue and glass are applied, or venetian red is mixed with the glue to give that tint to the glass and sand papers; and under Edward's patent, thin cotton cloth is used instead of paper, as the vehicle for the glass.—*See Flint, an article recommended instead of glass for the above and other purposes.*

GANNISTER STONE.—A species of slaty-stone, somewhat resembling the Charnley forest, or mount sorrel-stone, and which is abundantly used in repairing the macadamized roads around Sheffield. When calcined, pulverized, sifted, and applied on a straight buff stick of the bull neck leather, the gannister stone is preferred to most other materials, for smoothing the threaded shoulders of pocket knives after they have been filed, as it is considered better to preserve the keen threads or projecting ridges of the shoulders than other abrasive powders. The work is completed on a wheel brush fed with fine emery and oil, followed by another with crocus and oil.

GLAZERS, OR GLAZING WHEELS.—Wooden wheels covered with leather when charged with fine emery receive the above names, but when supplied with crocus and used for finer purposes they are called polishers. Such wheels charged with emery cake, bouldered and waxed to deaden the emery, are much used at Sheffield.—*See Wheels, Articles 50 and 51.*

GRINDSTONE.—Gritstones or grinding stones are varieties of sandstones, some of which are described.

1. "Newcastle grindstones abound in the coal districts of Northumberland, Durham, Yorkshire and Derbyshire, and are selected of different degrees of density and coarseness, best suited to the various manufactures of Sheffield and Birmingham, for grinding and giving a smooth and polished surface to their different wares."

2. "Bilston grindstone is a similar description of stone, of great excellence; it is of a lighter colour, much finer and of a very sharp nature, and at the same time not too hard. It is confined to a very small spot of limited extent and thickness, in the immediate vicinity of Bilston in Staffordshire, where it lies above the coal, and is now quarried entirely for the purpose of grindstones."

3. "Carpenters' rubstone is a hard close variety, used as a portable stone for sharpening tools by rubbing them on the flat stone instead of grinding. It is also much employed for the purpose of giving a smooth and uniform surface to copper plates for the engraver."

A much softer variety of sandstone, is usually cut into a square form from eight to twelve inches long, in which state they are used dry by shoemakers, pocket-book makers, cork-cutters, and others, for giving a sort of rough edge to their bladed knives and instruments of a similar description.

4. "*Devonshire Batts.*—A porous fine-grained sandstone in considerable repute, from the quarries of black down cliffs, near Collumpton."

5. "*Yorkshire grit* is a variety not at all applied as a whetstone, but is in considerable use as a polisher of marble, and of copper plates for engravers."

6. "*Congleton grit* is a very similar stone of a softer nature, and made use of by the same description of workmen."

7. "*Sheffield grindstone* is a hard coarse gritstone used for grinding large files, and similar purposes; it is obtained from Hardsley which lies about 14 miles north of Sheffield.

8. "*Wickersley grindstones* are very generally used in Sheffield for most purposes of grinding, as knives, scissors, razors, saws, and edge tools generally. Wickersley stones are quarried at a village of that name about 9 miles east of the town of Sheffield.

9. "*Sheffield bluestone* is a finer grained stone than either of the last two kinds, and is very generally used at Sheffield for finishing the grinding of articles of cutlery that have been prepared on the Wickersley stones. The act of grinding on a bluestone is called "whitening," and the blades of table and pocket knives are always thus treated in Sheffield. The bluestones are found very abundantly in the neighbourhood of Sheffield at from $\frac{1}{2}$ to $1\frac{1}{2}$ miles on the north and south sides of the town.

HONE SLATES.—A mineralogical distinction for various slaty stones that are used in straight pieces or slabs for whetting or sharpening the edges of tools subsequently to their having been ground on revolving grindstones. The following quotations are from Mr. Knight's paper in the Trans. of the Society of Arts, vol. 50, page 233 :—

1. "*Norway Ragstone.*—This is the coarsest variety of the hone slates. It is imported in very considerable quantities from Norway in the form of square prisms, from nine to twelve inches long, and one to two inches diameter; gives a finer edge than the sandstones, and is in very general use.

2. "*Charnley forest stone* is one of the best substitutes for the Turkey oilstone, and much in request by joiners and others, for giving a fine edge to various tools and also penknives. It has hitherto been found only on Charnley wood forest, near Mount Sorrel, in Leicestershire." The best Charnley forest stone, is by some considered to come only from the Whittle Hill quarry, the other stones from the neighbourhood are more pinny, or present hard places.

3. "*Ayrstone, Scotchstone, or snakestone* is most in request as a po-

lishing stone for marble and copper-plates ; but the harder varieties have of late been employed as whetstones." These stones should always be kept damp or even wet, to prevent their becoming hard.

4. "*Idwall or Welsh oilstone* is generally harder, but in other respects differs but little as a whetstone from the Charnley forest. It is obtained from the vicinity of Liyn Idwall, in the Snowdon district of North Wales," and is now in more general use for small articles of cutlery than the Charnley forest stone.

5. "*Devonshire oilstone*, is an excellent variety for sharpening all kinds of thin edged broad instruments, as plane-irons, chisels, &c. and deserves to be better known. This stone was first brought into notice by Mr. John Taylor, who met with it in the neighbourhood of Tavistock, and sent a small parcel to London for distribution ; but for want of a constant and regular supply, it is entirely out of use here.

6. "*Cutlers' green hone* is of so hard and close a nature, that it is only applicable to the purposes of cutlers and instrument makers, for giving the last edge to the lancet and other delicate surgical instruments. It has hitherto been only found in the Snowdon mountains of North Wales.

7. "*German razor hone*.—This is universally known throughout Europe, and generally esteemed as the best whetstone for all kinds of the finer descriptions of cutlery. It is obtained from the slate mountains in the neighbourhood of Ratisbon, where it occurs in the form of a yellow vein running virtually into the blue slate, sometimes not more than an inch in thickness, and varying to twelve and sometimes eighteen inches, from whence it is quarried, and then sawed into thin slabs, which are usually cemented into a similar slab of the slate to serve as a support, and in that state sold for use. That which is obtained from lowest part of the vein is esteemed the best and termed 'old rock.' The German hone is now used almost exclusively for razors, as being very soft ; it is cut by any instrument applied at an angle, and not laid flat down as a razor invariably is.

8. "*Blue polishing stone*, is a dark slate of very uniform character ; in appearance not at all laminated ; is in considerable use among jewellers, clock-makers and other workers in silver and metal, for polishing off their work, and for whose greater convenience it is cut into lengths of about six inches, and from a quarter of an inch to an inch or more wide, and packed up in small bundles of from six to sixteen in each, and secured by means of withes of osier, and in that state imported for use.

9. "*Grey polishing stone* is a stone of very similar properties to the blue, but of a somewhat coarser texture and paler colours. Its uses are the same, and both kinds are manufactured near Ratisbon.

10. "*Welsh clearing-stone* is a soft variety of hone-slate, the use of which is confined to curriers, and by them employed to give a fine smooth edge to their broad and straight-edged knives for dressing leather. They are always cut of a circular form."

11. "*Peruvian hone* has been recently introduced as a whetstone, and is said to be imported from South America. It cuts freely with either oil or water, and is suitable for sharpening large tools that do not require a very fine edge.

12. "*Welsh hone*.—See Article 4.

13. "*Oilstone, white and black*.—These are varieties of the Turkey stone.—See oilstone.

14. "*Arkansas stone*, from North America ; is of unequal texture and cuts slowly.

15. "*Bohemian stones* are imported from Germany, and are used by jewellers in the same manner as the blue and grey polishing stones for polishing small works, such as the settings around gems. The Bohemian stones cut well, and keep a good point for small work.

HORN.—Horn is sometimes used by watchmakers as a vehicle for the application of polishing powders to flat works.—See Machinery, Article 13.

IRON STONE.—A straight slab of the hematite iron ore, ground flat on the one face ; is sometimes used by the Sheffield cutlers after the yellow German hone, in polishing the "cannell" or chamfers made by the German hone in setting razors. The iron stone is very hard, and leaves a very smooth edge, almost fulfilling the purpose of the razor strop, but it must be used very lightly and sparingly.—See the Article on setting razors, Chap. xxxiii, Sect. 2.

LAPS.—Metal polishing wheels.—See Wheels, Articles 37 to 47.

LEAD—Is the basis of many of the laps, and is rendered sometimes harder by the addition of variable proportions of tin and antimony.—See Wheels, Articles 37 to 47.

LEATHER.—The leather principally used for polishing in the manufacturing towns of Sheffield and Birmingham, is the beast hide, or the leather of the ox as prepared for the soles of shoes, which is much softer and open in the grain before it is hammered as for the soles of shoes. The hide is usually cut into parallel pieces or strips, which are glued around the edges of wooden disks ; then constituting buff wheels if charged with emery, and polishers if dressed with crocus ; and the leather is also fixed on straight sticks known as buff sticks.

The leather varies much in thickness, that about the neck of the hide being sometimes nearly an inch thick, and very soft, this part being designated as bull neck, a material for which the thick hide of the sea cow or sea horse is frequently substituted. Occasionally the curried hides of the horse, and other leathers used in making harness, are employed for buff wheels ; and in the me-

tropolis in particular, the thick buff leather of old regimental belts is much employed for similar uses, but although cheaper it is softer and far less durable. Wash leather, prepared from sheep skins split in two, is also much used in polishing, but mostly after the manner of a dusting cloth, or to prevent the hand touching the goods.

LIME—Is occasionally used as a polishing material on account of its cheapness, as the only preparation required is to slake the lime with a little water, it then falls to a fine powder and which is sometimes sifted. Lime is used for polishing the commonest works in bone, such as brushes, and also for Albata spoons.

LOAM—Is used with water by some manufacturers as a cheap material with which to grind in the conical plugs of brass valves and cocks. Loam contains more siliceous matter than the generality of the clays, but which also are occasionally used for polishing common works.

MOSLINGS.—The thin shreds or shavings of leather shaved off by the currier in dressing cow, or calf skins. They are frequently used for removing oil from metals that are being polished and serve extremely well, being as bibulous as blotting paper. Cotton waste is similarly employed especially in the vicinity of cotton mills.

OILSTONE.—The Turkey oilstone can hardly be considered as a hone slate, having nothing of a lamellar or schistose appearance. As a whetstone, it surpasses every other known substance, and possesses, in an eminent degree, the property of abrading the hardest steel, and is at the same time of so compact and close a nature, as to resist the pressure necessary for sharpening a graver, or other small instrument of that description. Little more is known of its natural history than that it is found in the interior of Asia Minor, and brought down to Smyrna for sale. The white and black varieties of Turkey oilstone, differ but little in their general characters; the black is, however, somewhat harder, and is imported in larger pieces than the white.

2. *Oilstones fitted in cases*.—The rough irregular pieces of oilstone, scarcely ever exceed about 3 inches square and 10 inches long, and are generally about one-third smaller; when cut into rectangular forms it is done with the lapidary's slitting mill and diamond powder; the blocks are then rubbed smooth with sand or emery on an iron plate. The piece of oilstone is generally inlaid in a block of wood, in which it is cemented with the putty used by glaziers, and to avoid the deposition of dust a wooden lid is usually added; the lid is sometimes covered with a thick piece of buff leather which serves to absorb the oil from the tool and is used in the manner of a razor strop. The oil employed on the oilstone should be indisposed to dry or thicken; in this respect sperm oil is the best, but neat-foot oil is nearly as good, and has no offensive smell.

The joiner often puts three or more small points in the stock or bed of

the stone, that it may take a firm hold of the work bench when dabbed down thereupon; and the turner adds two fillets so that it may fit transversely on the bearers of the lathe.

3. *Oilstone slips* are small pieces of this useful stone cut into different forms by the lapidary. Some oilstone slips are wide thin pieces, the edges of which are rounded to adapt them to the curvatures of gouges, and such slips are usually cut wedge form, that the semi-circular edges on the one slip may be of two sizes and curvatures; these are used for gouges, for various figured tools used by turners, and also for plane irons for mouldings. Other oilstone slips for polishing are cut into pieces from $\frac{1}{4}$ to $\frac{3}{4}$ inch square and 3 to 6 inches long, to be used after the manner of files, by mechanics, watchmakers and other artisans.

4. *Oilstone powder*.—Fragments of oilstone when pulverised, sifted and washed, are much in request by mechanics. This abrasive is generally preferred for grinding together those fittings of mathematical instruments and machinery, which are made wholly or in part of brass or gun metal; for oilstone being softer and more pulverulent than emery, is less liable to become embedded in the metal than emery, which latter is then apt continually to grind, and ultimately damage the accuracy of the fittings of brass works. In modern practice it is usual, however, as far as possible, to discard the grinding together of surfaces, with the view of producing accuracy of form or precision of contact.

Oilstone powder is preferred to pumice-stone powder for polishing superior brass works, and it is also used by the watchmaker on rubbers of pewter in polishing steel.

OXIDES OF IRON.—The red and black oxides of iron, and mixtures of them, are prepared by manufacturing Chemists at Liverpool, Sheffield, Derby and elsewhere, as polishing powders, commercially known as crocus, rouge, red stuff, colcothar of vitriol, &c. and the same substances are also employed as pigments, under the names of red-brown, purple-brown, &c. The ordinary manufacture of crocus will be first noticed, and then the more exact method, required in the higher branches of scientific art, in order completely to avoid the accidental admixtures of siliceous matter and other impurities. As, however, these several matters have been elsewhere described with great exactness, it is conceived best to quote these passages, and it is to be observed that articles 1, 4, 6 and 7 are literal extracts from Mr. Thomas Gill's paper on the preparation of the metallic oxides, contained in Tech. Repos., vol. 1, pages 431-5.

1. *Crocus and Rouge*.—"These articles are manufactured at Liverpool," said the late Mr. Samuel Varley, "by persons who make it their sole occupation, in the following manner;—They take crystals of sulphate of iron (green vitriol or copperas) immediately from the crystallising vessels, in the copperas

works there, so as to have them as clean as possible; and instantly put them into crucibles or cast iron pots, and expose them to heat, without suffering the smallest particles of dust to get in, which would have a tendency to scratch the articles to be polished. Those portions which are least calcined, and are of a scarlet colour, are fit to make rouge for polishing gold or silver; whilst those which are more calcined, or have become red, purple, or bluish purple, form crocus fit for polishing brass or steel. Of these, the bluish-purple coloured part are the hardest, and are found nearest to the bottom of the vessels, and consequently have been exposed to the greatest degree of heat.

2. *Mr. Andrew Ross's mode of preparing Oxides of Iron.*—"Dissolve crystals of sulphate of iron in water; filter the solution, to separate some particles of silex which are generally present and sometimes are abundant; then precipitate from this filtered solution the protoxide of iron by the addition of a saturated solution of soda, which must also be filtered. This grey oxide is to be repeatedly washed and then dried; put it in this state into a crucible, and very gradually raise it to a dull red heat; then pour it into a clean metal or earthen dish, and while cooling it will absorb oxygen from the atmosphere, and acquire a beautiful dark red colour. In this state it is fit for polishing the softer metals, as silver and gold, but will scarcely make any impression on hardened steel or glass. For these latter purposes, I discovered that it is the black oxide that effected the polish (and this gives to the red oxide a purple hue, which is used as the criterion of its cutting quality in ordinary); therefore, for polishing the harder materials, the oxide must be heated to a bright red, and kept in that state until a sufficient quantity of it is converted into black oxide to give the mass a deep purple hue when exposed to the atmosphere. I have converted the whole into black oxide; but this is liable to scratch, and does not work so pleasantly as when mixed with the softer material. The powder must now be levigated with a soft wrought-iron spatula, upon a soft iron slab, and afterwards washed in a very weak solution of gum arabic as recommended by Dr. Green in his paper on specula. The oxide prepared in this manner is almost impalpable, and free from all extraneous matter, and has the requisite quality in an eminent degree for polishing steel, glass, the softer gems, &c.—See *Emery, Article 4.*

3. *Lord Rosse's mode of preparing the Peroxide of Iron.*—"I prepare the peroxide of iron by precipitation with water of ammonia from a pure dilute solution of sulphate of iron; the precipitate is washed, pressed in a screw press till nearly dry, and exposed to a heat which in the dark appears a dull low red. The only points of importance are, that the sulphate of iron should be pure; that the water of ammonia should be decidedly in excess, and that the heat should not exceed that I have described. The colour will be a bright crimson inclining to yellow. I have tried both potash and soda pure instead of water of ammonia, but after washing with some degree of care, a trace of the alkali

still remained, and the peroxide was of an ochrey colour till overheated, and did not polish properly."—See *Phil. Trans.*, 1840, p. 521.

4. *Jewellers' Rouge*—"Is prepared by persons in this metropolis, by decomposing sulphate of iron with potash; well washing the yellow oxide of iron, to free it from the sulphate of potash, and slightly calcining it, till it acquires a scarlet colour."

5. Specular iron ore when finely pulverized and washed, makes a polishing powder which is greatly recommended by Mr. Heath for razor strops and other uses. It closely resembles both in appearance and effect the crocus artificially prepared from the sulphate of iron.

6. *Artificial Specular Iron Ore.*—"This is made in the following manner. Equal parts of sulphate of iron and hydrochlorate of soda (common salt) are to be well mixed, by rubbing them together in a mortar: the mixture is then to be put into a shallow cupel or crucible, and exposed to a red-heat; a considerable quantity of vapour will be disengaged, and the matter will run into fusion. When vapours no longer arise, remove the vessel, and let it cool.

"The mass will be of a violet brown colour, covered with extremely brilliant scales resembling mica, and perfectly like the specular iron-ore. This mass must be dissolved in water; as well to separate the sulphate of soda which is formed by the decomposition of the two salts employed, as to wash over the lighter particles of uncrystallized oxide, which forms an excellent polishing powder.

"The fire must not be continued too long, nor be too violent; for then the powder would become black, extremely hard, and produce no good effect. The artificial specular iron ore is the more preferred, the nearer it approximates to the violet colour.

"The micaceous scales which subside after the washing over of the powdery part, afford an excellent material for razor strops, when applied to the strop with a little grease previously rubbed over it, as we can vouch, from our own experience in the use of it, for several months past."

It has been suggested to the author by an experienced Chemist, that the atomic proportions of the sulphate of iron and common salt, should be taken for the last process, and when it is considered that, as noticed by the Earl of Rosse, the present limit of perfection in the polishing of specula, depends mainly on the fineness and efficiency of the polishing material, it becomes evident that the subject demands every care in its investigation, and which may apologize for the length of the foregoing articles.

7. *An improved Tripoli, for polishing gold and silver.*—"The basis of this excellent tripoli consists of a mineral substance, abundantly found in the coal and iron mines of Staffordshire, &c. &c. known by the name of clunch, or curl stone. It had formerly been employed for no other purpose than as a ma-

terial for mending the roads. It is a compound of iron, alumina, lime, and silex." Mr. Gill proposed this application of clunch from the external and chemical resemblance it bears to septaria—the well-known basis of the Roman cement, the employment of which in polishing he had previously advocated in the Annals of Philosophy. He goes on to say "the polishing effects of the calcined and pulverized clunch are, however, still superior to that of the septaria, when prepared in a similar manner; and are, indeed, in point of quickness of action in producing the polish, and in the beautiful black lustre which it gives to the gold or silver, far beyond any thing I have ever met with."

PUTTY POWDER—Is the pulverised oxide of tin, or generally of tin and lead mixed in various proportions. The process of manufacture is alike in all cases. The metal is oxidized in an iron muffle, or a rectangular box, close on all sides, except a square hole in the front side. The retort is surrounded by fire and kept at the red heat, so that its contents are partially ignited, and they are continually stirred to expose fresh portions to the heated air; the process is complete when the fluid metal entirely disappears, and the upper part of the oxide then produced, sparkles somewhat like particles of incandescent charcoal. The oxide is then removed with ladles and spread over the bottom of large iron cooling pans and allowed to cool. The lumps of oxide, which are as hard as marble, are then selected from the mass and ground dry under the runner; the putty powder is afterwards carefully sifted through lawn.

As a criterion of quality it may be said that the whitest putty powder is the purest, provided it be heavy. Some of the common kinds are brown and yellow, whilst others from the intentional admixture of a little ivory black are known as grey putty. The pure white putty, and which is used by marble workers, opticians, and some others, is the smoothest and most cutting; it should consist of the oxide of tin alone, but to lessen the difficulty of manufacture, a very little lead (the linings of tea chests), or else an alloy called shruff (prepared in ingots by the pewterers) is added to assist the oxidation.

The putty powder of commerce of good fair quality, is made of about equal parts of tin and lead, or tin and shruff; the common dark coloured kinds are prepared of lead only, but these are much harsher to the touch and altogether inferior.

Perhaps the most extensive use of putty powder is in glass and marble works, but the best kind serves admirably as plate powder, and for the general purpose of polishing:

2. *Putty powder for fine optical purposes is prepared by Mr. A. Ross by the following method, which is the result of many experiments.* Metallic tin is dissolved in nitro-muriatic acid, and precipitated from the filtered solution by liquid ammonia, both fluids being largely diluted with water. The peroxide of tin is then washed in abundance of water, collected on a cloth filter, and

squeezed as dry as possible in a piece of new clean linen; the mass is now subjected to pressure in a screw press, or between lever boards, to make it as dry as possible. When the lump thus produced has been broken in pieces and dried in the air, it is finely levigated while dry, on a plate of glass with an iron spatula, and afterwards exposed in a crucible to a low white heat. Before the peroxide has been heated, or whilst it is in the levigated hydrous state, the putty powder possesses but little cutting quality, as under the microscope, the particles then appear to have no determined form, or to be amorphous, and on being wetted to resume the gelatinous condition of the hydrous precipitate, so as to be useless for polishing; whereas when the powder is heated to render it an hydrous, most of the particles take their natural form, that of lamellar crystals, and act with far more energy (yet without scratching) than any of the ordinary polishing powders. The whole mass requires to be washed or elutriated in the usual manner after having been heated, in order to separate the coarser particles.

Mr. Ross usually adds a little crocus to the putty powder by way of colouring matter, as it is then easier to learn the quantity of powder that remains on the polishing tool; and it may be added that this is the polishing powder employed by Mr. Ross in making his recently improved achromatic object glasses for astronomical purposes.

RED STUFF.—A name applied by watchmakers to some kinds of crocus, or the oxide of iron, the manufacture of which is described under the head oxide of iron.

RUBBERS.—The rubbers used in polishing often follow very nearly the form of the plane, the file, or the turning tool, accordingly as the respective artisans use the plane, file, or turning tool in their several avocations. For instance, the carpenter wraps glass paper around a square flat piece of cork; the smith and others using files, fold emery paper upon that instrument, or use, after the manner of the file, square pieces of wood and metal fed with the several powders mixed with oil, and they also employ either the sides or the sloping ends of square slips of the polishing stones.

Many of the turned works in the metals, &c. are polished with pointed sticks of deal, by the ends of which the gritty substances are forcibly applied as the work revolves.

2. The rubber used by masons and statuary is frequently a slab of grit stone, to which a handle is attached by means of an iron strap, or cement. Sometimes the handle is short and perpendicular, at other times long and horizontal, or inclined at a small angle or loosely attached by an eye bolt, and stones of two or three qualities, from coarse to fine, are used in succession. The same forms are also given to the handles of flat plates of iron and lead that are fed with sharp sand for polishing stone, or with emery for metal; and the

plate may in this case be made of such a weight as to supply the required pressure, leaving to the workman alone to put it in movement to and fro upon the work, with strokes evenly distributed throughout its surface.

3. The block or cloth rubber used for marble, consists of a wooden block about 12 or 14 inches long, 3 to 6 wide, and 2 to 3 thick; a hole is bored through the wood at one end for a transverse stick or handle which projects horizontally on both sides, and there are fillets of wood on the top by which lumps of lead are temporarily affixed to give the required pressure. Felted cloth nearly half an inch thick (called nap) is fixed below the rubber by folding the cloth a little way up the ends and nailing it, or thinner woollen and also one or more layers of coarse linen cloth are also used according to the degree of hardness required.

4. Large cloth rubbers for polishing marble are sometimes made of woollen or other rags placed in a rectangular iron frame, connected by two side screws which compress the rags into a dense mass, the surface of which is allowed to wear itself flat or it is levelled with a red-hot iron; sometimes the ring is entire and the rags are fixed by wedges; at other times the ring is in two parts and connected by side screws to produce the compression, and a socket is added for the attachment of the handle by which the rubber is moved.

5. Small cloth rubbers or rollers used for various purposes in polishing, are commonly made of a coil of list or the selvedge of woollen cloth, wound up spirally to the diameter of two to four inches and tied round tightly with string. They are usually covered with a cloth of some kind that may easily be renewed.

6. Rubbers for French polishing are made of little balls of wadding (that used for ladies' dresses) covered with a linen rag. The rubber is placed on the open mouth of the bottle which is then turned up; the varnish thus collected is covered with a second rag, and moistened with one or two drops of linseed oil, the varnish gradually exudes according to the degree of pressure given to the ball, which is of about the size of a walnut, and is thrown away after four or five minutes' use, as it hardens from the accumulation of the varnish and then scratches instead of polishing the work.

ROTTEN STONE—Is a variety of Tripoli, almost peculiar to England, and proves a most valuable material for giving polish and lustre to a great variety of articles, as silver, the metals, glass, and in the hands of the lapidary even to the hardest stones. It is found in considerable quantities both in Derbyshire and South Wales.

RUMBLE OR SHAKING MACHINE.—This contrivance is sometimes used for polishing small articles principally by their attrition against each other. The rumble is a cylindrical vessel with a side door for the introduction of the work, and is generally made to revolve as a churn by a winch handle or pulley, or is

shaken end-ways by a crank in imitation of the mode of cleaning nails in a sack, and it is thence called a shaking machine. The following are some of the uses of the rumble in mechanical works:—

For scouring small castings to remove the sand coat.

For brightening iron tacks previously to their being tinned; water is in this case introduced.

For polishing steel with saw-dust after they are hardened and tempered.

For polishing needles and brass pins with saw or bran.

For polishing bone buttons with Trent sand.

For polishing lead shot with black lead powder.

For cleaning the rust from cannon balls by their attrition against each other.

For drying small articles in saw dust after they have been annealed and pickled with acid, as in the blanks for coin.

For dissolving gums in spirits of wine as in making lackers and varnishes; and to which processes might be added numerous others.

SAND, which is nearly pure silex, is used in sawing and smoothing building stones and marbles, and in many other of the preliminary grinding and polishing processes. River sand and pit sand are in general sharper than sea sand, which is more rounded by attrition. Stone masons prefer the scrapings of roads that have been repaired with flint stones, the particles of which become knocked off and abraded by the traffic; and Engineers sometimes employ grindstone dust, collected after turning the grindstone into form, or obtained by crushing the grit or sandstone with a hammer or pestle and mortar, as the grindstone dust cuts more sharply than Flanders brick, another form in which sand is employed.

2.—Trent sand is collected from the banks of the river of that name which runs in to the Humber. It is largely employed at Sheffield, and somewhat throughout England generally, for polishing. This sand is remarkably fine and sharp, and serves very economically many of the purposes of emery and other polishing powders prepared by art; it is very much used for Britannia metal goods.

The Sheffield cutlers are in the habit of making the Trent sand with water, into balls 2 or 3 inches diameter. The balls when dry are burned for a few hours in the kitchen fire, and from being of a moderately dark brown, become brick red. The lumps are then crushed between the hands and passed through a fine hair sieve.

The burnt sand is considered to cut quicker than the unburnt.

• For common work they use the blue stone pulverized and sifted instead of

Trent sand, that is, the blue gritstone, not the blue hone slate used for brass work, &c. Flanders brick when scraped may be used as a substitute for Trent sand, but being contaminated with the clay required in forming the brick, it cuts less keenly than the unmixed sand.

3.—Sand paper is made with the common house sand, and only of one degree of coarseness; but in other respects exactly like glass paper, to which it is greatly inferior; as the particles of sand are less angular and cutting than those of glass, when applied upon wood, &c., but on metals sand paper assumes a character intermediate between glass paper and emery paper.

SAW DUST—Is used by jewellers, brass finishers, and others, in drying the metals after they have been picked and washed. The saw dust of boxwood is preferred for jewellery on account of its freedom from turpentine or resinous matter. The saw dust of beech wood is next in estimation.

SILEX—Is the basis of tripoli, sandstones, sand and some other polishing powders. It constitutes from about 65 to 98 per cent of these substances, and is the fourth or fifth of the polishing materials in the order of hardness—silex being preceded by carbon and alumina, and probably by the oxides of iron and tin.—*See page 1029 of this volume.*

Dutch rush and charcoal owe their abrasive qualities, and the enamel of teeth its hardness, to the silex they respectively contain.—*See also Crystal and Quartz.*

SKIVE.—The iron lap used by the diamond polishers in finishing the facets of diamonds for jewellery. The skive is charged with fragments of diamond powder that are burnished into its surface.—*See Diamond, also page 176, vol. 1.*

SLITTING MILL—Or the slicer, is a very thin sheet-iron disk, the edge of which is charged with diamond powder, and lubricated with brick oil. The slicer is the circular saw of the lapidary.—*See the chapter on Lapidary work.*

SOAP AND WATER—Have been proposed by Mr. Reveley, to be used on hones instead of oil, in setting razors and other fine instruments, as being more cleanly and effective.

The hone is to be wiped clean with a wet sponge, and the lump of soap also wetted, is to be rubbed on until it produces a thin lather, which is to be sponged off when the hone is laid by.—*Trans. Soc. of Arts, vol. xxxix, p. 137.*

TOUCHSTONE—Is a compact black basalt or Lydean stone, of a smooth and uniform nature, and is used principally by goldsmiths and jewellers as a ready means of determining the value of gold and silver by the touch, as it is termed; that is, by first rubbing the article under examination upon the stone; its appearance forms some criterion; and, as a further test, a drop of acid, of known strength, is let fall upon it, and its effect upon the metal denotes its value.

TRIPOLI, according to Phillips, is an earth of a grey yellow red colour,

used in polishing, that was first introduced from Tripoli in Africa, whence its name; but it is found in France and elsewhere, and is said to contain nearly 90 per cent of silex.

2. *Red Tripoli*, has been largely prepared from a brick earth found near Battle in Sussex. When burned in lumps it is nearly as heavy as emery stone, after which it is ground and sifted, and presents the appearance of crocus, but is coarser and is used for similar but inferior purposes.

A red Tripoli prepared by calcining and pulverising clunch or curl stone, found in the coal and iron districts of Staffordshire, &c. is highly recommended by Mr. Gill.—*See the articles on the oxides of iron.*

3. *Yellow Tripoli*, sometimes called French Tripoli, is employed for polishing generally, and amongst other substances for light-coloured hardwoods that would be stained by the absorption of darker powders into their pores.

A large quantity of fine yellow Tripoli was obtained in digging the canal in the Regent's Park, London; some additional particulars are given on this subject at the conclusion of the article on varnished works.

WASHING, or the separation of powders into different degrees of fineness by washing over or elutriation. On the advantages of the careful separation of the polishing powders some remarks were offered in the introduction to this division of the work (see page 1031); the practice of washing, which is within the reach of every one, is described in this catalogue under the head Emery.—*Articles 3, 4, 5 and 6.*

The author has been in the habit of washing some others of the polishing powders, but generally into two sizes only of each; the times employed for their respective depositions, which are somewhat influenced by the specific gravities of the substances are subjoined;—

Powders.	No. 1.	No. 2.
Chalk.....	1 minute	2 minutes.
Crocus.....	10 seconds	30 seconds.
Oilstone Powder.....	30 "	3 minutes.
Pumice-stone Powder.....	30 "	3 "
Rottenstone.....	30 "	3 "
Tripoli.....	30 "	1 minute

Washing is constantly employed in metallurgy, for the separation of the metallic particles from the earthy matters in the pounded ores, in the manufacture of porcelain for the separation of the coarse and large particles from the fine clay, and prepared flint therein used, and in the preparation of polishing powders and some drugs.

WHEELS.—In almost every branch of the manufacturing and mechanical arts, the processes of abrasion are advantageously fulfilled by rotatory motion

applied to various grinders and polishers. These are generally circular disks, made of a great variety of substances, and are for the most part fed with abrasive powders. Most of these apparatus, with the exception principally of the grindstone, are known by the cutler and the toolmaker as wheels; by the mechanician as laps, by the lapidary as mills, by the optician as tools, and also by many other conventional names; the first name, or wheels, has been selected for the title of this article as being the most general. A few words will be first offered on the principal modes in which these wheels are employed.

1. *General mechanical arrangements.*—Cutlers and toolmakers place the axes of the wheels horizontally, and employ both for the grindstone and the polishing wheels the same frame work or apparatus. Mechanicians frequently employ nearly the same arrangement as cutlers and toolmakers, and in some few cases mount the laps and wheels as adjuncts to the lathe. Seal engravers always use a small lathe mandrel, to which their delicate grinders are attached. Lapidaries, unlike the abovenamed artizans, mostly place the axes of their mills vertically, and frequently drive them by the left hand, as will be explained. Opticians fix their spherical tools for grinding and polishing lenses, horizontally, on the top of a fixed post, and rub the lenses or specula upon the same with an elliptical motion given by the hands, and they continually walk round the post, to change the direction in which the grinder and tool successively meet.—*See Chap. xxxiii.*

These and other mechanical arrangements, will however be touched upon in the course of the chapters immediately following, and therefore, it is intended at this place principally to direct attention to the abrasive apparatus, and which will be classed under seven heads, namely:—

- A.—Wheels of natural stone such as grindstones.
- B.—Wheels of factitious stone, or composition wheels.
- C.—Wheels of metal, or metallic laps.
- D.—Wheels of wood, or glaze wheels.
- E.—Wheels of leather, or buff wheels.
- F.—Wheels of cloth, or cloth wheels.
- G.—Wheels of bristles, or wire, or brush wheels.

In every case but the first, the cement, metal, wood, leather, cloth or bristles, are to be viewed solely as the vehicles or carriers by which the abrasive matters or powders are applied. And in speaking of these apparatus, their structure will be first noticed, and some observations on the modes of using them and keeping them in order, will be then subjoined. The first of the seven sections or the natural grindstones will be now considered under their principal although varied features;—

SECTION A.—WHEELS OF NATURAL STONE, SUCH AS GRINDSTONE.

2. The reader is referred to the article gritstone, for the description of the principal varieties of the sandstones or gritstones used in the mechanical arts for various purposes, the most important of which uses is the grinding of various cutting tools; indeed, the removal of the grindstones from our workshops, would be an almost insuperable loss. The principal modes of employing grindstones will be now described.

3. *Grindstones used by Hand.*—In the most primitive method the tools to be ground are simply rubbed on the quiescent stone, as stonemasons and others whet their chisels on the foot pavement, after the manner of sharpening a tool upon a hone; or smaller slabs of gritstones are employed after the manner of the butchers' steel; in fact as in whetting a scythe with the rubstone.

It is, however, very far more usual to fashion the grindstone as a thick disk, or very short cylinder, and to perforate it with a square central hole or eye, for the iron axis upon which the stone is mounted and put in rotation, as described in the succeeding paragraphs.

4. *Grindstones moved by Winch-Handles.*—These present the greatest degree of simplicity of all rotary grindstones, and must be familiar to almost every one; when the stone does not exceed about one foot in diameter, it is commonly mounted on the upper edges of the little wooden box or trough, which serves both to support the pivots of the axis on which the stone revolves, and to contain the water with which it is moistened. The one extremity of the spindle is squared for the winch-handle, the central part is squared for the convenience of wedging on the stone with wooden wedges, and there are cylindrical necks or pivots on the axis, the bearings for which are sometimes of hard wood such as *lignum vitæ*, or far better of metal.

In the most common form, two iron staples which surround the pivots are simply driven into the top edges of the wooden trough: in the best form, the trough and bearings are both in metal, and there is a small bar or rest parallel with the axis for supporting the tool which is held in the right hand, whilst the stone is turned with the left. The stones thus mounted sometimes measure nearly as much as 20 inches in diameter and are used by general artizans for small tools and also by opticians for fitting in the lenses of spectacles.

5. *Ordinary Grindstones used by Carpenters, Smiths, and many others,* and which stones vary from about two to four feet in diameter, are often mounted very nearly the same as the last, so as to be worked with a winch-handle, which is then, however, turned by an assistant, but the frames for these larger stones are continued to the ground or are sometimes let into the ground, and between the four legs of the frame is placed the water trough.

In these cases, there is no objection to the stone dipping a little way into

the water whilst its revolves, as the surface velocity of the stone can be scarcely so great as to cause the water to be thrown off by the centrifugal motion; but the stone should not be allowed to remain immersed at one particular part, or it will be there softened and become more disposed to wear irregularly; the trough is consequently often suspended on a hinge or joint at the one extremity, and hung up by a chain at the other, so that it may be occasionally raised for moistening the stone.

6. *Grindstones moved with Treadles.*—For stones from about 20 to 40 inches diameter, this method is highly to be commended, as the stone whilst in rotation, then supplies enough momentum to act as a fly-wheel, and in such cases it is only needful that some part of the iron axis for the stone should be formed as a crank of three or four inches radius, from which a connecting rod, or crank hook should descend to the treadle, jointed to the two back feet of the framework, nearly as in a turning lathe. A higher velocity may be thus given to the grindstone than with a winch-handle, and the workman does not require an assistant to put the stone in motion as when a winch-handle is used. The employment of the treadle, is even now far from being so general as it deserves to be, notwithstanding that it was known and published so long as three centuries back.

7. *Grinding Lathes, or small Grindstones driven by Footwheels and Treadles.*—Stones not exceeding a foot and a half diameter, do not present sufficient momentum to admit of their being driven as in the last example, unless a foot wheel of moderate weight is added to the lower part of the frame, the upper part of which then carries the grindstone spindle fitted with a pulley, so that a leather strap or a catgut band may communicate the motion of the foot-wheel to the spindle, in a manner analogous to that employed in foot lathes; whence this arrangement has been called the grinding lathe. The same frame or lathe is commonly fitted with buff and brush wheels, and is then much used by cutlers for many parts of their works, that requires but secondary care; this apparatus is also used by many of the workers in horn, tortoiseshell, ivory and other materials; but cutlers always polish the blades and superior parts of cutlery, upon the apparatus next to be described.

8. *Cutlers' grindstone driven by the fly wheel.*—Cutlers' grindstones range from about 6 to 24 inches diameter, and are fixed upon square iron spindles from 12 to 30 inches long, terminating in steel pointed centres; the stone is wedged fast near the right hand extremity of the spindle, and near the left is fixed the pulley for a leather strap which usually measures from 1 to 2 inches wide. The strap commonly proceeds from a hand-wheel of about 5 or 6 feet diameter, turned by a labourer who is situated at the back of the grinder, and the entire arrangement, from the length of space occupied is familiarly termed the long wheel, but in large establishments, the stones are generally driven by steam or other power.

The framework for supporting the grindstone spindle, usually consists of two long pieces or sleepers that lie on the ground and are united at their extremities, they have near the one end two perpendicular posts or standards, at the upper parts of which are placed the hollow centres for the spindle to run in; lignum vitæ is the material preferred for the centres; horn is sometimes used, and in a few cases screws with steel centres are employed. The centre block on the left hand for the centres near the leather strap, is usually pierced with three or four holes on a horizontal line, for the convenience of making the strap more or less tight, and also for adapting it to pulleys differing somewhat in diameter, without shifting the wheel. Sometimes the post for the centre on the right hand, is fitted between two transverse pieces or bearers, and secured by a wedge, like the popit heads of very common turning lathes in order to serve for spindles of various lengths; because the same framework is commonly used by the cutler not only for grindstones, but also for various laps, buffs and glaze wheels.

The Sheffield grinders generally employ ash for the centre blocks and wedges for grindstone spindles, and they mostly run all their stones and glazes in one set of holes, and adjust the length of the straps for various sized pulleys by using short pieces of strap of different lengths, which they apply by means of round buckles.

Between the standards and below the stone lies a long narrow water trough of wood lined with lead or of cast iron, sometimes called the "dog pan," but which should never contain enough water to reach the stone, as the centrifugal motion would splash the water about in an inconvenient degree; the water is therefore at intervals thrown on from a pail with the hand, or is allowed to flow from a thread, like jet on the side of the stone very near its periphery. The workman is seated astride a board called the horse, which rests behind on the bearers or sleepers of the frame, and in front is propped up by a transverse bar of wood, which is shifted to or from the stone, to adjust the front end of the horse to a convenient height, dependent on the diameter of the grindstone.

The edge of the horse near the stone is commonly shod with iron, that it may be used for supporting the turning tool employed in turning up the grindstone, and the horse has mostly also a piece of leather or sacking or a sloping board to keep off the wet thrown up by the centrifugal motion. The framework is sometimes furnished with a splash-board, which is placed almost perpendicularly on the other end of the trough, and projects above the top of the stone, so as to catch most of the water that flies off and re-conduct it to the trough; but the splash board is not always added.

9. *The Position of the Grinder when at work* is highly favourable, he is seated before and rather above the stone, with his feet resting upon the

ground or other firm support, and in the act of grinding and polishing delicate works, they are held by both extremities in the two hands, whilst the elbows rest upon the knees, so that the grinder can thus keep his person very steady, and is enabled to feel with great delicacy and exactness the position of the work upon the stones or polishers. But in polishing the handles, springs, middle parts of pocket knives, and other small pieces the cutler frequently employs the grinding lathe just described in article 7.

10. *Large Grindstones stones for heavy Edge Tools, Saws, Gun Barrels, &c.*—Manufacturers in these branches use much heavier grindstones than cutlers, and mount them somewhat differently. Stones larger than 3 feet diameter and 4 or 5 inches thick, and those extending to the dimensions of 8 or 10 feet diameter, and 12 to 16 inches thick, are commonly wedged upon square spindles having cylindrical necks, that run on bearings either of hardwood or metal, and the pulley is generally placed at the extremity of the spindle and outside the one bearing, so that it may be changed agreeably to the decreasing diameter of the stone without the trouble of lifting the stone from its bearings, which is not commonly done until it is worn too small for its particular use. A deep groove is then turned in the periphery of the stone, and which, after removal from the spindle, is split in two by chisels and iron wedges to serve for smaller works.

The arrangements of the trough, horse and splash-board, for large grindstones differ principally in size alone from the preceding; frequently, however, the axis of the stone is level with the ground, and the bearings are fixed on two sleepers, between which the earth is simply excavated to form the trough, as the grinders' tools are generally of the most simple and inexpensive kind.

11. *Large stones are always driven by Power*; a drum of three to five feet diameter commonly extends across the grinders' shop, and the stones are arranged in a line on each side of the same. The surface velocity of the drum is commonly about 200 feet in a minute, and the diameter of the pulley being about one-third that of the stone, the surface velocity of the latter is from about 500 to 600 feet a minute. This speed gives rise with large stones, to so much momentum as to endanger their being split, if there should be the smallest flaw in the stone, or that from neglect it acquires a heavy side, from being allowed to wear out of the true concentric figure. The centrifugal force then sometimes breaks the stone, and drives the huge fragments with frightful violence through the roof or walls of the building, to the occasional destruction of human life.

12. *Flanges and Rings to prevent stones from Breaking.*—The liability of grindstones to be broken by excessive centrifugal force, is materially lessened if not altogether averted, when four or six holes are made through the stone,

and iron plates or rings covering about one-third to one-half of the diameter are bolted on each side, sacking, felt, pitch or some soft materials being interposed, so that the stone and two side plates when bolted together, may form a compact solid mass; flanges are also used as well as rings, but neither of them so generally as they ought to be, especially when from cupidity it is attempted to drive the stone as fast as it will bear with hoped for safety, in order to hurry through as much work as possible.

In the new and unprotected stone, there is considerable body of the material or length of radius to withstand fracture, but when the stone is reduced to half its primary diameter, and its axial speed is doubled to maintain its original surface velocity, the risk is much increased, because there is then so much less bulk in the stone to resist accidental fracture.

13. *Engineers' Tool Grindstones or those employed for keeping in order their working tools*, vary from two to five feet diameter, and four to eight inches thick, and as may be supposed, the structure of the framing is usually in metal, and much more engineer-like than the last. For instance, the trough is made either entirely of cast iron, or with cast iron sides united with a wide strip of boiler plate rivetted to each. The trough has usually feet to support the axis at two to two and a half feet from the ground, to suit the erect position of the workman, who holds the tool securely on a horizontal iron bar that is fixed near the stone, and at a convenient height by means of pedestals secured to the frame; this arrangement gives the choice of position in the rest or bar. The axis is cylindrical throughout and the stone is fixed on its central part, as will be explained: the spindle lies in two plummer blocks or brasses, which are fixed on the edges of the trough, and one end of the spindle overhangs the same to receive the strap pulley, by which the stone is driven from the main shaft running through the building. There is likewise provision for changing the diameter of the pulley on the main shaft or on the spindle, to increase the velocity of the stone as it becomes reduced in diameter; but unlike the generality of machines in the engineers' shops, the grindstone does not require fast and loose pulleys to connect or disconnect it with the power, as from its frequent use it is kept continually running when the engine is at work.

Engineers mostly fix the stone between cast-iron flanges or plates, the one keyed on the spindle against a shoulder, the other forced up by a screwed nut or key passing through a diametrical mortice in the spindle. Mr. Roberts of Manchester prefers the latter mode, and in hanging the grindstone he fits a square piece of wood into the eye of the stone, then bores it to fit the spindle, and afterwards having smoothed the central parts of the sides of the stone, he inserts two disks of soft pinewood between the cast-iron flanges and the stone; the wood adapts itself to the trifling irregularities of both parts, and serves as a somewhat elastic cushion to ensure contact, and

consequently a firmer grasp on the stone, to the extent of about one-fourth of its diameter, to which the flanges extend; by these precautions accidents rarely occur. Engineers sometimes use stones of the before-mentioned diameter of 8 or 10 feet for brightening the coarser parts of machinery, and such large stones are mounted nearly the same as those just described, but nearer to the ground.

14. *Turning up Grindstones.*—As soon as the stone is wedged truly on its axis, it is turned on the cylindrical edge or face, and part way down each side. This is done with a rod of iron or steel drawn down at the end to about $\frac{3}{16}$ ths to $\frac{5}{16}$ ths of an inch square. The tool is not held radially but pointed downwards, at an angle of about 20 degrees, and is continually rolled over and over to present a new angle, which in its turn is rapidly worn away. The process is, nevertheless, much quicker than might be supposed.

