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MADRAS RECORD OFFICE

GOVERNMENT OF MADRAS

Revenue..... DEPARTMENT

G.O. No.	2044.	Press
B.P. No.		Mis.
Dated 2 - 10 - 1875 . 196 .		

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MADRAS RECORD OFFICE

GOVERNMENT OF MADRAS

..... *Revenue* DEPARTMENT

G.O. No.
B.P. No.

2046

Press
Mis.

Dated

2-10-1875-196 .

Not to be folded or roughly handled

From Surgeon J. J. L. RATTON, M.D., Madras Army,

To C. A. GALTON, Esq., Acting Sub-Secretary to the Board of Revenue.

SIR,

I have the honor to inform you, that pursuant to instructions contained in the Proceedings of the Madras Government, Revenue Department, dated 30th October 1874, received by me on the 28th December, I went to the India Office on the 31st December to make inquiries, and applied also by letter on the same date to the Under Secretary of State for India for the credentials to enable me to visit with facility the salt manufactories in the south of France.

2. I found on inquiry at the India Office, that no previous intimation had been received there on the subject of my visit, and that it would take more than a week to obtain the necessary credentials from France. Under the circumstances, although my privilege leave would not expire until the 31st of January, and although in any case the time of my departure had not yet arrived, I determined to proceed at once to the south of France, and commence work either with or without the credentials as best I could. The brief interval at my disposal to visit the salt-pans and travel to India before the 28th February seemed to me to necessitate prompt action. I left London, therefore, on the morning of the 3rd January, and making inquiries by the way, reached Montpellier, the head-quarters of the salt-manufacturing industry on the Mediterranean Coast, on the 7th of January. Soon after my arrival, I applied personally to M. Mion, Representative of the *Compagnie Des Salins du Midi, Société Anonyme*, proprietors of the most extensive and best conducted of the salt concerns on the south coast of France, and from him learnt as follows:—

3. The French Government do not make their own or any salt. There are a large number of salt manufactories on the Mediterranean Coast, and yet a larger number of small ones on the Biscayan Coast, possessed by individuals or by Companies as private property. These make as much salt as they can without restriction or interference on the part of Government, but for every ton of salt they sell in France, they have to pay the Government a *droit* or tax of one hundred francs. To insure the due collection of the tax, Government requires that the salt-pans be arranged and the salt stored in a manner to enable the Customs officers effectually to guard against smuggling and fraud. The Government itself maintains a guard of *Douaniers* at the pans, whose duty it is, as in India, to prevent contraband and to weigh or assist at the weighing of all salt delivered for home or inland consumption and observe the amount. The tax is collected accordingly. It is interesting to note that these Customs officials are chosen from the Army, that none but soldiers who have received a good conduct badge are eligible, and that the rate of pay in the Customs Department is higher than in the Army. No tax is levied on export salt.

4. Having ascertained that the French Government had nothing to do with the actual conduct of salt manufacture in France, I commenced my inquiries at once, without hesitation, without the credentials. I represented the matter to M. Mion, to whose great courtesy I have very

Miscellaneous No. 930.
Prices Current of Food Grains in the several Districts of the Madras Presidency, during the Fortnight ending 15th September 1875.

QUANTITIES PER RUPEE BY THE SEER OF 80 TOLAHS.