In turning small grindstone driven by the long wheel, the stone is moved the reverse way, and more slowly than in grinding, so that the horse may be used for supporting the turning tool. In turning large grindstones driven by power, in which case the motion cannot be so readily reversed nor slackened, the workman goes to the back of the stone and supports the tool upon a wooden or iron bar placed across the water trough, and employs a larger pulley than for grinding. Sometimes a cross strap is allowed to run upon the edge of the stone itself, to reverse and reduce the speed of the stone when it is turned after having been mounted.

Large stones are seldom turned up, except when they are first set to work, but they are retained of a cylindrical or slightly convex figure, almost exclusively by the following process.

15. *Hacking Grindstones.*—At intervals during the time a large grindstone is in regular work, the strap is flung off and the stone is retarded by still applying to its surface the article to be ground; but before the stone comes to rest, the high places are marked at six or more parts of its width, by holding a piece of chalk or charcoal steadily upon the horse, and gradually approaching it so as to mark the more prominent parts. When the stone has stopped, the grinder hacks or notches the high places denoted by the marks, by means of a tool called a "hack hammer," which is like a small adze of 2 or 3 lbs. weight, but longer and more curved in the blade, and with a very short handle. The grinder cuts with the hack hammer shallow oblique furrows about one inch asunder and crossing each other, producing a chequered surface.

When the stone is again used, the greatest wear occurs at these roughened places, and by a continual recurrence to the dressing the circularity of the stone is sufficiently well preserved, and with but little interruption to the work. It is very impolitic to defer the dressing too long, for fear of giving the stone a heavy side, and risking its safety.

16. *Stragglings or Ragging.*—This process is principally adopted on fine and smooth grindstones into the surfaces of which particles of iron or steel have become embedded, and which greatly impede the action of the stone. In stragglings, or ragging, the stone is kept running as usual whilst a piece of soft iron about a quarter or half an inch square, held upon the horse like the turning tool, is wriggled against the edge of the stone by a motion of the wrist, as in using a brad-awl, the iron is applied all over the surface, and, lastly, the edge of the bar is wriggled obliquely upon the top of the stone. This process also assists in correcting small inequalities in the figure of the stone.

17. *Turning and roving smooth Grindstones.*—A different and perhaps more general mode of keeping the stone in order, especially when it is driven by the hand wheel, is followed by other workmen.

The motion of the stone is reversed, and the edge is turned with a bent tool, usually made out of an old file, by forging the end taper and to a thin wide chisel edge, and about one inch of the tool is then turned up nearly at right angles to the stem of the file. This tool is used as a hooked turning tool upon the horse, and it scrapes the surface tolerably true and smooth, and afterwards whilst the stone is at work its edge is cleared with the roving plate, a piece of either iron or steel plate just like a joiner's scraper, held upon the top of the stone and not quite perpendicularly but meeting the stone at a small angle.

From its unstable position the roving plate chatters and jumps, and appears to fill the stone with minute furrows from dislodging some of the particles from its gritty surface. This mode also gives the stone a tooth, and, as well as the last method, serves to clear the stone from the thick dirty water or slush that otherwise fills its grain and considerably retards its action; frequently also the grinder throws a small handful of water on the stone, and applies his open hand very gently upon the same, in order to wash off the loose muddy coating it acquires whilst in use.

18. *General remarks on using Grindstones.*—In order to avoid the wasteful destruction of the stones they should be exposed to as equal circumstances as possible; thus they should in the first instance be selected free from hard veins that impede, or flaws that accelerate the wear at the respective parts. The object ground should be continually traversed backwards and forwards to use the stone alike all over; the stones should not be allowed to remain long out of condition, as they get rapidly worse; neither should they ever remain partially immersed in the water in the trough, which would soften those parts and expose them to more rapid wear, than the remainder.

In almost every case the grindstone is made to revolve away from the workman, so that should the work slip from his grasp it may be carried away from his person and not against him. But this direction of motion leaves a wry

film on tools with thin cutting edges, and which the regular grinder occasionally avoids, by holding the tool back-handed, or with the edge towards his person. Many of the tools used in turning metal do not require to be sharpened on the oilstone, and to avoid the wiry film, such tools are usually ground with the stone running towards the workman.

The Bilston grindstone has the preference for small tools from the comparative smoothness of its grain, and occasionally, a coarse and a fine stone are fixed on the same spindle; and when the shop grindstone is driven by power, the workman goes to the front or back of the stone accordingly as the motion is best suited to his immediate want.

19. *General remarks on grinding various kinds of tools.*—The general position of the grinder described under article 9, serves for grinding all ordinary tools, such as chisels, axes, and many others of ordinary kinds, which are simply held to the stone by the hands, and receive the pressure of the arms and upper part of the person.

20. Massive works, such as anvils, are suspended loosely by a chain, the man has then only to guide them, and their one weight supplies the pressure.

21. Large heavy plates, such as the bright cast-iron fronts of stones, are allowed to rest in an oblique position, jointly upon the surface of the horse and the stone, the grinder slides them about, to expose all parts of the surface to equal action, and often bears on them with his knees to increase the pressure.

22. Saws are too thin and elastic to be thus treated, and such flexible objects are applied on a flat board to give them support, the man leans upon the board with his whole weight and moves them up and down at an inclination of about 45 degrees to grind each part successively and equally.

23. The blades of table knives are before being handled ground on the side of a stick, about $2\frac{1}{2} \times 1\frac{1}{2}$ inches and 2 feet long with a staple under which the shank of the blade is placed; the stick is rounded at the ends to serve for the workman's hands, and the workman sometimes applies also his knees to the central part, and the effect of the stone is then very rapidly felt on the blade.

24. Small works that are ground lengthways, are sometimes nipped between the horse and the stone, an enormous pressure may be then given much less laboriously than by the arms; this is often done in grinding the surface of files preparatory to their being cut with teeth, and in stripping the teeth from old ones, prior to re-cutting them; but this practice throws a great pressure on the stone; sometimes enough to check the speed of the steam engine.

25. Small works are in many cases difficult to be held unassistedly, because of the risk of grinding through the skin of the fingers, or of burning them from the heat of the work; a small pointed stick is frequently used to press the work on the stone, and in some cases a small square piece of thick leather or

felt, called a patch, is similarly employed. Sometimes also small tools are temporarily fixed by their tangs in a wooden handle to facilitate their presentation to the stone; the handle is called a "half pipe" and is commonly a short piece of hazel rod. But the more usual course at Sheffield is to employ a pair of tongs or pliers, the reins of which do not cross as pliers and scissors generally, but consists simply of two rods of iron retained by a link across their middle. The work is fixed by being inserted between the rods at the one end, and a wooden wedge driven in between the opposite extremities, binds the whole together very securely. The sliding tongs, fig. 861, page 862, vol. ii, are also used occasionally.

26. *Adaptation of Grindstones to the forms of works.*—Convex works may of course be ground upon the cylindrical edge of the grindstone, as by rolling the work about every part of the same may be brought into contact with the stone, in the same manner that round or convex works may be filed with a flat file; but in grinding concave works, it is of course needful that the stone if not altogether a counterpart of the work, would be sufficiently modified in form to penetrate to the bottom of the hollow.

Thus in grinding a pruning bill, the hook of which is of small radius, it is indispensable the one edge of the stone should be rounded to the fourth of a circle; in grinding that part of a table knife where the blade is united to the shank, a similar curvature in the stone is also required. In grinding hollow or fluted works such as the concave parts of gouges, it is necessary to turn the grindstone to the exact counterpart form, or into beds of different width and sweeps, and various other examples might be quoted.

In order to reach within that keen edge in the blade of a penknife which unites the square shank for the joint to the remainder of the blade (which angle is technically called the *chorl*), the edge of the stone is kept remarkably keen and sharp; this is assisted by waxing the side of the dry grindstone close to the edge, and which tends to prevent the same from crumbling away, and also prevents the stone cutting into the shoulders of the blade.

27. *Wet and Dry Stones.*—Grindstones are almost always used with water, as in the humid state they cut more quickly, because the wet prevents the grain of the stone being choaked with particles of metal; but when the stone is used dry although it cuts somewhat more slowly, it leaves a smoother grain upon the work, and on which account the dry stone is always resorted to by fork-grinders and needle pointers.

28. The dry stone is somewhat used also by most grinders, but only for a small part of their work, as when vigorously applied it gives rise to so much friction, that it frequently heats the work to a blue, or almost to a red-heat, and would destroy the temper of the tools; its use is therefore nearly restricted to the roughing-out of tools, before they are hardened, an operation called

"scorching;" at this early stage of the manufacture of tools they receive no injury from the great heat sometimes thus given them.

29. *Hardened and tempered blades* that have been ground on the wet stone, are often smoothed on a dry Bilston stone, in order to leave less work to be accomplished in the next stage of manufacture, by the metal lap with fine emery; but the judicious cutler then applies the dry stone so moderately as not to reduce the temper of the blades, but only to smooth them.

30. *Danger of using dry stones.*—A still worse and more fatal mischief than spoiling the work attends the continual practice of dry grinding, as the fine particles of stone and steel that are given off, raise clouds of dust which are inhaled by the workmen, and so commonly does this contaminated atmosphere induce pulmonary complaints, that it is considered rare for a needle or for grinder to live beyond the age of twenty-five or thirty, at which period they generally become afflicted with asthma and premature decay.

31. To avert this calamity Mr. Abraham of Sheffield, invented magnetic guards which were placed close to the grindstone, and sometimes also around the mouth and nostrils of the individual.—*See Trans. Soc. of Arts, vol. 40, plate xxiii.* The magnet attracted the particles of steel and together with them drew the greater part of the stone dust, but the men were too heedless to avail themselves of this philanthropic invention, notwithstanding its complete success.

32. The only contrivance now employed is also due to Mr. Abraham; the stone is enclosed in a wooden case that only exposes a part of its edge, and from the box a horizontal tube also of wood, proceeds as a tangent from the upper surface of the stone to the external atmosphere. The current of air generated by the motion of the stone makes its escape through the tube, and carries with it nearly the whole of the dust arising from the process; sometimes the tube alone is retained.

But even this contrivance (which may be viewed as comparable with the revolving fan now used in blowing furnaces), although so much less elaborate than the magnetic guards, yet nearly as effective, is also for the most part neglected, owing to the unpardonable heedlessness of the workmen themselves.

Mr. W. Lund invented an apparatus almost identical with Clark's revolving blower with a small fan; it was driven by a short band from the stone, and was described in the *Mechanics Magazine* under the signature "Gulielmus;" this also merely obtained a very limited use.

SECTION B.—WHEELS OF FACTITIOUS STONE OR COMPOSITION WHEELS.

33. Of composition wheels the corundum wheels deserve the first notice; they consist of particles of corundum cemented into a mass by means of shell lac and which composition variously prepared is nearly the universal grindstone

and polisher of the East Indies. The reader is referred for the details of their preparation to the articles corundum in this catalogue.

34. *Barclay's artificial Emery Stones.*—The manufacture of these very useful grinding and polishing wheels, is fully described under the head Emery Article II; in most respects they are superior to the corundum wheels of the Asiatics described under the head Corundum. They may each be made of various degrees of coarseness and rapidity of cut; when properly compounded their texture is very uniform and free from the hard veins and flaws that sometime occur in grindstones.

35. Opticians sometimes employ fine crocus made into a solid body with wax, and moulded or turned into form.—*See the article on Lenses and Specula in chap. xxxiii, Sect. 4.* The wax polisher is generally used with water, which greatly prevents the destruction of its surface and also assists in carrying off those particles of glass or metal which do not become embedded in the polisher. The introduction of this composition is ascribed to Mr. Varley.

36. Crocus mixed with powdered chalk and melted glue, constitute a composition employed by Mr. Bass in the formation of little wheels, employed by him in sharpening the long slender straight blades of his cork-cutting machine. In cutting each cork the knife sweeps by against a square piece of cork, which, during the time, makes one revolution, and the four angles are removed in one piece. The knife in proceeding to and fro, is rubbed on its upper side by three of the crocus wheels which revolve slowly against it with slight pressure, and the lower side of the knife rubs against two or three hard steel-rings, which act as burnishers and keep up the fine wiry edge required in cutting cork.

SECTION C.—WHEELS OF METAL, OR METALLIC LAPS.

37. *Metal Wheels or Laps*, made of nearly every metal and alloy in common use, have been more or less employed in the mechanical arts, as vehicles for the application of several of the polishing powders, but of all laps, notwithstanding their variety, those of lead slightly alloyed, and supplied with powdered emery, render the most conspicuous service. Generally the plane or flat surface of the lap is employed; at other times the cylindrical edge, as by cutlers, but the portion actually used is in either case called the face of the lap.

38. *Lapidaries, Marble Workers*, sometimes also mechanics and others, place the spindle vertically, so that the lap revolves in a horizontal plane, and in which case the lower end of the spindle is supported in a centre fixed to the cross rail of the wood frame or bench, the upper in a bracket or overhanging arm extending from the platform, and beneath the latter is placed the pulley by which the spindle is driven. In some cases the upper centre is dispensed with,

and the spindle works in a metal collar just beneath the lap, after the manner of a lathe, if we conceive the mandrel to be placed perpendicularly.

The lap in all these cases revolves within a shallow trough, extended two to six inches above the lap, in order to catch the emery and water that are thrown off. The emery is usually applied dry, the lap having been previously moistened with a small brush dipped in water or with a mop made by twisting a wire around a few rags, the wire serving also as the handle; the dry emery powder then readily adheres to the lap, and less water is required than if the emery and water were previously mixed. In some cases the lap is screwed upon the mandrel of an ordinary turning lathe like a chuck, but which is hazardous, lest the emery should find its way to the collar of the lathe mandrel.

39. *Cutlers' Laps* are fixed on spindles placed horizontally, in fact in the same form that serves for their grindstone and other apparatus. Cutlers' laps measure from about 4 to 20 inches in diameter, the best razors being smoothed on laps of 4 to 6 inches diameter, and commoner razors on those from 10 to 12 inches, which act the more expeditiously but leave a thicker edge.

40. *Differences of construction in Laps.*—The lap is in some cases a thin disk of metal fixed by means of a screwed nut against a shoulder on the spindle, but it is better with lead laps to employ an iron plate cast full of holes to support the softer metal. The casting mould may in this case be either an iron disk with a central screw to fix the iron centre plate at the time of pouring, or the mould may be made of sand and in halves after the usual manner of the foundry. In either case the iron plate should be made as hot as the fluid metal, which by entering the holes becomes firmly united to the iron especially if the holes are largest on the reverse side or that away from the lead.

41. *Cutlers' narrow Cylindrical Laps* are sometimes similarly cast upon the edges of cast-iron wheels or disks, but it is far more usual to make a wooden centre on account of its lightness. In order that the wood centre may not contract nor lose its circular form, it is made in four quarters or of more pieces, with the grain pointing to the centre; the pieces are united by two circular disks of wood or metal, nailed to the sides; after this the edge is turned to the required width and cylindrical, with a groove in the centre and a chamfer on each edge, to retain the lead.

A better construction is followed by Mr. Lund; he makes his wheels of common Honduras mahogany, or rather a species of cedar, in about thirty-two sections, and arranged in two layers or disks, sixteen in each, so as to break joint. No nails are used, and although the parts are only united by glue they are found to endure the transitions from heat to damp to which they are often exposed. In uniting them they are glued joint by joint, and quickly arranged together upon a flat board, and when nearly a half circle is combined, a few nails are driven round the margin to allow the last wedge or sector to be driven

in tight; when two such sectors are dry the last wedge is fitted into the space between them with the trying plane, and driven in tight to make out the last joint, the parts being restrained from slipping away by the use of a few nails as before; lastly, the two circles when flattened are glued together and compressed by several hand screws.

The mould for casting laps, is generally an old grindstone in the centre of which is placed the wooden disk, and around the latter is built up at the distance of 1 or 2 inches a border of soft clay. The metal, usually 1 part tin and 4 or 5 parts lead (the lining of tea chests being preferred, on account of the tin with which it is alloyed and soldered) is then melted and poured in, but the heat should be barely such as to scorch white paper. The lap when cold is fixed on the spindle, and its edge is turned true, the horse being used as the support for the turning tool.

42. The cylindrical edge of the lap, and which alone the cutler employs, is called the face, and the dressing or coating of emery, which is never used by cutlers with water, is called the head, terms applied in common to his other wheels. In order to make the smooth metal retain the fine emery, it is scored or scratched with a pointed knife, by which two series of slight oblique furrows are scored in the face of the lap, to produce a faintly but coarsely checkered surface.

43. In lapping razors and large articles, fine emery and oil are mixed up in a cup; a small quantity is spread on with the thumb whilst the lap is nearly at rest; the emery is then pressed in the lap with a spoiled razor blade, or a short bar of razor steel (that from which the blades are forged), whilst the lap is in motion, and when the lap is charged the work is drawn steadily across from end to end and entirely of the lap, to reduce it to an uniform surface.

After having preparatively lapped about one dozen of razor blades on both sides, which is called the first course, the process is repeated with finer emery, or else "to fine the lap," the head is rubbed off with a piece of felt, or with thick woollen cloth, and the surface of the metal is rendered as fine as possible, with a smooth piece of flint, or with a steel blade; and the lapping is completed in the last course on the nearly naked lap, a stick of charcoal being commonly used still more to deaden the emery before the flint is applied, and the charcoal moreover gives a black polish that could not otherwise be left from the lap.

44. In lapping penknives and small articles, it is more usual to charge the wheel whilst it is at rest, by rubbing on it a lump of emery cake, made of emery compounded with suet chopped fine and rendered down, and mixed with a very little wax; sometimes the dressing is rubbed in with the agate or bouldering stone, and as before explained, to fine the lap, at the conclusion the head is rubbed off and it is smoothed with the agate.

When the lap is coarse and the work is pressed heavily it produces a white colour on steel, and when the lap is fine and the work is pressed lightly, and gradually drawn from the one end to the other it gives a black polish; to attain this end the emery is worn down fine with the work, and afterwards with the bouldering stone, and the effect of the emery is still more deadened by putting a little bees wax on the face of the lap, the smoothness of which is tried with the finger before applying the work.

45. *Comparative durability of Laps.*—The metal wheels and grinding tools are from several reasons highly advantageous, as in the first place they admit of being fashioned with more exactness, and they longer retain that exactness than natural stones and the compositions previously referred to. For instance when gritstones are in use, disintegration is constantly and rapidly going on, as in the course of work the particles of the stone are rubbed down and torn out: so that the abrading surface is incessantly changing, by the gradual exposure of the part of the grindstone previously beneath. Much care is required to keep the edge of the stone circular and of the precise form required.

With the cement wheels, this progressive change as constantly, although more slowly occurs, from the abrading and structural materials being mingled.

46. *On the action and durability of Laps.*—Metal laps are under very different circumstances from grindstones or cement wheels, as the metal constituting the lap has no cutting power in itself, but only derives it from the particles of emery which become embedded in its surface and act as the teeth of a file. Other particles of the emery live continually between the metal lap and the article to be ground, and separate the two; these grains have a partially rolling motion and, in all probability, have a tendency to grind both the work and the lap also. When the emery is crushed very fine, or that it is wasted, so that the lap and work come nearly in contact, the abrasion becomes so much reduced that fresh emery is generally thrown on to restore the action, and this again separates the lap and work, which therefore rarely come into absolute contact. It must not be supposed, however, that although the metal is generally more cohesive than stone or cement, that it is not at all worn away, as the metal laps are likewise depreciated in form, but in a much slower degree than the cement wheels or natural stones.

47. *Metals employed for Laps and their respective Purposes.*—In the selection of the metals for laps, there is much of prejudice, and speaking generally it may be said the softer the metals the more readily do they retain the grinding powders, but the sooner are they worn out of form. In the following tabular view the more usual metals for laps and their purposes are given:—

Brass is used by opticians with fine emery and water for smoothing lenses and specula.

Cast-iron is used by glass-grinders; with coarse sand for roughing; opticians, with sand or emery for rough grinding; engineers and machinists, with emery water for general purposes, in metallic construction; diamond polishers, for polishing the facets of diamonds for jewellery; the iron laps or skives are charged with diamond powder.

Copper is used by engineers and machinists, with emery and water for general purposes, in metallic construction. Copper is considered to retain the emery remarkably well;

By lapidaries with flour emery for grinding small and hard gems, and for cutting facets;

By glass grinders, with emery for fitting stoppers into bottles;

By glass engravers, with emery for their small disks and tools.

Lead, generally alloyed, is used by engineers and machinists, with emery and water, for metallic construction generally;

By cutlers, with emery and oil, for fine grinding or perfecting the forms of cutlery prior to polishing the pieces;

By lapidaries, with emery, first coarse and then fine, for grinding and smoothing most stones, except some few of the hardest, which require copper;

By lapidaries, with rottenstone and water, for polishing most of the stones, except a few of the hardest, which require hard pewter or copper.

Lead, mixed with a variable quantity of antimony or alloy, like type metal, is much used by engineers and mechanics for laps.

Pewter is used by gold cutters, for cutting and faceting gold and silver to which a most splendid lustre is given by means of crocus, which is general rubbed into the lap with the burnisher;

By watchmakers, with crocus or red stuff as above, for polishing some of their brass and steel works;

By lapidaries, with emery for fine grinding, and also with rottenstone for polishing. Pewter being selected for those small and hard stones, for which lead is too yielding.

All these artisans select in preference the metal of old pewter plates, which consisted of pure tin with a minute addition of copper. Some of the modern pewters appear to be tin and lead in nearly equal parts, and are much the same when used for laps, as lead hardened with a little antimony, which is much less expensive.—See *Articles Pewter*, vol. i, page 284, and *Lead*, page 277 of the same volume.

Tin may be considered as being applicable to all the purposes of the genuine old plate pewter, which is now difficult to be met with.

Zinc, alloyed with tin, which is much harder than tin or pewter, is said by Mr. Gill, to be employed by the Geneva jewellers in lapping gold and silver works.

SECTION D.—WHEELS OF WOOD OR GLAZE WHEELS.

48. Lapidaries employ wooden wheels in smoothing soft and rounded stones. The wheels consist usually of beech, birchwood, or mahogany, cut out plankways, fixed on the spindle and turned flat. The wood wheels are fed with flour emery and water, as described under the article in this catalogue on alabaster.

49. Glass cutters employ the edges of similar wheels with pumice-stone and water for smoothing, and with putty and water for polishing; the edge of the wheel is turned flat, angular or circular, according to the fashion of the work. Willow, poplar or alder, which are amongst the softest of our woods, are much used for the glass cutter's wheels; their face wheels, which are far less common, are mostly thick transverse sections of the tree, and consequently the grain is then upright at every part, and both more equable and durable.

50. Cutlers use wood wheels under the name of glazers; these should be constructed of two layers, each consisting of 6, 8 or more pieces with the grain radial, so that the periphery may be entirely formed of the end grain of the wood; walnut, oak, crab-tree, birch and mahogany are severally used, but the latter is on the whole the best. The cutler's wood or glaze wheels are mostly fed with emery cake, already described, and which is applied whilst the wheel slowly revolves.

The edges of glazers are occasionally scored with a pointed knife, to enable the emery cake to penetrate, and for fine work; they are also bouldered down with a flint, or other hard and smooth stone, and waxed to render the edge smooth, just in the manner recently explained in reference to cutlers' laps. Sometimes a wood wheel fed with emery and oil is first used, and afterwards a wood wheel with emery and wax.

SECTION E.—WHEELS OF LEATHER, OR BUFF WHEELS, GLAZERS AND POLISHERS.

51. This title includes three different kinds of apparatus, all of which have wooden centres covered with leather, and are thence sometimes indiscriminately called buff wheels, but they are distinguished into three kinds as above by practical men, thus:

First. Buff wheels which are covered with thick soft leather, sometimes half an inch thick, the bull-neck being commonly employed. In the metropolis old regimental belts are sometimes used from economical motives, instead of the new kinds of leather abovenamed; but this seems to be a questionable policy, as the belt leather is less durable, and although it may serve for glazers,

it is too thin for buff wheels. The coarse buff, or sand buff, is supplied with Trent sand and oil, the fine buff, with rottenstone and oil; these are not used for steel but for softer metal such as brass, Britannia metal, &c., and for horn, tortoiseshell and ivory.

Secondly. Glazers are wheels covered with harder leather, upon the face of which emery is attached by glue; they are almost invariably used dry, and for steel. The leather used for glazers and polishers in the manufacturing towns of Sheffield and Birmingham is "beast hide," that is, the same leather which when hammered is used for the soles of shoes; the leather is cut into strips, and used, without having been hammered, thick and thin parts being selected according to circumstances; as glaze wheels require moderately thick leather supplied with emery; and polishers soft thin leather employed with dry crocus.

Thirdly. Polishers are wheels covered with thin soft leather, and supplied with crocus which is rubbed on dry, and without the intervention of glue or oil. In Sheffield one kind of leather is tanned expressly for polishers, it being important that the whole of the grease should be extracted, as if any remain in the leather it will not polish properly. The polishers are used alone for steel, and with very small velocity.

52. The smallest buff wheels, called bobs, are used in polishing the insides of the bowls of spoons; they are simply disks of leather, nearly an inch thick, known as sea-cow or bull-neck; they are perforated so as to be mounted on spindles, and are turned of a nearly globular form.—*See Albata.*

53. Buff wheels and other leather wheels, with wooden centres differ much in size; those for cutlers usually measure from $\frac{1}{4}$ to 4 inches wide by 4 to 20 inches diameter, although they are sometimes of twice that diameter; they have wooden centres disks usually cut out the plankway of the grain, in similar woods to those used for glazers, but they are better when constructed of various pieces in sectors, the best mode being that recommended in article 41, or two layers of sectors each consisting of about sixteen pieces and glued up so as to break joint. The largest of these wheels, say those exceeding two feet diameter, are generally made up of one set of middle sector, like pieces, screwed fast between two circular iron plates which are themselves keyed on to the spindle, and then a set of felloes is nailed or screwed round the periphery on each side; making the thickness out to three, four, or even five inches. When the wood centres have been constructed according to some of the above modes, and turned cylindrical or rounded as the case may be, they are turned smooth on the edges and then covered with one thickness of leather.

54. In covering the wheels, the wood, and also one side of the leather, are plentifully glued; the extremity of the leather is fixed down by two or three

nails driven a little way into the wooden disk, the leather is stretched tight and nailed at short intervals, and its other end is also fixed down, and when the entire surface is covered with one strip if possible, the glue is allowed to dry. It is a matter of great importance that the ends of the leather should be made to butt closely one to the other to make good joints, otherwise the work jumps when a bad joint passes beneath it. The nails are afterwards withdrawn, the leather is turned true and regular with a flat chisel. Sometimes the glazers are required to be very hard, and in this case the leather is soaked in water for a few hours before being glued on the wheel, it is then secured as above whilst in the wet condition, and in drying the leather contracts and becomes considerably harder.

Buff wheels even of the small diameter of 10 or 12 inches are frequently made three or four inches wide, and covered with soft leather half an inch thick. In such cases the thickness of the wood centres is also very nearly three or four inches, or the width of the leather, which however is allowed very slightly to project, and the sides of the wood are considerably hollowed in the sweep of a circle from the edge to the centre to allow the works to be turned round on the edge of the leather in reaching into hollow and rounded angles, as already noticed; the buff wheels are used either with Trent sand or rottenstone mixed with oil, and for various materials excepting steel.

Emery wheels, when the leather with which they are covered has been turned smooth, are brushed over with glue, rolled in a heap of dry emery powder, and afterwards on a smooth board to consolidate the head and make the periphery smooth.

55. Coarse emery wheels are always used dry, and they give off a splendid display of sparks with some of the risk of overheating the work that attends the use of the dry grindstone; the finer emery wheels are sometimes used just as explained with the wooden wheels, namely they are dressed with the emery cake, and bouldered down with the flint, to bring the head to a smooth and regular condition.

Toolmakers use the buffs or glazers immediately after the grindstone, and select the coarse and fine buffs according to the degree of finish required. It may be observed the dry wheels give the brighter gloss, but do not generally leave the work so smooth as those which are greased.

56. In renewing the face of the emery wheels, or in putting on a "new head," the wheel is wetted with a sponge and cold water, and allowed to soak for about an hour; the used emery is then scraped off with an old knife, and the surface of the leather is made somewhat rough, after which it is again glued, and rolled first on the emery and then on a flat board as originally. It is useless to attempt "to put one head upon another" or to apply new emery, until that which has been used has been thoroughly scraped off.

57. The polishers for razors and fine cutlery are soft leather wheels charged with crocus, which are always used dry. It is necessary that both the polisher and blade should be hot, as without a moderate and equal degree of heat, short however of that producing a colour on the steel, the process does not succeed, and a good polish is not produced. It is therefore usual with some workmen before commencing work to take a piece of razor steel, which is held against the revolving polisher to prepare it for the work itself, by crushing and regulating the powder with which the polisher is charged.

58. *Action of the Polisher.*—Although the polisher is made to revolve much more slowly than the other wheels, the razor is moved to and fro from end to end, very quickly and with considerable pressure, to distribute the heat equally, and the blade is not drawn slowly across and off as in lapping; on the contrary the work is moved end long actively, and pulled off quickly. In examining the work, the polished part is occasionally wiped clean with the patch or thick piece of cloth or felt, which serves both to protect the fingers from the heat of the blade, and also to supply the polisher with crocus, as the patch is dabbed upon a small quantity of dry crocus close at the workman's hand, and is then rubbed on the polisher, to transfer the powder to the wheel.

Occasionally the surface of the polishers becomes very hard from being somewhat scorched by the heat generated in polishing, and its surface is then more or less filled with scratchy lines which disfigure the blade; at such times the wheel is stopped, and the face of the polisher is roughed up, or thoroughly scraped with an old razor blade or knife as in erasing writing, in order to remove all the old head or polishing stuff, and render the leather a little rough and quite soft; after which the polisher is recharged by means of the thumb or patch.

59. The flat sides of wheels are not often covered with buff leather except by lapidaries, but in imitation thereof glass and emery paper are frequently glued on flat chucks of wood and used for finishing the flat surfaces of small works in the metals, woods, ivory, and other substances, and Mr. Larkin dusted the naked wood with a covering of pulverised flint, as noticed in the previous article on flint.

60. A flat polishing machine, actuated by rotary motion is used in America for flat works, such as brass hinges, parts of locks and other metal works. The principal part consists of an endless strap of leather, which is put in motion by its encircling a foot-wheel as in a lathe; but the strap instead of giving motion to a pulley, passes over and in contact with a narrow flat board, the edges of which are rounded or furnished with small cylindrical rollers to lessen the friction; sometimes two oblong holes are simply made in the bench. The strap is charged with emery glued on exactly as in the emery wheels or

buff. The work when applied on the part of the strap which is flowing over the flat surface of the board is polished with considerable rapidity and a tolerable approach to a plane surface.

SECTION F.—WHEELS OF CLOTH, OR CLOTH AND LIST WHEELS.

61. The cloth used for wheels is usually thick woollen cloth such as that for white great coats, and the blankets of printing machines; felted cloths are likewise used. Sometimes the cloth or felt is simply glued around the edge or upon the face of the wooden wheels precisely the same as in buff wheels; and is employed for similar purposes.

62. Opticians' cloth tools, consist of a circular piece of cloth cemented by means of pitch upon the surface of one of their brass concave or convex tools of the required curvature, the cloth if new is seared with a hot iron to remove the nap before it is cemented down.

Sometimes the opticians' metal tools are covered with a broad strip of thick silk or lute string, which is folded around the edges and cemented at the back of the tool. The cloth and silk tools are always used with putty powder.—*See the articles Lenses, Chap. xxxiii, Sec. 4.*

63. The lapidaries' cloth mill is a face wheel having an annular surface about two inches wide; there is first a centre of wood of about 6 inches diameter, then a spiral coil of wide list or cloth which is wound up closely until the diameter of the cloth becomes about 10 inches. The cloth is secured partly by tacks driven first into the wood centres, and then by small nails driven into the plate of wood that forms the back, and the outer coil is nailed around the edge of the principal disk, so that the whole forms an annular face with a loose pliant surface, the top of which is dressed level with an iron heated to a dull red.

The list or selvedge of woollen cloth is commonly used, and as this is thicker on one edge than the other, it is the practice of many lapidaries to roll on two coils at once by aid of two individuals, the thick edge of the one coil being downward and of the other upwards; this mode equalizes the tension and prevents the list gathering up as a cone; and in this case it is only usual to nail the list at the beginning and ending of the coil.

The list wheel is employed generally with pumice-stone and water, and from its elasticity it yields admirably to the curved surface of shells and stones; it is also employed for plane surfaces on many soft substances, as explained under the article Alabaster in this catalogue.

64. Ivory workers' list wheels, consist of 10 to 20 circular pieces of cloth screwed fast between two disks of wood about 2 or 3 inches smaller than the cloth, which therefore forms a pliant edge projecting an inch or upwards beyond the wood, and which is well adapted to the curvilinear surface of

umbrella or parasol handles, and many such works; the wheel is fed with Trent sand, loam or chalk, or it is better to have one wheel for each of these substances.—*See Ivory.*

SECTION G.—WHEELS OF BRISTLES, OR WIRE, OR BRUSH WHEELS.

65. Wheel brushes or brush wheels are very largely employed in the arts; they are made both hard and soft, and of all diameters from about 2 to 8 inches, with the hairs placed radially, so that the outer rows lean a little towards the centre to give them more stability.

Wheel brushes are used with emery, crocus, rottenstone, putty powder, whiting, and in fact all the polishing powders both with oil and dry, and they are employed for curved, indented, chased, open and pierced works; but it is to be remembered the brush rapidly obliterates keen angles, the preservation of which requires particular care and patience, and the employment of hard buffs or the wood and metal polishers already described; as the greater the degree of exactness that is required in the angles and edges of polished works, the greater should be also the degree of hardness in the face of the grinders and polishers employed.

66. Wheel brushes made of iron and brass wire, instead of hairs, are occasionally used after the manner of scratch brushes made of metal wire, and for the same general purposes; as for cleaning and scratching the metal preparatory to gilding and silvering, but not for polishing. The ends of the wires are a little curved to soften the abruptness with which they would otherwise meet the work.

WHITING—Is common chalk, ground, washed for the separation of sand and other impurities, and dried in lumps.—*See Chalk.*

APPENDIX C.

ART. XXV.—MINERAL RESOURCES OF SOUTHERN INDIA, NO. 7,
CORUNDUM RUBY, AND GARNET LOCALITIES;

BY LIEUTENANT NEWBOLD, F. R. S., &c., MADRAS ARMY.

Read June 4th 1842.

COMPARATIVE REMARKS ON THE GEOGNOSTIC POSITION OF THE CORUNDUM IN EUROPE AND INDIA.—As I am not aware of any detailed account having been published regarding the geognostic position of the corundum in Peninsular India, and since the rocks with which it is associated in the particular locality which I first visited differ from those in which it has been stated to occur in Europe and Southern India, I am induced to preface this paper with the following remarks. Professor Thomson (*Outlines of Mineralogy*, vol. i, p. 213) informs us that "the corundum occurs in imbedded crystals in a rock which consists, according to Count Bournon, of indianite, and contains felspar, fibrolite, several varieties of angite, and also octohedral iron ore; the hair brown or reddish-brown varieties are called adamantine spar. They occur with fibrolite and octohedral iron ore in a sort of granite containing no quartz." And again (page 256) he states, that "fibrolite is a mineral found accompanying crystals of corundum in the Carnatic and that it is a component part of the granite, which is the matrix of the corundum of China." Professor Jameson, in his *Geognosy of Peninsular India* (*Ed. Cab. Lib., No. VIII, p. 349-50*) gives a summary of what is known regarding the corundum of Southern India, and states that it occurs embedded in granite and sienite in the district of Salem, in the Madras Presidency among the mountains of the Carnatic, and in other parts of the Peninsula, associated with cleavelandite, indianite, and fibrolite. Now in the locality I am about to describe, it was found to occur in decomposed beds of a talcose slate, to which gneiss is subordinate, associated with nodules of indurated talc, and of a poor quartzzy iron ore: asbestos, chlorite, actinolite and schorl were found embedded in the talcose slate.

Passing last year through Gram, a village and fort in the Mysore country, about ninety-eight miles westerly from Bangalore, between it and the Western Ghauts, I was informed by the Natives of the place that corundum (corund kapathar*) was found in this vicinity; at Golhushully, in the division of Noo-

* Corund is the Hindustani term for corundum: can this be indicative of its having first been imported into Europe from India?

gyhully; at Kulkairi, Burkunhulli, Kundeo, and Yedgunkul, in that of Chinarayapatam; at Norhik, in Narsipur; at Deysani Curbonhully, in Banawaram, and at Apyianhully in that of Harnhully. The localities I visited were Golhushully and Kulkairi, at which places the best corundum is said to be obtained. The mines lie about forty-five miles north by west from Seringapatam, and about seven or eight east by north from the fort of Gram. The formation around Gram is gneiss, associated with protogine. Proceeding from it in a westerly direction, the northern shoulder of the insulated range, south of the village of Belladaira, running nearly north and south, is crossed, and the soil suddenly changes from a light sandy colour to a deep red. The surface of this swell is covered with fragments of a ferro-siliceous schist, with quartz in alternate layers. This mountain-range, as night was coming on, I was not able to examine, but from its singularly sharp outline, the elevation and shape of its highest peak, and its direction conformable with that of the primary schist, I should say it was, probably, a large ferruginous quartzose bed, in the gneiss associated with quartzzy iron ore, fragments of which are seen as its base. The Natives have a tradition that gold was formerly got from this hill, which is not at all improbable, as it is found in similar gangue near Baitmungalum, sixty-one and a half miles east from Bangalore, and at Malliyalum, near the south west border of Mysore in Coimbatore. Minute grains occur in the sandy bed of a brook here.

A little farther west, where the talus of the mountain subsides into the plain, the gneiss reappears, alternating with talc slate in nearly vertical strata. The dip, as observed in an adjoining nullah between the mountain and the village of Belladaira, is to the east by north, and the direction of the strata N. 22° east. The corundum mines of Golhushully lie four or five mile north-east of this place, and those of Kulkairi about a mile farther. The surrounding country is a succession of smooth slightly convex plains, except to the south-east, where the gneiss rises above the soil in a rocky ridge, terminating in a knoll about 700 yards to the east by south of the mines to which it descends, rising again into a slope to west, north-west of the mines, on which lie fragments of a light brown compact quartzzy iron ore. Nearly at the bottom of this slope are the mines, from which the ground descends on both sides, to the north-west to a tank, and towards the south-east to the village of Golhushully, about a mile distant. Between the mines and this village, near the bottom of the ascent on which they are situated, runs a nullah, the bed of which gives a tolerable section of the strata resting on the gneiss.

The first (No. 1) commencing from the surface is a thin sandy alluvial soil; next (No. 2) succeeds a dark brown gritty soil, apparently decomposed ferruginous quartz, but sometimes sandy, from two to three feet thick. Below this we see the detritus (No. 3) of the subjacent gneiss; the quartz veins of which, remaining undecomposed, are observed penetrating into the substance of

the soil from below. Some of the veins are broken by the superincumbent weight, aided by their own approach to decomposition. The quartz and felspar veins contain nests of a disintegrating blackish mica. The direction of the beds of gneiss is S. 10° E. with a dip of 60° a little to the N. of E. The surface of the ascent from Golhushully to the mines, except where the blocks of the brown ore above described; and a few edges of talc slate crop out, is covered with the dark brown soil (No. 1, Sec. 2) containing small particles of iron ore, and the broken up veins of the subjacent rock to the depth of about three feet: below this lies a bed (No. 2) varying from one to two feet in thickness, of chert, angular and rounded fragments of a poor quartz iron ore, nodules of a whitish, highly indurated talc, talcose quartz, and felspar. A variety of schorl occurs imbedded in an indurated brownish talc, generally in three-sided prisms: it fuses into a lighter coloured enamel than the European specimen in my cabinet. This schorl has a shining lustre; fracture uneven; breaks easily across the axis of its prisms; opaque, streak grey, scratches glass and quartz, the latter with difficulty. In this bed the best kinds of corundum are found. Below this is a bed (No. 3) of greenish earth, evidently of decomposed talcose slate: it is slightly greasy to touch, and falls to pieces with a hissing noise when put into water. Before the blowpipe in the platinum forceps it melts partially into a brownish slag, covered with minute globules of a white enamel, streak slightly coherent, shining, approaching earthy; adheres slightly to the tongue, and emits an argillaceous odour when breathed on. It is traversed by veins (A. A.) of a compact talc in laminae which in some places bear traces of dislocation. The red earth and a quartz ferruginous paste in small reniform and pisiform nodules, resembling those of hæmatite, are found intermixed with the more decayed portions of the schist. Beds (No. 4) and veins of white earth are also found in it, occupying the bottom of some of the excavations, as at Kulkairi. These are composed of talc, quartz, and minute particles of the corundum of which the vein is the gangue; streak and fracture earthy; feels gritty, and slightly greasy; adheres slightly to the tongue; does not emit so strong an argillaceous odour as the green earth; falls to pieces when put into water with a hissing noise. Before the blowpipe, fuses partially and with difficulty into a whitish enamel. The corundum is imbedded both in this earth and that arising from the decomposed talcose schist; the whiter fragments occur sometimes as hexagonal prisms tapering off to the extremity. The locality can be easily distinguished by the external appearance of the crystals, those found embedded with the iron ore having a ferruginous covering, whilst those found in the white talcose earth present a white or greyish appearance. Microscopic particles of corundum occur disseminated in this earth, more numerous in some parts than others, as if converging to certain central foci of molecular aggregation. In fact, the whole of the component parts of the surrounding talcose slate appear to be separating from their combined state, and about to enter

into some new form. Disintegration in the interior of certain rocks, whether from heat, cold, moisture, electricity, or other cause, seems to be, in some cases, a preparatory stage in Nature's mystic laboratory to matter assuming new forms; and under certain relative conditions we find the same agents that caused their decomposition, actively operating in their re-aggregation. Heat and electricity are powerful dispersive and aggregative agents. For familiar illustration, I need scarcely point to the flame produced by the blowpipe reducing at one point a metal to dust, and at another restoring the dust to its metallic state. By the judicious application of heat nearly solid particles can be made to move through and converge in the centre of a nearly solid mass, as exemplified by the experiment of Breislak, who succeeded in forming a nucleus of a variegated copper in the centre of a mass of pure copper pyrites, by subjecting it to a heat below that of fusion. Decomposition, however, is not an absolutely necessary condition for the production of adamantine spar, as I have seen it in canular nests in gneiss but little disintegrated.

The talc schist is sometimes hardened and consolidated by contact with the iron ore, as seen in blocks thrown out of a mine near the foot of the ascent. Both the chert and a dark red ferruginous jasper are used by the Natives as flints. Salt springs occur in the vicinity. The wells about Gram were, I am told, both sweet and brackish within a short distance, and I picked up a fragment of a rock-salt in the green earth of the mine. This is to be accounted for by the nearly vertical position of the strata between which they find their way towards the surface. A little to the east of Kulkairi I crossed a low plain nearly covered with a white travertine, partly compact, partly cellular, resembling that found in the bed of the Cavery at Seringapatam.

Mines of Kulkairi.—The corundum mines at Kulkairi are situated both near the summit, and at the foot of the rising ground there. There are a series of excavations, varying from two to twelve feet in depth, sunk perpendicularly through similar strata to those just described. The corundum is thrown out, cleared, and separated by the miners into four classes, viz., the red, the white, the scraps of both, and the refuse. The three first form the article of commerce, which is carried to Mangalore and Tellicherry; and, according to my Native informants, there sold by the contractor to the Bombay and Arab merchants, at prices from twelve and fifteen to thirty rupees the candy, according to its quality. A very large quantity (2,000 bags) is now (January 1837) lying at Tellicherry unsold, owing to a disagreement about the price between the contractor and the merchant. The present contractor for corundum in Mysore is a Lingayet, named Bussetti, an inhabitant of Bowenhulli, in the talook of Arculcode; his contract has almost expired, and, in consequence, no miners are at work. He took the mines for two years, for which he was to pay the sum of 530 Canteray pagodas. The former contractors paid 500 for two, or 250 for one year; consequently it may be supposed that the produce has risen in value. These mines were only

opened about seven or eight years ago by a native, named Hari Ram. I need scarcely add, the corundum is used by natives, pounded as emery, to polish precious and other stones, particularly granite and basalt. It is also mixed for this, and other purposes, with melted lac, in fine and coarse powders, as we use a mixture of glue and sand. It is said to be found at Mundium in Mysore, at Gudjelhutty in Coimbatore, at the Tapoor Ghat in Salem, at Chennimully in Coimbatore, and in Cuttack.

At Namaul and at Viralimodos, on the north bank of the Cauvery, in the Permutty talook, Salem district, it occurs embedded in gneiss, and a greyish earth, resulting in part from the disintegration of that rock. It is found in this vicinity in great abundance, in a low hill near the village of Sholasigamany, Trichingode talook, Caranel, Anpore, Mallapollaye, and at various localities up the river Cavery, as far as Cocarambadi, where it is dug for by the Natives in the fields; and there are the remains of many ancient excavations still to be traced.

The corundum was formerly sent as an article of traffic to Palghatcherry, and thence to the Western Coast and various other parts of India. It can still be procured at the rate of from fifteen to thirty measures the rupee, each measure weighing fifty-seven ounces, avoirdupois. The caste usually employed in collecting it is the Vittaver.

Ruby localities.—Fine rubies have, from time to time, been discovered in many of the corundum localities just enumerated, associated with this gem, particularly in the gneiss at Viralimodos and Sholasigamany. The Natives inform me that it occurs also in the Trichingode talook and at Mallapollaye, but it is rare, comparatively speaking.

Garnet.—This gem, the red variety, is very generally diffused over India. Its geognostic position, the hypogene or metamorphic schists, more particularly near their line of junction with the plutonic rocks, or trap dykes; for instance, in the crystalline and metalliferous areas of Salem and Nellore, already described, whence the finest crystals are procured, and sold by the Native merchants at an insignificant price. Colophonite is not uncommon in these tracts, as also in Mysore, the Neilgherries, the Carnatic, and other provinces of Southern India. It usually occurs in the granite, associated with the hypogene schists. That beautiful variety of dodecahedral garnet, called cinnamon-stone or essonite, has been discovered in the Neilgherries in the hypogene hornblende rock, near the seven Cairns Hill, by Dr. Benza, where their number is such, he informs us, that entire portions of the rock are formed almost exclusively of them. The essonite and hornblende are in large separate crystals, imbedded in a paste of compact felspar and hornblende; the former is very liable to disintegrate, leaving, in falling out, small cavities in the rock.

Green garnet is of rare occurrence: the only locality where I discovered this gem was in the Salem district at Sankerydroog, lat. $11^{\circ} 29' N.$, long. $77^{\circ} 58' E.$, associated with other green crystals in quartz veins, penetrating hornblende schist. The latter is associated with gneiss, garnet rock, actinolitic schist, and altered limestone, thrown into disorder by the intrusion of a porphyritic granite. The green garnet is not found in considerable quantities.

A mine of precious garnet occurs at Gharilpit, about eight miles south of Palunshah, in the Hyderabad country, in the detritus of a granitic rock, penetrated by trap dykes, and composed of mica, garnets, kyanite, quartz, and felspar. Dr. Voysey, who gives a description of this mine,* states that the precious garnets are found at the depth of eight or ten feet in the alluvium at the foot of the rock. The surface of the rock and soil were strewn with garnets in great profusion, but these were generally of a very coarse kind. The garnets when collected are gently pounded, and the bad ones broken: those which survive the blows are reckoned of good quality.

Earthy Minerals: Alumina, Corundum.—Bournon considered indianite and fibrolite to be the matrix of corundum in Southern India, and Phillips states, on what authority is not mentioned, that its gangue in the Carnatic is a coarse grained white marble. I have always found it, both in Mysore and Salem, in talc, mica, or hornblende schist, associated with iron ore, asbestos, and sometimes indianite and fibrolite. It occurs imbedded in the rock in grains and crystals. Viralimodos and Sholasigamany are its principal localities in the valley of the Cauvery; Golashully and Kulkairy in Mysore, where it also occurs at Mundurim,† near Seringapatam, Tippaty, Beygoor, Bannercotha, Baugoopilly, and other places. It is also said to be found in the hypogene schists of Nellore and Guntoor. The spinel ruby (dodecahedral corundum) and sapphire (the corindon hyalin of Haüy) are occasionally found with the common corundum in the Salem district, and in the valley of the Cauvery. Emery, or granular corundum, is found at Bombardipadu,‡ about twenty-four miles northerly from Tripaty in North Arcot, in hornblende rock, in pieces varying from the size of a pea to that of a hen's egg, or even larger. Common corundum is also found where the Godavery escapes through the eastern ghauts, east of Papconda, from the Nizam's territories to the plains of Rajahmundry and the sea. Beryl occurs at Paddoor in Coimbatore; and, according to the Native at Vaniambaddi, at the north base of the Neilgherries.

Fibrolite occurs but rarely with indianite and corundum, as has been before alluded to, in speaking of the last two minerals. Kyanite I found asso-

* Asiatic Journal of Bengal, vol. II, p. 404.

† Macgregor, Madras Quarterly Medical Journal, July 1842, page 284.

‡ Clarke, Madras Journal, January 1839, page 121.

§ Hayne's Tracts, page 110.

ated with adularia, asbestiform tremolite, and magnetic iron ore, at Adipuram, in the Nellore district, in gneiss: it occurs in the same rock near Gharibpett,* in the Nizam's territories; also in Mysore,† and in the maritime districts of the Godavery and Kistna,‡ with tremolite, pearl spar, bitter spar, almandine and staurolite.

Passing last year through Gram, a village and fort in the Mysore country, about ninety-eight miles westerly from Bangalore, between it and the Western Ghats, I was informed by the Natives of the place that corundum (Corund kaphar)§ was found in this vicinity; at Golhushully, in the division of Noogyhully; at Kulkairi, Burkunhulli, Kundeo and Yedgunkul, in that of Chinrayapatam; at Norhik, in Narsipur; at Deysani Curbonhully, in Banawaram; and at Appianhully, in that of Harnhully. The localities I visited were Golhushully and Kulkairi, at which places the best corundum is said to be obtained. The mines lie about forty-five miles north by west from Seringapatam, and about seven or eight east by north from the fort of Gram. The formation around Gram is gneiss, associated with protogine. Proceeding from it in a westerly direction, the northern shoulder of the insulated range, south of the village of Belladaira, running nearly north and south, is crossed, and the soil suddenly changes from a light sandy colour to a deep red. The surface of this swell is covered with fragments of a ferro-siliceous schist, with quartz in alternate layers. This mountain range, as night was coming on, I was not able to examine; but from its singularly sharp outline, the elevation and shape of its highest peak, and its direction conformable with that of the primary schist, I should say it was, probably, a large ferruginous quartzose bed, in the gneiss associated with quartz iron ore, fragments of which are seen at its base.

* Voysey.

† Clarke, Madras Journal of Literature and Science for January 1839, page 120.

‡ Macpherson, Asiatic Researches, Vol. XVIII, page 120

§ Corund is the Hindustani term for corundum; can this be indicative of its having first been imported into Europe from India? Since ascertained that the first specimens of corundum were sent by Dr. Anderson of Madras to Mr. Berry, a Lapidary in Edinburgh, is the substance used in India to polish masses of stone, crystal, and all other gems except the diamond. It was examined by the

APPENDIX A.²

GRINDING AND POLISHING IMPLEMENTS.

PREFACE.

THE MILITARY BOARD AND COMMISSARY GENERAL having referred to me for information regarding the grindstones and honestones of this country, I furnished all the information I then possessed on the subject. Since the date of my former communication, however, I have added to it selections from the books in my possession, chiefly from the *Cyclopædia of useful Arts*—the Catalogue and Reports of the Juries on the London Exhibition; the Report of the Madras Central Committee for that Exhibition in the belief that it may be of some value to collect together all that is known connected with these implements and the modes of preparing and using them.

GOVERNMENT CENTRAL MUSEUM, }
MADRAS: 12th May 1855.

EDWARD BALFOUR,
In charge.

GRINDING AND POLISHING IMPLEMENTS.

Grinding and polishing are two important processes in the useful arts, variously applied, one for the production of form, and the other for that of surface. In the production of form by cutting, the material is mostly removed in chips and fragments, which in the case of metal admit of being re-united by fusion; but in the production of form by abrasion, of which grinding and polishing may be considered as the two extremes, the materials removed are ground to powder, and seldom admit of further application.

Most of the substances employed in the mechanical arts from the three kingdoms of nature admit of being ground and polished, by the application of certain abrasive surfaces or powders, applied by means of appropriate tools or apparatus. In some cases, the same substance may form the material to be polished, the polishing material, or the tool. For example, glass is ground and polished, as in plate-glass, cut-glass, and lenses; glass pulverised and glued upon paper is used as a polishing material; glass is also used as a tool or rubber, by means of which polishing powders are applied to metal works while being polished. So also with respect to iron, this metal is ground and polished in various forms; it is also used in the form of a disc or skive, with diamond powder, as a lap for polishing diamonds, for jewellery; in the form of peroxide, or crocus; it is used for many purposes, such as polishing the specula of reflecting telescopes.

The grinding and polishing materials used in the arts, principally consist of carbon, as in the diamond, and compounds of alumina and silice in various degrees of crystallization and admixture, and usually combined with oxide of iron or lime; such as sapphire, ruby, corundum, emery or rottenstone; flint, tripoli, polishing slate, Bohemian stone, Turkey stone, and pumice stone; oxide of iron, oxide of tin and chalk, are also used as polishing powders.

Some abrasive substances are used in the solid form, as the grindstone, oilstone, hones, charcoal, Dutch-rush, cuttle-fish bones, and fish-skins; a few are pulverised and mixed with various cements, as the grindstone and razor hone of the Natives of India; crocus mixed with wax is also used by English opticians. But the polishing powders having been separated into grains of similar magnitude, are usually applied by means of metal, wood, paper, leather, cloth, or bristles, proceeding gradually from the coarser to the finer powder, as

the form of the work becomes gradually developed. The grinding powder is, of course, harder than the substances to be ground, but the implement or grinding tool is softer, and generally agrees in form with the analogous cutting or moulding tools used for producing work of corresponding shapes in other substances. Thus turned works are often polished with wooden tools, applied with the powders; flat works require factitious saws; files and planes: a convex surface requires a concave grinding tool, and so on.

Great care must be taken in polishing to prevent the different powders and materials from becoming mixed. A grain or two of a coarse powder mixed with the fine, would produce deep scratches, and entirely nullify the effects produced by the powders of intermediate degrees of fineness. Hence, great cleanliness is required on the part of the operator, and between every two stages of polishing, there ought to be a careful rinsing of the work with water, and the entire removal of the previous materials used.

GRINDSTONE.—A large variety of grits* are used in the arts for grinding articles into shape or for giving them a smooth and polished surface: for cutting parts of machinery and grinding and mending tools.

These gritstones or grinding stones are all of them varieties of quartzose sandstones, of various degrees of fineness according to the purposes for which they are intended: their abrading or polishing powers depend upon the degree of hardness of the stone, the size of the particles constituting the mass and the silicious character of the stone.

Grindstones vary in size from half an inch to 24 inches, and are adapted to all purposes from the cutting of diamonds to the shaping of swords and bayonets.

They are formed into flat circular stones, of different thickness, and made to revolve with different degrees of velocity. When not in constant use, they are commonly turned by winch handles; but at Sheffield, Birmingham, and other places, where they are in constant use, they are mounted in large grind or blade mills, and are turned by straps acting on their axles, the moving power being either water or steam.

Amongst others we may mention that the Bohemian stones have long been

* **GRIT** is a name given to a variety of sandstone to which distinctive terms are applied in particular districts, as millstone grit, red grit, white grit, grindstone grit, &c. In the North of England, the term freestone is applied to gritstones as will work easily, and with a good face: calliard stones are intractable, close grained, almost flinty grits; hazel is applied to some hard grits in Aldstone Moor, Cumberland; at Newcastle, the word post signifies a bed, and is generally associated with gritstone rocks. The calcareous grit of Geology, is part of the middle oolite formation. Millstone grit contains beds of quartz pebbles, and is a coarse irregularly laminated rock.

imported into England from Germany and used by jewellers for polishing small works, such as the settings around gems.

These stones are fine and silicious and for small work, cut well and keep a good point.

The grindstones, made of sandstones from Mænig's quarry, Bohemia, are used for glass, minerals, teeth, fine tools &c. producing a fine edge and polished surface.

A rock called the grey band at the top of the Silurian group gives grindstones in Esqueezing and other parts.

Belgium consists in great part of Palæozoic deposits and possesses a great number of rocks adapted to the manufacture of grindstone and hones.

The following are a few of the substances used for the grindstones in common use in England:—

1. *Newcastle grindstones*, from the coal districts of Northumberland, Durham, Yorkshire, and Derbyshire, are selected from different degrees of density and coarseness, for the various manufactures of Sheffield and Birmingham.

2. *Bilston Grindstone* is similar to No. 1, but of a lighter colour, much finer, very sharp, but not too hard. It is confined to a small spot of limited extent and thickness, near Bilston, in Staffordshire, where it lies above the coal, and is quarried entirely for the purpose of grindstones.

3. *Carpenters' rubstone* is a hard, close variety, used as a portable stone for sharpening tools by rubbing them on the flat stone instead of grinding. It is also used for giving a smooth and uniform surface to copper plates for the engraver. A much softer variety of sandstone, is usually cut into a square form, from eight to twelve inches long, in which form they are used dry by shoemakers, pocket-book makers, cork-cutters, and others, for giving a rough edge to thin-bladed knives, &c.

4. *Devonshire Batts.*—A porous, fine-grained sandstone, in considerable repute, from the quarries of Blackdown cliffs, near Collumpton.

5. *Yorkshire grit* is used as a polisher of marble, and of copper plates for engravers.

6. *Congleton grit*, a similar, but softer stone, and similarly applied.

7. *Sheffield grindstone* is a hard coarse grit used for grinding large files, &c.

8. *The grindstones* from the Ardsley oak quarry near Barnsley are of sandstone. They are of excellent quality and are chiefly used in cutting certain parts of machines and in grinding and mending tools.

Grindstones of 9 feet 7 inches in diameter and $14\frac{1}{2}$ inches thick are used for grinding machinery: 4 feet in diameter and 6 inches thick for grinding tools; 2 feet 6 inches in diameter and 9 inches thick for grinding files.

These grindstones are also used principally in Yorkshire and Lancashire for edge tools, needles.

9. Grindstones of Nitshill, Hurlet, near Glasgow, are called *freestone*. The sandstones and greenstones of Nitshill are chiefly or entirely of the carboniferous period.

10. *Wickersley grindstones*, from Wickersley, about 9 miles east of Sheffield, are used for most purposes of grinding, as knives, scissors, razors, saws, and edge tools.

11. *Sheffield bluestone* has a finer grain than No. 7 or No. 10, and is used at Sheffield for finishing the grinding of articles of cutlery that have been prepared on No. 10. The bluestones are found in abundance on the north and south sides of Sheffield. Grinding on a bluestone is called whitening.

HONES.—*Hones* or *Hone Slates* is a term applied to various slaty stones which are used in straight slabs for whetting or sharpening the edges of tools after they have been ground on revolving grindstones.

Hones are variously known as *Turkey-stones*, oilstones, whets, whetstones, whetslates, honestones, hones, and polishing slates, and Mr. C. Meinig, who is the largest dealer in London, procures hones from Turkey, Persia, the Arkansas, from the banks of the Niagara, Spain, Peru, Ireland and Wales. All these stones, however, notwithstanding the difference of locality whence they are obtained, possess very remarkable analogies. They are of a yellowish white or light-green colour, fine grained and all appear to belong to altered argillaceous schists of the Palæozoic period: the whetstones for scythes or scythestones are made of sandstone; but hones have also been manufactured from bands of talcose slate in Madoc, Stanstead, Hatley and Slippton.

The hones of Belgium are good and well known. A considerable variety are obtained from the slaty rocks of the Luxemburg, available for many purposes. These, like most of the whetstones of commerce, are silicates of alumina, obtained from metamorphic rocks. They are of great hardness, of a light green colour, slaty fracture, and generally associated with clay slates.

Mr. Knight in his paper in the 50th volume of the Transactions of the Society of Arts, has enumerated the principal varieties of hones, viz.

1. *Norway Ragstone*, the coarsest variety of the hone slates. It is largely imported from Norway in the form of square prisms, from nine to twelve inches long and one to two inches in diameter. It gives a finer edge than the sandstones, and is in very general use.

2. *Charnley forest stone* is one of the best substitutes for the Turkey oilstone, and is used by joiners and others for giving a fine edge to various tools and also to penknives. It is found in Charnwood forest, near Mount Sorrel, in Leicestershire. The best variety is said to come from the Whittle Hill quarry, the other stones in the neighbourhood being more pinny, i. e., presenting hard places.

3. *Ayrstone, Scotchstone, or snakestone*, is used for polishing marble and copper-plates; but the harder varieties are used as whetstones. These stones are always kept damp or even wet, to prevent them from becoming hard. Small pieces of this stone are cut into slips of different forms for the use of the lapidary and others.

4. *Idwall or Welsh oilstone* is similar to No. 2, but generally harder. It is obtained from the vicinity of Llyn Idwall, in the Snowdon district of North Wales, and is more generally used for small articles of cutlery than No. 2.

5. *Devonshire oilstone*, from the neighbourhood of Tavistock, is described as an excellent, but little known variety, for sharpening all kinds of thin edged broad instruments, as plane-irons, chisels, &c.

6. *Cutlers' greenstone* from the Snowdon mountains of North Wales, is of so hard and close a texture, as to be applicable only to the purposes of cutlers and instrument makers, for giving the last edge to the lancet and other delicate surgical instruments.

7. *German razor hone* is known and esteemed throughout Europe as the best whetstone for the finer descriptions of cutlery. It is almost exclusively used for razors, for being very soft; it is cut by an instrument applied at an angle, instead of being laid down flat as the razor is. This stone is obtained from the slate mountains near Ratisbon, where it occurs in the form of a yellow vein running into the blue slate, sometimes not more than an inch in thickness, and varying to twelve, and in some places eighteen inches, from whence it is quarried, and sawed into thin slabs, which are usually cemented into a similar slab of the slate to serve as a support. That which is obtained from the "old rock" or lowest part of the vein, is esteemed the best.

8. *Blue polishing stone*, is a dark slate of uniform character, and not laminated in appearance. It is used by jewellers, clockmakers and other workers in silver and metal, for polishing off their work. It is cut into lengths of about six inches, and from $\frac{1}{2}$ inch to one inch or more wide, and then packed into small bundles containing from six to sixteen in each, and secured by withes of osier, in which state it is imported for use.

9. *Grey polishing stone* is similar in properties and uses to the blue, but

somewhat coarser in texture, and its colours are paler. It is obtained from the same locality.

10. *Welsh clearing-stone* is a soft variety of hone-slate cut in a circular form, and used by curriers, for giving a fine smooth edge to their broad straight-edged knives used for dressing leather.

11. *Peruvian hone* has been recently introduced as a whetstone, and is said to come from South America. It cuts freely with oil or with water, and is suitable for sharpening large tools that do not require a very fine edge.

12. *Arkansas stone* from North America, is of unequal texture, and cuts slowly.

13. *Bohemian stones* are imported from Germany, and are used by jewelers in the same way as Nos. 8 and 9, for polishing small work, such as the settings around gems. They cut well, and keep a good point for small work.

In addition to the above, it may be here noticed the Turkey oilstone, although, from the absence of lamellar or schistose structure, it can scarcely be considered as a hone slate. Mr. Holtzapffel remarks, that "as a whetstone it surpasses every other known substance, and possesses in an eminent degree the property of abrading the hardest steel, and is at the same time of so compact and close a nature, as to resist the pressure necessary for sharpening a graver, or other small instrument of that description. Little more is known of its natural history, than that it is found in the interior of Asia Minor, and brought down to Smyrna for sale. The white and black varieties of Turkey oilstone differ but little in their general characters; the black is, however, somewhat harder, and is imported in larger pieces than the white. The rough irregular pieces of oilstone scarcely ever exceed about 3 inches square and 10 inches long, and are generally about one-third smaller. When cut into rectangular forms, it is done with the lapidary's slitting mill and diamond powder. The blocks are then rubbed smooth with sand or emery on an iron plate. The piece of oilstone is generally inlaid in a block of wood, in which it is cemented with the putty used by glaziers, and to avoid the deposition of dust, a wooden lid is usually added. The lid is sometimes covered with a thick piece of buff leather, which serves to absorb the oil from the tool, and is used in the manner of a razor strop." Spermin or neat's foot oil, or an oil not disposed to thicken should be used.

Oilstone powder is also used for grinding together the brass or gun-metal fittings of mathematical instruments; and this powder is preferred to pumice-stone powder for polishing superior brass works.

The following are the analyses of a few polishing stones:—

	Polishing slate.	—	Bohemian stone.	Turkey hone.
Alumina,.....	4.0	7.0	1.0	3.33
Silica,.....	83.5	66.5	79.0	72.0
Lime,.....	8.5	1.25	1.0	13.33
Iron,.....	0.6	2.5	4.0	—
Water,.....	9.0	19.0	14.0	—
Magnesia,.....	—	1.5	—	—
Carbonic acid,.....	—	—	—	10.33

DIAMOND POWDER. The use of diamond powder is very general. Mr. Holtzapffel remarks, that "notwithstanding the apparent expense of the diamond powder, it is very generally employed, and is used for cutting nearly every Turkey oilstone that is sold; and although for this and some of the softer stones emery, or in some cases even sand, might be successfully employed, the diamond powder is almost exclusively used, as it is found to be the most economical, when the time occupied in the cutting is taken into account. The diamond powder cuts more rapidly than emery, and is very much more enduring: it also admits of being employed with very thin plates, and consequently the progress is also more expeditious on this account, and comparatively only a small thickness of material is wasted in the cutting. This is sometimes an important object with valuable stones, and the slicer is then made of small diameter, in order that it may be as thin as possible, and still retain the required degree of stiffness." Diamond powder is prepared from bort, [See Carbon, Vol. I, p. 311] from imperfect diamonds, and the fragments removed by the jeweller in splitting or cleavage. These fragments are crushed in a mortar, Fig. 1272, containing a deep cylindrical hole, terminating in the bottom in a spherical cavity of hardened steel, into which the pestle *b* accurately fits by grinding.

Emery manufactured in the form of bars and circular discs, or dusted-over paper or cloth, is used in the arts for grinding and polishing various substances, and the modes of using it are described below:—

Emery paper is prepared by brushing the paper over with thin glue, and dusting the emery powder over it from a sieve. There are about six degrees of coarseness. Sieves with 30 and 90 meshes per linear inch, are in general the coarsest and finest sizes employed. When used by artisans, the emery paper is commonly wrapped around a file or a slip of wood, and applied just like a file, with or without oil, according to circumstances. The emery paper cuts more smoothly with oil, but leaves the work dull.

Emery cloth only differs from emery paper in the use of thin cotton cloth instead of paper, as the material upon which the emery is fixed by means of glue. The emery cloth when folded around a file, does not ply so readily to

t as emery paper, and is apt to unroll. Hence smiths, engineers, and others, prefer emery paper and emery sticks; but for household and other purposes, where the hand alone is used, the greater durability of the cloth is advantageous.

Emery sticks, are rods of deal about 8 to 12 inches long, planed up square, or with one side rounded like a half round file. Nails are driven into each end of the sticks, as temporary handles; they are then brushed over one at a time with thin glue, and dabbed at all parts in a heap of emery powder, and knocked on one end to shake off the excess. Two coats of glue and emery are generally used. The emery sticks are much more economical than emery paper wrapped on a file, which is liable to be torn.

Emery cake consists of emery mixed with a little suet chopped small, rendered down, and mixed with a very little bees' wax, so as to constitute a solid lump, with which to dress the edges of buff and glaze wheels. The ingredients should be thoroughly incorporated by stirring the mixture whilst fluid, after which it is frequently poured into water, and thoroughly kneaded with the hands, and rolled into lumps before it has time to cool. The emery cake is sometimes applied to the wheels whilst they are revolving; but the more usual course is, to stop the wheel, and rub in the emery cake by hand. It is afterwards smoothed down by the thumb.

Emery paper, or Edward's patent razor strop paper (patented in 1843) is a new article, in which fine emery and glass are mixed with paper pulp, and made into sheets as in making ordinary paper. The emery and glass are said to constitute together 60 per cent of the weight of the paper, which resembles drawing paper, except that it has a delicate fawn colour. This emery paper is directed to be pasted or glued upon a piece of wood, and when rubbed with a little oil, to be used as a razor strop.

Barclay's artificial emery stone.—In 1842, Mr. Henry Barclay took out a patent for a method of combining powdered emery into disks and laps of different kinds, suitable to grinding, cutting, and polishing glass, enamels, metals, and other hard substances. The process of manufacture is as follows:—Coarse emery powder is mixed with about half its weight of pulverized Stourbridge loam, and a little water or other liquid, to make a thick paste; this is pressed into a metallic mould by means of a screw press, and after having been thoroughly dried, is baked or burned in a muffle, or close receiver at a temperature considerably above a red heat, and below the full white heat. In this case, the clay or alumina serves as a bond, and unites the particles very completely into a solid artificial emery stone, which cuts very greedily, and yet seems hardly to suffer perceptible wear.

Superfine grinding emery is formed into wheels exactly in the same manner as the above, but the proportion of loam is then only one-fourth, instead of one-

half that of the emery. These emery stones, which are of medium fineness, cut less quickly, but more smoothly than the above.

Flour emery when manufactured into artificial stones, requires no uniting substance, but the moistened powder is forced into the metal mould and fired, some portions of the alumina being sufficient to unite the whole. These fine wheels render the works submitted to them exceedingly smooth, but they do not produce a high polish on account of the comparative coarseness of the flour emery. Stourbridge loam is not the only ingredient used in uniting the particles of emery. Many other substances answer as well; such as slate, Yorkshire gritstone, crocus, &c., and in this way the hardness and cut of the emery stone may be varied to a great extent. Most of the grinders made of the emery stone are formed with central holes, so as to admit of being attached to the lathe upon appropriate chucks or spindles; and the substance is so porous as to absorb much water, which is gradually thrown to the surface by the centrifugal motion, so as to keep the edge conveniently moist; or with excessive velocity, the water is thrown off as in trundling a mop. Mr. Barclay has made the disks of various diameters, from $\frac{1}{4}$ inch to 8 or 10 inches diameter, but the difficulty increases with the size, as the large ones are liable to warp and crack in the firing. When the emery stone laps are required to have plane surfaces, angular or convex edges, &c. that could not be readily moulded, the composition is partially fired at a low heat, then turned in a lathe to the proper form, and fired at nearly a white-heat. The coarse emery stone has been used, it is said, successfully, in glass-cutting.

Common corundum is much used in this country as an abrasive. Like emery, it owes its valuable property to the highly crystalline alumina of which it mostly consists. The lapidaries in this country also use corundum wheels by cementing powdered corundum with one-third by volume of lac-resin. The corundum powder is put into an earthen vessel and heated over a clear fire, and when hot enough to fuse a piece of resin easily, the resin is stirred in, in small portions at a time. The mass is then taken out and beaten with a pestle upon a smooth stone, then rolled upon a stick, re-heated several times, and continually kneaded until a uniform mixture is produced. It is then separated from the stick, laid again upon a stone slab previously covered with very fine corundum powder, and flattened into the form of a wheel by an iron-rolling pin. The wheel is then polished by a plate of iron and corundum powder, and, lastly, a hole is made through the middle by a heated copper or iron rod. These wheels are made with a grain more or less fine. The coarser perform the first rough work, and the finer cut the stones, which are moistened and sprinkled with corundum powder. These wheels are mounted on a horizontal axis, and the workman sitting on the ground, makes them revolve with a spring bow held in his right hand, while the stone to be cut is held in his left. The polish is given by wheels of lead and very fine corundum powder.

Corundum Rubbers are made by melting lac, and then intimately mixing corundum powder with it. The composition is then moulded in the shape of a brick of about 6 by 4 inches, and $1\frac{1}{2}$ inch deep, with or without a handle of wood about 6 inches long at the end, having a rise of about 30° for the convenience of working it. For *coarse rubbers* the proportions are, by weight, lac 8; corundum 1; for the *medium*, lac 12 to 16 and corundum 1. The *fine* rubber is made by mixing the grindings of agates, cornelians, and the like with lac, and as the wheels upon which they are ground are made of corundum and lac, the grindings must contain a portion of those materials; a good proportion is 6 lac to 1 grindings.

Mr. Holtzapffel states that some dentists employ old files thinly coated with a cement of emery and shell lac in finishing enamel or mineral teeth.

In the Madras Presidency, at the present day, the powdered corundum is chiefly formed into whets and wheels, and Salem and Mysore are the districts where these are most commonly manufactured.

The corundum wheels are made as follows:

The corundum whets are formed like the scythe-stones of England; they are imported from Mysore in great abundance, and have almost entirely superseded the other implements formerly in use among the Nalbunds and others.

EMERY—MODE OF PREPARATION FOR THE PURPOSES OF THE MECHANIC.
—We come now to describe the various methods adopted in England for preparing emery for the manufacturer and the mechanic. In the ordinary process, the lumps of emery ore as they are imported are broken up in the same manner as stone is for repairing macadamized roads, and into lumps of similar size. These lumps are then crushed under stampers, such as are used for pounding metallic ores, and driven by water or by steam power. It is supposed that the stampers leave the fragments more angular than they would be if ground under runners, a mode which is sometimes employed. The coarse powder is then sifted through sieves of wire cloth, which are generally cylindrical, like the bolting cylinders of corn mills; but the sieves are covered with wire cloth, having in general about 90 to 16 wires to the inch. The following figures show the number of wires usually contained in the sieves, and the names of the kinds respectively produced by them:—16, corn emery, 24, coarse grinding emery; 36, grinding emery; 46, fine grinding emery; 53, super-grinding emery; 60, coarse flour emery; 70, flour emery; 80, fine flour emery; 90, superfine flour emery. No. 16 sieve gives emery of about the size of mustard seed; and coarser fragments, extending nearly to the size of pepper corns; are also occasionally prepared for the use of engineers. The sieves have sometimes as many as 120 wires in the inch; but the very fine sizes of emery are more commonly sifted through lawn sieves. The finest emery that is obtained from the manufacturers, is that which

floats in the atmosphere of the stamping room, and is deposited on the beams and shelves, from which it is occasionally collected. The manufacturers rarely or never wash the emery; this is mostly done by the glass-workers, opticians, and such others as require a greater degree of precision than can be obtained by sifting.

Washing-over or elutriation, as the process is called by chemists, is a beautiful application of the law of gravitation to the useful arts. Thus the alluvial deposits of some of the tropical rivers are washed in order to separate the particles of gold which they contain. A small portion of the mud of the river is stirred in a large quantity of water contained in a broad shallow basin; the gold, being many times heavier than the earthy particles, quickly subsides, and the mud, which remains suspended for a long period in the water, is removed by pouring off the water from the valuable sediment. In a similar manner the particles of emery and other powders may be separated according to their magnitudes, in a more accurate manner than can be accomplished by sieves. A portion of emery powder of uncertain size is thoroughly well mixed in a large quantity of water, as in a common wash-hand basin, and at the end of 10 seconds the liquid is poured off from the sediment which has fallen down in that period: the sediment is laid aside in a separate vessel. The bulk is again stirred and poured off at 10 seconds, and this second sediment added to the first, and which process is repeated until no further sediment is deposited in the period of 10 seconds; the process requires watchfulness and a steady hand. A fresh deposit is similarly collected from the residue after a longer period of rest, say 20 seconds, until the whole quantity of emery is divided into grains of so many sizes, as may be required for the particular branch of manufacture for which it is intended. Mr. Holtzapffel states that for many years he used emeries in the construction of mechanism of twelve degrees of fineness, part of them prepared by himself by washing over; namely:—No. 1, corn emery of commerce; No. 2, grinding emery; No. 3, fine grinding emery; No. 4, superfine grinding emery, all prepared by sifting: No. 5, deposited at the end of two seconds; No. 6, at the end of five seconds; No. 7, ten seconds; No. 8, twenty seconds; No. 9, sixty seconds; No. 10, three minutes; No. 11, fifteen minutes; No. 12, sixty minutes. The emeries of the sizes 5 to 12 are preserved in glass bottles, to keep them pure.

In the preparation of emery for optical purposes Mr. Ross mixes 4 pounds of the flour emery of commerce, with one ounce of powdered gum arabic, and then throws the powder into two gallons of clear water. He collects deposits, as above described, at the end of 10 seconds, 30 seconds, 2 minutes, 10, 20, and 60 minutes, and that which is not deposited by 1 hour's subsidence is thrown away as useless for grinding lenses. The use of the gum arabic, which renders

the water slightly viscid, was recommended by Dr. Green for preparing red oxide of iron, for polishing specula.

Another mode of preparing emery was pointed out some years ago by Mr. Hawkins. That gentleman finding that the emery sold in the shops was inadequate to the purpose of grinding two flat surfaces of hard cast steel accurately, thought of applying to emery a process which he had seen for washing over diamond dust. To ensure a good hard quality of emery, he procured of an emery-maker a quantity of those small lumps or grains which had longest withstood the action of the cast-iron runners and bed: these pieces were reduced to powder in a cast-iron mortar and then separated into different portions by sieves. The finest emery thus obtained was washed over with oil instead of water, the oil holding it in suspension a much longer time, and in this way he obtained a series of emeries which had floated 1, 5, 10, 15, 20, 40 and 80 minutes, amongst which he found every variety necessary for his purpose, and keeping them in boxes which were numbered according to the minutes they had floated, he could at any time prepare more of any one kind. In this way Mr. Hawkins readily obtained his object, and by selecting those grains of emery which resisted longest the action of the pestle and mortar, he obtained some so hard as to be capable of cutting a ruby when employed instead of diamond dust.

Mr. Gill, by grinding Greek emery-stone between two flat and hard steel surfaces and washing off the lighter portions in oil, found that those which subsided in half a minute, when examined by a microscope, had entirely resisted the friction, and were perfectly crystallized sapphires.

Mr. Chezy prepared very fine emery for optical purposes in the following manner:—After having well ground the coarse emery on an iron plate with an iron muller, it is thrown into a vessel which must be rather wider at bottom than at top by a gradual increase. The vessel must then be filled with clear water, so that it may stand 8 or 10 inches above the emery. The whole is then strongly agitated with an iron spatula and left to settle for an hour. The short branch of a syphon is then introduced to the depth of four inches below the surface, and the turbid water withdrawn without disturbing the vessel. The water thus drawn off is received into another large vessel, and the first vessel is again filled and its contents agitated as before. The same operation is repeated until the water flows clear through the syphon. The powder collected in the second vessel is too fine for grinding glass. The vessel being emptied and cleared, the same operations are to be repeated, but the water is to be drawn off at the end of half an hour, until the water passes clear through the syphon. The emery thus obtained by subsidence, is preserved for use under the denomination of emery of half-an-hour. The same operation being repeated, allowing only a quarter of an hour for subsidence, gives a fine emery, but not so fine as

the proceeding; this is known as emery for a quarter of an hour. In this way emeries may be obtained of $\frac{1}{2}$ or $\frac{1}{4}$ of a minute.

Washing emery by hand as above explained, is far too tedious for those who require very large quantities of emery, such as the manufacturers of plate-glass and some others, who generally adopt the following method. Twelve or more cylinders of sheet copper, of the common height of about two feet, and varying from about 3, 5, 8 to 30 or 40 inches in diameter, are placed exactly level, and communicating at their upper edges, each to the next, by small troughs or channels; the largest vessel has also a waste pipe near the top. At the commencement of the process, the cylinders are all filled to the brim with clean water; the pulverised emery is then churned up with abundance of water in another vessel, and allowed to run into the smallest or the three-inch cylinder, through a tube opposite the gutter leading to the second cylinder. The water during its short passage across the three-inch cylinder, deposits in that vessel, such of the coarsest emery as will not bear suspension for that limited time; the particles next finer, are deposited in the second or the five-inch cylinder, during the somewhat longer time the mixed stream takes in passing the brim of that vessel; and so on. Eventually the water forms a very languid eddy in the largest cylinder, and deposits therein the very fine particles that have remained in suspension until this period; and the water, lastly, escapes by the waste-pipe nearly or entirely free from emery. In this simple arrangement, time is also the measure of the particles respectively deposited in the twelve or more vessels, their number being determined by the quantity of sizes respectively required in the manufacture to which the emery is applied. When the vessels are to a certain degree filled with emery, the process is stopped, the vessels are emptied, the emery is carefully dried and laid by, and the process is recommenced.

Emery, a mixed granular corundum, extensively used in the arts for grinding and polishing metals, glass, &c. The use of emery in the arts is of very ancient date, as is proved by the existence of works on hard stones, which could not have been executed except by the use of emery, or of minerals of that nature. It is probable that some of the localities of emery which have recently been discovered were known to the ancient Greeks and Romans. Thus the locality of Gumuch-dagh is near the ancient Magnesia, on the Meander, and between Ephesus and Tralles, twelve miles from each of these cities, and the same distance from Tyria, in all which cities the arts flourished, especially the art of cutting hard stones, if we may judge from the specimens which have been transmitted to modern times. The quantity used was, however, very small compared with what it now is, especially since plate-glass has become so common.

During several centuries, down to within the last two or three years, the Island of Naxos, in the Grecian Archipelago, was the only source for the supply

of emery. This kind is often known under the name of Smyrna emery, from the fact of its coming to us from that port. Its price at the end of the last century was from 7£ to 8£ 10s. per ton; and between the years 1820 and 1835, even less than this. About this period, the monopoly of the Naxos emery was purchased from the Greek Government by an English merchant, who so regulated the quantity given to commerce, that the price gradually rose from 7£ to 30£ per ton, a price at which it was sold in 1846 and 1847. About this time, however, Dr. J. Lawrence Smith, an American mineralogist, being at Smyrna, saw some specimens of emery ore from a place twenty miles north of that port, which had been discovered through the agency of a knife-grinder of the country, who had been in the habit of using it to charge his wheels with. The importance of this circumstance to the Turkish Government, as well as to the arts, induced Dr. Smith, in 1847, to examine the supposed locality of this mineral. An English merchant named Healy also pointed out other localities of the mineral. The first locality examined was that of Gumuch-dagh, a mountain about twelve miles east of the ruins of Ephesus, and composed of bluish marble resting on mica slate and gneiss. On the very summit of the mountain the emery was found scattered about, and projecting above the surface of the soil. It was in great profusion, in angular fragments of a dark colour, and in large masses of several tons weight. On penetrating the soil, the emery was found imbedded in it, and a little further down it was come to in the rock. By breaking the marble that projects above the surface at this spot, nodules of the mineral were found. In some places the emery formed almost a solid mass, several yards in length and breadth, the spaces between the blocks being filled with an earth highly charged with oxide of iron. In other places the masses were consolidated by carbonate of lime of infiltration, which must not be confounded with the emery in its original gangue (the marble), in which it is found in nodules, sometimes round, and at other times fissured so as to represent angular fragments. In no place did it present anything like a vein, nor had it signs of stratification. The largest unbroken mass seen by Dr. Smith must have weighed from 30 to 40 tons.

Other localities of emery are Kulah, Adula, and Manser; also the island Nicaria, in the Grecian Archipelago. In the island of Naxos the emery is found in large blocks mixed with a red soil, and also imbedded in white marble. It is taken principally from the north and east side of the island: the best comes from Vothric, nine miles from the shore, and is embarked at Sulionos. Another good locality is at Apperanthos, seven miles from the shore, and it is embarked at a small port called Montzona. In the south of the island it is found near Yasso. It is in such abundance on this island that, notwithstanding the immense quantity carried off, it has not yet been found necessary to quarry the rock.

Dr. Smith having reported his discoveries to the Turkish Government; a

commission of inquiry was instituted, and the business soon assumed a mercantile form. The monopoly of the emery of Turkey was sold to a mercantile house in Smyrna, and since then the price has diminished in the English market to from 10£ to 15£ the ton. The different mines explored are those of Naxos, of ancient date; of Kulah, commenced in 1847, and now abandoned for those nearer the sea; of Gumuch-dagh commenced in 1847, and worked largely; and of Nicaria, commenced in 1850. From all these different places the emery is sent to Smyrna, and from thence principally to England, the vessels taking it at a very low price, as it serves for ballast. The various mines belong to the Turkish and to the Greek Governments. The latter now sells its emery in lots of several tons; but as the former has sold the entire monopoly of its mines, the operations are controlled by a single interest; but it is expected that this monopoly will be abolished in virtue of a commercial treaty existing between Turkey and the other powers. The effect of this will be greatly to reduce the price of emery.

Of the different varieties of emery used in the arts, that of Naxos is still preferred, as it is more uniform in its quality than that from Kulah and Gumuch; but if the best qualities of Nicarian emery are found in abundance, and such only sent to the market, they will prove equal, if not superior, to the emery of Naxos.

The mining of emery is of the simplest character. The natural decomposition of the rock in which it occurs facilitates its extraction. The rock decomposes into an earth in which the emery is found imbedded. The quantity procured under these circumstances is so great that it is rarely necessary to explore the rock. The earth in the neighbourhood of the block is almost always of a red colour, and serves as an indication to those who are in search of the mineral. Sometimes before beginning to excavate, the spots are sounded by an iron rod with a steel point, and when any resistance is met with, the rod is rubbed in contact with the resisting body, and the effect produced on the point enables a practised eye to decide whether it has been done by emery or not. The blocks which are of a convenient size are transported in their natural state, but are frequently broken by large hammers: when they resist the action of the hammer, they are subjected to the action of fire for several hours, and on cooling they most commonly yield to blows. It sometimes happens that large masses are abandoned, from the impossibility of breaking them into pieces of a convenient size, as the transportation either on camels or horses requires that the pieces shall not exceed 100 lbs. each in weight.

At Kulah, the quantity of emery detached from the rock was not very considerable, as it had been protected from decomposition by the beds of lava that cover it. There the marble was quarried to get at the emery, which was done in 1847 with profit, although the emery had to be carried 110 miles on the backs of camels. Since the diminution of the price of emery, this mine has

been abandoned, for the quarrying into the marble was found very difficult, the tools used in boring, &c. being thrown out of use in a very short time by the pieces of emery encountered at every instant. At the time when Dr. Smith wrote, all the emery sent from Asia Minor was from the mine at Gumuch-dagh.

Emery appears to be a mechanical mixture of corundum and oxide of iron; that from Naxos is of a dark grey colour, with a mottled surface, and with small points of a micaceous mineral disseminated in the mass. It frequently contains bluish specks or streaks, which are easily recognised as being pure corundum. The emery from the other localities has each its own peculiar aspect. The fracture of emery is tolerably regular, and the exposed surface granular: it is exceedingly difficult to break when not traversed by fissures, or not of a lamellated structure. When reduced to powder, it varies in colour from dark grey to black. The colour of its powder affords no indication of its commercial value. The powder examined under the microscope shows the distinct existence of the two minerals, corundum and oxide of iron. Emery when moistened always affords a very strong argillaceous odour. The specific gravity is about 4. Its hardness is its most important property in its application to the arts; and was ascertained by Dr. Smith in the following manner: fragments are broken from the piece to be examined, and crushed in a diamond mortar with two or three blows of a hammer, then thrown into a sieve (with 400 holes to the square centimetre). The portion passing through is collected, and that remaining on the sieve again crushed, and so on until all the emery had passed through the sieve. The powder is then weighed, and the hardness tested with a circular piece of glass, about 4 inches in diameter, and a small agate mortar. The glass is first weighed, and placed on a piece of glazed paper: the pulverized emery is then thrown upon it at intervals, rubbing it against the glass with the bottom of the agate mortar. The emery is brushed off the glass from time to time with a feather, and when all the emery had been made to pass once over the glass, it was collected, and passed through the same operation three or four times. The glass was then weighed, again subjected to the same operation, the emery by this time being reduced to an impalpable powder. This series of operations is continued until the loss sustained by the glass is exceedingly small. The total loss in the glass is then noted, and when all the specimens of emery are submitted to this operation under the same circumstances, an exact idea of their relative hardness is obtained. The advantages of using glass and agate are, that the latter is sufficiently hard to crush the emery, and in a certain space of time to reduce it to such an impalpable state, that it has no longer any sensible effect on the glass; and, on the other hand, the glass is soft enough to lose during this time sufficient of its substance to allow of accurate comparative results. By this method, the best emery was found capable of wearing away about half its weight of common French window-glass. The blue sapphire of Ceylon, pulverized and experimented with in this manner, wears

away more than four-fifths of its weight. This furnished the standard of comparison.

The following Table shows the results of the examination of ten specimens of emery:—

No.	Localities.	Effective Hardness Sapphire 100.	Specific gravity.	CHEMICAL COMPOSITION.					
				Water.	Alumina.	Oxide of Iron.	Lime.	Silica.	Total.
1	Kulah.....	57	4.28	1.90	63.50	33.25	0.92	1.61	101.18
2	Samos.....	56	3.98	2.10	70.10	22.21	0.62	4.00	99.03
3	Nicaria.....	56	3.75	2.53	71.06	20.32	1.40	4.12	99.43
4	Kulah.....	53	4.02	2.36	63.00	30.12	0.50	2.36	98.34
5	Gumuch.....	47	3.82	3.11	77.82	8.62	1.80	8.13	99.48
6	Naxos.....	46	3.75	4.72	68.53	24.10	0.86	3.10	101.31
7	Nicaria.....	46	3.74	3.10	75.12	13.06	0.72	6.88	98.88
8	Naxos.....	44	3.87	5.47	69.46	19.08	2.81	2.41	99.23
9	Gumuch.....	42	4.31	5.62	60.10	33.20	0.48	1.80	101.20
10	Kulah.....	40	3.89	2.00	61.05	27.15	1.30	9.63	101.13

Other substances in very minute quantities occur in some of the emeries, as titan acid, oxide of manganese, oxide of zirconium and sulphur. Those emeries which contain the least water, everything else being alike, are the hardest. The silica is usually in combination with alumina, or the oxide of iron, or both; so that the quantity of alumina must not always be regarded as an indication of the quantity of corundum in the emery.

PUTTY POWDER, an oxide of tin, or of tin and lead in various proportions, much used in polishing glass and other hard substances. The best putty powder consists of pure oxide of tin; but as the manufacture of this is difficult, the oxidation is assisted by the addition of a small quantity of lead, for which purpose the linings of tea-chests are employed, or an alloy prepared in ingots by the pewterers, and called shruff. Common putty powder of good fair quality, is prepared from equal parts tin and lead, or tin and shruff. The inferior dark coloured kinds are made from lead only. Putty powder is prepared by placing the metal in an iron muffle kept at a red heat; the metal fuses, the

oxide forms on its surface, and it is frequently stirred to expose fresh surfaces to the air. When all the metal has disappeared, the process is at an end, and the upper part of the oxide sparkles like particles of incandescent charcoal. The oxide is removed in ladles, and is spread out in iron cooling pans. Hard lumps of the oxide are then selected and ground dry under a runner, and the powder thus produced is sifted through lawn. The whitest powder, if heavy, is generally the purest: some of the common powders are brown and yellow; those known as grey putty contain a small portion of ivory black. The pure white putty is preferred by opticians, workers in marbles and others: it is the smallest and most cutting, and answers well as a plate powder, and for polishing in general. The putty powder prepared by Mr. A. Ross, the optician, for the optical purposes, is noticed under Lens.

SEPTARIA, lenticular concretions of clay ironstone intersected by veins of clac spar. When calcined and ground to powder they form a good hydraulic cement.—*See Mortars and Cements.*

ROTTEN STONE.—A variety of Tripoli, almost peculiar to England. It occurs abundantly in Derbyshire and South Wales, and is much used for giving polish and lustre to articles in silver, glass, and stone.—*See Grinding and Polishing.*

Tripoli, a fine grained earthy deposit, with a dry harsh feeling, and a grey, yellow, or red colour. It contains 81 per cent of silica, mostly derived from the casts or skeletons of infusorial animalculæ, 1·5 per cent of alumina, 8 per cent of iron, sulphuric acid 3·45, and water 4·55. The forms of the animalculæ are readily distinguished by the microscope, and their analogies with living species may be traced; in many cases according to Ehrenberg, the petrified appear to be identical with the living. The species are distinguished by the number of transverse lines on their bodies: the length is about $\frac{1}{385}$ th of a line. Tripoli was first brought from Tripoli in Africa as a polishing material, but has since been found in France, Italy, Germany, and other places. Red Tripoli is prepared in large quantities from a brick earth found near Battle in Sussex. When burned in lumps it is as heavy as emery stone; it is then ground and sifted, and resembles crocus, only coarser: it is used for similar purposes. A red tripoli is also prepared by calcining and pulverizing the clunch or curl stone of the coal and iron districts of Staffordshire, formerly used only for mending the roads. It is composed of iron, alumina, lime, and silex. Clunch resembles the Septaria nodules, used as the basis of Roman cement.—*See Mortars and Cements.* Mr. Gill says, "the polishing effects of the calcined and pulverized clunch are superior to those of the Septaria when prepared in a similar manner; and are, indeed, in point of quickness of action in producing the polish, and in the beautiful black lustre which it gives to the gold or silver, far beyond any thing I have ever met with."

Yellow or French Tripoli, as it is called, is used for the general purposes of polishing. It is also used for polishing light coloured woods that would be stained by the absorption of darker powders into their pores. A large quantity of fine yellow Tripoli was obtained in digging the canal in the Regent's Park, London.—*See Rottenstone, Grinding and Polishing.*

Lapidary Work (Lapidarius, pertaining to stones, from Lapis, a stone).—The art of the lapidary does not include the various modes of working or finishing stones, as its derivation would seem to imply, but is restricted to the cutting, grinding, and polishing of gems, small stones, &c., for jewellery, or for mineralogical specimens.

The stones cut by the lapidary are of various degrees of hardness,* and in cutting or polishing any particular stone; another harder stone is used, in the form of a powder applied to the edge or the surface of what are called mills, which are disks of metal and other materials, revolving horizontally on vertical spindles. Thus, the slitting-mill, the roughing-mill, the smoothing-mill, and the polishing-mill, are generally of metal; but for soft stones, the smoothing-mill may be a disk of willow wood or mahogany. The polishing-mill may be a spiral coil of list, the surface presented by the edges being the part used, or wood covered with buff leather may be used.

The processes of the lapidary vary with the hardness of the stone. Taking alabaster as the type of soft minerals, cornelian as the type of minerals of medium hardness, and sapphire as the type of hard minerals, three distinct groups may be formed in which the mode of treatment corresponds for all the members of each group.

* The following is the scale of hardness in minerals. In the examples selected, each mineral is scratched by that which follows it. The use of this scale is to determine the hardness of any given mineral by reference to the types here selected. Thus, suppose a body neither to scratch nor to be scratched by fluor spar, its hardness is represented by 4; but if it should scratch fluor spar; and not apatite, then its hardness is said to be from 4 to 5. The degrees of hardness are numbered from 1 to 10. The third column contains the names of some of the minerals, metals, and other substances of similar degrees of hardness; and the fourth column contains the number of minerals which in respect of hardness are ranked under each of the ten grades. The hardness of other minerals is represented in whole numbers and decimals.

No. on the scale of hardness.	Types of Hardness.	Examples.	No. under each.
1	Talc.....	Lead Steatite or Soap stone, Meerschäum.....	23
2	Compact Gypsum.....	Tin, Ivory, Pot stone, Figure stone, Cannel Coal Jet, &c.....	
3	Calcareous spar any cleaveable variety.....	Gold, Silver and Copper when pure; soft brass Serpentine, Marble, Oriental Alabaster, &c.....	90
4	Fluor spar, any cleaveable variety.....	Platinum Gun-metal.....	71
5	Apatite in transparent crystals.....	Soft Iron.....	58
6	Felspar, cleaveable variety.....	Soft steel Porphyry, glass.....	43
7	Quartz, limpid and transparent.....	Hardened steel, Silex Flint, Agate, Granite, Sandstone. Hardest Steel.....	52
8	Topaz.....	Ruby and Corundum.....	26
9	Sapphire or Corundum stone.....	Cuts all substances.	6
10	Diamond.....		1

ALABASTER HARDNESS 1.5 to 2.

Amber,	Jet,	Opal,
Cannel Coal,	Lava,	Pot-stone,
Coral,	Malachite,	Satin stone,
Enamels,	Mother of Pearl,	Steatite,
Glass,	Macreous-Shells,	Turquoise.

CORNELIAN HARDNESS 7.

Agate,	Elvans,	Mina Nova,
Amethyst,	Emerald,	Onyx,
Aquamarine,	Felspar,	Opal,
Beryl,	Flint,	Pastes,
Blood-stone,	Fluor Spar,	Peridot,
Brazilian Topaz,	Garnet,	Plasma,
Carbuncle,	Granite,	Porphyry,
Cat's-eye,	Heliotrope,	Quartz,
Calchedony,	Jade,	Sard,
Chrysolite,	Jasper,	Sardonyx,
Chrysolite,	Lapis Lazuli,	Serpentine,
Crystal,	Marble,	Topazes,

SAPPHIRE HARDNESS, 9.

Mineralogists and Jewellers apply several names to the sapphire, depending on its colour and lustre, namely—

White Sapphire, when transparent or translucent.

Oriental Sapphire, when blue.

Oriental Amethyst, when violet-blue.

Oriental Topaz, when yellow.

Oriental Emerald, when green.

Oriental Ruby, when red.

Chatoyant, or Opalescent Sapphire, with pearly reflections.

Girasol Sapphire, when transparent, and with a pale-reddish or pale-bluish reflection.

Asteria, or star sapphire, has six milk-white rays, radiating from the centre of a hexagonal prism, and placed at right angles to its sides. The asteria is found in both the red and blue varieties of sapphire, and is always cut so as to show the figures.

All the above sapphires, the chrysoberyl, the zircon, and some other gems, are cut with diamond powder, and polished with rottenstone.

The grinding and polishing of cutlery form an important part of the operations carried on at Sheffield. They are usually conducted in buildings called wheels or mills, each of which is divided into separate rooms called hulls, and in each hull are six troughs with a grindstone and a polisher in each. Motion is communicated to the stones by means of a steam engine. The most celebrated of these grinders is the Castle mill, situated near the junction of the Shief and the Don. A view of it is given in one of our large engravings. Its castellated appearance has given it a name, and it comprises a central courtyard, with buildings running along the four sides, containing numerous apartments occupied by the grinders, who contribute each a certain sum for rent and for steam power. The stones vary in quality and size with the article to be ground. They range from 6 to 24 inches in diameter, and are fixed upon square iron spindles from 12 to 30 inches long, terminating in steel pointed centres: the stone is wedged fast near the right hand extremity of the spindle, and near the left is fixed the pulley for the driving belt. The spindle is supported on two long pieces or sleepers united at their extremities and resting on the ground; near one end are two upright posts, at the upper parts of which are hollow centres for the spindle to run in: the centres are of lingum vitæ, horn, steel. The Sheffield grinders commonly use ash for the centre blocks. Between the standards and below the stone is a long narrow water-trough of wood lined with lead or iron, called the dog-pán: it is not allowed to contain

water enough to reach the stone, or it would be splashed about by the centrifugal force; but the water is thrown upon the stone from a bucket with the hand or is allowed to flow in a thin jet upon the side of the stone. The man sits astride a-board called the horse, which admits of being shifted to or from the stone. The edge of the horse near the stone is commonly shod with iron, for supporting the tool used in "turning-up" the stone. A splash board, or some other contrivance, is erected on the other end of the trough, projecting above the top of the stone so as to catch most of the water that flies off and return it to the trough.—(See *grindstone*.)

Saws, fenders, &c. which present a large extent of surface, require stones of great diameter, while razors and the smaller articles of cutlery are ground upon small stones. Saws, scythes, and edge tools which require a certain temper, are ground on a wet stone, for which purpose water is kept in the trough to such a height as just to touch the stone. An extensive class of small articles, such as razors, scissors, pen and pocket knives, forks, needles, &c. are ground upon a dry stone. Dry grinding is a more expeditious operation than wet, but several articles of cutlery are first ground on a dry stone, and afterwards on a wet one. Fork grinding, however, is always performed on a dry stone, and hence the peculiarly destructive character of this branch.

In the grinding and polishing of glass the plate being still hot and yielding when it is slid into the oven, takes an impression of the bricks of the oven upon which it rests, while the upper surface is generally made smooth and bright from the action of the fire, but it is not flat. The plates as they come out of the annealing-furnace are about $\frac{1}{4}$ inch thick, of an irregular mottled appearance. They are carefully examined, to see whether the glass is sufficiently free from defects to admit of forming large plates, which, of course, have a much greater comparative value than small ones. If the defects are such as cannot be removed by grinding, the plate must be cut up into smaller plates, so that the defective portions may be rejected. The plates having been squared, next undergo the processes of grinding and polishing. These were formerly done by hand, but of late years this laborious work is almost entirely performed by machinery. The first object is to produce a level surface, which is done by grinding one plate upon another, a rough or rolled surface being opposed to the comparatively smooth or casting-plate surface. The grinding machines for large plates are arranged in pairs consisting of two benches of stone, 15 feet long, 8 feet wide, and 18 inches high. On the surface of each bench one or more plates of glass are imbedded in plaster of Paris, close together, and quite level. Other plates of glass are cemented upon the lower faces of two swing tables or runners, which are made to traverse over the fixed beds by appropriate machinery, in such a way that each runner is made to rotate around its own axis, and by a combination of two movements to change continually the relative position of the fixed bench and runner. Such an arrangement tends to

the mutual correction of the two surfaces of the glass, and greatly assists the equal distribution of the sand and water. All the irregularities of the surface are first ground out with sharp river sand, which has been washed and sifted into three sizes: the sand and water are thrown on by hand from time to time. When the plates have been ground quite flat, the finer sand is employed: this is followed by one finer still, which removes the scratches made by the coarser. The plates of glass are well washed between every change of sand, and when one side has been ground, the plates are reversed and the other sides ground. When the plates become sufficiently smooth to require the application of emery, there is a tendency to cohesion between the surfaces, which, travelling over each other with moderate velocity, produce so much friction that one surface will frequently tear the glass from the other. Hence it has not been thought safe to trust the next process, namely, the smoothing, to machinery, and hand labour has been employed. Lately, however, machinery invented by Mr. Blake, of the Thames Plate-glass works, has been introduced. The Editor has seen it in action, and it appears to answer the purpose admirably; its object being to imitate the motions of the arms and legs of the persons employed in smoothing. The following is the method by hand. The plates are put upon flat stone benches about 2 feet high, covered with wet canvas, which serves to hold them firmly. The surface of each plate is sprinkled with emery and water, and a small plate is usually used as a grinder or runner; but if the plates be large, a few flat lead weights, of about 14 lbs. each, are put on the runner near the middle, to distribute the pressure uniformly, and the runner is made to traverse with a swinging rotatory stroke: each stroke is made to follow a slightly different path from the preceding one, and the runner is gradually twisted round as the smoothing proceeds. In this way every part of the bed plate and runner is exposed to an equal amount of grinding, and the emery is uniformly distributed. Young girls are employed on small plates: but the large ones, which require more dexterity, and a much larger amount of traverse, are smoothed by two women, who stand on opposite sides of the bench, and, placing their out-stretched hands flat upon the runner, swing it with a kind of eccentric circular stroke. Women are said to perform this rude work better than men, on account of their superior delicacy of touch, which leads them to use the moderate degrees of force required, and to detect and remove particles of grit amongst the emery. About three sizes of carefully washed emery are used; and between every size the plates, canvas, bench, and hands are thoroughly washed: the dress must also be quite clean, as any particle of grit would ruin the work, and require the smoothing to be recommenced. The fine emery last used gives a very smooth and partly polished surface.

The polishing is completed by rubbers, covered with thick felt, and worked by machinery. The plates of glass are embedded close together with their surfaces quite level upon moveable platforms fixed upon a traversing bed. The

rubbers, which measure 8 by 6 inches each, are attached, one foot asunder, to reciprocating carriages, which drag the rubbers backwards and afterwards over the surface of the glass, while the latter traverses beneath the rubbers a space equal to the distance between the two lines of rubbers, so as to expose all parts of the glass equally to their action. Each rubber is made to exert a pressure of about 15 lbs., by means of lead weights. The powder used for polishing is Venetian pink: this contains only a small portion of oxide of iron, mixed with earthy matter, it admits of being mixed with water, and thus reduces the friction, and prevents the glass becoming heated by the action of the rubbers. Tripoli crocus, or putty powder, used with water, are too active to produce a high polish on glass; but they may be employed dry for the last finish in hand-polishing. In polishing by machinery, dry powders must be avoided on account of the friction and heat evolved. Hand polishing is very tedious, and is apt to produce a wavy appearance; hence machine-polished glass is to be preferred. The machinery represented in figs. 1090 to 1093 will convey a very good idea of that used in the grinding and polishing of ordinary plate glass.

The grinding and polishing of the plates reduces their thickness as much as one-third, and in some cases one-half. Should the glass be defective, the polishing will only serve to heighten the defects; hence, a second and more careful examination selection of the plates is now made. The defective ones are cut up into smaller plates, and these are polished again: the perfect ones are reserved for silvering, the process for which will be described presently.

To prevent or diminish the waste in the grinding, Mr. Bessemer has materially altered the whole of the arrangements of this manufacture. The furnace and the pots of glass are so arranged, that each pot, as soon as its contents are in a fit condition, is wheeled out of the furnace, and tilted, so as to pour the melted glass between two rollers placed at a certain distance apart, and kept cool by a current of water passing through them. In this way a uniform thickness of glass is ensured. The hot sheet of glass, on passing between these forming rollers, is received between two finishing rollers, and being closer together, and moving with accelerated speed, the glass is made smooth and flat. A fluted or a chequered surface can be given to the glass by the making rollers; such a surface is said to retain the sand used in grinding, and greatly facilitate that operation. After the hot plate has passed between the second pair of rollers, it slides down a curved surface upon a flat table, and when sufficiently rigid by cooling, it is transferred to the annealing-kiln, which is heated by hot air, the direct action of the fuel being prevented. In polishing, the plate is secured to a slab of slate, and an endless band or strap of gutta-percha, covered with felt and polishing material, is made to pass rapidly over the surface of the glass, in contact therewith: at the same time, the band is made to traverse slowly at right angles to the line of its motion.

Plate-glass is sometimes made by the blowing and flattening process already described. The irregularities of its surface arising from the imperfect action of the flattening process are, from the best glass, removed by grinding and polishing. The moving parts of the grinding machine employed for the purpose will be understood from Figure 1090, in which the dotted lines represent the framing. This consists of continuous beams 1,1, united by vertical parts 2,2; and above is an axis 3,3, carrying one pair of bevel-wheels, which turn the upright shaft 4 and its crank 5 to the right or left at pleasure. The pin of the crank 5 communicates a circular motion to that point of the moving table to which it is attached, while the fixed radius bar 6, 7, 8 makes the centre of the table describe an arc about the point 6, and these two motions bring all parts of the running surface, in succession, in opposition to nearly every part of the lower bed: this bed rests on railway bars 9,9, and is very slowly reciprocated to and fro by the bar 10, which sets a large number of machines in motion by means of a crank attached to it. The circle described by the crank 5 is about two-thirds of the length of the moving-table. The lower face of this table is covered with slate, upon which the glass is cemented; another sheet of glass is cemented upon the lower table, and the upper table is loaded with 4 or 8 weights, arranged so as to distribute the weight equally. Coarse emery and water are used for the grinding; and when the machines are used with finer emeries for smoothing, the whole apparatus is carefully washed. In some factories the plates of glass are smoothed by rubbing them upon one another by hand.

The sheet-glass having been ground flat and smoothed, is polished by machinery, the principle of which is roughly illustrated by the following figures—1, 1, Figures 1091, 1093, is the main shaft, extending throughout the length of the building, and having for every row of machines one double and two single cranks, which, by means of connecting rods, move the two long central beams, 2,2 to the right, and at the same time the two exterior beams 2', 2' to the left. The travelling beams, or rods, carry rubbers 3, 3 about 12 by 5 inches on the face, and covered with leather; they are suspended by a joint to the loaded levers 4, 4', Figures 1092, which press them on the glass.

The joint which unites 4 and 5 is situated in a mortice of the long travelling beam 2. In order to raise the cushion from the glass and throw it out of work, the piece 5 is raised and laid down in the position 5', which brings the lever 4 into the position 4'. The rubbers all assume an inclined position in consequence of the several tables which carry the glass having a very slow transverse motion, which is brought about in the following manner:—The main shaft 1,1, communicates with a pair of sliding bevel-wheels 6,6, Figure 1093; these through 7 move the tangent screw 8, and thence the worm-wheel 9, which latter, by the pair of bevel-wheels 10,11, moves the long shaft carrying the line of pinions 12,12, one or two of which are under every table,

and traverse the same by the aid of plain rollers 13,13. A tumbling-bob is affixed to the table nearest the cranks and gear, by which the position of the pair of bevels 6,6, is shifted to make the tables traverse first in the one and then in the opposite direction.

GLASS GRINDING.—When two hard bodies are rubbed or ground together there is always a tendency for one of them to become convex and the other concave, and it is by taking advantage of this tendency that glass is ground into lenses. It can be proved by certain optical properties of a well formed lens, that no part of its surface deviates by a ten-millionth of an inch from a truly spherical figure; indeed, surfaces cannot be made so accurately plane as they can be made convex.

In the grinding of lenses counterpart tools of metal are used, adjusted to the curvatures of the lenses, and serving as a medium for applying the grinding and polishing powders. Each tool consists of a convex and a concave surface, which are first ground together into shape and thus made to correct each others defects. In preparing one of these tools a convex and a concave template is first made to the radius of the required curve. If the radius be large the templates are cut out of crown glass by cementing a sheet of that material upon a bench, and mounting a glazier's diamond upon the end of a light radius bar, a brad-awl being stuck into the bench serves to support the other end, the distance from the diamond to the awl being the radius of the curve. The glass, being cut by the diamond, is broken in the line of the cut, by which means concave and convex edges are formed; these edges are ground by being rubbed together with a little emery and water with the pieces in a flat position, one of them being occasionally turned over in order to verify the curves. Templates are more usually formed of sheet-brass; those of large radii being cut with a strong radius bar and cutter, whilst those of a few inches radii are cut in the turning-lathe.

The tool used in making convex lenses is a concave shell of cast-iron, shewn in Section Figure 1298. The wooden pattern used in casting this shell is carefully turned to the curve of the template, while a similar shell, turned to a radius of about $\frac{1}{2}$ inch larger than the template, is used as a foundation for the polisher. A convex tool, or runner of cast iron, Figure 1299, of about $\frac{1}{2}$ inch less radius than the template, is used as the support for common glasses, a number of which are ground together. A pair of brass tools, Figure 1300, of the exact curvature of the templates, are also prepared and made to fit each other with great nicety. The concave half is used for correcting the curvature of the lenses after they have been roughly shaped in the concave half, Figure 1298. The convex half is used for preserving the true shape of the concave grinding tool and polisher. The screws at the back of these tools admit of their being fitted to the lathe mandrel, to be turned to the curvature of the

template. The screws also serve to secure the tools to the top of an upright post or pedestal, about 3 feet high, firmly fixed into the floor, and furnished at the top with an iron block and a vertical screw. The brass tools having been turned to the proper curve, the convex tool is fixed by its screw to the top of the post; a wooden handle is screwed into the back of the concave tool, and they are then ground together with emery and water, or with dry emery distributed as uniformly as possible by rubbing it level with a piece of glass of similar curvature, wiping off any excess from the margin of the tool. The operator works the concave upon the convex tool with a circular swinging stroke, and between every few strokes he moves a little way round the post, the object being to bring the two surfaces in contact in every possible position, and to rub them upon each other at all angles, so as to produce a true spherical figure.

The glass for the lenses is brought into circular form by means of shanks or flat pliers or soft iron, which do not slip as steel would do. The iron jaws being applied near the edges of the glass cause it to crumble away in fragments, and by this shanking or nibbling the glasses are made circular, but they are left somewhat larger in diameter than is required for the finished lenses. A small quantity of cement is then poured upon each glass, and when this has set, more is added, until it rises in a hemispherical mass capacious enough to be grasped with the fingers.* Each glass is next rough ground within the shell, Figure 1298, with river sand and water, or coarse emery and water, until the surfaces are brought nearly to the curve of the shell. The shell is placed within a shallow tray, for the purpose of catching the loose sand or emery thrown off in the grinding. The glasses are rubbed with large circular strokes, and when this rough grinding is completed on one side the glass is warmed to detach the handle of cement, which being attached to the ground side, the other side is similarly ground. By leaving the edge of equal thickness all round, the two surfaces are kept tolerably parallel.

All lenses are rough ground in this way; those of the best quality are next ground into the correct shape in the brass tool, and polished one at a time. For common lenses several are operated on together. As many as four dozen common spectacle glasses are sometimes cemented upon a runner and ground and polished together; but they must be arranged symmetrically round a central lens as 7, 13 or 21; or a group of four may form the nucleus, in which case the numbers are 4, 14, 30. Lenses of medium quality and sizes are often ground true and polished 7 at a time. Taking the last case, the method is as follows:—The cement at the back of the lenses is flattened with a hot iron, and the 7 lenses are placed with the cemented sides upwards in the

* The cement is formed by mixing with 14 parts of melted pitch about 4 parts of sifted wood ashes, the latter serving to reduce the adhesion of the pitch. If the cement be too hard and brittle, it may be softened with tallow or hog's lard.

concave brass tool, one lens in the centre and the other six at equal distances around. The iron runner is then heated and carefully placed upon the backs of the lenses; the cement softens and adheres firmly to the iron, which is then cooled with a wet sponge, matters being so arranged that the spaces between the lenses are nearly filled up with the cement, but the cement must not be quite level with the surface of the lenses. The block of lenses thus formed, Figure 1299, is screwed into the post and ground with the concave brass tool, Figure 1,300, six sizes of washed emery being used in succession, each finer than the one previously used; the last size being the fine powder collected after one hour's subsidence, and which produces so smooth a surface as to appear partly like a polish. The grinding is continued with each size of emery until all the marks produced by the previous size have been removed, the whole apparatus being carefully washed after each application so as entirely to get rid of one emery before a finer one is used. The tracing of the lenses, as it is called, being completed, the polishing is next proceeded with. The polisher is made by warming an iron shell; coating it uniformly with about $\frac{1}{4}$ inch thick of melted cement, and then pressing down upon the cement, by means of the brass convex tool, a piece of thick woollen cloth with the nap worn off, or seared off with a hot iron. Putty powder* is then sifted uniformly over the cloth, moistened by sprinkling water over it, and worked into the cloth with the brass concave tool. Fresh powder is added, and the working continued until the surface is quite level. For small lenses a polisher of Kersey-mere is used: this is more readily filled up with the putty powder than the coarse woollen cloth. The polisher is placed upon the block of lenses, fixed on the post, and worked with wide and narrow elliptical strokes, the operator continually moving round the post. The putty powder must not be so wet as to run loose upon the polisher, nor so dry as to be cut up by the edges of the lenses. It must be wet enough to take a partially glazed appearance from the action of polishing; and when entirely glazed a little water must be sprinkled over it. The pressure must be very moderate.

* The putty powder used by Mr. A. Ross, the optician, is prepared as follows:—Metallic tin is dissolved in nitro-muriatic acid, and precipitated from the filtered solution by liquid ammonia, both being largely diluted with water. The peroxide of tin is washed with plenty of water, collected on a cloth filter, and squeezed as dry as possible in new linen cloth: the mass is next pressed in a screw press as dry as possible. The lump thus produced is broken up, dried in the air, and finely levigated on a plate of glass with an iron spatula, and exposed in a crucible to a low white heat. Before being heated the powder has but little cutting properties, but being made anhydrous by heat, the particles assume the form of lamellar crystals, and act with far more energy, yet without scratching, than any of the ordinary polishing powders. The coarser particles are separated by washing over. A little crocus is added by way of colouring matter, which makes it easier to ascertain the quantity of powder remaining on the polishing tool.

The next process is grind the edges of the lenses circular, and in order that the axes of the lenses may coincide with the axis of the tube of the telescope or other instrument in which they are to be mounted, the lenses are cemented upon a chuck in the lathe, and before the cement has set the lathe is made to revolve, and the reflection of a candle or any fixed object watched, and the lens adjusted, until the image appears to be quite stationary understanding the motion of the lens: the axis of the lens and that of the mandrel of the lathe are then known to coincide; and the edge is ground circular with a piece of brass supplied with emery and water, placed beneath the lens, and gradually raised by a screw.

Concave lenses are ground and polished in the same manner as the convex, only they are fixed in the concave tools and ground upon the convex, which is always the lower tool, when several glasses are worked together.

In the transactions of the Society of Arts, Vol. XLIX, Mr. C. Varley has described a lathe for grinding and polishing lenses and specula. In this arrangement, the lower tools are not mounted upon a fixed post, but upon a vertical revolving axis. By this means the process is considerably expedited, but the results are less accurate than by the plan already described in the 5th volume of the same transactions. Dr. R. Greene's machine for grinding and polishing specula and lenses is also described.

Common lenses, which are produced in large quantities in manufactories, are also ground and polished by machinery. "The block of lenses is mounted upon a slowly revolving axis, placed vertically, and upper tool has an eccentric motion given to it by means of a small crank, fixed on the lower end of a second vertical axis, placed a little on the side of the central line of the lower axis. A pin fixed in the centre of the back of the upper grinding tool, enters a socket in the crank, and the revolution of the latter causes the upper tool to describe small circles, which, combined with a slow revolution of the block of lenses, causes every point of the grinder to describe epicycloides upon the surface of the lenses, much the same as in the circular strokes employed in grinding lenses by hand. The radius of the crank admits of adjustment, to give various degrees of eccentricity to the upper tool, and the pressure is regulated either by a spring, or by adjusting the weight of the grinder.

The best lenses for object glasses of telescopes, are ground and polished singly by hand. They are polished with putty powder upon thick lutestring silk cut to the width of about $\frac{1}{4}$ ths the diameter of the lens: this is stretched across the middle of the brass tool, and the lens is rubbed backwards and forwards in straight lines along the silk, the lens being continually twisted round in the hand.

In making the object glasses of achromatic telescopes, it is of importance to be able to measure accurately the radii of curvature of the lenses, which are

first tried experimentally, and then made as nearly as possible to the radii obtained by calculation, so as to correct the chromatic and spherical aberration. In the transactions of the Society of Arts, Vol. LIII, Mr. A. Ross has described an instrument called a spherometer, for measuring the curvature of the grinding tools.

Small microscopic lenses, varying from $\frac{1}{4}$ to $\frac{1}{100}$ th of an inch in diameter, are also ground and polished singly, the radius of curvature being too small to allow of a number being grouped together. "The templates are made as small discs of steel with slender stems turned in the lathe. For lenses, the radii of whose curvature are 5, 10, or 20 hundredths of an inch, the diameter of the discs are 10, 20, or 40 hundredths. They are made with square edges, and when hardened, are applied diametrically, as the finishing tools for turning the small metal cups or concave grinding tools. For measuring the diameters of the dics they are applied either in the sector gauge, or one of the sliding gauges often used for measuring the diameter of wire, and graduated decimally for reading the width of the opening to the $\frac{1}{100}$ th or $\frac{1}{1000}$ th of an inch. The cups when turned, are charged with emery, and put in rapid revolution in the lathe, which, for these minute lenses is in general very small, and worked with the drill bow. The lenses cemented with shell lac, upon a small wooden stick, and held against the grinding tool with a continual change of angle, the end of the stick being moved in the arc of the circle, while it is, at the same time, twisted on its axis." The grinding is performed with the same succession of emeries as is used for the larger lenses. The polishing is done with bees-wax hardened with fine crocus, of such a consistence as to assume the form of the lens with moderate pressure, the form of the lens and hard enough to retain the figure during the polishing. The brass cups used in the polishing are turned in the lathe of a little larger radius than the grinding tool, and the surface is roughened for holding the wax, which is poured into the heated tool, and when cold, moulded into shape with a convex tool, or turned in the lathe first, with a thin scraping tool, and then with a circular disc, as in the case of the grinding tool. In polishing the lens, the wax is kept wet with fine crocus and water applied with a feather. The lenses are separated from the runner or handle by warming them, so as to soften the shell lac; and the last particles of cement are washed off by means of spirits of wine.

Lenses for spectacles are formed out of Brazilian pebbles of transparent colourless quartz. The stone is cut into slices by the lapidary, then snipped into the form of the lenses, and ground and polished by the methods above described.

* This instrument is also figured and described in the third vol. of Holtzapffel's Mechanical Manipulation, to which Mr. Ross contributed much of the valuable and interesting information respecting the manufacture of lenses. Gill's Technical repository also contains some interesting details on the subject.

The first serious difficulty in polishing specula of large size was, that when the layer of pitch used as a bed for the polishing powder was thin, as it must be to produce a good figure, however accurately it fitted the speculum at first it soon ceased to do so, and the polishing did not proceed properly. During the operation of polishing, the abraded matter, mixed with the polishing powder, is in part taken up by the pitch, but not equally over the whole surface. As pitch is not sensibly elastic with a moderate pressure, however most is taken up there the surface will be most prominent, and the figure of the polisher destroyed unless the pitch can spread laterally. It occurred to his Lordship that by grooving the layer of pitch provision might be made for its lateral expansion, without increasing the thickness of the layer, which is most objectionable. The experiment was tried by reducing the thickness of pitch one half, and making furrows in it by means of a hot iron quite down to the metallic plate; the furrows were 2 inches apart, and there were 2 sets at right angles to each other. The result was that the defining powder of the speculum was immediately much improved. But the difficulty of keeping the furrows open, of preserving the figure of the polisher, and of reducing the thickness of the pitch to a minimum, which was a great object, still existed; but all defects were remedied by dividing the iron disc itself instead of the pitch: this was accordingly done by turning circular grooves in it $\frac{3}{8}$ inch deep and $\frac{1}{4}$ inch wide, and also grooves at right angles $1\frac{1}{4}$ inch apart, $\frac{1}{4}$ inch wide, and $\frac{1}{4}$ inch deep. Figure 552. The speculum was truly ground with the polisher first, and then the layer of pitch or resinous composition applied, the grooves remaining empty. The improvement which followed this single device was decided; for the divided 3 feet speculum defined better with a power of 1,200 than it had done before with a power of 300. The two conditions necessary to success, are that the polisher should fit the speculum exactly during the whole process, and that the resinous surface in contact with the speculum should be as hard as possible consistent with its admitting the polishing powder to imbed itself in it. A mixture of common resin and turpentine was found preferable to pitch, on account of the gritty particles so common in the latter. It is desirable also to use the resinous composition of two different degrees of hardness, so as to form two very thin strata, the outer one being the harder. Thus the surface in contact with the speculum can be made as hard as necessary with the thin subjacent layer of soft resin expands laterally so as to preserve the figure of the polisher. The composition is prepared by melting common resin, and when nearly boiling adding about $\frac{1}{2}$ of its weight of spirit of turpentine: when the mixture has been incorporated by stirring, a piece of cold iron is immersed in it, and then placed for some minutes in a vessel of water at the temperature of 55° ; if then a moderate pressure of the nail makes a decided impression without splintering it is of a proper hardness for the first layer on the polisher, and only requires to be strained through canvass. For the second layer

is mixed with $\frac{1}{4}$ of wheat flour, which by increasing its tenacity and diminishing its adhesiveness, prevents the common fault so much complained of, viz. the separation of minute particles of pitch from the polisher. It is to be boiled till the water of the flour has been expelled, and the mixture becomes clear, and the boiling further continued till some of turpentine has been driven off, and the mixture has become so hard that at 55° a very strong pressure of the nail makes but a slight impression. An equal weight of resin is then added to it, when it will be hard enough to produce a very true surface, and yet soft enough to allow the particles of polishing powder to become imbedded. When the resinous mixture is remelted, the vessel is suspended to the beam of a scale, and the heat applied so gradually as not to drive off any of the turpentine, which is immediately perceptible by the disturbance of the equilibrium. To apply the resin the polisher is first heated to about 180° , and the soft mixture laid on with a large flat brush to about the thickness of $\frac{1}{30}$ th or $\frac{1}{25}$ th of an inch. It is then suffered to cool to 100° , and the hard mixture is applied in the same way, and to about the same thickness. When the temperature has sunk to 80° , the polisher is placed on the speculum, previously covered with peroxide of iron and water, of about the consistence of thin cream. The speculum is made to revolve in a cistern of water, C Fig. 550, maintained at the constant temperature of 55° and the hardness of the resinous composition is adjusted to suit this temperature as above explained. When the polisher is first applied at 80° , while the speculum is at 55° , there is no danger of fracture, because the layer of resin retards the transmission of heat; but in grinding, where there is no resin, such a difference would lead to the fracture of the speculum. In grinding the 3 feet speculum formed in separate pieces, the iron plate happened to have been washed with warm water, and though but little warmer than the speculum, the moment it was put on several of the plates cracked; these of course admitted of being replaced. Had it been the other speculum in one piece, it would of course have been destroyed.

The polishing powder must be prepared by precipitation with water of ammonia from a pure dilute solution of sulphate of iron. The precipitate is to be washed, pressed in a screw-press till nearly dry, and then exposed to a heat, which in the dark appears a dull low red. The sulphate of iron must be pure, the ammonia in excess, and the heat not greater than that indicated. The colour of the powder will be a bright crimson inclining to yellow.

APPENDIX B.

ON THE ELLIOT MARBLES.

**ON THE ELLIOT MARBLES, BEING A REPORT BY THE REVEREND WILLIAM
TAYLOR, MADRAS.**

MEMOIR ON THE AMRAWUTTI SCULPTURES.

CHAPTER 1—INTRODUCTORY.

The following correspondence will explain every thing initiatory as to the present Memoir:—

No. 514.

GOVERNMENT CENTRAL MUSEUM,

Madras, 14th December, 1855.

FROM SURGEON EDWARD BALFOUR,

In charge of the Government Central Museum.

To

THE REV. WILLIAM TAYLOR, MADRAS.

SIR,

I have the honor to subjoin Extract Minutes Consultation dated 11th December No. 1556 of 1855, the 3d, 4th and 5th paras. of which contain the expression of a desire on the part of the Right Honorable the Governor of Madras in Council that you would undertake to draw up a Memoir on the Amrawutty Sculptures; and I would feel obliged by your favoring me by mentioning how far such an occupation might be agreeable to you, and mentioning in what manner it would be in my power to remunerate you for your labours.

I have the honor to be,

Sir,

Your most obedient Servant.

(Signed) E. BALFOUR,

Surgeon, in charge of the Govt. Central Museum.

No. 1556.

Public Department.

EXTRACT FROM THE MINUTES OF CONSULTATION,

Dated 11th December, 1855.

Para. 3. The Governor in Council requests that Dr. Balfour will ascertain, in reference to para. 4 of his letter, whether the Rev. W. Taylor would under-

take to draw up a Memoir of these sculptures; stating the circumstances under which they were discovered, the notices to be found of them in Oriental Works, with a description of the marbles at Madras, and his views on the subjects of the sculptures and the era to which they belong.

(Paras. 4th and 5th not of permanent consequence.)

EDWARD BALFOUR, Esq., M. D.,

Honorary Director Central Museum,

&c. &c. &c.

SIR,

I have the honor to acknowledge the receipt of your letter of 14th ultimo with Extracts of Minutes of Consultation of 11th ultimo in reference to the Elliot Marbles, or Sculptures of Amrawutti now deposited in the verandah of the Central Museum.

2. It will give me great pleasure to do what I can as to description and elucidating their era. I am satisfied that the inscriptions on them have yet to be translated. The most important point is a search among the Mackenzie, and other manuscripts at the College as to the possible notices to be found, in illustration of the site and connected history of these marbles. This search will require some time (considering other occupations); and I do not wish to be hurried. I would allow myself from five to seven months; but with a pledge, on honor, to get the Memoir finished, as much earlier as I can.

3. As to remuneration I leave that point entirely to your discretion.

4. Remembering the consideration paid (when I was in England) to the Arundel marbles at Oxford, and to the Elgin marbles in the British Museum, I would most respectfully suggest to you the propriety of removing these—which I think may be most appropriately designated the Elliot marbles—to a room, or place by themselves, where the Archæologist may look at them undegraded by present associations. The two ornamented porticos from Humpee are besides worthy of a corner in that room; but they are more modern, of a well known period, and of more ordinary finish.

5. The above Arundel marbles are valued only for the inscriptions on them. The Elgin marbles were intended to be seen from a height, around the cornice of the Parthenon at Athens; and are cut rudely, though, with elegant contour. These Amrawutti sculptures are better finished, for a nearer view. I had the privilege of a leisurely survey of the antiques in the Musée Royal at Paris, busts and statues excepted; I remember nothing superior of this kind there; and I am of opinion that, were these marbles (decorated with uncial Greek letters) placed in that Museum, they would, by common consent, be deemed the most remarkable objects there.

6. Under these impressions I deem myself fortunate in having been referred to; and I venture to ask of you to add still further to the acquired lustre of your own name, by giving to these early reliques all possible distinction.

I have the honor to be,

Sir,

Your most obedient servant,

(Signed) W. TAYLOR.

COLLEGE, }
January 4th 1856.

No. 90.

GOVERNMENT CENTRAL MUSEUM,

Madras, 24th January, 1856.

FROM SURGEON EDWARD BALFOUR,

Officer in charge of the Govt. Central Museum.

TO THE REV. WILLIAM TAYLOR, Madras.

SIR,

I have the honor to subjoin copies of Extracts from Minutes of Consultation of date the 22d January, No. 58 of 1856.

I have the honor to be,

Sir,

Your most obedient Servant,

(Signed) EDWARD BALFOUR, SURGEON,

Officer in charge of the Government Central Museum.

No. 58.

Public Department.

EXTRACT FROM THE MINUTES OF CONSULTATION,

Dated 22d January, 1856.

Para 1. The Right Honorable the Governor in Council concurs in opinion with Dr. Balfour as to the research required to be made in compiling the Memoir on the Amravati Marbles, called for by Government.

2. Dr. Balfour will be good enough to request the Revd. Mr. Taylor to take the work in hand at once.

4. The correspondence on the subject of those Marbles in the Government records, will be communicated to Mr Taylor through Dr. Balfour, for perusal when required.

(True Extract.)

(Signed) T. PYCROFT,

Chief Secretary.

(A true copy.)

(Signed) EDWARD BALFOUR, SURGEON,

Officer in charge of the Government Central Museum.

To SURGEON EDWARD BALFOUR, Esq., M. D.

Officer in charge of the Government Central Museum.

&c. &c. &c.

SIR,

I have the honor to acknowledge the receipt of your letter of 24th ultimo, conveying Extract from Minutes of Consultation, dated 22d January 1856.

2. My time and engagements having been apportioned up to the end of the past month, I have the honor to state in reply, that the work in question may be considered as beginning from to-day: and I shall do my best to merit your favorable report to Government, as to results.

I have the honor to be,

Sir,

Your most obedient Servant,

(Signed) W. TAYLOR.

COLLEGE,
1st February, 1856. }

Further explanation will be developed by anterior correspondence:
From

WALTER ELLIOT, Esq.,

To

EDWARD BALFOUR, Esq.

WALTAIR, July 30th, 1853.

MY DEAR BALFOUR,

Touching the Marbles which I brought from Amaravati in the Guntoor District, you will find some notice of the place and of the first discovery of the interesting remains there, about the year 1801, in the 9th volume of the Asiatic Researches, by Colonel Mackenzie (page 273, of the 8vo. Ed.) Some further account of subsequent researches prosecuted by the Colonel in the same locality in 1815 to 1817, was published I think in the Asiatic Annual Register; but I have not the work to refer to.

It would probably occur in one of the volumes from 1815 to 1820.—About 1830, the late Mr. Robertson (who died Collector of Bellary) when in charge of the Bunder district, founded a Pettah in Masulipatam which still bears his name; and, to beautify it, brought down some of the Amaravati Sculptures, and placed them in the square of the market-place. Benza saw, and described them in the 5th Vol. of the Madras Literary Journal, page 44. These are now in the possession of old Mr. Alexander. I am not aware by what title; but Goldingham can tell, for he made them over to him, when he was officiating as Collector of Bunder.

Extract from a Letter to Sir H. C. MONTGOMERY, BART.,

Chief Secretary to Government.

SIR,

With reference to the question of the Honorable The Court of Directors, and the order in the Minutes

II. It is stated by Mr. Balfour that "there is lying in the green in front of the College a very valuable collection of Sculptures, which ought immediately to be placed under cover.—The exposure to the elements which they have now, for two years been exposed to, if continued, must do them immense injury."—We desire to be informed of what these Sculptures consist; in order that we may determine whether any of them are worthy of being transmitted to this country for deposit in our Museum.

No. 873. Extract from the Minutes of Consultation, dated 13th September 1853.

7. A copy of these *paras.* will be furnished to Surgeon Balfour, with a request that he will (with reference to *para.* 10 of his Minute dated 1st December 1850) report on the Sculptures therein noticed.

of Government as per margin, I have the honor to mention that most of the Marbles lying in front of the College were brought down to Madras, about 14 years ago, by Walter Elliot, Esq., and have, ever since then, been lying on the ground exposed to all the vicissitudes of this fierce climate. They were brought from the ruined city of Ama-

ravati, in the Guntoor Collectorate, and are considered of a great beauty and value. I am informed (I have not the books to refer to) that some notice of these interesting remains (by Colonel Mackenzie) and of their first discovery about the year 1801, will be found in the 9th Vol. Asiatic Researches (Page 273, of the 8vo. Ed.) and that some further account of subsequent researches, prosecuted by the Colonel in the same locality in 1815 to 1817, was published in the Asiatic Annual Register, or Asiatic Researches, in some year between 1815 and 1817. Subsequent to that time, in 1830, the late Mr. Robertson (who died Collector of Bellary) when in charge of the Masulipatam Collectorate, founded a Pettah in Masulipatam, which still bears his name; and, to beautify it he brought down some of the Amaravaty Sculptures, and placed them in the square of the market-place; and the late Dr. Benza saw these, and gave a description of them at p. 44 of the 5th Vol. of the Journal of the Madras Literary Society;—and these are now, in the possession of Mr. Richard Alexander of Masulipatam. I have had correspondence (herewith appended) regarding this portion, with Mr. Goldingham of the Revenue Board, who was Collector of Masulipatam at the time that Mr. Alexander got them, or got charge of them, and copy of this was sent to Mr. Elliot. The late Dr. Malcolmson also briefly alludes to these Marbles and his high praise of their beauty and their value, will be found at page 543 of the Royal Geological Society's Transactions for 1837.

Some of these Marbles contain inscriptions, and the late Mr. Prinsep published in the Journal of the Asiatic Society of Bengal, about 1834 or 5* a fac-

* Recte 1837, Vol. 7, adverted to in Chap. 4 of this Memoir.

simile and translation of inscriptions in very ancient characters on two fragments then sent by Colonel Mackenzie.

So many of the aforesaid Marbles as were transmitted by Mr. Elliot to Madras are now deposited in the Central Museum; that is in the front entry, with its two side partitions: * more or less exposed to the forenoon sun; but otherwise sheltered. Some of them bear Telugu numbers, cut in, many years since. Other numbers are recently painted on. The matter next in hand is a description of the Sculptures. And this will be in the order of the painted numbers; which do not appear to have been guided by any principle of assortment, or classification.

CHAPTER II.—DESCRIPTION OF THE MARBLES, AND SCULPTURES ON THEM.

No. 1. A SLAB 5 feet by 2½ SCULPTURED TRANSVERSELY, OR CORNICE FASHION, IN BAS RELIEF.

On the left hand compartment a King seated and a Queen on his right hand side, but lower down; the King is being fanned by chowries. The Queen has two attendants females; and one seated lower down in the left-hand corner, thereby indicated (as being seated) that an inferior wife is intended. Beneath the Queen's seat are three pages, one holding a quiver, a woman patting his face with fondness; another page writing in a book. A *mantri*, or minister of state, is seated on the King's left. There are on this left side seven attendants, male and female. A Court in Session. (At the late introduction of Major Phayre to the Bauddhist Court of Burmah the Queen was seated by the King's side, lighted a cigar, and gave it to the King.) These are *Bauddhist* or *Jaina* Sculptures.

The left compartment is separated from the right hand one, by the pillar, and gothic curve of a semi-arch. The right compartment is religious. In the top right corner (the place of honor) is a large bundle gathered from the sacred *bo*-tree (in this age the *nigrodha*), borne by an aged woman, and a young one. The aged female is of high rank, shewn by an umbrella (the emblem of royalty) rising over her head, in front of the bundle; probably designating the Queen-Dowager, and mother of the reigning King. This aged woman's face while round and full, indicating high living, is much wrinkled, and the artist has put into it a serio-comic expression; a consciousness of the importance of the work, with a slight expression of pain from not being accustomed to bear a burden. The artist conveying this expression was capable of great things, in the line of sculpture. The young woman, on the contrary, bears her share of the burden cheerily; thinking only of the honor of her office. Three aerial beings are paying adoration to the sacred bundle. Along the middle of

* Subsequent to my writing the above *para.* the whole of the Marbles (one broken pillar excepted) have been placed in the south-wing of the Museum.

this right-hand compartment four men are ranged fronting the spectator; bearing in their hands the body of a large snake (or a cable) a frequent emblem in these Sculptures; and this snake is marked with seven impressions of the sacred foot of *Buddha*. (*Vishnu* bears on his breast the impression of the foot of *Bhrigu rishi*, an emblem of the *Satvika guna* or high perfection of entire meekness: *Buddha* an incarnation of *Vishnu*, and the impression of his one sacred foot is every where revered by *Bauddhas*.) Each foot impression has within it the *chakra* (wheel, or discus) the special emblem of *Vishnu* (i. e. power to cut off the wicked). Two women are beneath, in adoration before a small altar. Above an ornamented cornice; and flowered cornice beneath; both in good taste.

There is a semi-circular navel between the two compartments (spring of the arch), on this the *Saiva* symbol cut by a line, not in bas relief; and this symbol is so entirely opposed to the rest that I regard it as a later, and spiteful addition, of which other traces may be found, in other numbers.

In explanation it may be noted that to the north of Telingana there was a race of people known as *Nāgas* (literally snakes), according both to Brahmanical and Bauddhist testimony. Moreover *Kalinga* is the name of an old kingdom the modern Orissa, down to the Godavery, connected with *Magadha*. The site of the *Amaravati* power was either there, or near it, at *Kondavir*. Hence the general subject of the piece seems to be—to commemorate the solemn presentation, accompanied by religious rites, of some trophy, won from the northern *Kalinga* nation, and received by the King, in full and solemn session of himself and Court. Corollary—The very ancient Telingana was not an united kingdom, but at least two; one northern, one southern; and, sometimes at least, hostile the one to the other.

No. 2. A SQUARE SLAB, ABOUT 4½ X 2 FEET. DIVIDED INTO TWO COMPARTMENTS, UPPER AND LOWER.

Upper Compartment.

A central male figure, intended to be gigantic, and in the attitude of *Krishna* supporting the Mountain *Govardhana*, right hand holding it up. The face is broken off. Two female figures (*Gopis*?) stand behind on the right side; two male figures on the left side. A horse caparisoned in waiting. Another figure is worn; but by comparison with the lower compartment, it is seen to have been the head of an elephant.

Lower Compartment.

A King seated, an umbrella held over his head by an attendant behind; face of attendant gone. The Queen is seated on the right of the King, her right hand touching his left one; indicating either attachment, or an inferior marriage. From her ancles upwards are several large rolls of silver (to indicate more than usual wealth).

A *Mantri* is seated to the King's left.

Between, there is an oval shield, or ornament somewhat turned towards the King, and away from the *Mantri*, to indicate the King's superiority. One standing attendant, and one kneeling, bringing an offering or present. Horse and elephant, both caparisoned standing near in waiting; index of state: as seen especially near *Aiyamar* fane, in the Carnatic.

This represents some more ordinary case of tribute paid; and the reference in the top compartment is probably emblematical to shew that the King protects his subjects even as *Krishna* protected the cowherds and cowherdresses, against the wrath of *Agni*, who sent a fire-shower to destroy them.

No. 3.—AN OBLONG SLAB 4 feet by 2 feet.

Figure of a young man, full oval face, seated on a lotos, in the attitude of a penitent, one leg bent under, sole of one foot uppermost. A chain band around the loins, and a narrow girdle around the waist, a double scholastic thread, and a similar necklace plain; right hand held up in benediction, the left holds a lotos, within which is placed a sacred book. The figure has long hair in pendent ringlets (as now a days worn by ladies), differs in this from the *jadamani* whose hair is rolled together, or rolled together in twisted braids; these ringlets hang down loose. Ornamented skull cap which covers a knot of hair worn on the top of the head. Pendent ear-lobes with drops in them. There is a side figure under the above lotos, holding a sort of boss, with a small altar cut on it. Two side aerial figures are damaged. The left top corner, which holds one of those figures, is fractured.

This figure is cleanly and neatly carved, and the whole is in excellent preservation. It does not represent a *Jina*, or even devotee of the severer class; but would seem to be rather complimentary to some young man of rank, beginning a religious profession: *Gautama Buddha* was such a one, in early life; being a son of a king of *Magadha*, and going through a noviciate before entering on the severe ascetic profession. This image may possibly commemorate that noviciate.

No. 4.—OUTSIDE ON THE GREEN OR LAWN IN FRONT.

A coarse granite figure, a female seated, or as though legs were buried. Two hands brought together, one holding the stalk of a lotos in bud only. Drapery, much time-worn. A highly ornamented head-dress, of the sacred kind: ear lobes pendent.

The figure is old but assimilates with the porticos from Hampi: it might harmonize with any class of native religions: nothing to identify it with the Amravati Sculptures.

No. 5.—ALSO IN THE LAWN.

A bird of large size apparently intended to represent the peacock vehicle

of *Subrahmanya* with closed plumage; but this is not quite certain. It may be intended for the poetical *Amsa*; the coarse granite not harmonizing with the marbles.

No. 6.—SMALL OBLONG SLAB, 2 by 1 foot.

A figure standing, disproportionate, very short legs, girdle and garment down to the ancles. Scholastic thread and necklace. Right hand broken off: left hand holds a lotos stalk, no flower; two small figures (*tirthakaras*) seated. The broken off hand would have yielded an identification: the small figures indicate that the larger one represents a deity.

No. 7.—A STANDING FIGURE OF THE *Digambara*, or naked ascetic class, black marble; of the ordinary class, and workmanship of *Jaina* images; without comparison, inferior to the Amravati Sculptures.

No. 8.—COARSE GRANITE.—A female figure seated holding a lotos. In its place I notice two lions outside on the lawn; without any number, properly a lion and lioness, of the type-common (as I learned from Dr. Balfour) in the Cuttack Province, till within late years; the male lion not having any mane. They are well cut, from the usual marble, and are large, near the natural size; of the same type and attitude; there are many others on the bas-reliefs, but, of course, minute there. Native Hindu artists never succeed with the figure of a lion; and were other proofs wanting, these two (injured) pieces, would prove a foreign chisel employed. They were evidently intended to be placed at the entrance door, or steps of a palace.

No. 9.—COARSE COMMON GRANITE.

A seated *Buddha* or *Jina* in penance, with a back shrine, and canopy over head. Two attendants seated behind with chowri fans. Two half *chakras* or wheels, and other coarse ornaments. Does not harmonize with the superior works.

No. 10.—TWO PIECES BEAR THIS NUMBER, the one fits into the fractured end of the other, each about 2 feet by 8 inches; length entire about 4 feet. The top compartment represents a dagobah or temple in the center. A female figure in each of two niches, on either side; ornamented arch work and aerial figures (*quasi* angels) over-head.

Next Lower Compartment.

A seated *ekambara-Jina*, glory behind the head. The right held up in benediction, the left on the lap. - Attendant figures, one on each side, two seated; small lion-couch with its roof-like canopy, ornament frieze work.

Next Lower Compartment, (top of the second fragment.)

A seated *ekambara yōgi* or *Jina*, his seat borne on the heads of four small figures. Two standing female attendants, and two others behind headless; the

heads being on the other fragment, and would meet on the pieces being put together.

Lower Compartment.

An ascetic standing, being *ĕkambara*. One female on the right, three devotees standing on the left. A horse caparisoned, a kneeling figure under it, from whom the ascetic appears to receive some offering.

This emblem may designate an *Asvapati* or Mahomedan, bringing a present to propitiate the favor, or intercession of some sacred person, holding a civil office, like that of a *Niyogi* Brahman in a Hindu *Rāja's* Court. A circle is over the head of the principal figure. (This represents a married man of dignity; but not of religious sanctity, equal to those in the ascending scale.) Base—ment scroll.

This pillar appears to have been an ornament of a palace, or temple: Sculpture good.

No. 11. A FRAGMENT—BROKEN CORNICE.

A male figure with three male attendants, or followers, is forcibly carrying off a very young woman in his arms. Female figures resist him; one of them has taken up a dish, or some such thing, to strike him with it; four women are seated, two of them are resisting the outrage; two of them passive. There are three bosses, the ends chipped off; which, after a little consideration, I determined to be the kind of brass or wooden knobs seen on inside doors of native houses, the heads of strong rivets. Hence, wherever these bosses occur (as they do often) they indicate the partition of a door. Outside the chamber stands a young man, in a careless attitude, unconscious of what is going on inside; in which he ought apparently to be deeply interested.—*See chap. 6.*

This piece is greatly time-worn; there is an injured line of inscription, much of it chipped off; ten letters only remain.

No. 12. A SMALL BLOCK OF THE USUAL MARBLE.

Two *Jinas* doing penance seated, and two small dagobahs between: nothing further particular.

No. 13. A SMALL TIME-WORN PIECE.

A King seated, with various attendants. A pillared partition on the right side; a dagobah beneath with attendants; resting on five bird-supporters. Surface of all, worn off, or chipped off: greatly exposed to weather.

Another No. 13. A CORNICE 2 FEET BY 1½ FOOT.

A seated male figure, with attendants.

A partition arch. In the right hand corner of the compartment a dagobah, (temple) three female devotees standing, and two others kneeling.

On the left hand side much worn, and the figure shattered. Birds' heads supporters under the cornice. Both pieces probably are parts of one cornice, divided.

No. 14. GREATLY TIME WORN.

A long piece of cornice work 5 feet by 1 foot, containing 5 compartments; separated by bosses, to designate those common on doors to native houses; the ends chipped off.

1st, or right hand compartment, male and female figures defaced.

2d. A male figure seated, and two female figures seated, denoting wives; four standing and two kneeling attendants.

3d. A seated male figure, two females kneeling; two standing behind them, bearing two small children on their shoulders, denoting servants.

4th. A seated chief and queen on his left with attendants; much defaced.

5th or left hand compartment two figures defaced.

No. 15. A SIDE GATE POST WITH MINUTE SCULPTURES, AS ORNAMENTS. Three *Bauddhas* or *Jinas*. The principal one in the centre; the one above, and the one below less laboured. Male and female supporters bear the seats of those three on their heads.

No. 16. A counterpart piece; but in better preservation; less time-worn. The chiselling better defined. A slight difference only in the figures. Both appear to have been ornamental merely, at the entry to some edifice.

No. 17. A SLAB 9 × 2½ FEET.

Top and bottom semi-circles of lotos carving, as usual: of neat workmanship, but time-worn. At the bottom corner are two fish-monster heads, with open jaws, of frequent occurrence. They designate an enemy.

Below the centre circle, which is lotos-flower only, are three *bhūtas*, or fat goblins of comic intent; and not appearing to have other reference.

Over the circle in the middle is a *Nāga*, or five-headed serpent; on each side is a woman, each one treading on the fish-monster of frequent occurrence; only here, the mouth is closed, and the body straitened out; from which it would seem that a gayal of the Ganges, or alligator may be intended. This compartment is allegorical. The two women bear offerings, and have a very composite head dress; the girdle is modest, such as I think No. 18 originally had. At the top over the semi-circle are a very small dagobah, and three elephants, cornice work.

It is of importance to settle the allegory.

The *Nāga* is connected with *Vishnu*, and is seen over the head of *Buddha* also, as a canopy. In this place I take it to be an emblem of one of the 24 *tirthakaras*. The *Pandiyān's* banner was a fish—and he from a *Bauddha*, became *Saiva*

—Did the Pandiyani assist these northern *Jainas*; or does the matter refer to the affairs at Madura? or is the reference to a Gangetic power? After having attended to No. 18 I am enabled to decide that the power thus subdued, and prostrate was Mahomedan.—See the following No.

No. 18. A LONG SLAB 9×3 FEET.

At the bottom and top the often occurring semi-circle of lotos flower and petal carving, very neat. Cornice below of flower work; two fish monsters, one on either side, as in No. 17, only mouth open destructively: flower wreath around the semi-circles, one large flower (lotos beginning to unfold itself) on each side.

On the top cornice a dagobah with four votaries. Two monsters at the sides. On the left side, a man pushes the upper jaw, as if to force it down, while another in front thrusts a spear through the mouth into the throat.

Inscription on the top cornice; one of the letters gone at the beginning. It commemorates a victory.

Top Compartment.

Three partitions: centre one a *bo*-tree with pedestal, and on it two feet of *Buddha*. Nine kneeling devotees, with very composite head-dresses or turbans; two faces chipped off.

Right hand partition five devotees in various attitudes, composite head-dresses and girdles. Left hand, seven standing devotees, with like head-dresses and girdles.

Centre Compartment.

A circle with flowered and leaf cornice around it. A *bo*-tree in a sort of tub; borne up by two attendants kneeling. Beneath it a cushion, with two feet of *Buddha*, bearing the *chakra* marks. Five devotees, on one side, bearing offerings; eight on the other side, also bearing offerings; on the former side, two heads of oxen, and a small *bo*-tree.

Lower Compartment.

Three divisions: centre one a *bo*-tree, on its right two females standing, two heads of others appear behind; composite head-dresses and girdles. Rolls round the ancles, indicating people of quality. (On the person of these two females there is an indelicacy, which I do not think original, but done subsequently—See Nos. 1 and 17.) On the left side of the tree, a dwarf bearing a load of pieces of rock. Three others, two faces gone. One of them has a serpent, of exquisite workmanship, twined or folded around its shoulders, and it holds the reptile by the neck. Right hand of the centre, a figure of a chief, another man holding an umbrella over him. A *bo*-tree behind; a pedestal beneath it, bearing two feet of *Buddha*, with the

chakra marks. Other side (allegorical) a mounted horseman cowering beneath an enraged elephant, the trunk of which is forcibly held in by a dwarf. Another holds a mallet in his hands, as if about to strike the cavalier. Above a *bo*-tree, the leg of a man reversed, foot upwards: a large but defaced figure above the elephant's head, designating perhaps a king of Warankal.

The meaning of this lower compartment is to commemorate offerings rendered on the occasion of a victory by the *Ganapatis* (or else the *Gajapatis*) over the *Asvapatis*, or Mahomedans; it being intimated that mercy tempered their overthrow.

The upper compartment renders it possible that the sea-monster or alligator represented the Mahomedans; giving the same meaning, under another emblem.

The centre compartment lays the glory of the victory at the feet of the deity, and his symbol the *bo*-tree.

A large cobra twined round the vital parts of a boy, or dwarf, while he firmly grasps it by the neck, is a symbol of like import, and quite above the level of native intellect. The sculpture of the snake's skin, and its careful preservation are equally remarkable. Thus on one slab, there are three emblems of a Mahomedan invasion, successfully resisted.

No. 19. AN IRREGULAR SLAB 4×3 FEET.

A *dagobah* with the lower gate thrown open; and, in the aperture, a deity seated on the coils of a serpent (as an *avatara* of *Vishnu*), the serpent upheld by three female votaries, kneeling on a plank; which is again supported, on their heads, by two men. The principal figure has its head guarded behind by many serpent heads (*Adi sésa*) as in figures of *Vishnu*. On the front of the serpent coil is the figure of an ellipsis, impressed with the two feet of *Buddha*.

On the right and left, supporters, female votaries, and dwarfs with offerings, cornice work. Pilasters, lions couchant. Small figures to represent sculptured, or plaister figures, on the dome of the *dagobah*; as on *gopuras* of *Saiva* and *Vaishnava* fanes.

Cornice work, men riding on lions. The principal figure is *Buddha*, as an incarnation of *Vishnu*; reposing on '*Adi sésa*'; all the rest emblematical.

No. 20. A LIKE IRREGULAR SLAB, $3\frac{1}{2} \times 2\frac{1}{2}$ FEET.

A *Gopura*, or *dagobah*, with the lower gate thrown open. A small circle with a *Buddha*, and halo around the head. Another circle, a led horse caparisoned, with attendants. Two dwarfs beneath, bearing salvers on their heads. Lions couchant. A circle. On the two sides at top two large impressions, each one bearing two feet of *Buddha*, on a cushion; on each foot the *chakra* mark of *Vishnu*.

No. 21. AN IRREGULAR FRACTURED SLAB, 4 FEET LONG BY 2 FEET BROAD.

Three Compartments.

The top one, a large dagobah with the gate thrown open; a serpent, with five heads seated; lions guard it overhead. The figures are greatly defaced.

Centre Compartment.

A *chakra*, or else image of the sun; on a pedestal. A figure on either side, but greatly defaced. This *chakra* may possibly be the distinguishing sign of the 15th *Tirthakara*.

Lower Compartment.

A *bo*-tree, and chair of state: beneath it is a square cushion, having two feet impressions, bearing the *chakra* mark: male and female attendants, on either side; but equally defaced with those above. This slab bears the Telugu No. 78.

This piece appears to be only of religious reference.

No. 22. THREE FRAGMENTS PUT TOGETHER.

The subject is a dagobah, having five front pilasters. The principal figure is a *tapasvi* (or penitent) seated, hands over his head, with attendants. Two lions seated on their haunches, and two lionesses. Various small figures; being devotees, in great variety of attitudes: some figures on horse back. It would seem from this piece that a first-rate dagobah had sculptures, or plaister figures like those now seen on *gopuras*; though differing as to meaning. This number would appear to be merely ornamental.

No. 23. A SLAB 6 × 3 feet.

A semi-circle at the top has been broken off, and is now wanting.

Centre Circle.

This represents (*quasi, un lit de justice*, or King's Bench,) a King seated in a Court of Justice. In front of him is a *zastri* seated, having a book open resting on his knees; he seems to be engaged in expounding the law of a case: there is a peculiarity visible in a circular knot of hair on the right side of his head. Assistants are seated lower down: their hands in a reverential position. The swearing officer stands behind, holding a vessel filled with sacred water: other attendants. A *bo*-tree visible behind: to indicate religious sanction. Behind the King, a female attendant holds a fan of peculiar construction, with other symbols, broken off. Two wives of the King are seated behind. Five suppliant female figures below, being suitors in the Court. This centre circle has cornice work around it.

Lower Circle.

This has three compartments representing suitors in attendance, outside the above Court; with their counsel or pleaders; who are more fully clothed, than is common in these sculptures. Below is the usual semicircle, lotos-flower and leaf ornament, very well cut. The open mouths of two crocodiles, on the sides below in the cornice.

These figures are very good; though not quite equal to the very best, as to the chiselling; fully so as to the expression given. They are much time worn.

No. 24. A SLAB 4 × 4 feet.

It is fractured irregularly, so that the principal figure in the centre compartment is gone. There remain figures of female devotees, one with hands reverentially joined by the palms, fingers pointing upwards; another woman is making the Mahomedan *Salâm*. Others have their eyes steadily regarding one object, or figure, which is broken off by the fracture; above are some heads of male figures, with the wig-like appearance seen at *Mâmallapuram*, and other places: one holds a drum, and stick to beat it.

A partition and a square compartment.

In the centre of it a King is seated, his right hand held up in the attitude of benediction; the Queen is seated on his right hand on the same plank, or bench: this is borne up on their heads by five female attendants.

A female, standing on the left, wields a chowri fan. A canopy over head; upon it what may be ornament; but at the same time are letters,* which appear in the inscriptions of some of the slabs.

Other females standing: one behind the Queen holds a covered pot, or vessel (for betel and areca perhaps). A *bo*-tree near her, and two others. On the opposite side are females, having modest girdles. A horn for music; a *bo*-tree; beneath a figure blowing a flute. The carving is good; a fracture runs transversely, and through the eyes of the Queen. A glory is around the heads of the King and Queen.—Once for all I note the entire exposure of the female breast, which is a feature in all the sculptures; and corresponds apparently with the state of manners of the court of the *Bauddhist* Kings.

No. 25. A SLAB 2½ × 2 feet.

The figure of a *chakra*, the characteristic sign of *Dharma*, the 15th *Tirtha*—

* The distinctive initial of the dynasty, like G. R. or V. R. It occurs on Bactrian coins, and serves, as the initial letter, to designate the word *gaja*—elephant. It is the Chaldee *gimel*, manuscript form.

kara, or else of a sun, on a pedestal; a couch-seat beneath it, and under this, on a cushion, two feet of *Buddha*, having the *chakra* mark. There are kneeling attendants, and celestials in the air. All the figures are injured, and defaced; the carving is rather rude. On the cornice beneath is the following one line inscription.

Dhaṅṇa zadi chana Mariti garu patiyānu yuddha jayana samahrayenu.

From which I conclude that the piece commemorates a victory by *Chana Mariti garupati*, a chieftain over the *Dakhini* Mahomedans; in some skirmish of no great importance.

No. 26. A LONG SLAB 6 by 2 feet, fractured.

The lower fragment large, three upper fragments. A carved pedestal runs up the centre divided by six pedestals, borne by caryatides of various kinds:

1st row, three stout human figures, holding up hands in support, their heads also supporting. 2d row, three like bearers, time worn. 3d row, fractured; has heads of animals. 4th row, three figures as before. 5th row, animals. 6th row, worn off: supporters on both sides, lions, horses. Lion with human face (Assyrian emblem) bull; one strange animal, with mane. At the top, a figure of larger size supporting the roof; as far as the faces have expression, it is mirthful, sportful. The sculpture would seem to have been merely ornamental.

No. 27.—A LONG SLAB 10 by 3 feet, fractured beneath.

The characteristic sign of *Dharma*, the 15th *Tirthakara*.

The sculptures on it appear to commemorate an ovation.

In the centre is a large dagobah, the door open, a five-headed serpent over it, as a *Tirthakara* or *Vaishnava* emblem: another one lower down. On its right top a small *bo-tree*.

On the right side of the dagobah is a military procession of horse and foot, and one man on a camel (an animal not common in these sculptures, and not of good contour). The procession is going through a fortified gateway, as if of a fort. The front footman is beating a drum, slung from his neck, as is now still the custom; the next footman behind blows a conch, the symbol of triumph; another footman wields a spear.

On the left of the dagobah, are two *bo-trees* above, as on the other side.

Six devotees with their hands held up, reverentially. Two horses' heads above them.

A chief hierophant in front, and conspicuous, wearing a cloth of the *ekambara* sect of the *Jainas*. His right hand is held up in the attitude of benediction; the left hand holds something, but what, is indis-

tinged. Five subordinate *ekambaras*, like him, with shaven heads. Their hands held in the reverential form, known as *kumpidam*; that is the palms joined, the fingers and thumbs pointing upwards. Beneath them are six kneeling secular devotees. A large *bo-tree*, on a square vessel with earth, or pedestal; beneath this vessel are five figures, seated: the hands as above, reverentially joined. The foremost figure is the largest; hands benedictory: these figures are like *Brahmans*; but their position according to the heraldry observable in these sculptures is one of humiliation, or degradation. Another small *bo-tree*. To the left, three ordinary warriors at ease, near a woman, who is selling something to them. Here are the wall and steps leading into the Fort, on the opposite side to the triumphal entry.

A long line of inscription runs along the entire top cornice, and is mutilated, where that is broken off, to the left of the slab, but fronting the spectators right; the letters are so much time worn that they cannot be copied; except perhaps by impression.

The general subject is decidedly historical. It commemorates the return of an army in triumph, and their being received within the fort, at the temple, with religious rites. The camel, and man riding on it, designate, I conceive, Arab allies. The two horses' heads are in a place of honor, and imply respect to the Mahomedans; while the degraded *Brahmans* beneath the feet of the *Jaina* hierophant, and under the *bo-tree*, as also low down in the escutcheon, appear to intimate that the victory was over some strictly *Brahmanical* power; such as the one at Warankal or *Vijayanagaram*; and probably at the fort of *Kondavir* in the more immediate neighbourhood. The inscription, if the letters can be made legible, may settle this point. The soldiers and sutler, at the other gateway, are merely artistic, and tasteful. The *Jainas* have three principal distinctions of their hierophants, the *digambara* the *ekambara* and the *svétambara*. The paintings from the caves of Ajunta (*Ajayanta*) shew that the *svétambara* class was there in office and honor. The three words mean, *without garment*, with *seamless garment*, and with *white garment*. The strictly orthodox *Bauddhas* are *pitambara*, wearing reddish yellow, like the *Saiva andis*; and of like shapes, girdle fashion; only their heads are bare and shorn.

Foregoing numbers left it uncertain if the sculptures were *Bauddhist* or *Jaina*; the present one settles that question. On one of them besides there is a distinct *Jaina* emblem; to be noticed in its proper place.

Since the foregoing was written I have ascertained, from one of the Mackenzie papers in Telugu, that Arabs were in that neighbourhood; and that their boasting was an inducing cause leading *Krishna Raya* to invade and conquer *Kondavir*: driving away the *Gajapati* ruler there. The horses also in the procession must not be passed by: they designate the *Asvapatis*, or Mahomedans; and the sculptures on this slab, by consequence may commemorate a victory by Mahomedans (Turcomans and Arabs) over *Krishna raya*, whose

REPORT ON THE ELLIOT MARBLES,

warlike doings with them, according to *Perishta*, was a succession of advantages, and reverses. Between *Krishna-raya*, and the *Gajapatis* there was long continued hostility; these latter therefore would rejoice when their potent enemy sustained any humiliating defeat.

No. 28. A CORRESPONDING SLAB, PINNED ON TO IT, BACK TO BACK, WITH STRONG IRON-RIVETS.

The main feature herein is a strong cable, or it may represent a very large snake, borne up on the heads of four strong and stout men, the said material forming curves.



Here it issues out of the mouth of two sea monsters, with open jaws. The emblem recurs in another number, and may be taken together. Above the heads of the men supporting this flexible something, are *Caryatides*, supporting the cornice for ornament. Other ornaments, *Chakra*, dagobah, small figures.

Two of the above bearers trample on a large serpent of the cobra kind: the other two the same apparently; only the sculpture is less distinct.

No. 29.—A LONG SLAB 9 + 3 feet, sculptured on one side, the back plain, fractured at one end, and a little broken off the corner at the other end; a line of inscription at the base is thus injured, at the beginning, and at the end.

A large elephant is forcing its way through the gate of a fortress; immediately above is what looks like an immense gun-carriage, and recalls what is stated in Welch's reminiscences as to an immense piece of Artillery over the gate-way of one of the Mahomedan fortresses. Within the fort, and in the centre of the piece a camel, and an enraged small elephant, both bearing riders, meet front to front. Many people in confusion; one of them thrown down on his knees. Various figures at the other end, and a large *bo-tree* with a couch underneath it.

On the side of the attack, but outside the fort, a King is seated, with down-caste, but wily expression of countenance. He would seem to feign sorrow, but to be inwardly glad, because of the assault.

People embarrassed. The carving is much time worn; but it commemorates the storming of a Fort by the *Gajapati* ruler. The small elephant inside seems to represent the *Ganapati* ruler of Warankal, from ally turned to foe, and fighting inside the Fort with Arab auxiliaries. The immense gun-carriage doubtless indicates a Mahomedan fortress.

A degree of uncertainty, as yet, accompanies the inscription, but it appears to commemorate the capture of a hill fortress.

CHAPTER III.—THE SAME SUBJECT CONTINUED.

No. 30. TELUGU MARK No. 20. A FRAGMENT BROKEN OFF ON THE LEFT HAND: remains $3\frac{1}{2}$ x $2\frac{1}{2}$ feet. Cornice with small head ornament, flowers above; lions in chase beneath.

In this sculpture there is the large kind of cable, as in No. 28; borne up in this by two stout men on their right shoulders—ordinary dress, except collars, and hair dressed as now worn by some palankeen bearers, in a round knot at the top of the head.

A circle with a *bo-tree* and attendants: above a small dagobah supported by snakes, and two attendants, one on either side: time worn. Another pillar near the left fragment supports a *bo-tree*, figures near it.

The exact nature of the carved ornamented cable in 28 and 30 is not yet clear: it may be compared with that in No. 1, but it indicates something different. There exists at present a mode of trussing straw, very similar as to appearance merely; but what this could signify other than abundant harvest of rice-grain (the best in kind) I do not well see. Perhaps from a joyful harvest-home sort of countenance in the bearers, that may be the reference: the immediate vicinity of the *Krishna* river being probably very fertile.

No. 31. A SLAB SIMILAR to No. 30. The figures are less time worn. Two strong athletic figures bearing on their heads the ornament cable, as above. It has a *chakra* on the chief lower bend, which seems to indicate that it is consecrated as a tithe, or offering. Above it a pedestal, supporting a figure of the sun. Two figures near with reverentially closed palms; figures pointed upwards.

Open mouthed animals on the side whence the cable proceeds. Seated figures on the right, and left hand corners; hands reverential as above. All faces wear a smiling expression, as of pleasure. Head-dress, and ear drops, as in other numbers; but quite different from any known modern *coiffure*. The chiselling and *tournure* of the whole indicate a cornice in the Grecian fashion.

From the sun being introduced into this sculpture, with homage paid to it, I am led to conclude that an offering from the harvest is designated: in that case the side fish monsters with large mouths, whence the cable issues, represent the *Krishna* river, as the secondary cause of fertility; the sun being a superior cause. That symbol of a fish-monster must nevertheless have other meaning in other numbers.

The modern custom is to pile corn when reaped, in stacks, of a conic-section figure; and to truss the straw only for sale. An offering is now taken from the threshed grain only: anciently a portion of the corn, in stalk may have been trussed, and so presented. I can only conjecture on these points.

Nos. 32, 33, A LONG SLAB 9 x 3 feet SCULPTURE ON BOTH SIDES. No. 33, OUTSIDE TIME WORN. No. 32 INSIDE, IN GOOD PRESERVATION. At the bottom, and top, lotos semi-circles, top one fractured: over it this imperfect line of inscription:

—*cha yajamagi pata jayapitaha, to the conquering yajama a victory tablet.*

A lower cornice, and lotos flower. Over it a *bo*-tree, with attendants; beneath the tree two feet, bearing the *chakra* marks; two side partitions, attendants in reverential attitude.

In the centre circle, or principal device, a large *bo*-tree in a tub, which is held up by four kneeling attendants.

Various female devotees, bringing offerings, or standing in reverential attitudes.

The roofs of four cottages are visible. Over this circle, feet of *Buddha*, two birds, one bird, two birds, as if swimming in a pond; two smaller *bo*-trees. Two compartments. One has a King or Chief, and two Queens; four other females, kneeling, bearing offerings.

These devices tally very well with the apparent meaning of the imperfect inscription that the slab is a tablet commemorating a conqueror, named *Yajama*, an hereditary name of the *Velligotivaru* Chiefs in that neighbourhood.

No. 33—THE OUTSIDE—TIME WORN.

It has also a centre lotos flower circle, and two like semi-circles top and bottom. Between the lower semi-circle, and outer circle, are three fat men (or *bhutas*) comic in expression. Between the centre circle, and top semi-circle, is a *dagobah*; a man and woman on either side kneeling, hands held up over their head, highly devotional. Two side partitions; in each one a man, and woman reverential. At the top a small *bo*-tree, two elephants, two horses: may be intended to put the *Gajapati*, *Ganapati*, and *Asvapatis* in a place of honor; if so the victory was probably over the forces of the *Narapatis* of *Vijayanagaram*.

Both sides are quite harmonious, as commemorating a victory won.

No. 34. A CIRCULAR GROIN: it seems to have fitted into a wall; one third of the edge, and the inside being cut rough for that purpose, and bearing marks of having been separated from chunam.

A large circle with but little ornament. A King is standing, leans his left arm on a horse, held by a clothed groom; his right hand *a-kimbo*; attitude careless, but graceful; figure of the heroic proportion. A Queen (figure much mutilated,) seated on a couch; she looks old (*venter* wrinkled) appears to be sick, or dying. Servants in various attitudes. There is the identical old woman (two portraits,) of No. 1: leaning one arm on the King's right shoulder; an umbrella (token of royalty over both) confirming the former conjecture of her re-

presenting the King's mother. A female attendant with folded arms, expressive of waiting, without hope of the patient's recovery.

Another old woman behind the Queen's back, with a bowl; as if containing gruel or medicine for the sick. Other attendants in different attitudes. Three underneath bear up the Queen's couch on their heads. One figure seated below the King, with something like a serpent in lap, sex equivocal. One or two old, and curious spectators outside. A gateway is seen over the head of the King's horse behind.

There is no inscription. The tablet seems to commemorate a case of hopeless sickness; it might be construed into a case of poisoning. The attitude of the King expresses reckless *nonchalance*, very different from sorrow.

Nos. 35 and 36.—TWO CIRCULAR GROINS FOR SUSPENSION, BY THE CENTRE PIN. Two carved faces, one a convex with lotos-flower pattern; one flat with bas-relief figures.

Two females supporting a sort of couch, or settee, with figure of the full moon in the centre. Others, male and female in adoration. Two persons looking like Brahmins behind: above females. The carving time worn.

No. 37. A SLAB 6½ by 3½ feet.

At the bottom an inscription of three lines, much time worn, and hard to be copied with certainty.

In the lower square a *bo*-tree on a stool. Side supporters a chief and his wife; with each a female attendant. Two aerial beings. On a cornice, lions in chase.

Centre Square.

A *chakra*, or else a sun supported on a pedestal. A man on one side, a woman on the other side, hands held up in adoration. Two kneeling attendants. Two aërials. Flower cornice.

A *dagobah*, a kneeling attendant on each side. Two aërials. An umbrella over the *dagobah*.

The inscription, as well as it can be made out, appears to be poetical.

1. *Nurayu etc.*

2. *Nulanu "*

3. *Nuchanu "*

Native poetry has the rhythm at the beginning of the lines.

No. 38.—A CORNICE SLAB 7 by 2 feet.

Two small lotos flowers, which may have some sexual reference. Two seated *bhutas* or fat beings, of bad proportions; but so intended, as farcical. One has a serpent in front. The snake, or cable, or whisp of straw, above discussed,

here also occurs with seals, or other marks upon it. The slab bears the Telugu No. 76.

No. 39. SLAB $6\frac{1}{2}$ by 3 feet.

Centre lotos flower, and two semi-circles of like pattern; as in other numbers. One large flower unfolding. There are three lines of inscription between the top semi-circle and the centre circle. These letters show some varieties of form; supposed to be later in date than others.

No. 40. A SLAB $6\frac{1}{2}$ by 2 feet.

Of like pattern with the last No. that is a central lotos pattern circle, with a circular navel in the midst, and two semi-circles, like pattern well cut. A wavy cornice beneath. Inscription; some letters wanting at the beginning and end.

It appears to commemorate a gift to some ascetic; but as yet the sense is not perfectly clear.

No. 41. A SLAB 5 by $3\frac{1}{2}$ feet. COARSE SCULPTURE, AND TIME WORN.

In the lower square a large dagobah, two kneeling worshippers, having large top knots of hair. On a cornice, three lions in chace. A cornice of flower work, time worn. Over it three *chakras*, or else suns on pedestals, and heads of fish monsters, mouths closed; so as to form merely a sort of ornamental scroll.

The like ornament occurring in another No. leaves it doubtful whether the device be not a trefoil.

There are two small *chakras* cut on a pilaster, beside one of the two kneeling figures. The object seems to be only religious; and not important.

No. 42. A SLAB 4 by 3 feet. COARSE SCULPTURE AND TIME WORN.

Lower narrow cornice, three lions in chace. Another cornice, time worn. Above it three suns, or *chakras* on pedestals; and above each an ornamental scroll, like that in No. 41. Here however the appearance seems rather to be that of a large trefoil. Such leaves are not unusual; though I do not remember so large a kind. As the shamrock has a meaning, like the rose, thistle, and lily, so this device may have a meaning; at present unknown. See Chap. 7, where the emblem is probably resolved.

No. 43. A SLAB, 5 $\times$ 3 feet.

A lower cornice, and three compartments above. On the lower compartment a dagobah closed, two kneeling figures, palms of hands reverentially joined; two aerial beings with some device, now obliterated. On the middle compartment a ram in the act of butting a lion going before, another lion following.

On the top compartment three *chakras*, or else suns, borne on ornamental pedestals. The carving is coarse, and time worn. The only construction appears to be a votive commemoration of a fruitful season; or possibly three consecutive years.

Nos. 44 and 45. TWO CIRCULAR GROINS, (which appear to have been fitted into a wall) 4 feet diameter, one foot in thickness: carved on the circular faces; one much worn as having been exposed to the weather; the other and inner face in high preservation. They are cut in the usual lotos flower pattern; the workmanship fine. There are marks of a broken pillar on the inside; the outer side has a socket, as if the rounded end of a pillar once fitted into this navel. This piece bears the Telugu No. 43. It seems to have been only ornamental.

No. 46. A BROKEN SLAB, with a central lotos flower circle, just like the centre piece of No. 39, bears the Telugu No. 3.

No. 47. A CENTRE PIECE TO FIT INTO A ROOF OR CEILING; lotos flower pattern, neatly cut.

No. 48. A PAIR TO No. 46. NO INSCRIPTION, ON EITHER ONE.

No. 49. A SLAB 5 $\times$ 4 feet.

It presents the appearance of an oval urn, or very large flower pot; out of the narrow neck and mouth of which proceed stalks with lotos buds and full blown flowers; but shaped as in No. 51, which see: below the urn, on either side, is a pendant globular fruit, like those in No. 51.

Two lines of inscription are apparent; but so greatly time worn as to be illegible; except only a few separated letters.

No. 50. A FRAGMENT; only a side ornament remains; the centre is gone.

No. 51. A SLAB 3 $\times$ 2 FEET FRACTURED INTO ONE LARGE, AND FOUR SMALL PIECES.

A large urn, like the dome of a dagobah; out of the narrow neck and mouth of which proceed stalks of lotos-flower buds, with four full-blown flowers. Two large globular fruits hang pendant. The full-blown flowers are coarsely cut, oval form, and with two inner ovals; so shaped as to typify apparently the female energy of the universe. Some of the *Bauddhas* (I learn from Mr. Hodgson of Nipāl) have devices connected with that system; which the lotos flower generally alludes to; though less visibly than in the above device.

No. 52. A SLAB 4 $\times$ $1\frac{1}{2}$ FEET, MORTICED AT TOP TO FIT ON TO ANOTHER SLAB.

The surface is divided into small squares with a small circle lotos, or other flower, inscribed in each square. Two narrow cornices, one has flowers and

lions, one the cable, or serpent-like figure of frequent occurrence; but it does not issue from the mouth of a fish, as in other cases.

No. 53. A CORRESPONDING SLAB 2 feet long; the cornice work only differs. It is much time worn.

No. 54. A FRAGMENT 2 $\times$ 1 foot the top broken off with side fracture. Ornamental.

At the top small figures seated, and standing, but broken off above the hips.

No. 55. A SMALL FRAGMENT BEHIND THE LAST No. (1 foot by 10 inches) mere ornament; only it has the distinguishing mark of one of the *Tirthakaras*

 the 7th if I remember aright; that is the one termed *Suparsva*.

No. 56. A SLAB 3 feet by 1 foot. A sort of pillar, flat behind, but cut into three faces in front. In the centre of the front face a circular lotos, and smaller flower ornament. In the navel of the lotos there are very small circles, possibly cut in at a later date.

No. 57. A LIKE PIECE, $3\frac{1}{2} \times 1$ foot: a semi-circle, and half navel, with like very small circles.

On the face of this there is an inscription in the same character as others noted; but worn, either by express rubbing, or by people's feet constantly passing over it; the latter is the idea conveyed by the kind of appearance: illegible as a whole; a few of the letters may be read.

At the end a brief inscription is added, of later date, and other character, in perfect preservation, as if cut very lately. The two first are figures probably 51, the following word is *Crodhi* the name of a cycle year, and the next probably the abbreviation for the word *varusham*, being a probable compound of *ru* and *sha*. The letters are small, and very neat, corresponding exactly to the cut of the spurious addition to No. 1; and both doubtless of the same age, posterior to the original.

This character is *Hala Kannada*, and is the same in kind as copied by Col. Mackenzie at *Shavanur*, or *Madecasi*, (As. Res. Vol. 9th) and the same with the characters on the *monoliths* (or *rathas*), at *Mamallapur*.

From this seemingly very trifling addition arise conclusions, important in the present antiquarian enquiry.

It was made after the conquest of this part of the country by *Krishna raya*; from the worn state of the other, if not expressly done, it is to be inferred that the other defaced inscription, with its letters, is of much greater antiquity: the cutting of the monoliths at the seven pagodas may be concluded to be of no very great antiquity; not much earlier than A. D. 1500: and by other hands than the statuaries concerned in these sculptures at *Amravati*; possi-

bly persons taught by them, or workmen employed by them, or descendants of such workmen.

These conclusions harmonize with what I shall have to state in a subsequent chapter, and with an indication given in my notes to an account of *Mamallapur* in the *Madras Journal of Literature and Science*.

No. 58. A LONG CORNICE SLAB FRACTURED; two pieces broken at the ends. A narrow cornice below, broader one above, cut with leaves and flowers.

A large bull with hump on shoulder, drawn by a stout young man with a rope, one hoof rests on the keeper's leg. Another animal with an ornament, its paw rests on a leg, the only part of the keeper remaining; the head of the animal is wanting.

No. 59. A VERY SIMILAR CORNICE as if continued, two pieces 3 feet long.

A man with a rope; before him is a panther, with ornament pendant from the fore haunch: the face is that of a panther—a pair to the headless animal of the last No.

No. 60. A CONTINUANCE OF THE SAME SLAB, OR CORNICE. An elephant, the rump gone. A man holds one tusk; the man's back is shewn—right leg broken off at the thigh.

The foregoing parts of one cornice are evidently cut with a view to be seen from an elevation; such as the frieze of a palace, or temple. This further coincides with Grecian art, and strengthens the various indices of that sort, to be found in this Memoir.

No. 61. A TWO-HANDED FIGURE, one hand rests on the hip, one lifted up—seems to have held a lotos stalk, or flower; now broken off. A highly ornamented conical cap: girdle and cloth from the loins: scholastic thread over one shoulder. Flower necklace, ear lobes pendant: an oval as if a glory behind the head. There is a double trident, near the head, of the form used in *Saiva mantras*.

No. 62. AN IMAGE STANDING ON A LOTOS PEDESTAL. The robe that of an *ékāmbara*, in folds or plaits: arms broken off, the head gone. Another inferior head of coarse sculpture attached; but not the one properly belonging to it. The piece bears the Telugu No. 37.

No. 63. THIS NUMBER AFTER MUCH SEARCH COULD NOT BE FOUND. There is a pile of fragments of this kind of marble, without any number on it.

No. 64. A SQUARE SLAB BROKEN. On it is carved a fish of prey swallowing another fish. An emblem sufficiently plain, but of doubtful application.

The natives speak of three fishes as *mingalam*, *timingalam* and *tini timingilam*: of which the second eats the first, and the third eats the second.

No. 65. FRAGMENT OF A CORNICE $1\frac{1}{2} \times 1$ foot. Figure of a man, much worn—part of an ornamented cable, having on it much carved work, as if to

imitate the appearance of straw. Part of some vessel. A square with small *chakra*, and the sign of the 7th *Tirthakara*,  interwoven together.

No. 66. A COARSE, AND WEATHER-WORN FRAGMENT. An emblem of the sun, on a pedestal, carved devotees worshipping it. Telugu No. 46.

No. 67. A SMALL FRAGMENT, a time-worn male figure, with a ball in both hands; his knees rest on two female heads, which only remain. Supposed to be some exhibition, like Chinese seats, or those of *mali jettis*, in this country. At all events mere ornaments.

No. 68. A BROKEN FRAGMENT, the usual semi-circle lotos carved ornament.

Over it a small dagobah with umbrella. Two elephants bearing coconuts as offerings. Another unknown animal (panther-like) with a kind of raised saddle, in waiting; it has no tusk.

No. 69. FRAGMENT, COARSE SCULPTURE. Another lotos flower, with one side flower, one over it at top, one opening flower, two buds. Possibly the emblems of females, in some distinguished family.

No. 70. PART OF A FRACTURED PILLAR, the back is flat, it has five smaller faces, on the front a semi-circle carved work, time worn. On other side faces, smaller semi-circles, and figures. A King and Queen seated on the same bench; their heads broken off. Nothing beyond ornament.

No. 71. FRAGMENT OF A PILLAR. The fracture shews the stone to be horizontally laminated; the laminæ thin, alternately greenish, and whiter in color.

A pedestal pillar $2\frac{1}{2} \times 1$ ft. and one foot thick. A small semi-circle on the front face, time-worn; under it an inscription in small letters; the same in kind as in other numbers, but in a more flourishing style, and imitating the Hala Kannada mode of forming vowel affixes. The letters are worn, and many of them defaced. Much care will be required to copy them successfully. I notice, for the first time, the circle with a dot in the middle, which is Pelasgian, Grecian, Telugu, Canarese and *Grant'ha* for *t'ha*. The semi-lunar, Pelasgian letter often occurs: here with a high flourish over it, the supposed vowel affix *z*.

Further notice must be deferred to the chapter on the inscriptions.

No. 72. THE BASIS OF A PILLAR, SQUARE, with a beautifully cut rounded chapter, or torus, fluted in the Doric style; broken into fragments. This is not Indian, but Grecian, architecture.

No. 73. BASEMENT OF FOUR STEPS, and upon it a like chapter or torus, rounded smooth, inside a circular socket for the foot of a pillar to fit into it. More than one instance occurs of a pillar rounded, as a mortice to fit into such a socket; the fillet, and torus are Grecian in style.

* No. 74. FRAGMENT OF A PILLAR (a *laya stambha*). Octagon in shape, with delicately carved flower and figure work, on the different faces. Parasite plants, lotos flower, sacred *bo*-tree. One end is sunk into the ground on the lawn, in front of the Museum, the fractured end has its vertex about 7 feet from the ground. This first attracted my attention; and especially from seeing that it had a short inscription, in letters very similar to those on the *lath* of Firozshah, near Delhi. They are of later date; but seeming of older, and simpler form than other letters of like kind, on other numbers: The two last letters being those which the late J. Prinsep, Esq. rendered *danam*, I so read them at first; but doubt first began here, as to Mr. Prinsep's rendering. The inscription has no place in the Madras Pandit's copies, and *soi disant* translations.

This is my reading of the inscription.

-vohanu petanu-papu tahanunu laphi tahanu chatitacagai layam.

* Pillar raised on place of the burn-ing, accomplished loss.
Monumental pillar for some one, name imperfect.

No. 75. (Telugu No. 16). A SMALL FRAGMENT OF A CORNICE; a few small figures quite unimportant

The piece bears an inscription. (The original letters cannot be printed; and a few are not yet decyphered. The sculptor has given his name as *Rama*, with a prefix.)

No. 76. FRAGMENT OF A CORNICE, lotos-flower pattern. Above it a naked man, on a large horse couchant. Above it monkeys: one holding a vessel, and the peculiar emblem of frequent occurrence—cable, or straw; but it is here so shaped as very possibly to have some emblematical, and sexual reference.

No. 77. Fragment about 2×1 foot: the figures wholly defaced.

No. 78. A small broken fragment, (Telugu No. 82.) Seems to have been part of a cornice: two lions chasing a deer, and another beast.

No. 79. A SLAB, which represents an ornamented flower pot, lotos flowers issuing from the top, some full blown with three buds. Probably a family emblem.

No. 80. A FLAT SLAB, plain outside, and rounded in a semi-circle at the top.

A figure, as supposed of *Padmavati devi*, seated, well carved. The position is that of *Bauddhist* figures in *tapas*, but having a bowl for food in the two front hands; two other hands held up, one of them has a string of beads; the other one (the left) holds a small vessel. On the side, near the right hand, a lotos in bud only, to signify that this deified devotee was always a virgin. The figure is seated on an open lotos flower; but that is common in images of

Lakshmi and merely designates the negative power, or female energy of the universe.

This statue bears a high rounded cap; an oval glory behind: an umbrella over head, emblem of great dignity. Two very small figures, seated in *tapas* in places of dignity, over the two raised hands of the statue, representing *Jinas*, or else *Virbhakaras*, a sort of demigods, or deified mortals. The work is elegant, and in good preservation.

No. 81. A SMALL IMAGE OF a *Buddha*, or *Jina* in *tapas*, or doing penance.

A dagobah behind; over head a small canopy; ornamented with the head of a beast, sometimes called *Yali*, sometimes *Singham*. There is a fabulous beast, thought to have been more dreadful than a lion.

No. 82. (PAPER MARK ONLY LABELLED ON.)

A small square pedestal, with an altar guarded, and girded by a serpent; upon the altar are two footsteps of *Buddha*. Two prostrate votaries, and one seated, have been deprived of their heads (as if in scorn). There is wreath work, with animals underneath. The whole is blackened, through butter oil, or other material poured over it.

No. 83. A SEATED *durga* or *kali* FOUR HANDED; one holds the *ankusa* or elephant hook, the hands, and legs are broken.

I am guided by the number; but this image belongs to the rival system: the party that overthrew, and destroyed the *Jinas*, in the vicinity of the river *Krishna*; see 84, duplicate 11 and 86, 90.

No. 84. A WARRIOR, sword in hand, and kneeling, is struck by a five-pronged *sila*. A standing female figure behind holds a choury (or ox-tail fan) lifted up in her left hand. An indistinct flower, or *chakra* in a place of degradation, the lower left-hand corner. This seems to be an emblem of the destruction of the *Jinas*. A trident would have designated *Saiva* power; but the five teeth are more strongly expressive, as the *Saiva* emblem is *panchácshara*, five lettered. The *Saivas* under *Ganapatidéva*, and *Pratápa Rudra*, destroyed the *Jinas* in the locality whence the sculptures came. There was a duplicate No. 11, which, after having described, I directed to be omitted. On reconsideration I insert it here, as connected with the above No. 84.

Duplicate No. 11 of coarse granite, does not relate to the other Sculptures; it is Brahmanical. A small figure of *Vira-Bhadra* (a vindictive emanation from *Siva*) with four hands. In the right front hand a sword; behind it a hand with mace or club; left front hand holds a platter or cup. The hinder one holds a *súlam* or trident (*Saiva* emblem).

In the right hand, lower corner, is a small seated figure, holding up the legs of a figure over-thrown.

No. 85. HAS NOT BEEN MET WITH. Such being the case I take occasion to notice two flat slabs about a foot square, of brownish granite, both fractured. Each one has a smaller engraved square (lines and marks cut in, not in relief), and among the marks are Chinese, or Mongol, or other characters. I would not hastily term them Assyrian, or Babylonian; but they certainly have the arrow-headed perpendicular, and triangular side lines, such as are published by Layard, Rawlinson, and other writers.

No. 86. A SMALL DARK COLORED STONE, a highly ornamented niche, in which a *tapasvi* is seated on an inverted lotos flower (the *Jainas* overthrown). Very large Brahmanical thread, over the shoulders; left hand holds a string of beads, the right hand is over the head with the thumb, and forefinger meeting on the vertex; where according to the *Puránas* the soul is located. Cap on the head Brahmanical fashion. This, as to material, and meaning pertains to Nos. 83, 84, 90.

Nos. 87 and 88. These Nos. have been very recently (April 1856) painted on the lion and lioness on the lawn; which before were without numbers: and which I briefly specified in default of No. 8.

No. 8. (Since affixed). This number has been found to be given to an image of granite (like material to No. 9) a female figure seated; to which a larger male figure (without any No.) is a pair. Both figures hold an unfolded lotos flower; the male figure in right, the female figure in left hand: which is the only mark of identifying with either *Jainas* or *Vaishnavas*: may be the latter. The seat of the female figure is a rough block with foot-stool for the right foot, the left foot is raised to the seat, and the left elbow rests on the left knee; the right hand rests gracefully on the right knee. High conical cap; very large ear drops, with concentric circles. Breasts rounded, and very prominent; bound by a narrow, and embroidered band. Garment from the waist to the ankle, only faintly sculptured.

There is a large figure of *Vishnu*, and a smaller one of *Lacshmi*, on the lawn in front; which, in material and style of sculpture, harmonize with No. 8 and the connected male figure. As a guess I should say these two last designate *Krishna* and *Bukmini*, considered simply as man, and woman; though both have the demi-god and goddess (or something superhuman) indicated; wanting the distinguishing tokens of *Vishnu* and *Lacshmi*. The sculpture is good; but not Grecian.

No. 89. FRAGMENT 2 BY 1 FOOT. Telugu No. 71. A dagobah, and figures seated near it; their faces are gone.

No. 90. A SMALL PIECE OF GREEN STONE. An ornamented arch representing some Fort gateway. A warrior on horse back with helmet, brandishing a drawn sword, a dagger in sheath at his girdle. The horse is badly cut, disproportionably large, with big saddle, and heavy looking ornaments.

ZZU

REPORT ON THE ELLIOT MARBLES,

Though the material is different from Nos. 83, 84, 85, yet it is of kindred workmanship (any thing but Grecian); and it appears to tell the same story; that is the overthrown of the *Jainas*, through the artifices of *Brahmans*, by the *Saiva* king *Pratāpa Rudra*, or his predecessor *Ganapati deva*. I suppose the said Nos. came from *Amravati*; and, if so, such is the legend they visibly bear; tallying with the record of history.

The description so far (which I have found somewhat operose) relates to marbles, and sculptures which to the best of my information, were excavated from a mound, or heap of rubbish, under the directions of the Honorable Walter Elliot, Esq., then Commissioner in the Northern Circars, and by that gentleman, transmitted at a great expense, to Madras; with an ultimate view of presenting them to the Court of Directors: a result still likely to be accomplished. By circumstances, not within my knowledge, the marbles remained for some years, in front of the College. My eye had rested on them almost daily; without giving them a near inspection; being deterred by two very common statues, on coarse granite of *Vishnu* and *Lacshmi* (noted above) which had an undue prominence given to them. For better preservation, as I understood, the whole were removed to the Central Museum; where I first studied them; with wonder, that I had never carefully looked at them before.

The fop attracts the gazer's e'en,
While modest merit walks unseen.

In addressing the Government with a view of having drawings of them taken, Dr. Balfour remarks in a parenthesis "there are ninety of them."

These ninety have been attended to by me, according to my engagement.

There are others since arrived (during the month of April) from Masulipatam; which may be more fully adverted to hereafter, when the arrival is complete. These appear to include the slabs which first attracted the notice of Major Mackenzie (As. Res. Vol. 9.) with several others since dug out of rubbish. They were seen, and ordered to Madras by the then Governor; briefly described by Doctor Benza: and are those alluded to (I believe) in a following extract. The surface of the marble in these is from long exposure, and probable scouring, of a lighter tint, than those before described by me; but, with the exception of a piece or two of a greenish cast.

The sculpture is such as would attract a superficial observer; but as records, they seem to me, with one exception, of less value than those described. Until the whole have arrived, and the inscriptions have been copied, and the sense of them made out, a decisive opinion would be premature.

As regards the nature, and intention of these tablets they appear to me to be mainly one in design, or object, with the tablets, on like material dug out of the remains of *Konyunjik* and the *Birs Nimroud* by M. Botta, Layard, and others. They are, like those, hieroglyphical, emblematic, commemorative.

They seem also to have been inserted into the walls, or ceilings of a palace; or made ornamental to porticos. A few might have been placed in a dagobah, or temple; but I doubt if such was the intention of many; even as all pictures, having a religious reference, have not always been affixed in churches. The attentive reader will have seen that some pieces, wherever placed, carry a degree of license (it might be added licentiousness) with them; and this feature is more marked in a tablet or two of recent arrival. They indicate a state of manners unknown to Europe; but they are faithful records; and this feature stamps their value; in connexion with artistic skill, and highly curious inscriptions.

As to the material, on first looking closely at the broken pillar No. 74, in company with Dr. Balfour, I asked that gentleman if it was magnesian limestone. He replied in the negative: from its wanting the unctious touch of that kind of marble. My highly esteemed friend has yielded me a reference (in letter 18th January 1854, before quoted), from which I make an extract, and with it close this chapter.

Doctor Malcolmson (Trans. of Geol. Soc. 2nd series, Vol. 5, part 3d, page 543, quarto) after describing various other rocks, and "clay slate formation," which he rather designates "argillaceous limestone," adds:

"The limestone is a compact rock, but the strata are usually thin, and are often intersected by vertical partings; a circumstance which frequently limits its use in ornamental architecture. Its most common colour is a light blue, passing into black; but it occasionally occurs of a nearly pure white, and affords an admirable material for basso-relievos. On this stone the finest sculptures of the ruined city of *Amravati* are executed; and for delicacy of workmanship, they have perhaps never been surpassed."

CHAPTER IV.—ON THE FIRST DISCOVERY OF THE MARBLES; AND MATTERS PERTAINING TO THE NAME, AND SITE.

In the year 1801, and in the course of his duties as Surveyor General, Colonel (then Major) Mackenzie heard of sculptures in the neighbourhood of Ongol; with an indication that these were probably *Jaina* in kind. The account is contained in the original quarto edition of the Asiatic Researches Art. 4, from pages 273 to 278. In consequence he determined to call at *Amresvaram*, in order to inspect the recently found antiquities there. He left Ibrampattam very early in the morning, and went along the north bank of the *Krishna* river. At day light his cortege was in the bed of the river, and ascended the opposite bank to *Amresvaram*. The *Chintapally* Zemindar had lately built temples there. Beyond the town was a circular trench 10 feet wide, 12 feet deep; so much having been dug into a mass of brick work: the bricks of large dimensions. In a ditch was a white slab broken, with figures in relievo; three or four other like slabs were in an inclined position. Sculptures

were only partially visible. Some description is attempted, but erroneous: the Major having mistaken a *bo*-tree for a *lingam*; and the drawing given is incorrect. Another fragment was found, with part of an inscription: a few of the letters given are correct, and legible; but, as a whole, either badly copied, or badly engraved. Another slab was met with, having two compartments; one representing the attack of a fortified place, and the other four figures of men at their ease: this slab was made to serve as a roof, over a small *Siva mantapa*. A few other figures are noticed; and on the opposite page, without any description, is given a plate from a sculpture and inscription at *Sravangudi* near *Madecari*: the sculpture a horse and foot warrior in direct collision. An inscription is over head, three or four letters of which are like in kind to the *Amravati* sculptures; but the whole merging towards the *Hala Kannada*: the copying, or engraving is not to be trusted. In a note Major Mackenzie adds that in 1804, Mr. William Brown had made some further discoveries of sculptures, inscriptions &c.

The Colonel instituted other enquiries, and excavations, at a later period; and published an account of his proceedings; but I have not been able to procure a sight of the work: nor is it of consequence. It was natural that a hasty visit, curtailed by exposure to the sun, should lead to endeavours with better means, and appliances; and the results being tangible, the *modus operandi* may be dispensed with. I saw the head of the younger Memnon in the British Museum, before I read any thing of the difficulties of conveying it to the Nile: and read the account afterwards, without much interest. In like manner, sculptures from *Amravati* were brought to Masulipatam by Mr. Robertson when Collector of the district; they there excited attention from Lord Elphinstone and suite. The Honorable Mr. Elliot, at a later period, visited *Amarapuram* (or *Amravati*), had further excavations made, and slabs transmitted at great expense to Madras; intended for the Court of Directors in England. Those formerly in Masulipatam have been sent down, by the present Commissioner J. Goldingham, Esq. and have also found their way to the Central Museum.

The matter was at first quite new to me. I had not just then the information conveyed in the preceding portion of this Chapter. I was disposed to consider that the correct name was *Amravati*. I have since found that Wilford gives this as the true name of the capital of Ava; which has since rejoiced in the orthography of "*Ummeeraipooram*," the capital of a *Bauddhist* country. What is of more consequence, I find Mr. Sterling in an able article (*As. Res.* Vol. 15, Art. 5.) expressly uses the word *Amravati*, as the name of a capital town on the *Krishna*, concerning which he was unduly sceptical; for it is the very place under consideration: and I have since also found the like orthography in one of the Mackenzie papers in Telugu, examined by me. However having found reason to doubt the accuracy of taking the Sanscrit as a basis of

interpretation of inscriptions, such as will hereafter come to be noticed; and finding some seeming confirmation as to the spelling and pronunciation *Amravutti*, I next thought of the *Magadha-bhasha*, or *Pali* of Ceylon, as the possible basis; and with this idea looking at the first volume of the *Mahawanso* by the late Honorable Mr. G. Turnour, for a stanza, in which the *Magadha-basha* is termed the primal language, my eye rested on a page* in which several towns are specified, and two of them having this same termination *vatti*; Mr. Turnour stating that the *Pali v* is rather pronounced *w*, and so he always writes it. The mere name thus became tolerably clear. I presume that the Sanscrit possibly might be *vratta*, a circuit or district; rather than *vati*, commonly affixed to names of distinguishing females. Thence the affix is equivalent to the now common word *grāmmam*,—*pagus*; or may be equipollent to the *paralia* of Athens, or the *parousia* of Rome. *Amrita* is *undying*; and hence the word *Amravati* appears to mean *pagus-immortalis*. Should *Amravati* prove to be the true name, then like *Padmavati*, it must be taken as a female personification.

In the paper above referred to, Colonel Mackenzie uses the word *Amaraipooram* and *Amarésvaram*; the first means *Amara* town, and the other name arose from the *Saiva*s, at a modern period, having built a temple to *Siva* with the title of *Amarésvara* or lord of *Amara*. Colonel Mackenzie's main assistants, and advisers, were *Saiva Brahmins*; a circumstance which I have found it needful to bear in mind, in the process of my investigations.

My first looking for the site was in a book and map published by Pharos and Co., in which I made out a likely town, though curiously spelt. On enquiry, in a competent quarter, I found I was right, or nearly so; and hence my researches, among old books at the College, were directed to the neighbourhood of Guntoor; and to the former *Chintapalli* district, or zemindary. I need not be particular as to some disappointments; but ultimately I met with more encouraging success. Enquiring of an aged friend, who had travelled much in that neighbourhood, *Kondavir* was mentioned to me, as having an ancient fort, on a hill, and very curious buildings. This was a useful clue. I found that a class of the Mackenzie papers began with that locality; and incidentally there will be occasion to state some matters concerning it. In the same book my eye rested on the word *Annaveram*; and, without entering into details philological (as to local corruptions of names) I had no doubt this was the place in question.

It is followed by an account of *Pedda gandela*, and between the two would seem to be situated the heap, or tumulus, whence these marbles were excavated. The following is a translation of the brief reference:—"Near *Peddintima padu* a so-called township on the north-east boundary, there is a locality where an-

* Page xxxv. Introduction.

ciently many *Jainas* dwelt. In the time of *Vaddi Reddi garu*, and during the *Karnataka* government, the *Jainas* ceased to be. Whereupon, that place became a mere heap. Afterwards the *Sundūr* people put the rejected scavengings of the town to the south eastward of the said heap, a quarter coss (less than a mile) distant.

"East of this town they established a granary for corn, dug into the said heap; and it became a very large storehouse for corn. Afterwards some people went out from *Sundūr*, and constructed a *palliyam*, or town on the spot: which came to be called *Peddagadela*, or great granary.

"After the Moghul conquest of the *Karnataka* people, it became a talook, and was given as a Jaghir to two Mahomedans."

It is added that, at a later date the *Camuvars* built a fane to *Siva*, under the title of *Amaresvara linga Mūrti*; and another class of *Camuvars* built a temple to *Vishnu*, under the name of *Vēna gōpala Svami*.

We have thus the "immortal district" (converted, in the fluctuation of human affairs, into a heap of rubbish) pointed out, as to locality, with sufficient distinctness.

From a larger, and better map than the one before alluded to, I have since better made out the localities specified. *Kondavir* is a short distance S. W. of *Guntoor*, and *Amravati* is about N. N. W. from *Guntoor*, on the south bank of the river *Krishna*. A short distance due north, beyond the opposite bank, is the fort of *Condapalli*. This *Amravati* must be distinguished from another town of the same name (spelt *Amravati*) S. W. of *Nagpur*, and at some distance from a branch of the *Godavari*; with which place a distinguished literate in Bengal confounded it; though retaining the site as to the *Krishna* river. A place named *Dharana Kōta* is not far from the site of our *Amravati*; and its construction, as an earthen fort, I find ascribed to the Prince, who finally extirpated the *Jainas* from that neighbourhood.

Though wanting Col. Mackenzie's own account of his further proceedings, as before stated; yet I have met with the journal of the individual employed, named *Ananda Rao*; and as this journal comes within my own special commission, and is an additional document, it is better perhaps than abstract of the Colonel's account, had I met with it. In the book No. 56 of Telugu documents of one class, his journals are in transposed order; which it will be best to rectify in my notice.

He acted under the immediate orders of a gentleman, whom he simply styles *Hamilton garu*. I think he may have been a gentleman of the Civil Service, or very possibly an Assistant in the Survey Department; and I will take the liberty of substituting Mr. Hamilton, for the writer's native term of

respect. The journal is from the 1st January 1817 to 31st May; but I shall indicate the matter of any interest summarily; and only translate verbally two passages in April and May.

At the commencement of 1817, he was occupied in preparing an account of *Dharana Cota* and *Dīpala Dinna*, another name for the heap aforesaid. He began to copy inscriptions in Telugu, with Sanscrit *ślokas* from a pillar in a porch at *Amarēsvaram*; bearing as it would seem a weather cock, and finished doing so by the 4th January. Next day he took off an oil-paper impression of a newly found pillar at *Dīpala Dinna*, and sent the copy to Mr. Hamilton. The day following he found in the porch at *Dīpala Dinna* three small stones, white, red and green, and shewed them to Mr. Hamilton, who told him to take care of them, and remit them to Madras. On the 10th January he received orders from Mr. Hamilton to mark the locality of *Amarēsvaram*, as to boundaries, with flags; which he did very carefully; naming each spot, and extending his marks to the banks of the *Krishna*, including the *Dīpala Dinna*.

At the direction of a gentleman named Scot he wrote out the legends of *Nandi-gramam*; and, up to 23d January, also visited three villages specified. On the 24th he forwarded copy of inscriptions, and the above three gems (?) with matters of account to Madras. To the end of the month he was engaged, with the village accountants, in writing out an account of *Dharana Cota*. I suppose it to be the book which I looked over with care; but found it to contain mere accounts, and boundaries.

At the opening of February Mr. Hamilton ordered him to be ready to write out the boundaries of *Amarēsvaram*. On this account (with a statement of festivals of *Amarēsvara Svami* included) he was occupied till the 15th; on the 16th he had a large white mable slab lying at *Dharana Cota* carefully scoured, and whitewashed. The two following days he copied off the inscriptions on it fully; and gave the transcript to Mr. Hamilton, who said he would send it to Madras. On the 20th he sent his account of *Dharana Cota* to Madras. Thence to the 23d he was engaged with his notices of *Amarēsvaram* before Mr. Hamilton; and up to the 29th with his notices of boundaries &c., of the *pergunnahs* of *Condapalli* and *Bezawada*.

I do not see any account for March: the diggings in April were important; and I translate his brief account of them verbally:

"Mr. Hamilton having stated that there are a goodly number of marble slabs at the *mantapa* of *Dīpala Dinna*, he directed me to take them out, and place them on the open plain; which accordingly I did, by employing two tank diggers for the purpose. I sent word of the circumstance to Mr. Hamilton. From the 2d of the month up to the 22d, as many as ten slabs had been dug up, and placed as directed. Mr. Hamilton saw them. From the 22d to the 30th other four slabs were taken up from beneath the *mantapa* (porch or perhaps

dagobah). According to the Government order these were all placed separately (or apart) : I gave corresponding information to Mr. Hamilton."

The labor seems to have ended with the month ; perhaps the expense was deemed an object. From the 1st to 7th May nothing of consequence occurs. On the 8th he writes :—

" According to instructions from *Lacshmayya* (Colonel Mackenzie's *factotum*) I sent to Madras two of the above mentioned small stones (or gems) and also one pewter coin." From the 9th to the 31st he was occupied in ascertaining, and writing down the boundaries of *Condapalli* and *Bezawada* pergunahs. On the 13th he received a letter from *Lacshmayya*, dated the 5th ; and notes that he attended to the instructions so received. On the 25th five small red stones, and one small black stone, with three small white stones (" *utah* like") in all ten stones, with accounts of costs, and other expenses, were forwarded to Madras ; the sender of them being then at *Amravati*.

The 14—20 slabs so excavated are probably those taken to Robertson pettah, to adorn the market place ; and now, very recently, (April, May 1856) brought to Madras. There are of them about that number ; and some notice of them is referred to a supplement. One of those seen by Major Mackenzie in 1801 was taken to Calcutta ; and according to an incidental mention by the late J. Prinsep, Esq., " now forms a principal ornament of the Society's Museum," that is the Museum of the Bengal Asiatic Society.

From deference to the judgment of those who think, with considerable reason, that old inscriptions on stone or copper, are more trustworthy than copyings of old books, or oral traditions, I next advert to a book No. 20, which contains copies, or translations (in the Telugu character and language) of inscriptions ; doubtless inclusive of those above mentioned, as taken by Ananda Rao. They are confusedly entered in the book ; one of the latest date being placed first ; but I here put them in chronological order : era of *Sālivāhana* denoted by S. *Saca*, or S.S.

S. *Saca* 450—by *Bōda Māha rāzu*.

S. S. 925—by *Chicka Bhima rāzu*.

S. S. 1054—*Bhanesvara*, gift of ninety-six small hamlets to *Niyōgi Brahmanas* as *mirāsi* ; copper-plate inscriptions.

S. S. 1077—*Palnatti dēsam* ; *Viśhnu Sanceranti*.

S. S. 1104—to *Matanesvara* and *Pātāpadma* by *Dēva Raya*, *Dharana kota*.

S. S. 1148—Gift to *Mantalēvara* by townspeople.

S. S. 1214—by *Kakateya rāzu*, gift of a hill (*pushpa giri*) for a *lingam*, and *Saiva* fane.

S. S. 1267—by *Charana reddi* to *Amarēvara dēva*, gift of lands for ritual service.

S. S. 1267—by *Malaiya reddi*.

S. S. 1283—*Orama reddi*, or *Vēmana reddi gāru*.

S. S. 1308—by *Madavāla konda kota reddi*, who gave *Vegu pūnam*.

S. S. " —*Kesava raja* and *Sacama raju* and *Lingam raju* ; they gave 8 *kalams* of grain in free gift, for the daily service in *Amarēvara* temple.

S. S. 1347—Gift to *Mantalesvara* of fifty-five buffaloes, and daily one measure of butter oil.

S. S. 1437—by *Krishna raya*.

S. S. " —by *Krishna raya* to *Srīman Mahādi raya Paramēvara*.

S. S. 1443—*Chima Vēru raya* built a *mantapa* (or choultry) in the *Kondu vidu* country, and endowing it with 5 *kuchchalas* (50 cawnies) of land, gave the same in free gift (exempt from tax) to *Venkata yogi*, an ascetic.

S. S. 1478—Gift to *Srīmat rajah raju Paramēvara Jīva dēva maha rājulu* of *yogili* township in *Kondavir* principality ; by *Srī Parata para* (possibly *Pratapa rudra*).

S. S. 1501.—Gift to *Kamacsha dēvi*, the word *Padmavati* also occurring. The first is a name of *Parvati*, this of *Lacshmi*, and applied to a goddess of the *Jainas*.

Of the two first in order, it may be best to give a translation from the book No. 20.

This is near to the fane of *Sāmēvara Svami Sal Sac* 450, that is to say in *Saumya* year, in *Jyestha* month, in the *bahula* (dark half lunation) on Friday ; *Srīmat Veruri mula sthanam* to *Sāmēvara dēva srīman Mandalesvara* possessing banners of the three worlds at *Alavantala kara* village ; *Deva Bodu maha rajalu* gave the charity thus recorded (to wit) :

" In the country of *Kondavēti Makuchēleru Veruri Pramana* to *Somesvara dēva* from a field for dry grain, he gave three *bottas* (i. e. 288 marcalis) to the value of"—as much money as would purchase 3 *bottas* as a free gift. (I prefer that literal mode of rendering to any transposition for the sake of elegance.)

" *Sal Sac* 925. In the *Uttarayana Sanceranti* (vernal equinox) *Adhupati Bhēda Chicka Bhima razulu* to the original shrine of *Somanatha dēva* he gave an offering : (to wit)—" To the value of two *kalams* of grain to *Sāmi natha* (son of *Saresvara Panditulu*) the ruler of this fane, to his children and heirs in perpetuity. Closed by a Sanscrit *śloca* denouncing the pains of hell, on any one that might subvert the said gift.

Now, as regards these two, it may be inferred that the givers were *Jainas*. There is a two-fold spelling *Sama* and *Soma*. A very trifling mark in Telugu

writing, being omitted, would make *Sōma* to read *Sama*. *Somesvara* would seem to be the word, and it implies worship paid to the moon. There is a trace of this homage on one of the sculptured tablets. *Kesava raja*, and *Sacama raja*, in another place, are names which I think will be found on the epigraphs of the marbles. I take them to have been *Jainas*. As to the inscriptions above S. S. 1000 they appear to indicate the ascendancy of *Brahmans*: one only S. S. 1104 being doubtful.

But a question arises as to genuineness, and orthography. We have seen that *Anand Rao*, took copies, the impression on oil cloth (or paper) might be trusted. Copying by hand, or by sight, would have claimed a being compared by some second person. If the older inscriptions were in the letters cut on these tablets, I doubt any correct rendering.

Colonel Mackenzie's *Brahmans* made use of the *Grantha* letter as a key; but that will not serve all purposes; and has, I doubt not, caused great mistakes.

In the Journal of the Asiatic Society Vol. 6, No. 63, March 1837, Art. 8 some brief notice is given of the place, and sculptures; and fac-similes of two inscriptions. It is in this article that the oversight, above adverted to, occurs—"Antiquities at *Amravati* a town in the Berar province, situated on the *Krishna* river, to the west of *Nagpur*."

As to the shorter of the two fac-similes, the letters are rudely formed: most of them can be identified with letters neatly cut on the marbles, and some are confused; but I would vouch nothing for such a transcript. The other larger one is in the *Hala Kannada* character. Of course the language is the ancient form of Canarese; but it has been tortured into Sanscrit by *Pandits* and the Rev. Mr. Yates, and a "modified transcript" in *Nagari* letters, and elegant language given. The translation is, and must be inane; that character was not introduced to that neighbourhood, till after the subversion of the *Jainas*; and any supposed reference "to the foundation and endowment of some *Buddhist* institution, by the monarch of the day" must be a hasty assumption.

A few lines of local description may here, with propriety, be quoted:—

"The majority of the sculptures of *Amravati* seem to belong to a magnificent dagobah or *Buddhist* shrine; but there is an admixture towards the end of the volume of objects of the *linga* worship. An accurate map of the town is prefixed, whence it appears that the ruined dagobah whence the relics are taken was on a mound of 150 feet diameter, now converted into a tank. It is called *Dipalidinna*, (translated by Colonel Mackenzie "the mound of lights.")—J. As. S. vol. 6, p. 218, art. 8.

The next point will be to refer to book records, for such traces as have been found in them of *Jainas* in that neighbourhood; and of their extermination.

CHAPTER V—CONTINUATION OF ABSTRACTS AND TRANSLATED EXTRACTS FROM MACKENZIE M.S.S.

There is a remoter connection of the present subject with the *Gajapati* power at Cuttack in the province of Orissa; which I defer tracing just for the present; and a nearer relation to the *Ganapati* power at *Eca sila nagaram* (Sanskrit name) or *Orangkalu*, (corruptly *Warankal*) intermediate between *Amravati* and Cuttack. I find also that the political site of *Amravati* was known as *Dharana kota*;* though it does not appear that any fort, worthy the name, existed, till an earthen fort was thrown up by a conqueror, to hold the country in subjection. By means of this term *kota* (fort) I arrive at some appreciation of the state of things, while the place was held by *Jainas*. The old *Tondaman-dalam*, around us here at Madras, bounded east by the sea, south by the *Palar*, west by the ghauts, north by the *Pennar*, was anciently divided into sixty-four *kotas*; and the country was inhabited by *Jaina Curumbar*; whose occupations were mainly pastoral. *Ambur*, near the western ghauts, is the only one I know of that ultimately came to have a real fortress. One of those sites I have repeatedly inspected: it is a sorry third, or fourth rate village near the large town of Trivalore; and without the slightest traces of any fortification. But the chief one of the sixty-four stations, was *Puralur Kota* hodie the Red hills. In that neighbourhood between *Eriamattu palliyam* and *Canyaputtur* there are two sides of a large quadrangle, looking like the half of a natural fortress. In that neighbourhood there was power; and a deadly, long continued struggle took place before the country was conquered. The Mackenzie Tamil papers contain vestiges of very sanguinary affairs in other parts of the said *Tondaman-dalam*; they have also intimations of like people, and like rule, indefinitely beyond the *Pennar* northward. My present researches have been among the Telugu papers; and these are less definite, with regard to the exact status of the *Jaina* rule, or tenantry of whatever kind. It is difficult to suppose them to have been a warlike people; yet the sculptures tell a different tale; and they must at least have been mixed up with warlike operations.

I find that there is one and the same tale concerning a king of the *Ganga Vamsam* at Cuttack, and the most ferocious of the *Ganapatis* at *Warankal*. However it may be best to waive the more remote, for the present, and to take *Warankal* for a starting point; thence descending downwards.

The Manuscript book No. 32, in Telegu local papers, received much attention from me, when analysing the Mackenzie M.S.S. some years since; and a brief notice, in my analysis, as to the *Jainas* there induced me again to inspect the book more closely. The first site of power was a hill named *Anuma*, and the founder is termed a *Vardar* or huntsman; which, in the style of those

* Which may mean either "fort of *Dhara*" or "earthen fort."

papers, is equivalent to *Curumbar*. I have translated an extract concerning him and his sons :

“*Yeruca déva raju*, his son *Anumadu* with *Nágadu* and *Gangayudu*, these four ruled for a period of 186 years, at *Anumaconda*. About that time some *Jainas* came to that place; and on a hill, called by them *Padmavati*, built a temple, putting into it some images; those of *Parsva natha*, and other like idols. The goddess named *Padmavati* is deemed* to be connected; and the other images there were *Jaina* in kind. Some images were also cut out from the rock of *Anuma* hill. It was a *Jaina* place; and the *Jainas* there acquired celebrity.”

A change of dynasty to the *Kakateya* race occurred; and the chief consequent details are of wars and conquests; alternating between these, and the rulers at Cuttack in Orissâ. They are foreign to our present purpose; but the following extract occurring further on, than the last one, is relevant:

"To the south-west of *Anuma* hill on the hill, named *Padmavati* in the temple of the goddess, built in a rocky situation, there are a great many *Jaina* images. Besides these, in the temple of *Padmacshi*, there were images connected with the *Jaina* way. Before the image (*lit.* in the lap) of the said goddess the people professed the *Jaina* religion: and the image of the said goddess was an object of ritual homage (*puja*). Afterwards, when (*lit.*) the *Jainas* had left the *Brahmans* made *puja* there to the goddess (if *Vaishnavas* they needed not to change the name, as it would apply to *Lacshmi*). At present in that country, and on that hill in particular, there is no one professing the *Jaina* religion. Opposite to the fane of that goddess there is an upright black stone; and, on the four sides, are carved *Jaina* images, and praise of *Prathamajña nêtrin*."

In the course of time *Kakati prol raju* was killed, by his son *Rudra*, through a mistake; and the son of this *Kakati-rudra* was *Ganapati raju*. He had sustained a reverse from the *raja* of *Deva giri* (*Deogherh, Dowlutabad*) and his uncle was slain. He renewed the war; conquered the *Deva giri* ruler; and further humbled the latter by taking his daughter to wife.

That *Déva giri* ruler probably protected the *Jainas*; for inscriptions in the caves of *Ellora* are in the same characters as those on these *Amravati* marbles; and much of the statuary is *Jaina* in kind. Being relieved of apprehensions thence, this *Ganapati raju* (who seems to have been a bigotted *Saiva*), proceeded as stated in the following extract:—

“The son† of *Kakateya prole* named *Ganapati raju* warred with those
braves of the *Pandu-desam*, and overthrew (or dispersed) them. Hearing

* No doubt of it whatever.

† Some of the writers are very delicate as to any admission of slaughter.

† *Recte*, grandson.

these tidings (as to the success of his troops) he greatly rejoiced, and thereupon thinking that the internal concerns of his kingdom ought to be settled, he determined, after some consideration, to demand of the *Jaina Bhaktas*, whose temple and worship were upon the *Anuma* hill, to come to a public discussion ; in order to test the strength of their credence, and their skill to defend it : enquiring also into the nature of their (*vedam*) religion, and their ability to dispute. On being so summoned their (*sastris*) doctors ran away ; and he decided against them.

Thirty-six *Jaina* (*bastis*) temples, by his order, were deprived of the usual ritual homage ; and of the people some were cut up by the sword, others were crushed in oil-mills, and some others were driven away from the country ; or, in various ways thrown into disorder and confusion (*sinfara vandara*). The *Somayajins* (*Brahmans*) who remained acquired many decorative banners ; and, with high gratification, *Ganapati raja* gave to those *soma* (*yajins*) very many honorary dresses, and various kinds of jewel ornaments."

There was besides the more solid gift of lands and villages, sequestered or assumed after the massacre, or flight of the former holders. The book (No. 32) whence the preceding extracts are made, fixes the death of *Kakati rudra*, and accession of his son *Ganapati raju* in Sal. Sac. 1109 A. D. 1186-7; but a memorandum of grants in another book (No. 40) in the style of an inscription gives Sal. Sac. 1067 A. D. 1144-5. The accuracy of dates, in these papers cannot always be depended upon; and to state *circa* 1150 A. D. for the flourishing of this monster (one of several others about that period) may suffice. The said memorandum, or inscription, purports to be in the years of *Svasta sri Tribhuvana Chacraverti Srimat rājadhī rāja dēvara Vijaya rāja*; or “right fully sacred emperor of the three (celestial, terrestrial, inferior) regions, the prosperous king of kings, the divine conquering king”—such is this world’s usual style as to its chief scourges!

This *illustrious* one in Sal. Sac. 1067, in the cycle year *Raktisacshi*, in the *Bhadra pada* month the dark close of a lunation, at the meritorious time of a solar eclipse, gave the secular *Brahmans*, accountants by trade, the *mirasi* rights of fourteen villages, including expenses for various temple images, at or near *Kondaveti* (or *Kondavir*). The great king *Rama* was associated with him in this gift; supposed to be the humbled king of *Deva giri*, now his father-in-law.

The aforesaid book (No. 32) states that *Ganapati raju* had no male issue ; but only a daughter named *Umaca*, whom he married to *Vira Bhadra raju*. He is stated to have ruled 68 years, and to have died Sal. Sac. 1180 (A. D. 1257-8) giving S. S. 1112 for his accession (*supra* S. S. 1109). His widow *Rudrama devi* exercised the regency ; and made over the kingdom to her daughter's son (grandson of *Ganapati*) whose name was *Pratapa Rudra*, when

he became sixteen years of age. This was a sanguinary star of portentous import, which set in darkness: and soon after the glory of *Warankal* passed away.

Before entering on details as to the renowned destroyer, as his name signifies, I have thought it well to take a retrospective glance at the contents of another book (No. 5); which, from an early period, comes down to him, and his proceedings at *Dharana kota*. The writer professes to have followed two books, one by *Jaina Saca Peddama*, and the other by *Jaya natha daiva bhatti*. To the former seems to belong the more ancient matters; and to the latter, who may have been a *Saiva*, the details concerning *Pratapa Rudra*. Both names are new to me; and what measure of credence may be due to one, or both, I cannot determine.

The first of the two writers goes far back to the times of *Paricshita*, and *Janamejaya* at *Hastinapuri*. He gives to *Vicramaditya* the usual two thousand years, and states that *Salivahana* killed him; and to *Salivahana* he reckons 15 years. After them *Bhoja raja*. He introduces a *Mukanti raja* or triple-eyed king, and a *Jana Bhojadu*; who may be the same with the *Yavana Bhoja* of other books. He gives to one *Sancatanicalu* 10 years, and states that their old race ruled 100 years. Afterwards *Anjirasa maha raja* ruled 250 years. He then ascribes loosely to the *Asvapatis*, *Gajapatis*, and *Narapatis*, one thousand years. To all this I attach very little importance. He then intimates the existence of a dynasty, which I take to be the one at *Warankal* from S. S. 840 to 1609 or 769 years; chiefly specifying *Pratapa Rudra*, known as *Mukanti raja*; stating that he was taken prisoner by another king. Afterwards an anarchy: and again the *Asvapatis*, *Gajapatis*, *Narapatis* are introduced: 18 *Asvapatis* ruled in the North (Delhi or *Kalburga*); *Gajapatis* ruled in the east; *Narapatis* to the south. Then 56 *Reddis* ruled, under the *Gajapatis*, in the midland country (site around *Amravati*). Of these *Reddis* there is better, and more distinct mention in another manuscript (No. 1).—The book by the other author *Jaya natha* gives 430,000 years to the *Cali yuga*; and makes a rapid passage by very early times, in which the names of *Paricshita*, *Vishnu-dharma*, *Bhoja raja*, and *Nilakontha* appear; the latter ruling 130 years, consequently legendary. The author's main point is to come at the time of *Pratapa Rudra*. He gives to his reign 88 years, as is done by other writers also. A name of *Siva* (in Sanscrit *Trinetra*) was given him; in the popular dialect *Mukanti raja* "triple-eyed king." This *Pratapa Rudra* took *Dharana Kota*, and came and lived there; it would seem that the conquered ruler was named *Somana raja*. *Pratapa Rudra* built *Dharana Kota* and dwelt in it; that is, as would appear from other books, he enlarged, or repaired, or wholly rebuilt a poor fortress; but still it was a fortification of earth. Either then, or when at *Warankal* he set out *incognito* on a pilgrimage to Benares. His

wife *Anjica devi* missing him, and not knowing where he was, made enquiries of the *Jainas*, in the neighbourhood of *Dharana kota*; who, by means of their books, told her the king was gone to Benares; and she then set out to follow him thither.* On this incident in this book, and in other concurring documents, is made to turn the series of events, issuing in the extermination of the *Jainas*; and a giving their lands, with unsparing profusion, to a Colony of *Brahmans* from Benares, settled at, and around *Sri Sailam*; to which *Brahmans*, *Pratapa Rudra*, through his wife's indiscretion, had been forced to make promises, not easy, in any other way, to be performed. The narrative is given at length, in this book (No. 5) and I have had it copied. It occurs also in another book (No. 40) somewhat more fully in details; and less vaguely worded as to the final fate of the *Jainas*. *Jaya Natha* minces the truth by an equivocation—the *Jainas* went away, or ceased to be; which is not the whole truth. As to the mere composition in book No. 40, the writer either had a confused head, or want of practice in narrative writing. It is sometimes difficult to know what he means, or how to reconcile his leaps, or *non sequiturs*. Still, with these faults, it is the fullest in detail, and the prosopopeia is well used. I here insert it in what is, intentionally at least, a faithful translation.

"The rule of *Pratapa Rudra* was eighty-eight years; but, for some twelve years previous to his death, as troubles came over the land, some people left the country and went away."

This *Pratapa Rudra* had three eyes wherefore he was called by the people *Mukanti raja*. He living in *Dharana kota*, and ruling all the country got together great wealth, and possessions. He went to *Casi* and bathed in the Ganges. He paid homage there to *Visvesvara*; (a form of *Siva*;) and afterwards, without doing injury to the interests of his country, returned, and again sat on his throne.

His wife *Anjica devi Ammal* did not know of his setting off to Benares. One day on awaking from sleep, seeing how the case was, she enquired how he went away; and, greatly desiring to see him, was disappointed in her wishes. The *Jainas* were a good people; they understood matters of past occurrence, and of future occurrence. As *Anjica devi Ammal* was prepossessed in their favor, she desired that the *Jainas* might be called. They told her the details of *Mukanti's* going away, and probable returning. On learning so much *Anjica devi* set out to follow her husband; and at a time when she was bathing, with great beneficence—making many gifts, it being then with her after the manner of women, the king was intently thinking of her, and determined that he must not leave *Anjica devi* behind him; at the same time if he did not go from her, evil would probably befall his kingdom. Whereupon he called various *Brahmans* from *Casi* to the bathing in the Ganges; and, on their coming, he told them

in detail all needful matters.* In consequence they examined into them; and as, in those days there was a zeal to spread the influence of the *Vēda sastras* they treated with the king, in the time of bathing, saying—"your country is ill regulated; but if you in this bathing time, will promise to invite us to your country, and will there make us comfortable, with all needful munitions, then we, on our parts, engage to bear all the cost and charges of the present bathing; and moreover to carry you and your Queen back again, free of all expenses to you, as we shall bear them." As that *Mukanti* acceded to those words, they both bathed in the *Ganges*; and that *Mukanti* left his word firmly bound in the bosom of the *Ganges*. The *Brahmans* responded by bathing also; by giving benedictions, and by making statements as to the authority of their *Vēdas*, and as to their own skill in explaining them. Moreover, according to engagement, they bore the entire expense of transit of both king and queen, after bathing, safe to their kingdom.

The king enquired of *Anjica dēvi* how she came to know concerning his affairs, and proceedings, which he had kept secret from her. She replied that the *Jainas* knew the *Sastras*; that she had enquired of them, and highly recommended them. The king considered that the *Brahmans* had been the good people who had blessed them, and assisted them in the bathing, and in the journey back. The queen insisted that the *Jainas* were more skilful than those *Brahmans*; "these" she said "are the true witnesses; they speak the truth; they also teach the *vēdam*: if they bless no evil can befall. Their word is certain as being a good word. The writings of the *Brahmans*, whom you speak of, are vain." As she thus spoke, on behalf of the *Jainas*, the king grew angry, and nourished a secret grudge against the *Jainas*. He thought within himself "let us summon them all to a public dispute;" and, with this end in view, he got possession of a venomous serpent and had it concealed in a vessel, termed *mandasa*. He brought this vessel into the midst of the hall of audience; and addressing both *Brahmans* and *Jainas* said—"whichsoever among you shall tell me what that vessel contains, he is the skilful man. But which side soever of you shall fail to tell what is within it, that side shall suffer entire destruction of their tribe: I will see to it. Between your two modes of credence, I wish, more or less, to know of reasons." As this *Mukanti* thus spoke, the whole of the *Jainas* present unanimously agreed in telling the king that the vessel contained a fierce serpent. The *Brahmans* present nourished mischief in their hearts; and, notwithstanding the steadiness of the *Jainas*, they conceived the idea of circumventing them, and of getting

* Which here seems to mean his pecuniary embarrassments to meet the extra requirements, consequent to the unexpected coming of his wife.

their race destroyed. Hence they declined to reply immediately, and said "we will tell to-morrow." Each one of the *Brahmans* then went to his house. Afterwards they reflected thus—"the *Jaina* books are true books; we cannot withstand them; the king is angry, and we must devise the means of killing them." With this view they called a magician (*mantra vāti*) and gave him food and clothes. He assented to their terms; and advised them, on the re-assembling of the Council to state publicly that the said vessel contained a pearl. "By my art I will so manage that it shall contain the said jewel; and I will cause you to conquer." The *Brahmans* assumed their vestments, brought the sorcerer with them; made their usual benedictions to the king, and became seated. The *Jainas* also came. On the king again asking "what does this vessel contain?" the *Jainas* replied—"we yesterday said that it contains a serpent." The *Brahmans* all of them, with many prefixed benedictions said, "in the vessel there is a pearl." On looking inside the king was surprised, and said "I put a serpent within, and the *Jainas* said it contained a serpent; but now by the power of these *Brahmanical* benedictions it is turned to a pearl. What able, and pious men these must be!" As the king was, in this way propitiated, the victory was with the *Brahmans*. The craft of the *Brahmans* by means of their *mantras*, became understood by the *Jainas*. The *Brahmans*, suggesting that the *Jainas* were liars, burnt all their books. The *Jainas*, consulting among themselves, said "Upon reading our books the *Brahmans* burnt them; how shall we be able again to look them in the face? the king's decree also remains; to-day we live, to-morrow we die, we shall all perish; we must leave our bodies at all events." Whereupon, in their despair, they met their adversaries; and, on doing so mingled malediction with prophecy: saying in substance—"except what you retain of ours (the *Amara Cosha*) may your *vēda sastras* and other books perish! Whosoever comes to live in our (*palli yam*) district wrongfully, in our stead, let such go without victory! Those concerned in this trickery, and the magician employed, let him, and they all become beggars, seeking alms, and the like befall every one of their posterity. And this king, the dupe of magic, seeing that he did not properly enquire into the trick, he shall leave this *Dharani kota* and go to another place, and by the hand of another king, let him be led captive! Such as are our relations and have deserted us, may they become outcasts for ever!" In this way they anathematized. [A line or two very obscure on the *Jainas* giving the *Amara* or other books, in order to aid the *Brahmans*—and it is added]—"The *Jainas* then as *Vishnu bhaktis* (of the *Vaishnava* credence) received their death" [mode not specified].

"After their death a famine befell in the country, around Benares. The *Brahmans* of that land consulted among themselves; saying—"If we go to the land of that *Mukanti* will he keep his vow?" and in order to try, they came in a body, and halted at a place called *Attukūr*. As the *Krishna* river was then

full to the extreme verge of its borders they asked—"who can take us over?" "If we stay on this side we perish with hunger, and if we fall in trying to pass the river we only fall, it comes to the same thing—to perish, and if we do so, it will prove to be a time of merit" (i. e. as to future birth). With this thought they entered the river in a body, wives, children and followers; but wherever they passed, the *Krishna* river (miraculously) proved to be only knee deep. In this way six thousand householders came, and presented themselves before the king. The *Mukanti* gave to all of them food, and garments.

"As this *Mukanti* left *Dharana kota* and entered into *Warankal* he was a *pratāpa sali* (illustrious person) whereupon he acquired the title of *Pratāpa Rudra*. His date is *Calī yuga* 3600; and in the following *Dundubhi* year he was taken prisoner by the Delhi Sultan; thus the curse of the aforesaid *Jainas* was fulfilled. Moreover any one that lives on the lands of the *Jainas* never conquers. This is the narrative of the *Jainas*, and of *Pratāpa Rudra*."

To return to Book No. 5. In that a similar account to the one above extracted is given; but with less detail, and without any leaning towards the side of the *Jainas*. It is followed by very lengthened particulars of *Pratāpa Rudra's* gifts of lands to the *Niyogi Brahmans*; to whose coming his pilgrimage to Benares had been accessory. It is almost fatiguing to the eye to look over the whole; remembering the massacre by which it was preceded. However this remark may be made; which is, that this scourge of the *Jainas* must give the lands to somebody, for his own protection from loss. It must be understood that such gifts are not in full tenure, as freehold; which, with very limited exceptions (termed *manyam*) is not the usual tenure of this country. The *Kaniyācshi* as it is termed in Tamil, or *nirdai* the now more common Arabic term, is the right to the soil, and all beneath or above it; but with the reserve of the royal revenue, which is derived only from what is above ground, whether corn or fruits. The ordinary rate with *Hindu rajas* was one fifth of the produce; but the Mahomedans, on an ill-adjusted system, raised the rate to one half. When therefore *Pratāpa Rudra* took from the *Jainas*, together with their life, the property of the soil, he consulted his own interest in making the soil over to other cultivators: otherwise he must have ruled, like a tiger, in a desert. He also gratified his predilections, and ultimately paid the penalty.

If so many as six thousand secular *Brahmans* or even half that number, being males, came from Benares, to *Sri Sailam*, there would still be not enough for all of them. But this presumed fact joints in with another one. About that time, or a little before it, *Adonda* the illegitimate son of *Kulōttunga Chola* of Tanjore, had cut out for himself a kingdom, by the conquest of the *Tonda*.

mandalam, from the *Jaina Curambar*; and as this was accomplished avowedly by the favor of *Siva*, *Adonda* felt as little compunction in disposing of the *Jainas* as *Ganapati*, or *Pratapa Rudra*. Besides those *Curamabers* were herdsmen; not cultivators; and people acquainted with irrigation, and cultivation were required. Hence it is on record, that *Adondā* brought in secular *Brahmans* from *Sri Sailam* and the *Tuluva* country on the Western coast; and from that time, down to the present, in matters of revenue detail, the *Niyogi Brahmans* have governed the country.

After the details of grants in Book No. 5, there is a brief notice of *Guntoor* and the *Chintapalli* Zemindary. The *Jainas* are therein stated to have come to that neighbourhood originally from *Oāsi*, or Benares. It is the only instance that I have observed of any distinct statement as to whence they came. Now, that before the establishment of *Siva*, by one *Divodhatta*, at Benares, there were many *Jainas* around that neighbourhood is highly probable. This notice also makes the *Yadava* king *Vishnu Verddhana* (of Mysore) to be the donor of many alms-houses to *Brahmans*, of course in that district. He was at first a *Jaina*; but by means of his wife, and the celebrated *Ramanūja* he became a *Vaishnava*. Moreover this book states that after the death of *Krishna raya* (of whom see *infra*) the *Gajapatis* returned, and recovered the country wrested from them, with the distinct mention of *Kondavēdi*, *Venni Konda*, *Bellam Konda*, and *Nagarazuni Konda*, a string of hill forts usually mentioned together; and forming the strongholds of that part of the country to which these researches apply. I doubt if *Amravati*, notwithstanding the name *Dharana Kota*, was ever much of a fortification.

When looking over some sixty manuscript books in the Mackenzie collection, bearing on this neighbourhood of the *Krishna* river, one large one, from the label on it, was found to relate to *Kondavir*. It appeared hopelessly damaged; on trial it was found to be so much destroyed, by *termites*, as to leave no coherent meaning. On referring to my printed analysis I found it mentioned as being then 1838-9 in the same wholly unavailable condition. This is possibly a loss. However book No. 1, section 1, is on the same locality; and, though less full than the destroyed book, yet copious in detail.

I have abstracted the earlier part; and translated an extract, near the close, relating to the conquest by *Krishna raya* which in its main fact is beyond doubt historical.

CONDAVIR.

ABSTRACT.

Very anciently it was a wilderness dwelt in by hermits (*rishis*). It contained shrines of *Brahma*, *Vishnu* and *Siva*. *Krishna* conquered the country then known *Vitharpa désa*. In the *Diwapara yuga* there was a temple sacred to *Gauri devi*. Various matters as to *Bhishma raju*, *Sisupala*, and *Rucmeni*, are detailed (legendary of course). In the time of *Salivahana* a single *basti* escaped (this word for temple, is used only by *Bauddhas* and *Jainas*). Subsequently the *Asvapatis*, *Narapatis*, and *Gajapatis*, ruled. A ruler named *Gajapati Visvambara* ruled twelve years; and constructed the fort of *Kondavir*. He had four sons 1—*Ganapati deva*. 2, *Bala Bhascara deva*. 3, *Narahati deva*. 4, *Visvambara deva*. In the S. S. (era of *Salivahana*) 1067 (A. D. 1144-5) *Ganapati raya*, then ruling made a gift* to *Niyogi Brahmans*. The *Reddis* are introduced. In S. S. 1147 (A. D. 1224-5) one *Dhant ala reddy* built *Daragi* fort, and dwelt there. (A transition is made to *Anuma Conda*, the original site of *Warankal*; as if the *Reddis* ruled over both in common S. S. 1240 (A. D. 1817-18). A *reddi*, while ploughing in the field, found a treasure, and was ordered by *Raghava Svami* their god to dwell there, and build him a temple: said to be done at *Anuma Conda* the image being of gold. (The building of *Daragi*, fort, though prior in date, is mentioned after the above). Gold seems to have been common: said to have been ignorantly given to *Vemana* a bazar man, for betel leaf. Four *Reddis*, as rulers, are mentioned. They conquered *Condapalli*, and other forts. *Paliya Vema Reddi garu* is distinguished. He entered on *Dharani* fort of the *Kakateyas* (of *Warankal*). He built 108 temples to *Siva*, his chosen deity. He repaired decayed forts, anciently held by *Gajapatis*, and built forts. His rule is dated S. S. 1242 to S. S. 1243 or 12 years. *Anavotaiya Reddi garu* succeeded, and governed eighty-four forts. In his time another marvel occurred. A shepherd, or cow keeper was accustomed to lead his flock, or herd to a hill, on which was an image or temple of *Botti mori Venkatesvara*. (The first two words look like an imitation of the sound of பத்திமொரி *Bauddhas*). A recluse was there doing penance. At his request the cowherd every day supplied him with a small quantity of milk. At length the recluse told him to dig around a bush indicated; and he would receive a return for his kindness. He dug up the bush, and dug down for a whole day, or more perhaps. The hermit told him to put the bush in the pit, and set fire to it. On this being done, the recluse endeavoured to cast the cowherd on the fire; but the latter, being the stronger, threw the other on it, who thus became a human sacrifice (always deemed needful, in this country, for getting out treasure). The next day the cowherd returned to the pit, and saw in it part of an image of gold. He dug down to the feet, and took it out. He is yet said to have been so ignorant of its value that he cut off distinct members (as-fingers, hands

* See Chapter 5, *supra*.

&c.) and exchanged them with a bazar man for betel leaf. The trader became rich; and the circumstance coming to the knowledge of *Anavottarya reddy* aforesaid, he banished the dealer on a charge of fraud, and himself took possession of the treasure. He bought many lands, and districts; and his rule is placed in S. S. 1254 to 1283 (A. D. 1332 to 1361) being 30 years. *Anavema reddy* succeeded. He gave gifts to *Amarésvara Svami*; and ruled 12 years from S. S. 1284 to S. S. 1295. *Cumari giri Vema reddy* ruled from 1296 to 1309 or 14 years. His son *Gomati Vema reddy* went to see *Vijayanagara*, where *Hari Hara Cumara deva maha raya* then ruled: very lengthy details of that visit are given. The said *Gomati* did marvels there, either of legerdemain, or magic. After his return he built a temple to *Malla giri maha devi*. He ruled 28 years from S. S. 1310 to 1337 (A. D. 1388-1415).—His brother *Racha Vema reddy* succeeded and ruled 4 years, from S. S. 1338 to 1341; and with him ended this ducal race of *Reddis*. A commemorative stanza on them, as a whole, is given (one of many such memorial verses current in the south).

It appears that the *Gajapati* ruler of Cuttack conquered* the country, as *Langulu Gajapati* is made to rule from S. S. 1342 to 1353 or 12 years; and he is said to have repaired the forts of Cuttack and *Udaya giri* (the latter S. of *Condavir*). He was conquered by the *Anagundi* ruler the *Narapati Prtapa deva rayalu*, who ruled 7 years; and after him *Hari vira rayalu*, ruled 17 years, from S. S. 1354 to 1376 for both (23 years).

Again the *Gajapatis* conquered the *Narapatis*, and ruled seven years, from S. S. 1377 to 1383. During that time *Sri vira Pratapa Purushottama Gajapati* took many places, including *Vizianagaram*; and *Nara Sinha deva rayalu* fled to *Vijayanagara*. An inscription commemorates the circumstance in *slócas*. Letters were engraved on a *jaya stambha* or pillar of victory. From S. S. 1384 to 1418 a period of 35 years, the same, or another *Purushottama Gajapati* prince ruled. His son (*sic*) *Pratapa Rudra Gajapati* was crowned in S. S. 1411 (A. D. 1488-9) and after him his son *Vira Bhadra Gajapati* ruled. (It is obvious that there is some confusion as to the Orissa and *Warankal* rulers.)

(Extract translated)

Sri Purushottama Gajapati. Afterwards his son *Pratapa Rudra Gajapati* being crowned, and when ruling the kingdom, set out with the four kinds of arms, and conquered some countries; commemorated in a *slóca*. And, having so conquered, he set up (*Jaya stambhas*) pillars of victory in S. S. 1419 (A. D. 1596-7). After he had ruled some years, his son *Vira Bhadra Gajapati*, being associated with him in the government, the lord of the *Narapati* throne *Krishna deva maha raya* being the (*rudra*) destroyer seated on the jewel throne at *Vijayanagara*, and governing his paternal kingdom (*pūrva rāshayam*) it so oc-

* See Chapter 6 *infra*.

curring that one day he saw a very beautiful woman of the *Vanniya sangam* (the *banyan* caste;) and, becoming enamoured, he spoke, in the hearing of his queen, about bringing the said woman to his Court; whereupon the queen remonstrated, asking him if there was any deficiency of women among the daughters of *Asvapatis*, and *Narapatis*, that he bragged so about bringing home a woman of the oil-monger's tribe. Incensed at this jibe, he left the place where he lived with the queen; and went to his own personal residence. Thither he caused his chief minister (here named) *Sasva Timma rayu garu* to be called; and expressed his intention of setting out upon a conquering expedition; beyond his paternal boundaries. After the consultation he gave corresponding orders. Having enquired as to the propitious, or favorable time, he made also suitable offerings to obtain success. That same night, while so employed, a speech was reported to him as oracular. An Arab in the town, after eating his supper, was lying down in the pandal (or booth) attached to his dwelling, and in a merry mood said—"what is *Kondavir*! *Condapalli* is ours, is it not? who will dare venture to say it is not? Until some one venture to dispute that point, I maintain that it is ours." This braggadocio pleased the king; who said—"it is a good word" (omen); and then issuing the requisite orders, to all concerned, for the march, he set out, and laid siege to *Udayagiri* fort; and took it. He also captured *Adanki Venna konda*, *Bellam konda*, *Naga rajuni konda*, *Tangedi ketta varam*, and other strong forts; the whole of them were taken by him. Thence he came to *Kondavidu*, in S. S. 1437 (A. D. 1514-5) and demanded an account of the revenue (equivalent to summoning the place). He took the (*sabha griha*) council house of *Vira Bhadra Gajapati*, the son of *Pratapa Rudra Gajapati*, and made the (*durga*) hill-fort his own. Subsequently he restored it, as an asylum, to *Vira Bhadra Gajapati*, as is commemorated by a *slôca*. He conquered countries, as far as *Sinhachala* (lion-hill). He went on as far as to Cuttack; and there, falling in love with one of the ladies, he married a daughter of the *Gajapati* ruler. In consequence from *Sinhachola* even to other countries were relinquished, by him, to the *Gajapatis*. Returning to *Kondavidu* he committed the government of that fortress, together with its dependent cities, to *Sasva Timmayyar's* son-in-law, and to *Natanda Comantri*; while he, the *Raya* himself returned to *Vijayanagaram*. The *Gajapati*, king's daughter, named *Rucha dévi* felt disposed to remain near the *stambha* or *Cambha* (doubtful); and the *Raya* directed her to do so; while he returned to *Vijayanagaram*. That daughter of the *Gajapati* *Rucha dévi* said that as *Krishna raya* was the son of a *dasi* (pagoda prostitute) and she herself of noble tribe, illustrious by her birth, she preferred to abide by the *Cambham*. Her father sent her thither large sums of money: she sold those jewels, and had a very large water reservoir excavated, near to *Cambham*; and she distributed very extensive charities."

(End of the translation.)

The Manuscript Book No. 35 contains copy of inscriptions recording grants made by the said *Krishna raya* when he visited the temple of *Amarésvara Svami*. He himself was a *Saiva*. The date is S. S. 1438 (A. D. 1515-6). This temple, it will be remembered was built by *Camuvars*; after the overthrow of the *Jainas* in that town by *Pratapa Rudra*; and must have been quite new when visited by *Krishna raya*.

It further appears, to resume from the Book No. 1, Sec. i, that viceroys held the government of *Kondavir* to the end of the reigns of *Krishna ray* and his successor *Achyuta raya*; and from one of them it came to be called *Gôpi nathapuram*. During the reign of *Sada Siva raya* his minister *Ran rayu* held all the real power; and he fell in battle with the Mahomedans; he dated S. S. 1483 (A. D. 1550-1). This place was still held on behalf of the *Pennaconda* kings (who retired thither from *Vijayanagaram*). At length the Moghuls, crossing the river *Krishna*, with all arms, conquered the fort of *Kondavir*, and the *Velnavar* who defended it. Under their rule it was called *Murti jan nagara*; and it was *circar* or principal, over fourteen districts, including *Guntoor*.

I have brought the account of this Fort so low downwards, because some interest attaches to it, as the chief fortress in the immediate neighbourhood of *Amravati*, whence these marbles were extracted.

There is a Telugu poem in the Mackenzie collection, entitled *Krishna Raya Vijayam*, founded on his expedition against the *Gajapatis*, as above stated. It is abstracted in my printed analysis.* It affords some additional particulars; especially one, that the *Gajapatis* were in league with the Mahomedans, and aided by them, (which is apparent on some of the sculptures of the marbles). It also gives some strategic details; but the reference may suffice. I have also looked over a Tamil poem, ascribed to *Ottacuttan*, in the same collection, entitled *Calingatu Parani*: the subject being *Kulôttunga Chola's* invasion of *Calinga* or *Telingana*. It dwells however only on poetical common places; and would seem to be written chiefly for Court minstrelsy; by some one wholly unacquainted with the localities of the *Calinga* country.

CHAPTER VI.—CONNECTED MATTERS REGARDING THE GAJAPATI KINGDOM OF CUTTACK, KNOWN AS UTCALA DESA, UDRIYA DESA, OR ORISSA.

In the Asiatic Researches, Vol. 15, Art. 5, there is an article by the late A. Sterling, Esq., which appeared to me, on perusal, to bear on the foregoing subject; and induces me now to abstract a little from the part which relates to chronology and history, with some little comment of my own; and also to

* Madras Journal of Lit. and Sci. Vol. 7, January 1838.

take out a few extracts: one of which distinctly mentions *Amravati*, as a dependency of the Cuttack kingdom.

In the opening of Part 2, Mr. Sterling states some Native traditions as to the names of *Narapati*, *Asvapati*, *Chatrapati* and *Gajapati*; traced up as officers or wardens of State in the court of *Janamejaya* of *Hastinapuri*. On this I deem it sufficient to adduce an aphorism which I was led to adopt several years since, when analysing the Mackenzie Manuscripts; which is—that whenever a fact is recorded the cause or origin of which is unknown, Natives uniformly invent a legend to account for it; which, in process of time gains currency, as the veritable cause or origin. Before I have done I hope to shew better cause for the origin of the term *Gajapati*, which is most closely connected with the present subject. As to *Asvapati* all conquerors to the north west of our locality—Assyrians, Turcomans, Tartars—have been “men riding upon horses;” and by means of their cavalry their conquests were so rapid and extensive. This term relates to the Persians, Affghans, and others; as in later times to Mahomedans. The *Narapati* is uniformly a title of the *Raya* at *Vijayanagaram* on the *Tungabhadra* (or *Toombodra*) river. The *Chatrapati*, as belonging to the Berar and other Mahrattas, is not connected with our subject. Future occasion may arise to explain the term *Ganapati*, and to notice the camel as a symbol for Arabs, used in these sculptures. This symbol was unknown to earlier ages. The chariot-elephant-horse-infantry, are the “four-arms” and *Chatrapati*, *Gajapati*, *Asvapati* and *Narapati*, are terms which seem to have a corresponding relation to those arms.

Mr. Sterling's main subject relates to the *Gajapati* monarchs of Orissa; otherwise known as *Ucala désa*, or *Udriya desam*. His authorities assume what he deems an authentic shape from about A. D. 473, the accession of the *Kesari vamsa*, or race of *Kesaris*. This is a term, I remark, found in very early inscriptions in the extreme south of the Peninsula, too old to be coherently legible; but in which the term *kon* for king, and *kesari*, as a family name, occur. Mr. Sterling is perhaps over cautious as to times preceding; and does not distinguish when the *Gajapati* dynasty begins: certainly not with the *Kesari vamsa*; and therefore likely to commence antecedently on the overthrow of a former race by the *Yavanas*; probably Bactrian Greeks; and possibly their succeeding dynasty was the origin of the *Gajapatis*. I shall be able, I think, to support this conclusion, by the evidence of Bactrian coins. The *Kesaris* came after those *Yavanas*, whoever they were.

Mr. Sterling gives the title of his book authorities; which, if never perfectly satisfactory, are yet better than mere verbal traditions. His list begins with *Paricshita* and *Janamejaya*; like all similar ones. Eight names follow with a fabulous space of 1636 years. It is only important to notice that in the reign of *Bajranath Deo* (*Vajranatha deva*) the *Yavanas* invaded the land

in great numbers, from *Babul desa*, meaning Persia and Cabul. At a later period the *Yavanas* invaded the country from Cashmir. The term is loose, like the Greek word “barbarian.” It is quite possible that they may have been Greeks; for the date, as far as traceable, agrees very well with the reigns of Menander and Euthydemus, the most distinguished conquerors in India.

After those eight Mr. Sterling's authorities bring in *Bhoja raja* B. C. 180—53 as antecedent to *Vicramaditya*. This is altogether an anachronism. To *Vicramaditya* is given only 135 years, instead of the two thousand, liberally conceded by other documents. *Salivahana* is made to come from *Pratishthanapura* in the Deccan (which, otherwise than a town in his route, I altogether doubt). One of the written authorities entitled merely *Vansavali* (a genealogy) states that—“with the assistance (or at the instigation) of the *Yavanas*, *Nri Nikos Salivahana Saca Hara* fought many battle with the *raja* (i. e. *Vicramaditya*) and deposed him from the throne of Delhi. From that period begins the æra called the *Sacabda*.”

Now of the above titles *Nri* is Sanscrit for prince; *Nikos* is obviously Greek* for victory. *Sali* is the word on which so much etymology has been wasted; *vahana* a vehicle (compare “carborne Cairbar”—in Ossian). *Saca* is properly Scythian, and *Hara* (destroyer) as a name of *Siva*. That *Salivahana* reigned, or ruled, any great length of time personally in the Deccan is irreconcilable with the uniform statements concerning his invasion, can be traced to death, when recrossing a river on his return. But here it is of importance to trace a connexion between *Salivahana* and the *Yavanas*. I suppose that they, under the shadow of his terrible name, long ruled in the Deccan, in various places.

After *Salivahana* there is always a chasm in all documents. In Mr. Sterling's *Raj Chavita*, the names of *Bato-kesari*, *Tribhuvana deva*, *Nirmala deva*, *Bhima deva*, *Sabhan deva*, bring the dates from A. D. 77-78, the era of *Salivahana*, down to A. D. 318, as the accession of *Sabhan deva*. In his reign the *Yavanas* (Bactrians as I presume) came by sea in great force, under *Rakta bahu* (blood-arm, an epithet merely) and took the town of *Puri*; the *raja* fleeing to the jungles, and dying there. Marvellous accompaniments are stated; but perhaps only another version of *Salivahana* and his army, perishing in water, by the dissolving of their pottery, or earthen vehicles. Though the *Yavanas* are made to be swallowed up by an inroad of the sea; yet some of them, at least survived; and ruled for 146 years, or down to *Sal. Sac.* 396.

These, I think, were the original *Gajapatis*; and the period agrees pretty well with the conjecture of the Bactrians, pushed from their own regions by *Huns*, or other Tartars, and seeking other lands; until, in process of time, they came as far south as Cuttack; which they probably knew their forefathers had

* This is *νικος* victory.

plundered. That the Bactrians were driven from the confines of the kingdom of *Seleucus* so early, according to the current opinion, as 125 B. C. is contrary to the evidence of coins; as remarked by M. Masson* their industrious collector. He produces coins of Bactrian kings "names unknown to history," down to a later period.

Mr. Sterling's doubts again intrude concerning the *Yavanas*. As to the marvel very well; but why as to the fact? All traditional accounts in India number the incursions of *Yavanas* among those of other barbarians. Greek historians record the conquests by Bactrian kings in India. Coins shew that they ruled therein. Why is every thing relating to the *Yavanas* thought to be doubtful? Is it not conceding too much? to those, who, without considering that sufficient investigation has not been made, have insisted that India possesses no civil history; in common prudence they ought to have added "none at least that we are aware of," which is quite another matter.

The *Kesari patyam* or *vamsam* began A. D. 473: how the *Yavanas* were got rid of not being stated; but they were probably driven into the desert to the south: the first feeble roots of the *Warankal* kingdom appearing soon after A. D. 500. The *Kesari* rule, with names and some events stated, comes down to A. D. 1006: and something later; when treachery brought on a foreign invasion from the south. *Chwang†* or *Chor Ganga* invaded Orissa, and conquered Cuttack Sal. Sac. 1054 or A. D. 1181; and the *Gangavansa* dynasty began. It is left open to enquiry whether this was a *Chola* king, or rather a king of *Warankal*, said to have conquered the *Udriya desa*, about that time. His name was *Ganapati* (See chap. 5); though he built a town near *Ganga puram*, and may hence have derived a title. I now quote an entire passage:

"His son *Gangeswara Deo* succeeded A. D. 1151. His dominions reached from the Ganges to the Godaveri. He had five kutuks, or royal metropolises, viz. *Jajpur*, *Chondwar*, *Amravati*, *Chattu* or *Chatna*, and *Biranassi*, the modern Cuttack. The account which places *Amravati*, a town near the *Krishna*, in the heart of the Deccan, amongst the capital cities of this *Raja*, is one of the commoner genealogies to which I attach no great degree of credit. It is not improbable, however, that the place may have formed part of a principality held by *Churang Deo*, when invited to ascend the throne of Orissa, which thereby became annexed, temporarily to the latter *Raj*; and claims, and political relations, arising out of the possession of it, may have been one cause of the frequent expeditions south of the *Godaveri*, and the interference in the affairs of *Telingana*, and the Carnatic, which we shall find to be henceforwards exercised by the *Ganga Vansa Rajas*."

* See Appendix.

† In a M. S. which I shall presently have occasion to quote the name is written in Telugu letter *Chudanga*. This might very well be a corruption of *Kulottunga Chor-aa* (or *Chola*) only Tamil M.S.S. which state that he conquered *Calinga desam*, do not say that he reigned, and founded a dynasty there.

"As a specimen of the morals of the Court of Orissa in this age it should be mentioned, that *Raja Gangeswara Deo* committed incest with his own daughter; to expiate which offence he dug a superb tank, by the advice of the *Brahmins*, called the *Konsala Ganj*, which is still pointed out between *Khura* and *Pipley*."

The latter paragraph is quoted simply because I am not certain that it may not be the circumstance alluded to, or recorded in Tablet No. 11 of the sculptures: and any passage illustrating those sculptures is not irrelevant though it may be disgusting. The mention of *Amravati* is interesting; and worthy, we may now deem, of credit. At this period the country around was under the *Warankal* rule, and that this was then one with the Orissa rule—is a fact of importance.

The most famous prince of this line was *Raja Ananga Bhima deva* who besides many other matters was a great benefactor to the temple of *Jaganatha*, which, in later ages exerted so wide, and so disastrous an influence. The commencement of that king's titles was *Vira Sri Gajapati*, either recently adopted, or resumed.

It is unimportant (in this place) to follow the other reigns down to A. D. 1451. A failure of offspring led to the adoption of a youth named *Kapila Santra*, who in A. D. 1451 assumed the government, under the title of *Kapila Indra deva*. He was active, and a conqueror; by hyperbole as far as to *Ramiseram*.

"The subjugation of a fort called *Kondajoi* or *Kondjuri*,* perhaps *Coudapilly*, and his proceedings there are much spoken of. He is said to have deposed one *Raja*, and set up another called *Narsinh Rai*. Amongst his conquests, places called *Maligunda* and *Malka* (Malanca) are likewise mentioned. The particulars of the *Raja's* wars and expeditions in that distant quarter are, however, so loosely and indistinctly narrated, that it is impossible to make any thing satisfactory out of the account. He died near *Coudapilly*, on the banks of the *Krishna*; after a busy, and distinguished reign of twenty-seven years."

Passing by some other matter, poetical in kind, this passage, lower down occurs—"Pursottem deo (*Purushottam deva*) died after a reign of twenty five years, and was succeeded by *Pertab Janamuni*, the son of *Padmavati* under the title of *Pertab Rudra deo*" (*Pratapa Rudra deva*.) A. D. 1503; the person being highly panegyrised, as a model of all kinds of excellence. The tale follows, with some verbal differences, as given above, in Chapter 5. There is therefore a confusion between the Cuttack and *Warankal* princes, like that noticed under the heading *Coudavir* at the close of Chapter 5. That *Saiva Brahmins* would highly panegyrise *Pratapa Rudra* is very probable. The reader has had the means of forming his own judgment. One of the latest

* No doubt some clerical error for *Kondavidu*, or *Kondavir*.

acts of *Pratapa Rudra*, before his being captured by the Mahomedans (according to a M.S. in the Mackenzie collection) was his making a foray of cattle on the Cuttack territory. He and the Cuttack *raja*, must, by consequence, have been distinct persons.

It is apparent that Mr. Sterling did not translate direct from *Udriya* M.S.S.; but had the meaning given to him, through the medium of the Hindustani language: his original notes published in the Journal of the Asiatic Society also intimate as much. Hence if he employed a *Saiva Brahman*, as his medium, he was liable to be deceived.

The Manuscript Book No. 60, in the Mackenzie collection, contains two sections translated from the *Udriya* into Telugu. The first section is entirely occupied by details of the temple at *Juggernaut*. The other section, beginning with like details, goes on to state the *Kesari vamsa* and *Ganga vamsa*. From the latter I translate an extract, which shews that the incident, adverted to, occurred (much earlier than Mr. Sterling places it) under the fourth of the *Ganga* line who was named *Matana maha deva*.

Translated extract from the Manuscript Book No. 60 Sec. 2 entitled "an ancient record in the *Woodiah* character, translated into Telugu."

The *Kesari vamsam* is first given, and next the *Ganga vamsam*. The following extract is from the beginning of the last one. "*Chudanga deva maha rajah*, and *Gokerna Isvara deva retas*, having been born from the body of *Ganga devi*, they received the name of *Ganga vamsa*. This king gave many cows* as a sacrifice to *Betala devi*. Coming from the south to the town of Cuttack, with an army, the *Kesari raja* who was then in Cuttack left it, and fled." *Chudanga raja* having come to Cuttack, and finding the *Kesari* king gone went after him. He demanded from him the white umbrella and the image known as the *Kanaka Durga devi*, or golden *Durga*; but the other one cast the image into a hole in the *Nandikesavara khandan*, a river so called, and left the white umbrella behind. Whereupon this *Chudanga raja*, taking up the white umbrella, returned to *Cattaca desa*. On coming the *mantris*, and other officers, seeing the emblem of royalty, determined on making a new golden *Durga* (*Svarna Durga*;) and as ancient *rajas* had acted towards *Jaganatha svami* so they did in imitation; by giving a measurement (local use not understood here) of land in the *Kanda giri*, to that god. He (*Chudanga*) ruled 66 years 2 months and 10 days."

[His son was *Pratapa Deva maha raja*: various gifts by him omitted.

* The word *pasu* is literally translated. However this word is loosely used, and sometimes for other cattle. Moreover *pasu* and sometimes with the addition of *pilla* is used for a school boy. As *Betala devi* means an evil goddess, or she-demon, it is just possible that the above sacrifice may have been in *Khand* or *Goomsoor* fashion; to wit, human sacrifice of young men.

His son *Yega Jatta Cambala deva*; gifts by him passed by.]

His son was *Matana maha deva raja*. He built a fort at Cuttack. Legend of finding a *linga*, and terming it *Bhanikesara linga*.

TRANSLATION.

"In the days of this king (the following incidents occurred). There is hilly country in the district of *Paranga*, know by the name of *Hari-hara*, as one hill in particular was called *Hari-hara goda*. In this hill were eighty-four caves or holes in which *Bauddhas* were living. By the power of abstract devotion, they acquired the gift of foretelling future things. Going thence into the low country they told the common people things present, and future. Hence the people began to act with respect, and kindness towards them. In consequence a great number of *Bauddhas* came thither. One day when the king and queen were seated, and conversing together, the queen said to him "these *Bauddhas* are *Sarva gnanis* (endowed with all knowledge) they know all sorts of matters." The king hearing this remark said—"What! they are vile people; they worship women, and are *pashandis* (painted hypocrites) what can they know? honor must not be put upon them. The *Brahmans* are the excellent people: the word of a *Brahman* is trustworthy." On his so saying the queen suggested to make a trial, which of the two classes was the most clever, or skilful. Upon this suggestion the king sent for a serpent from the wilderness; and putting it into a vessel tying the mouth; the king and queen both saw it. One day the king called the people together and said "The *Bhatta misras* are indeed *Brahmans*:" then assembling both *Bauddhas* and *Brahmans* and addressing first of all, the *Bauddhas*, he asked "whatsoever there may be in this vessel tell me what it is?" The *Bauddhas* replied "there is a serpent inside." Then the Queen from behind a screen laughed to herself. The King, for the moment, felt humiliated; but calling the *Brahmans* he asked them "what is there in this vessel?" they knowing the *Bauddhas* had told the truth, said, in a rage, it contains *hasmam* (calcined powder;) the King then opening the vessel; and looking in, saw that the serpent, by magic illusion, had been turned into powder (more probably burnt to ashes); the King then said to the Queen "do you see the might, and skill of the *Brahmans*?" He caused the heads of some *Bauddhas* to be cut off, and had the heads of others broken (or bruised) between stones. The rest of the *Bauddhas* then said to the King "we spoke the truth, as the case really was; and though the *Brahmans* by their *crddhi* (wrath) have turned the serpent into ashes, yet there is no fault resting upon us. Now, since you unjustly have had some of us decapitated, others bruised between stones, that mouth of yours shall rot, and breed worms:" saying they condescended to arise; and went back again to the aforesaid hill, and again dwelt in the desert.

By that curse the King's mouth became diseased. Whereupon the King

suffered great disgrace; and, in consequence, he gave gifts according to the *therma sastras*, and used medicines. Yet the noisome disease did not leave him. One day the King saw, in a dream, a *Brahman* coming to him and saying "if you give to *Jaganâtha svami* gifts of land your trouble will be effectually removed." The following day, according to the instructions received in his dream, he resolved to give one hundred *patis*, each with a drop of water, and each drop falling on his diseased mouth. When the water was dropping he said, "I have given a thousand *patis*."*

[A detail then follows of the different places and lands which he gave; and it appears that the disease was cured. He ruled afterwards some years: no date given.]

The aforesaid translation illustrates a passage in Mr. Sterling's paper which is worth quoting in connexion with the present subject.—As. Res. Vol. 15 quarto pp. 311-12.

"About five miles west of Bhubaneser near the village of *Jagmara*, in the *Char Sudhi Khandaiti* of Khurda, and still within the limits of the *khetr*, a group of small hills occur, four in number, from one hundred and fifty to two hundred feet in height, which present many objects of interest and curiosity. These hills called severally the *Udaya Giri*, *Dawal Giri*, *Nil Giri* and *Khand Giri*, (by which latter name the spot is now generally designated) are composed of a silicious sand-stone of various colour and texture; and are all curiously perforated with small caves, disposed in two or three irregular stories. Each of the caves is large enough to contain from one to two human beings, in a sitting posture. Some of them appear to be natural cavities, slightly improved by the hand of man; others have obviously been excavated altogether artificially; and the whole are grotesquely carved, and embellished.

"The summit of the highest rock, is crowned by a neat stone temple of modern construction, sacred to the worship of *Parasnath*; all around, and in the neighbourhood of which, are strewed a quantity of images of the *Nirvanas*, or naked figures worshipped by the *Jain* sect, executed chiefly in the grey chlorite slate rock. At the back of these temples a highly remarkable terrace is shewn, called the *Deo Sabha*, or assembly of the gods, which is covered with numberless antique-looking stone pillars, or temples in miniature, some standing, others lying on the ground, about two or three feet long, having, on each of the four sides, a figure of the naked *Jain* deity rudely sculptured. The place is still frequented by the *Jain* or *Parwar* merchants of Cuttack, who assemble here in numbers, once every year, to hold a festival of their religion."

* Mr. Sterling calls the above King by the name of *Anang Bhim deo*, and ascribes his public works to another cause, as an expiation for the sin of having killed a *Brahman*. Mr. Sterling spells the above word† *batti*, each *batti* containing 20 *bigas*. (The *biga* is presumed to be the same as cawny; that is something more than an acre.)
† As. Res. 4to. Vol. 15, pp. 269-70.

A short distance up the *Udaya giri*, one of the hills, are the remains of an excavated palace, and still higher up "on the overhanging brow of a large cavern" is "an ancient inscription cut out of the sandstone rock," of which Mr. Sterling states he had obtained an "exact fac-simile." At a glance I saw that it was any thing but exact. It is now known as the *Khand giri* inscription; and since Mr. Sterling's day, has been more fully and carefully transcribed,* as I learned after I first saw the result of the united labour of Colonel Mackenzie, and Mr. S. in 1820. Mr. S. notices its coincidence of character with that on the Delhi pillar; adverts to a resemblance to Greek letters; and mentions inscriptions in like letters on the column at Allahabad, on the *lath* of *Bhima Sena* at *Saxun*, a part of the Elephanta, and part of the Ellora inscriptions, and at *Salsette*. I add the caves at *Carli* near Poonah; the letters on these *Amravati* marbles; and an inscription at *Haburenni* in Ceylon. The copper plate characters said to have been decyphered by Mr. Wathen of Bom-bay, are of kindred origin; but differ in details. There are variations in writing, or engraving this letter as may be seen, Journal Asiatic Society of Bengal, vol. 6, p. 460, from brief inscriptions cut in the *Sanchi* tope, near Bhilsa: which, the cuttings, without hesitation, I pronounce to be records of the decay of the individuals named. Even these *Amravati* tablets shew difference of form; the later ones (as supposed) running into a tendency to imitate the flourishes of the *Hala Kannada*. The character, in its purest form, is simple, chaste, and beautiful. This however is a subject which, only briefly adverted to here, merits a fuller consideration elsewhere, or hereafter.

CHAPTER VII.—SUPPLEMENTARY DESCRIPTION OF SCULPTURES ON THE MARBLES BROUGHT FROM MASULIPATAM, AND RECENTLY DEPOSITED IN THE CENTRAL MUSEUM.

It may be well to preface this part of the subject by an extract from the Journal of the late Dr. Benza, dated Masulipatam, January 16th 1835, as contained in Vol. 5, Art. 9 of the Madras Journal of Literature and Science.

"In the middle of the Pettah, at the spot where the two principal streets cross each other, are placed erect and arranged in circular form, thirty-three large slabs of a compact limestone covered with numerous figures in *basso* and *alto relievo*, of the most exquisite execution; excelling any in the few places I have visited in India, containing such relics of the remotest antiquity, the seven Pagodas not excepted. The Sculptures at Masulipatam, being cut in compact limestone, of a very fine texture are susceptible of receiving a delicacy, a kind of mellowness in the execution of figures and friezes, which it is impossible to impart to the coarse-grained pegmatitic rock of the seven Pagodas. There is such anatomical correctness in the figures, and so much nature and

* See Journal Asiatic Society of Bengal, Vol. 6, Art. 7, p. 1090.
† Journal Asiatic Society of Bengal, Vol. 5, p. 556.

freedom in their positions and attitudes, that Gaggino* himself would have been proud of acknowledging them as his work.

"These sculptured slabs were brought from the ruins of a pagoda seven miles from Masulipatam; and, by what I remarked in one of them, they must have belonged to a more ancient building, than the pagoda whence they were brought to Masulipatam. One of the largest slabs (more than four feet high) had one of the two surfaces, *convex*, the other, *plane*. On the *convex* one, were multitudes of figures, which covered its whole space, representing processions, sacrifices (?) of animals, and other religious ceremonies, said to be those of the *Jain* tribe. On the back surface was sculptured a reversed column, the pedestal turned upwards, and the capital downwards; showing that the two faces of the stone had been sculptured and used at two different periods, and for two different buildings.†

"Among the sculptures at Masulipatam there was a piece, apparently part of the entablature of an architrave, which was really in a very refined style; there were figures of lions, tigers, rhinoceroses, buffaloes and men, executed with so much taste and so exquisitely correct, as to call forth the admiration of all who saw it. (No. 116?)

"This, and many others of the sculptures, attracted the Right Honorable the Governor's attention; who, on the spot, gave orders for their transmission to a safer, cleaner, and more conspicuous place.

"The limestone of these slabs is stratified, and has great similarity to that used for lithographic purposes (No. 1)—colour yellowish gray—fracture splintery and dull, occasionally glimmering—semi-transparent at the edges; in short, it resembles magnesian, or some species of the alpine limestone. I was told that it is quarried on the banks of the *Kistna River*, near *Chindapilly*."‡

DESCRIPTION RESUMED.—No. 91, A RHOMBOIDAL BLOCK 3 × 2 feet. It has two *chakras* or suns above. A flowered plinth, and two lions in chase beneath.

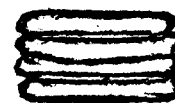
* The celebrated Sicilian Sculptor in *basso* and *alto* *relievo*.
† "It is common to find sculptures on both sides of a slab, either as a frieze, architrave, inscription, or other ornaments, in Greece. I discovered in the ruins of ancient Samos in Cephalonia (one of the provinces tributary once to Ulysses) opposite to Ithaca two sepulchres; the one having on the external surface of the cover the following inscription in ancient Greek: *Dionisia Vale*, and, descending into the sarcophagus, I saw, on the under surface of the same slab, some very old Greek letters, the remains of an inscription, which I could not decypher.

"On the cover of the second tomb, externally, there was no sculpture nor inscription of any kind; but on turning it was seen, in very rude, and apparently very ancient Greek characters, the following inscription: *Philostrate Attale Vale*. In the island of Corfu (Phæacia, olim,) at the summit of *Capo Bianca* (olim *Leucimne*) I found a tombstone with the following inscription: *Fulcennia Fausta, Annorum XX Vale*, Plate 17, fig. 3.) On the reverse of this slab there were arabesques, lines, &c., indicating that that side had been probably employed as an ornament in a more ancient building, before it was used as a tombstone." Dr. B. has turned the reading into latin. On fig. 2 there is *Philokrattale Xaire*.
‡ In this Memoir spelt *Chintapalli*.

No. 92. A CORNICE 6 by 1½ feet.—It contains ornamental work defaced. On a small plinth are lions chasing various other kinds of beasts.

An inscription imperfect, but *Yachama pati*, a chief and his building a *matam* or monastery called *rayana matam*, can be made out. This cornice, or beam probably was inside the said building.

No. 93. A CORNICE 4 feet by 10 inches.—It represents a *Jinendra* seated on a four-folded throne: a circle of glory around his head: standing attendants are fanning him. The figures are time worn. The sculpture was once good.



No. 94. OBLONG CUBICAL BLOCK 2 by 1 by 1½ foot.—On one square end the figure of a squat fat dwarf, as a caryatide—the upper side rounded off, two sides square mortice holes for means of suspension; carving on the under side intended to be seen from beneath, or overhead. A small dagobah in the centre, two *bo*-trees over it. In both corners a *bo*-tree one to each. An elephant on each side, with branch of a *bo*-tree in its trunk, as an offering. There is one long line of inscription in small letters.

No. 95. A SLAB 5 by 2 feet; not thick.—A dagobah rudely cut, or perhaps left unfinished, with a serpent in the doorway, the sign of one of the *tirthakaras* (sometimes an emblem for a fatal disease; but otherwise here). There is an appearance like two large letters (*kāli*); beyond, the stone is chipped off.

In all probability this was a monumental slab, not finished.

No. 96. A FRACTURED SLAB 5 by 3 feet.

Coarse sculpture and time worn. On the lower compartment a large *bo*-tree on a pedestal; five female attendants bearing vessels with offerings. Above these a plinth, and over that a royal couch: upon this is a sort of pedestal supporting a *chakra*, or sun. There are six male figures in various attitudes. This seems to be similar in object to the last one.

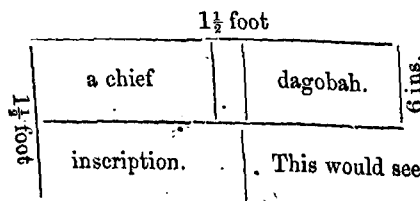
No. 97. SMALL FRAGMENT.—A seven-headed serpent, raised on its own coils.

Franklyn in his work considers "the *Jeynes*" to be ophites, or snake worshippers. The figure is probably the emblem of *Paravanditha*, the 23d *tirthakara*.

No. 98. A BLOCK 1½ by 1 foot by 3 inches.

A dagobah with an ascetic in the entry, two standing figures—coarse sculpture. This was probably a tomb-stone.

No. 99. A slab cut in this form:



A small dagobah with attendants, on the left side a chief seated with attendants behind, two *chakras*, under his feet. An inscription, part cut off.

No. 100. A long slab 5 1/2 by 1 1/2 feet: fractured at the lower end; three heads and one female bust holding a tambour remain.

The customary lotos circle, with a circular border. The usual fish monster, out of its mouth proceed two festoons of flowers; two large side-flower supporters.

Above the circle—two cavaliers mounted—three swordsmen lead on an attack—beneath their feet a figure prone on the earth as if dead; one bowman behind the centre horse, on the left side a large elephant with its driver, and another person behind, holding the driver's arm, as if to check any advance. A fortified wall, and on it within a sort of gallery are six soldiers, two of them holding long swords. In a small compartment on the right hand top (place of honor) is a king or chief, seated in a careless sort of attitude, queen behind him. On the other side are two female figures in a suppliant attitude on the left hand top side, a recumbent male figure with a serpent before him, implying danger.

Above is a semi-circular lotos of the usual pattern, with a flower wreath issuing from the mouth of a fish monster.

At the top of the whole an inscription in two lines.

The last word shows that a conquest is commemorated.

The import of the sculpture I take to be that the attack on a fortified place is by order of the chief or king, on the top right hand: and the chief whose fort is assaulted is the prostrate one, on the left, powerless, and exposed to imminent danger of life; the suppliants may be his mother and wife.

No. 101. Slab 4 by 3 feet.

Foot soldiers, a horse, and the bearer of an umbrella are issuing out from a gateway. It appears to commemorate the return of an embassy from the Mahomedans, or their retiring by capitulation.

There are some letters beneath, but so much time worn that their recovery is doubtful.

Though much worn I yet take the two last words to be *pura layam*, loss of a town, name going before.

No. 102. A slab 5 by 3 feet.

A dagobah, ordinary kind of work, in the doorway a five-headed serpent, raised on its own coils. Over the dagobah a very great number of small umbrellas, in token of honor to divinity. This, in all probability, was a monumental slab; fixed into the wall of the great temple at Amravati.

No. 103. Slab 5 by 4 feet.

The foot has space left plain, as if intended for other carving, or for letters.

A very highly ornamented dagobah, of uncommonly delicate, and beautiful work. Doorway medallions, with ascetics seated, and attendants. Figures of animals. Among other workmen bearing the cable or snake (of frequent notice) on their shoulders; here it would seem as an offering.

The great quantity of small and delicate work baffles any minute description. There are other sculptures of equal merit, but for delicacy and beauty this is the jewel of the collection. It may be the piece specified by Dr. Benza; though his description is not sufficiently discriminative. The patience, and labor required for this work must have been great; the skill not surpassed by any work in any time, or part of the world.

I do not know what to term it, supposing it to be too beautiful for a monumental affix, or tablet. There are counterparts in Nos. 19, 20, 22, 102, 116, 128, though not equal to this in workmanship; but so many like pieces would argue a common subject, perhaps to commemorate departed chiefs, civil or sacerdotal.

No. 104. A slab 5 by 3 feet.—Three compartments *left-hand* an elephant with attendants around. The elephant is being fed by one man, while a dwarf bears more food in a salver. This indicates tribute paid to a *Gajapati* chief.

Centre. A bullock bandy, almost of the present fashion with bamboo mats. Above this are two children with attendants leading them. It would seem as if they were hostages; and about to be sent away in the said cart.

Right-hand ascetics or hierophants of the *Jaina* class, heads shorn, but fully clothed.

The expression of the entire piece is very serious, approaching to the mournful.

No. 105. Cornice slab 5 by 1 foot.—This is much timeworn, so as to injure the finish; but the outline shews that the piece was once of very superior (Grecian?) workmanship: three compartments; *left-hand*—a king seated with many attendants. *Centre*—an elephant kneels head to the ground, before the standing and dignified figure of an ascetic, fully clothed, with circle of glory around his head; his manner implying authority. A young woman is being carried, seemingly against her will, by attendants, as if to be presented to this ascetic, or else to be put upon the elephant: which however has neither seat

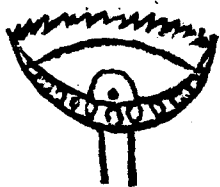
nor driver. Very many attendants. Another elephant is forcing its way angrily through a door on the right hand; *right-hand* compartment, an anti-chamber with two attendants there, and a warden, or door porter.

It seems to me not unlikely that the ascetic represents an Ambassador from *Krishna Raya* to the humbled Orissa King, and the daughter of the latter given over to *Krishna Raya*, on her part, reluctantly. The angry elephant represents a branch of the *Gajapati* power: there were three connected branches.

A very long line of inscription at the foot, in very small letters, was not accessible, from its position, till after the above was written. The first half of the line was found to be defaced and quite illegible, the remaining half imperfect; but useful in giving some new letters. They are of the latest type, with some imitation of *Hala kannada* and synchronise perfectly well, with the above interpretation.

No. 106. A slab 2 by 2 feet by 3 inches.

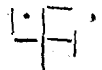
An ornamented *chakra*, or sun, carved over with flowers, on an ornamented support, and a large opening flower supported on the sides—the flower is in this fashion. I imagine that this is some device, or emblem to commemorate some young female of quality, coming to maturity, or perhaps her marriage.



No. 107. Block 2 by 1½ by 1½ foot: rhomboidal 4 inches thick.—This, on the contrary, is a mournful subject. From a glance at one or two only of these additional marbles I thought Dr. Benza had made a *grave* mistake; but as I studied this one and read the brief inscription, I felt convinced that as to this, and some other pieces, he was right.

Two very large feet of *Buddha*, are coarsely carved, each foot having the *chakra* of *Vishnu* in its centre. It has the mark of *Suparsva* on the heels, and other marks, thus



on each toe is the mark of the 7th *Tirthakara*  and on each great



toe  which is little other than the *Vaishnava namam*. Coarse flower work issues from the mouth of an urn. Beneath a person (poorly carved) dwarf like, seated with a sedate hopeless expression of countenance, holding a *cobra*, one hand at the

tail, the other a little way further on; while the reptile is erect, and prepared to dart at his breast. Hence the emblem clearly indicates a powerful, and fatal disease. The other emblems are those of life, and death.

On a narrow plinth, left hand below are letters *lata mapanu layam*, loss (decease) of the *Lata* grazier.

In the translation of the *Mahawanso* I see the *Chola Carnata*, and *Lada* kingdoms connected. *Lata* (or *lada*) appears to occur frequently as an epithet in these inscriptions. If a native be asked concerning any unknown inscription it is a common reply to say it is *lada bashu*. The second word is used in Tamil for a shepherd; but its Telugu meaning is rather one who causes others to graze cattle. The other word is of constant use in all obituary inscriptions; particularly those in the *Buddhist* temple at *Sanchee* near *Bhilsa* in Bengal.

No. 108. After some search this was found to be the reverse of No. 106, its face leaning downwards on No. 94. No. 108 is the counterpart of No. 107 as to the two feet and the marks on them; but wanting the figures of man, and serpent, and without any inscription. It is therefore very probable that the same slab was made to commemorate a propitious, and mournful event, as to the same female, without any clue to name, age, or circumstances.

No. 109. A FRACTURED SLAB 4 by 2 feet.—A large circle raised 3 inches from it: within this circle figures are sculptured in *alto relievo*. The principal figure is a man of athletic make, and fine proportions, holding a bow from which he has just discharged an arrow; the effect of which he watches (as if an idea from the *Apollo Belvidere*). The attitude is very graceful. There is a small throne, or seat near his right knee, with something like a fish, and also a serpent on it, indicating disease, or treachery. Eight females of quality in various attitudes, all of his family; they also observe the effect of the shot arrow. A man kneels and worships the archer. Four inferior females are prostrate under his feet: they seem to pertain to enemies. An ornamented flower border. Some special exploit in archery appears to be commemorated.

No. 110. A SLAB 3 by 1 foot, very irregularly fractured.—A stout figure with a cheerful countenance bears a highly ornamented truss of straw, or a cable of frequent occurrence (see chap. 2, 3), and on one side it issues from the mouth of a sea monster. Two side figures seated; of one the head is partly fractured off, in the other one wholly so. In a like case I thought the fish mouth might typify a river: the same may be the meaning here, *Macara*, or a sea monster is the distinguished sign of the 9th *tirthakara* named *Pushpa danta*, but I do not see the applicability of such a sign in these cases.

No. 111. A Slab 4 by 2 feet by 3 inches.

On the lower beading animals.

A dagobah with seven umbrellas over it. Two standing, and two seated attendants, hands reverentially joined.

A flowered plinth.

Above three lions coursing, bad work.

At the top three *chakras* or suns, with the usual supports; fractured at the top.

The whole, on this slab, is coarse work: time worn; it was probably a tombstone.

No. 112. A Slab 4 by 3 feet by 3 inches

A dagobah, and two men standing as if side supporters, holding each one a flower. Above three lions coursing, bad work. A flowered plinth. Three *chakras* or suns at the top. Probably a tombstone.

Heretofore I noticed the "trefoil" with some degree of embarrassment, the recurrence on No. 107 and on this No. induces me to think it the *Vaishnava* mark (*nama*) or trident ornamented. In European heraldry there is the cross *pati* and *fleur*; and so I think the simple trident is here ornamented



So ornamented it has frequently been met with.

The *nama*



is plain.

No. 113. A SLAB $2\frac{1}{2}$ by 2 feet by 4 inches.

A small dagobah with umbrellas over it. Two seated figures, hands reverentially joined—two above (aerial) bearing presents. Coarse cornice work. The whole coarse, and timeworn. Probably a tombstone.

I may anticipate an objection—"in a country where it is usual to burn the dead, what need of tombstones?" I may reply 1st that these sculptures evince customs different from those of Hindus of the present day.

2nd. That in the case of strict ascetics it is still the custom to bury; and as these slabs seem to have been placed in a sacred edifice they may have covered the remains of hierophants of the dagobah, or of other strict ascetics. Nos. 107.108 would be exceptions, coming under the 1st reply.

No. 114. A SLAB 4 by 4 feet by 2 inches. A circle raised three inches above the slab surface. This circle is convex and contains very neat lotos-flower work, of a type described in chap. 2,3. There is a counterpart circle, flat; but as this rests on the floor, its type is not known; supposed however to be of like pattern. Guided by a nearly similar diagram of the *Kaula* system, I understand this circle to denote what we term Creation; but which, on the *Jaina* system, indicates the spontaneous developement of the goddess NATURE.

No. 115. A FRACTURED SLAB 3 by 2 feet.

The chief device is a throne-seat, above it a pillar with globe upon it (the earth?) a shattered fillet. The fragment of a large *chakra* or sun. One male figure seated, hands reverentially joined to the sun; female behind, hands worshipping. The sculpture is coarse, and timeworn.

Below a horse's head, bad sculpture, and a chariot wheel.

On a plinth a line of inscription—not perfect; and copied with difficulty as timeworn.

The last word is *jayam*, victory.

The acquired victory by three persons, or over three things; the beginning defective. Being a conquest tablet the above device may be a throne to last while the *sun* and *moon* endure: the usual style of Indian grants.

No. 116. A COARSE AND ROUGH SLAB 4 by 2 ft. not finished at the foot—Above it is a dagobah, the counterpart to No. 103, but not quite so beautifully finished: still if that one were wanting this would appear a *chef d'œuvre*. There are great many sculptured figures, and several of them in the doorway. One man kneeling has hair looking like a wig. Another has hands placed over the head in extreme reverence. A throne-seat with some device, like a lamp, upon it. The height of this slab, from base to top, is about 5 feet.

As to figures of animals there are lions seated on haunches, a buffalo, a man riding on it, an elephant, a man riding on a lion: various minute work, very good and second only to No. 103. Such work could not have been meant to be placed high. These slabs must have been intended to be fixed on the walls of a sacred edifice, level to the eye; in the way in which monumental slabs are fixed in cathedrals, or other churches among ourselves.

No. 117. SLAB 3 by 1 foot by 3 inches.—On the base a lion, chasing a horse and a pig.

The principal figure is a man on a circular seat, back to the spectator, the outline very good. There are three other figures, but defaced. The principal one seems as if giving directions with the right hand held out, the other hand posed on knee, so as to imply self consequence. This work was not intended to be seen close. The outline and chiselling are fully equal to the Centaurs and Lapithæ of the Parthenon; and I mention this because the sculpture has about the same degree of finish. It is rather coarse; but the outline perfect.

No. 118. A VERY LARGE SLAB $5\frac{1}{2}$ by 4 feet.

A basement imitating stone work.

A central male figure clothed, and standing in a devotional attitude, the palms of hands joined, fingers pointing upwards, the chin resting on their tips. On one side a male supporter, a female behind. On the other side two female figures, one of them holding a fan: an umbrella staff passes behind both, the

umbrella is over the head of the principal figure, implying royal dignity. There is a line of inscription on a plinth.

From this it appears that the monumental slab commemorates the decease of one *Chana Yatama* (sometimes spelt *Yachama*) of a *Chola* town, who it would seem had been liberal in donations. Above the plinth is a carving of animals, and a man seated, with the basis of a throne; but broken off by fracture. The slab must have been very large when whole; at the base it is six inches thick.

No. 119. A SLAB 3 by 4 feet by 5 inches, at the foot 3 by 2 feet left blank, as if for an inscription.

Above this a dagobah like that in No. 103 but fractured off, only $1\frac{1}{2}$ by $1\frac{1}{2}$ foot remaining. The entrance to the doorway differs from 103. A small throne is supported by two sitting, and two standing figures—a pillar rises from the throne with a figure of the sun at top. It is not very unlike one of the Freemason's emblems. There is other work, like that in 103. Objects similar.

No. 120 A SLAB 3 by 4 feet by 6 inches. A narrow space left rough at the foot.

Various animals of small size coursing. Above this narrow plinth a dagobah rises. A semi-circle of lotos work is at the base of the doorway, and over it a five-headed serpent, raised on its own coils. Higher up is an ornamented gallery with a dome, some pillars in front, and a little other ornament; the remainder plain, perhaps unfinished: as other similar domes are covered with figures. This is fine workmanship, like that of 103 and 116, and among the latest of the sculptures. Object similar, whatever that may have been.

No. 121. A SLAB 4 by $1\frac{1}{2}$ foot by 3 inches. About 9 inches left rough at the base.

The lower portion of a dagobah; but broken off, at less than one foot high.

The device in the doorway resembles No. 103 in the style of workmanship, but the device is peculiar. It represents two females of rank, with two very young children, standing on a platform, which is borne up by three kneeling figures. Side supporters females, with a mournful expression of countenance—two dwarfs with platters as in others. This sculpture is very good, in the outline; but it is much worn either by time, or by exposure. It looks older than others. It may commemorate the death of children.

No. 122. This and No. 125 harmonize in character, and differ from almost every thing else in the collection. They also appear to be among the most recent of the sculptures.

This No. is a slab 5 by $3\frac{1}{2}$ by 6 inches.

At the basement 10 inches breadth left rough, unfinished—6 inches plain smooth, as if meant to hold an inscription. Above are four compartments.

On the right hand lower compartment is a *bo*-tree, with a female, having one hand raised up so as to touch it, the other posed *a-kimbo*; large rolls on her ancles. A male figure is near; his back turned to the spectator; four male figures bring an offering, looking like a quantity of cloths in folds. A tripod below for a seat, and as if intending to designate a sort of Pythoness. On the left hand a *bo*-tree planted in a square box; a man so seated that his legs are within side the said box. Women bring him offerings, resembling the other cloth, but less in quantity; they make the present very respectfully. Two female figures are behind, one of them holding an umbrella, small in size. Over head the lattice work of a gallery. Above it a chief carelessly seated, a woman, an inferior wife, on a seat lower down, with large rolls on her legs. Two female attendants behind. On the right hand of the chief four men are seated, and two others beneath; each of these six men holds up two fingers, appearing to be giving counsel, which the principal figure listens to with great carelessness, and a knowing smile on his countenance.

In the right upper compartment over a gallery is a Queen, reclining on a couch, hands over her head; three females, seated beneath, support the couch. Two women are seated above the couch, their hands reverentially joined.

The subject may be hieroglyphical (in the manner of the *Ajunta* cave paintings). It would seem as if there had been a royal quarrel. The Queen is shewn from the secrecy of her inner apartment, as if wishing for her lord; and so as in no wise to comport with western ideas of delicacy. He is seated on the left hand affecting indifference while listening to counsel, and below seem to be embassies from the King to a Pythoness, and from the Queen to the man near the *bo*-tree; both parties expecting by presents to propitiate a power that might effect a reconciliation. There is no inscription to aid the interpretation. The sculpture is very good; the marble light colored. The subject yields a striking contrast to the sepulchral subjects by which it is surrounded; and is very well adapted for Ackerman's "loose prints." *Pudet mihi.*

No. 123. A SLAB $3\frac{1}{2}$ by 3 feet by 9 inches.

A fractured basement imitating stone building. Upon it is a principal male figure, head gone, the right arm stretched upwards in an attitude of command; left hand placed on the breast. A suppliant male figure on his right side. On the left side two female figures seemingly the wives of the centre figure: large rolls round their ancles; which in these sculptures seem to indicate rank or wealth. Large ear drops (usual in most of the figures). Bodies naked above the waist, (also usual). The leg, and hoof of a horse are visible behind the second female figure; all above it being broken off. In consequence of the fracture the general design cannot be known. The outline is good, and the slab looks older than some others.

No. 124. A CIRCULAR SLAB 3 feet diameter, 3 inches thick.—The usual lotos-flower circle of delicate workmanship. A border of leaves and flowers around it. See remark on a former No.

The circle and semi-circle frequently occur; and observing in one; or more than one instance a sort of sacredness attaching, I suppose the design to be more than merely ornamental, as I had at first supposed.

No. 125. A CIRCLE ALSO ABOUT 3 feet diameter raised on a rough convex block, on the down side, which either, in that rough state, fitted into a wall, or else was left unfinished. There was once squared sides with angles; but these angles have been broken off. Some letters were on one corner; these* remain *tacháchara* part of two lines, I think they contained the sculptor's name, as *tacha* means *mason*.

This circle contains very beautiful work. The expression of figures, and countenances, and general style corresponding with No. 122; only this work is smaller, and the whole like a very large medallion.

Two male figures are seated, very much at their ease, in native style, on a couch; which I find, in various cases, means a throne. The saucy, careless expression of countenance, as in the chieftain No. 122, sits on the face of both here. Behind them are many female attendants, with chowris, fans of now unusual shape; one woman fully clothed (a great rarity) holding something like a coruncopia, and looking like a foreigner, in the midst of partially clothed natives. By the side of each chief, on a stool, is seated a Queen. Below one of them is another, a second-rate Queen. In a partition to the left are a male and female figures coquetting: and one female stands behind. Beneath there is a great variety of figures. One appears as if begging a present from the secondary Queen. Others are seated back to the spectator. The outline of the profile faces of females not usual; two have the Grecian outline; others have aquiline, and very long noses. One blows a shell; and others seem to be foreign singers.

It is difficult to form any notion of this piece, other than that of a court in a time of relaxation; listening to some foreign performance. The two principal figures are, in native term *bhagyavantudus* "fortunate men," to wit sensualists.

No. 126. A 3 FEET DIAMETER LOTOS-circle somewhat similar to No. 124.

This one however is raised like the last No. on a convex block. The lotos-flower work is in bolder relief than No. 124, the centre navel is rough, and unfinished; as is known by comparison with like pieces.

The angles of squares for fitting into some other work, in this also, are broken; but one remains by the side of the fracture bearing these letters.*

* The original characters cannot be printed.

Apart from this inscription I should not have supposed that such tablets as these were monumental. The usual word *layam*, loss, decease, however shews such to be the case. I am not so certain of the other words; as to be sure that they contain two proper names, but I think so; and that the tablet designates a deceased married woman. In this case the lotos-flower emblem, so frequent in occurrence, receives a sufficient solution. *Padmavati* (lotos-nymph) is a *Jaina* goddess. *Padmavati* may be applied by metaphor to any woman; and the lotos flower in bud, by consequence, as an emblem designates a very young woman, and when fully blown a matron, or married woman. *V. supra*.

No. 127. A SLAB 4 by 4 feet by 10 inches fractured at the top.—Below a basement of 1½ foot is left rough, unfinished—on it a row of small animals injured. A dagobah (similar to those in Nos. 103, 116, &c.,) thence rises, and is almost equal to those two in workmanship. At the threshold of the door a semi-circle of lotos-flower work. Above it a medallion, on which is carved a *jinendra* seated in the midst of worshipping attendants. Another medallion above; on it a horse without a rider, trampling on the heads of people. A man holds an umbrella over the horse, an emblem of the Mahomedan power: there are seven or eight attendants. Above is a devotee seated, people bringing presents to him, and two prostrate worshippers. A row of pillars. On the side two dwarfs, four lions, various people bringing offerings. Among them is the rope* and *chakra* borne on men's shoulders. Above are two feet of *Buddha* on a square, on each side of the dome with *chakras* marked on them. Various other small and delicate work, with a variety of figures. On comparison I see that this and No. 103 are quite alike, duplicates the one of the other; and only that is in better preservation, and finish: here the top of the dagobah is gone. This also is larger in size, and the figures somewhat larger.

No. 128. A SLAB 4 by 4 feet by 1 foot—at the basement a space of 2 feet off, left rough, or unfinished.

Above it a dagobah either much worn or else injured. The outline is the same, as in the last and similar monumental slabs; but the filling in of the sculpture (evidently by the same artist or artists) is very different in the conception, and purport. As side supporters, at the doorway, are figures seemingly of feminine proportions, but chipped off, and defaced. In the doorway a platform with people, and a *chakra* to represent the sun. Outside are seated lions, as usual; and there are also men bearing the cable and *chakras* in processions. About one fourth from the top of the dome is a sort of festoon of

* I have at length ascertained by a comparison of various specimens, that there was a custom of lodging emblems of the sun, and other figures, on these tissues of cloth, or straw, and carrying them round in processions on men's shoulders. In one case, two images of almost naked females are added to the *chakras*; and these processions being sculptured on the dome of temples shew that they were religious in kind.

urns, or vessels of the shape, which when occurring alone of large size, and holding flowers, designate the mothers of families. Here they are small, and do not contain any thing—hence the emblems of women in general. In the very small and beautiful work, like that of the last No. sports of men and women are represented. In one a man is hindered from proceeding by a bannage held before him, by two women, while one kneeling on the floor holds him by the leg—a sort of play as supposed. In another, a man, with a smirking countenance, holds a partially-clothed woman on his lap. Should preceding numbers be monumental and serious, one might suppose this to be a voluntary, by artists of another religion, intentionally ridiculing the serious work they had been employed to do. It is difficult to bring such sculptures as this under any category of religion; even though the *Jainas* should “worship women.” If my conjecture as to the *motive* is incorrect, I know not what other one to form.

No. 129. A SLAB 4 by 4 feet by 6 inches.—This is fractured below and above. On the basement are the heads of serpents. A line of seven devotees, seated, the right hands held up, in the attitude of benediction. Above, the sculpture is of large outline, to be placed high up on a wall. A horse is held by a man at its head. A chief leans against its side, his right hand placed on his breast, as if making an affirmation, the left arm posed a *kimbo*. Two females, his wives, are on his left hand; one of them lays her hand on his arm near the shoulder. Both females have prominent breasts, and large ear drops, with large rolls around the legs. A heavy-looking dwarf kneels while adjusting the leg roll of the favorite wife. At outrage on the persons of these two females (similar to No. 18) has been inflicted: the difference of color shewing the work to be recent; and in harmony with the vicious impertinence of this country. The sculptures have faults enough of their own; but must not be blamed for this bad taste.

This piece looks old; the outline is bold, and good.

GENERAL REMARKS.

In very early life (when about fourteen or fifteen years old) I carefully studied the proportions of the human figure, founded on Grecian models, as a part of the art of drawing: and my eye became accustomed to them. I have met with those proportions in many of the figures, in these sculptures; and in no other Indian sculpture beside. The next best are the fresco paintings in the caves of Adjunta.

I have now attended to most of the points of enquiry indicated by Minutes of Consultation in the Public Department of 11th December 1855, para. 3, before given, in the introductory chapter. The era to which these sculptures belong has been illustrated in part; but this is a point which now claims further notice.

It has appeared that there are sculptures which may be safely dated as posterior to *Krishna raya's*, conquest of *Kondavidu*, and Cuttack, in S.S. 1437-38—A.D. 1514-15. These tablets are neither the most ancient, nor the most modern. The letters, on tablets of this medium class indicate a transition state from a simpler, and chaster form, to one more florid and ornamental, imitating the Hala Kannada letter of that period. As regards tablets anterior in time, there is some difficulty in determining what is attributable to age, and what to exposure. If the whole had been always kept under cover, then some must be determined to be ancient; but if these were exposed, while others were protected, the mere appearance becomes deceptive. Only one tablet appears to bear a date, and the power of the two letters employed is not known. In general where the sculpture is good, and the letters simple, they may be allowed to be anterior to the aforesaid conquest, by more or less than a hundred years. When the sculpture is coarse, and with the appearance of being timeworn, these may be placed higher up, at various periods before or after A.D. 1000. There is another approximating process. The death of *Buddha* is fixed by Ceylon annals at 543 B.C. It must take up some few hundred years for that system to become extensively spread. At the commencement of the era of *Salivahana* A.D. 78, it had probably become widely prevalent. Again, time must be allowed for a dissentient system to obtain a spread and influence; and for this, perhaps, another five hundred years may be allowed. There is nothing to show that the *Amravati* principality was earlier in date and power, than the rise of the power at Warankal; and that seems not to have been distinguished earlier than about A.D. 800. I do not think that any of these marbles can be rated much higher than that date; and thence, partly as sepulchral tablets, and partly as conquest tablets, they came down to the mediævan period of *Krishna rayer*. Some tablets are posterior to that time. Nos. 103, 116, 122, 124, 125, 126, 127, 128, 129, I think are decidedly so; and as these, with others, give indications of being broken off, without being completed as to design and finish of workmanship, they may pertain to the troublous times that succeeded.

As general features it appears to me that the sculptures up to No. 90 are the oldest, and those from 91 to 129 later: but in both cases there are exceptions. A few of the ruder sculptures, among the later numbers, are coeval with any of those in the earlier numbers, and a few of these last are not very old.

As regards notices of them in Oriental works, I have given so much of that kind as is to be met with in publications by Orientalists; except one by Colonel Mackenzie, which is made up for, by a native document. Every thing available in the Mackenzie collection of papers, tending to illustrate the site the history, by connected circumstances, the manners, and the fate of the unfortunate people to whom these marbles refer, has been extracted and translated.

ed; at no inconsiderable extent of time, and labour. It must thereby be seen that notices of the marbles in the native languages cannot appear: because such would not be written by persons of a hostile creed; and because all *Jaina* books are stated to have been destroyed, when the people were massacred; with the one exception of the *Amaracosa*, a lexicon of Sanscrit, still in popular use. The Tamil *Nigandu*, a lexicon, is another exception; and at Madura the *naladiyar*, an ethic composition, was spared, when other *Bauddha* books were publicly burnt. If any *Jaina* records exist they must be sought for among the temples, hierophants, and remnant of that people, still found at *Chitambur* and other places, at some distance around Conjeveram.

A visit to such temples might possibly tend to illustrate any thing still dark, as to the religious bearing of any of these slabs; all that is historical is sufficiently plain.

CHAPTER VIII.—ON THE CHARACTERS OF INSCRIPTIONS, AND ON THEIR CONNEXIONS WITH BACTRIAM COINS.

This character was perfectly new to me; only that when I saw No. 74 first in order I recognised it as very similar to the *lath* characters on the pillar near Delhi, and on next looking at a slab, then in verandah of the Museum, the idea of the *Guru muc'hi*, or sacred alphabet of the Seiks (to which it has some resemblance) occurred to me. I also read the word *pati* (chief) at sight, and afterwards found that I was not mistaken. Doctor Balfour kindly shewed me the versions of *Bakhti Sali Pandit* the mere sight of which caused doubt; to wit, whether so much pains had been taken to transmit merely vague, jejune expressions of a sort of piety. I took following measures, needless to detail, which fully convinced me that my doubts were well founded: anterior to any attempt at decyphering myself. The Government had not committed this part of the subject to me; except only so far as the date, or period of the sculptures might be involved; because possibly of this pseudo-version* into Telugu, which had been turned into English, and attested by the official Translator.

Though not distinctly referred to me, yet the matter interested me. The Honorable Mr. Elliot kindly gave me a few hints and references; which, as I followed them out, only led me to discover other like mistakes, or impositions; not in place here to detail. With the aid of a book founded on Fry's *Pantographia* I made a somewhat extensive range of enquiry as to ancient alphabets,

* I will only mention in brief that I found the *Pandit's* painted copies incorrect, vowel marks being omitted. The fragment on No. 32 is Englished "the omnipresent lord of beings;" the Telugu version, being *annita nindi yunde bhutanayaca-daina*—which means "who filleth all things, the element-lord" a name being required to complete the meaning. The original is imperfect at the beginning. After a disconnected compound letter follows: *Yajama dota jaya pataka* "the warlike *Yajama's* conquest tablet: *ex uno disce omnia*."

and an old edition of the *Encyclopædia Britannica* was of some service. Mr. James Prinsep's first ideas on the Delhi pillar, in pointing out vowel inflexions appended to the consonants were an aid so far; but I could not for some time get at his subsequent decypherings; and when I did so, I found them of no use; save that, in a few characters, I was at one with him. The Abyssinian alphabet was of service; and I regret my not knowing wherein it varies from the ancient letter, or Nubian type, which latter appears to have influenced the very old Greek, and other most ancient letters. The most important step of early progress was my discovering the Telugu verbal termination *ayenu*. I thereby knew that the language was not Sanscrit* and by another process I found it was not *Magadha* or *Pali* as I had at one time supposed. Thereupon I founded a comparison of letters with the modern Canarese and Telugu alphabets, and in this way made out a few letters. Others were found from a slip of paper incidentally recovered, written by me some years since, and containing the manuscript form of Chaldee letters, as distinguished from the printed square Chaldee. This last discovery at once brought me to the key word, by which Mr. Prinsep proceeded to his solution of the Delhi type, as explained by that very talented, and now lamented gentleman in the June No. for 1837, Vol. 6, *Journal Asiatic Society of Bengal*. With partial agreement the difference† is material. But I differ from my quondam patron with extreme respect to his memory; and not without regret that it is so, because I cannot help it; for if the key given by him would have opened the *Amravati* inscriptions I should have gratefully used it. I have given indications in chapters 2, 3 and 7, sufficient I trust to shew that I am on the right track, if not quite *au fait*. I have been content with a simple meaning, if I might find it. The notion of altering, or amending, when a character is imperfectly known, has appeared to me mistaken. In old inscriptions we want simply the value of each character, and the meaning as a whole; even though it should prove to be mere *gramyamu*, or local provincial dialect.

Though afraid of verbosity, yet I may be permitted to state that I have never settled the value of any letter without a reason, and adequate authority. There may be one important exception, in which I have been guided by analogies of the Chaldee, the Arabic, and the *Pali* alphabets of Java. The *aleph* or *alif* (the *Pali ha*) is commonly regarded as the vowel *a*; but it is not so, being a mild aspirated consonant, corresponding with the first letter of all the above

* As the word *pati* only might have indicated *v. supra*.

† e.g.: Plate 27 of that Volume, No. 5, the inscription being on the wall of a sacred edifice. Mr. P. read "*Dhama-galikasa mata danam* the gift of the mother of (?) *Dharmagarika*" and I read *Rama garu hanu mata layam* (to commemorate) the loss (i. e. death) "of the mother of *Rama* a head man." Mr. Prinsep wrote p. 460 "it immediately occurred that they must record either obituary notices, or more probably the offerings, or presents of votaries."

alphabets. In a few letters I agree with other decyphers, but only when the sense has led to the conclusion; the coincidence being afterwards perceived.

In consequence of my enquiries concerning the characters on the pillars at Delhi, Allahabad, and other places, I was led to look at engravings of Bactrian, and other coins, as published in the Journal of the Asiatic Society of Bengal; but this was only incidentally, and while journeying, or halting by the way. When reading Art. 6, for June 1835, Vol. 4, wherein the late J. Prinsep, Esq., had adopted* the opinions of Col. Tod, and Mr. Masson that the letters on the above coins, other than Greek, were Pehlevi, I could not but feel dissatisfied with the results of that gentleman's conjectures; for such only they appeared to me. Closing the book under that impression, and having but a confused recollection of plates in Vol. 3, not then with me, I was induced mentally to lay down an inferential argument to this effect. "if on again consulting Vol. 3, it shall appear that coins bearing letters of the *lath* type, or those on the *Amravati* marbles, shall be found to have been mingled together when first discovered, then this will be an indication of some kind of intercourse between Bactria and India, *via* the Panjab: but if it further should happen that the same individual coins bear legends both in Greek and in the *Amravati* letter then this will be a proof of Bactrian rule, over India, inasmuch as it will show that the coins were intended for two classes of subjects, Bactrian and Indian." The first part of the proposition was all that I expected to prove. The said reading, and reflexion founded on it, was in my conveyance, in the morning; and after breakfast where I halted for a few hours, during the heat of the day, I again took up the book (Vol. 4) to look at the alleged *Pehlevi*, without the inconvenience occasioned by the motion of a conveyance. In doing so the book opened of itself at p. 366 with plate 26 opposite. The book is my own; but had only been taken up that morning, after a lapse of years; and this plate had not met my eye by the way. The first coin on the left hand bore on the obverse an elephant's head with an uncial Greek legend *Basileos Sôtêrou Menandr*; on the reverse a pillar of victory, two monograms, and a legend in which I recognised the *Amravati* letters, and read *raja yati*, with following letters not clearly formed, but not unlike *raja pâlaca*; which (if so) would translate the Greek, the name excepted; the following five letters very imperfect, and to express *Menandrou*, five syllabic letters would be required, as in Telugu. Two other coins had the Greek legend imperfect, and, on the obverse as before *raja yati*—and other letters not completely formed. Five coins of *Apollodotos* had the Greek more or less perfect; and, on the obverse, characters of the Indian type; in two of which I read *natha* lord. A coin of *Antil-*

* Contrary to a less hypothetical opinion given by him at an earlier time. "Greek legends of" the King of Kings, &c., "are visible on some, and what he (Col. Tod) supposes to be Pehlevi characters on the reverse; but I incline to think these characters of the Delhi type, &c."—Journal Asiatic Society Bengal, Vol. 2, 1833. p. 307

Antil has a Greek legend, worn, and partly illegible, with Indian letters beginning *raja* the other not clear. The coin bore the letters $\Lambda \Sigma$ but I think the old Latin A a mistake in lithographing. Another coin has the like device, but this is *gaja* an elephant, only the Greek *sigma*, is used, and would be pronounced *gasa* in the lisping Telugu mode. Another coin of Lysius was seen to have "*Basileos aniketou Lysiou*, and on the obverse an elephant in full figure, with the word *gasa* underneath. Here the sigma is so formed as to shew that this was the prototype of the letter which is uniformly *ja* in *Pali* and *Amravati* letters: as, for example in the frequent word—*jayam*, victory.

On the whole I felt surprised, and drew these inferences that the word *gaja* and figure of an elephant, as an emblem of power and of a dynasty, originated with the Bactrian Greeks; as also their recorded custom of taking or paying tribute in elephants* would seem to confirm; *pati* for lord would be added, and *Gajapati* or elephant-lord regularly formed. The state of the case seemed also to confirm my second above-mentioned inference; to wit, that Bactrian Kings held sovereignty over some parts of India; and, as it would seem much later in date than *Menander*. I was not then, and am not now satisfied with the lithographing of the coins: of course they must be worn, and partially defaced (like some of our inscriptions) but could I see them, a better judgment might be formed.

I may observe that *rajati raja* is the elegant Sanscrit reading for "King of kings:" but the reading being *raja yati raja* confirms my view that the letters are Indian; for this is the common, and popular mode of writing. While engaged in these researches, and looking over books in the ordinary Telugu, I have met with this precise mode of writing; that is *raja yati raja*, and nothing is more common in the popular Telugu than the constant use of *ya*, when, in polished language, the vowel *a* is proper.

Having reverted to Vol. 3, Journal Asiatic Society of Bengal I find that the earliest discovery in the tope at *Manikyala* gives a corrupted Greek letter, and Sanscrit letters of the Thibetian form. In the principal deposit was a cylinder on which letters were punctured or engraved, differing from the *lath* characters as manuscript differs from print, or careful sculpture. A brass cylinder was also found at Jelalabad with the like kind of engraving. In both I read letters, and entire words. Such as *gaja*, *pura*, *jala*, *maha*, *pracha*, *pit'ha*. As the cylinders are not definitely Bactrian, I do not enlarge; but is it too much to suppose that these were sepulchral urns, containing some remains of descendants of Greeks, who had become naturalized in India. I read the said letters and words on the same principle, as I read the letters on the *Amravati* sculptures.

* Vide Appendix.

In plates 8 to 13, in the former portion of Vol. 3, a variety of coins are copied. But the legends, as I apprehend, not very accurately. However with Greek on the obverse, there are *Amravati* letters on the reverse. These are coins of *Menander*, *Agathocles*, *Ausius* and *Ermaios*. The like remark applies to coins in plate 2, Vol. 5, especially those of *Menander*. I need not be minute; for what has gone before, if accurate, is sufficient.

Quitting the coins for a while I observe in Vol. 6 of the same Journal, Plate 33 a line of an old inscription at *Buddha Gaya* not quite perfect, but seemingly *Jhata tahaja gota layam*.* The decease of Gota recorded. In plate 9 an inscription from a cave at *Ajunta* in the Berar country extremely imperfect, but in which these same characters appear such as *ta*, *ma*, *ha*, *ga*, and *nu*. In plate 28, letters are given from a nearly obliterated inscription, on a rock near *Kapurdigarhi*, Peshawar, the two first letters of which read *gaya*, the others not clear, but the four first letters are of this type. My object is merely to note a sort of steps of ascent, from *Amravati*, N. W. to *Carli*, near Poonah, thence to *Ajunta*, thence to the Punjab, Peshawar and Bactria; and N. by *Kandghiri*, *Buddha Gaya*, Allahabad, and various places near or around, up to the Manikyala tope, Peshawar, and Bactria. These are vestigia left by the footsteps of time; and they do not need the keenness of a North American Indian to trace them with some considerable degree of certainty.

The question now arises whether conjectures as to Pehlevi† (without any known type of Pehlevi to correspond) are to stand good? If so my remarks on this point are good for nothing; but if my readings, as far as they go, are good, then they tend to establish the fact of a connexion between Bactrian kings, and the *Gajapatis* of India; they show some sort of relation between Greeks and *Bauddhas*, or *Jainas*, and so far harmonize with the evidence of the *Amravati* sculptures. Though it does not necessarily follow, that the artists of Grecian descent should be *Jainas* themselves in religion, yet as the *Jainas* alone have possessed sculptures, Grecian in type, and all other Hindu sculpture is very different, and inferior, it is a fair inference that the *Jainas* were somehow more closely identified with the Greeks, than any other section of the Hindu people. Poetic mythology, and *herolatria* apart, the religions of the Greeks and *Jainas* were fitted to harmonize. The recognition of deity in *Physis* or *Natura*, or the five elements deified, and operating in the forma-

* I do not know what language, perhaps Bengali, but it sounds like Hindostani *jata t'ha Hadji Gota layam* "the loss of the departed pilgrim *Gotha*."

† This passage, and what goes before on the coins were written before the preface by Mr. Prinsep to vol. 5. Journal Asiatic Society met my eye; in which (p. x) the Editor cautions his readers against implicitly adopting his version of the Bactro-Pehlevi character. M. Jacquet had come forward with a version founded on the Syriac, and the Editor adds—"we cannot doubt its superiority to our crude attempt." M. Jacquet's must necessarily be equally crude. Had he adopted a Chaldee basis there is much in the letters to aid it.

tion of the universe, almost to the ignoring of any independent, active, self existing mind, is a feature of the Grecian philosophy, and religion of the *Jainas*. In deifying men both agree; only the Greeks (like the *Vaishnavas*) beatify warriors; the *Jainas* beatify *monachs*, like modern Rome. In so far as the *Jainas* worshipped the nine planets, the Greeks would harmonize very well with them, and all other Hindus on that point; seeing that the poetic mythology of Greece is most of it obviously traceable to that source. If the *Jainas* were, in any sense, ophites or serpent worshippers, the Greeks would harmonize again; since it appears that the Minerva of Athens, the palladium of the acropolis (the *grama devata* as it would be expressed in India) was nothing more originally than the carved figure of a serpent: such as are common under trees, on the banks of water reservoirs, around us here at Madras, to the present day.

The Greeks would seem to have descendants still in India, known as *Lebbis* or *Jonacas*; who though Mussulman use the strictly vernacular languages. The terms *Jonaca* and *Yavana* are from a common derivation, as *Yavana* is derivable from *Ionia*; and the *Ionians*, the oldest of the Greeks, evinced by their name, their connexion with the farther east, and their having been on one side of an early, and great schism, which has left ramifications down to our day; and in which *Bauddhas* and *Jainas* bore their part. The *Saivas* hold to the opposite side; and they were the adversaries; and, in various instances, the exterminators of the *Jainas*.

It may not be amiss, before closing, to glance at the question as to the relative antiquity of the Brahmanical and *Bauddha* systems. It seems to have been raised by Colonel Mackenzie, and was discussed among others by Colebrooke, with his customary clearness. As observed by him it is a question of locality. Here in the south where Brahmanism is comparatively modern, all historical traces go to show that the *Bauddhas* in the *Pandiyam* kingdom, and the *Jainas* in *Maharashtra* and *Telingana* preceded the advent of the Brahmins. Colonel Mackenzie, under the old idea, that India is one homogeneous country, made that position general, for all India, which should have been special, for only a part of it. The division of the *Pancha Gauda*, and *Pancha Dravida*, the former for upper Hindostan, the latter for the Peninsula, south of the *Vindhya* range of mountains, though ecclesiastical in intent, applies historically. The first Brahman who crossed the *Vindhya* mountains is commemorated in the *Scanda puranam*, by the name of *Agastya*; and he is still regarded by Brahminical Hindus as the apostle of the south. Yet the *Bauddhas* from Ceylon were at Madura, and the *Jainas* from Benares were in the *Calinga* country, and probably in the *Tandamandalam* before him. But as to the far north, historical evidence is equally clear that *Buddha* separated from Hinduism, and formed a modified system; the main point of which was the rejection of cruental sacrifices; but with many

other matters acute and metaphysical, derived from schools of philosophy, and beyond the ken of Hinduism in the earlier day. With a view to this question I gave a careful perusal to an Essay on *Bauddhism* by Mr. Hodgson of Nipal; and just in the same way that I see, as to the *Vira Saiva* system, that it must have been a modification only of the older *Saiva* system, even so it is clear to me, from the deification of the five elements, and the recognition of *Adi Buddha*, for *Para Brahm*, that the system of *Buddha* was posterior to Brahmanism, and founded on it; though the modification was carried to a great extent. I also read over attentively an article on the *Bauddhism* of Burmah by the Rev. A. Judson, many years ago my early friend. Though perceiving it to be such as hierophants there might offer; yet I conceive it not to be so entirely a system of homolatriy as therein stated. Both *Buddhas* and *Jainas* have gone very far in this worship; but still they both recognise an original first cause; more or less connected with the female, or negative, or material cause of the universe. All the systems that I have met with recognise the necessary existence, and eternity of matter—the *quasi* of the Greeks. Our marbles alone prove all this as regards the *Jainas*. Another question has been whether the *Jainas* are wholly distinct from the *Bauddhas*, independent, anterior; as asserted by some of the hierophants in Mysore. Again our marbles prove the contrary, we have the sacred feet of *Buddha*, the sacred tree of *Buddha*, with the mark of *Vishnu* on the said feet, and another mark which is certainly a symbol of the supreme divinity; while on the same piece is the distinguishing mark (very often repeated) of a *tirthakara*, or deified mortal. There is homolatriy; but there is also the seeming recognition of supreme deity. I deem these marbles conclusive as to the original oneness of the two systems. But there are other reasons. Mr. Hodgson of Nipal expressed an opinion gathered from books, and conversation, that the *Jainas* were early heretics from the *Bauddhist* system. I was led to form the same idea, some years ago, when analysing the Mackenzie M. S. S.; and observing that there are internal divisions, and separations among the *Jainas* themselves, connected with indications of one earlier common credence with the *Bauddhas*. More distinctly my guide has been the *Mahawanso*, a *Bauddhist* work in Ceylon. From this it appears that after the death of *Buddha* three great convocations were held: the first one with the view to secure uniformity of doctrine, and ritual; the second to repel the allowance of certain indulgences, or a relaxed system; the third convocation was held on account of many schisms, seventeen in all: it lasted nine months. That it composed them all is not asserted; and in the nature of human things it could not be so. General councils have always confirmed, and strengthened heresy. It is not in my power positively to identify the *Jainas* with any of those doctrines, or relaxed customs deemed heretical; but the probability is very great that such was their origin. Besides, from many books at the College, that have passed under my examination,

I discover a retrocession towards the *Vaishnava* ritual; while in philosophy they tend to harmonize with the *Smartas*; because of a common dogma, that man may, in the present state, become one with the divinity. They have gone back from the *Bauddhist* system; and it is, on many accounts tolerably clear that they thence have their original.

Whatever may been their doctrines or practice, it is scarcely possible not to commiserate their fate. The Bartholemew tocsin, it would seem, was first sounded at *Kalyana* of the western *Chalukyas*, when the two Basavas, after founding a strange caricature of the *Saiva* system, proceeded to urge their followers to exterminate the opposite system of the *Jainas*: king and people there falling victims to fanatic rage. Next following appear to have been the affairs at Warankal* and Orissa. About that period an agent from the north known in the South by the name of *Sampantar*, went to Madura, caused *Kandam Pandiyan* to become a *Saiva*, and to exterminate the *Bauddhas*, destroying their books, one only excepted. About the same time occurred the massacres of *Jainas* in the *Tondamandalam* under *Adonda*, and later rulers. Here, the crushing in oil-mills was the ordinary mode. *Appar* was a *Jaina* and a Tamil poet. He turned *Saiva* and went about, with others, singing chants in honor of distinguished fanes. He relented; and went back to his early credence; and was crushed to death in an oil-mill. Last in order as I suppose, came the tragedy under *Pratapa Rudra* in the immediate neighbourhood of *Amravati*, fully detailed as to simulated cause, in the foregoing chapters. The phrase “mild Hindus” and “tolerant Brahmans” were coined by individuals, who only saw sycophants crouching before conquerors, and fawning where they dared not to bite. But the history, at least of the Peninsula, as far as it has been developed, sternly rejects such terms; especially as regards *Saivas* and ultra *Saivas*; numbering these last especially among the fiercest of fanatics, as relentless persecutors, and the most violent in the work of human destruction.

* See Chapter 5.

APPENDIX.

CONTAINING VARIOUS EXTRACTS ON *SALIVAHANA*, THE
YAVANAS—BACTRIAN KINGS, AND TRACES OF
THEIR POWER IN INDIA.

It may here be in place to state that, by the time I had advanced but a short distance in my enquiries, various faded reminiscences revived. Casually referring for the explanation of a doubt to a volume of my earliest* publication on kindred topics, I was led to look beyond to forgotten matter; not perused since published, twenty years since. Information flowing in from various sources—some of it surprising—has tended to confirm, on the whole, the view then taken, beyond my expectation. I think that a connected train of extracts (rejecting much by the way) will draw a useful outline, in the descending series.

"It appears, on the whole, that not Patna, but Rajmehal, thirty miles from Patna, is the ancient Rajgriha, or Capital of the Prachi, or Prasij, though only a suburb remains; the site of the ancient town being washed away by the change of current of the river Ganges—Vol. 1 p. 243.

"The Magadha kingdom is, however, remarkable for being the holy land of the Buddhists; if not the birth place of their prophet. The Ceylon era, dated from the death of Buddha, would fix that event 542 B. C., corresponding with the period of the pure Magadha dynasty. The language which was spoken in that country, as already noted, is the sacred language of the Birmese, Siamese, and Cingalese. The era of Buddha's appearance has been considered to be of importance; and the indication of date here afforded, harmonises much better with all the inductions which we have been led to form, than the fixing his appearance 2100 B. C., or even 1027 B. C., according to the rectified conclusion of Sir W. Jones, p. 246.

"We learn from Ferishta's history of the Deccan, that *Vicramaditya* (or *Bikramajit*, according to the Persian orthography) was conquered by *Sapores*, King of Persia; not, as we infer from contemporary dates, the *Sapores* who took prisoner *Vale*, Emperor of Rome, but his predecessor, the second† of the Sassanian dynasty. This plain historical fact gives us at once a simple and sufficient clue to the whole of the fables connected with *Salivahana*. P, 252:

* Or. Hist. M.S.S. translated with annotations 1835—36.

† Shapour, the son of Ardeshir, his surname was Tirdeh; he reigned thirty-one years. Of his works are Koureh-Shapour, in Fars; Nishapour, in Khorassan; Shad-i-shapour, in Cosvin; and Jondi-i-shapour, in Khusistan. Ouseley's *Tarikh Jehan Ara*, p. 43. The other Shapour, the eighth of the dynasty, reigned seventy-two years and built *Toureh-Shapour*; but he was posterior in date to *Vicramaditya*.

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