QUANTITIES PER RUPEE BY THE SEER OF 80 TOLAHS.																																		
DISTRICTS	Wheat			RICE			Great Millet (Cholum, & other) Helcus sorghum			Bulrush, Millet, (Cumboo, Bajra), Penicillaria spicata			Lesser Millets, Ragi, &c. (Kavara, Veragoo, Sawee, Chenna, Coralloo, Muthana, Naglee, &c., Pannum, Millicoma, Eleusine, Corneana, &c.			Horsegram			Salt			Peas			Paddy			REMARKS						
				Best sort			Common																		Best sort				Common					
	Present fortnight	Past fortnight	Corresponding fortnight of 1874	Present fortnight	Past fortnight	Corresponding fortnight of 1874	Present fortnight	Past fortnight	Corresponding fortnight of 1874	Present fortnight	Past fortnight	Corresponding fortnight of 1874	Present fortnight	Past fortnight	Corresponding fortnight of 1874	Present fortnight	Past fortnight	Corresponding fortnight of 1874	Present fortnight	Past fortnight	Corresponding fortnight of 1874	Present fortnight	Past fortnight	Corresponding fortnight of 1874	Present fortnight	Past fortnight	Corresponding fortnight of 1874		Present fortnight	Past fortnight	Corresponding fortnight of 1874			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32			
Chennai				Not received																														
Chengam	160	160	120	120	120	120	126	161	161	206	200	248	217	207	227	260	260	280	246	254	398	140	140	140	1458	1901	972	275	221	241	292	241	275	
Chidambaram	126	126	105	108	108	168	200	202	120	-	-	-	-	-	-	264	246	509	270	270	420	187	187	187	2400	2400	1610	320	216	285	301	320	290	
Chidambaram	132	125	118	186	186	162	196	196	79	250	200	250	-	-	-	320	320	250	210	210	316	175	175	184	1490	1490	1240	265	265	277	278	278	290	
Chidambaram	112	107	105	100	109	158	160	160	180	221	298	240	-	-	-	282	210	252	220	226	244	170	170	170	650	491	770	201	201	254	267	269	269	
Chidambaram	118	118	118	140	150	124	158	166	180	229	229	20	290	290	261	277	285	270	249	247	252	160	160	160	2400	2400	2400	209	209	227	315	315	277	
Chidambaram	160	160	144	128	128	118	146	146	140	216	206	220	188	207	240	252	260	270	250	266	224	161	161	161	972	972	972	295	295	287	300	300	300	
Chidambaram	120	120	120	108	108	120	150	150	182	210	209	27	-	-	-	260	-	-	-	-	-	160	160	160	2200	2200	1600	209	209	210	240	240	260	
Chidambaram	110	110	110	129	129	116	135	135	120	201	201	196	205	205	210	220	220	229	186	190	210	182	182	182	180	180	180	210	210	197	226	204	210	
Chidambaram	-	-	-	100	100	120	150	140	120	-	-	202	-	-	-	240	200	280	175	191	210	186	186	186	1001	1001	1001	-	-	200	-	-	-	
Chidambaram	112	110	102	160	160	150	179	179	160	241	270	286	-	-	310	282	282	271	226	226	171	164	164	164	1871	1871	1871	266	295	289	288	302	262	
Chidambaram	97	100	96	102	102	102	107	107	101	-	-	202	289	281	282	254	246	246	206	210	192	171	184	190	2007	2007	2007	247	247	247	247	247	210	
Chidambaram	110	110	99	149	149	120	-	-	-	251	251	-	290	282	210	202	270	270	270	219	210	170	170	166	166	1944	1944	1944	201	251	219	-	-	-
Chidambaram	99	106	106	101	101	119	156	156	100	200	202	182	254	241	190	290	270	270	270	241	216	185	184	184	184	184	184	184	184	184	184	184	184	
Chidambaram	150	109	100	122	122	101	107	160	104	250	208	219	209	294	220	256	270	270	270	270	249	200	160	160	160	160	160	160	160	160	160	160	160	
Chidambaram	80	90	80	100	100	70	121	121	91	-	-	-	100	100	110	200	200	14	156	156	156	150	150	150	150	150	150	150	150	150	150	150	150	
Chidambaram	100	100	117	120	117	101	122	100	106	220	204	200	227	214	206	200	200	200	200	200	200	190	120	120	120	120	120	120	120	120	120	120	120	
Chidambaram	114	114	85	101	99	80	112	106	96	104	107	104	140	160	160	150	166	150	149	166	180	110	120	92	120	120	120	-	-	-	-	-	-	
Chidambaram	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	
Chidambaram	120	100	86	97	97	97	107	100	100	-	-	-	-	-	211	220	211	172	162	151	140	110	160	160	160	160	160	160	160	160	160	160	160	
Chidambaram	101	101	100	121	121	125	100	100	100	-	-	-	-	-	201	201	201	210	210	160	144	144	171	171	171	171	171	171	171	171	171	171	171	

thankfully testify my indebtedness, and was told by him in reply that he would do everything in his power to facilitate my work. In fact, a day was appointed for visiting the salt works of Le Perrier and Aigues Mortes, adjoining manufactories situated about two hours railway journey from Montpellier, and on the 11th of January, as agreed on, accompanied by M. Mion, junior, from the office, M. Alfred Gervais, Chief Inspecting Engineer, and M. Espinaski, Engineer in charge of the works, I went down to Aigues Mortes. I must here return my best thanks to these gentlemen for their unvarying kindness and solicitous attention to afford me every information during the two days, the greater part of which they were good enough to spend with me plodding through the salt pans.

5. Before alluding further to Aigues Mortes, I will sketch the arrangement of this report. First, I may mention that I had no difficulty whatever in visiting the French salt works, except the difficulty of finding them out and getting at them, in out-of-the-way localities. M. Mion very kindly gave me letters of recommendation to the agents in charge of the other important stations belonging to his Company, and at those salt works belonging to private individuals that I visited, I encountered always the most obliging civility. I will first name the salt works that I visited with dates and a few brief remarks concerning their position and importance, without describing them in detail as they are so much alike that their several descriptions would be neither useful nor interesting. Then I will describe the French system of salt manufacture as a whole. Afterwards, I will take up each part of the manufacturing arrangements and examine in detail into its uses, construction, &c. Finally, I will compare the French system with ours, and suggest such improvements in our method as the comparison may seem to indicate.

6. The adjoining salt works of Le Perrier and Peccais, the latter commonly called Aigues Mortes, are situated close by the Mediterranean, at the southern edge of the Department Gard; they were visited by me on the 11th and 12th of January. Both of these works are situated on a sandy portion of the Mediterranean shore, which is lower than the sea level on an average by eighteen inches. They are surrounded by embankments, about six feet in height, both to protect them from the not infrequent risings of the Rhone and from the sea; for although the sea is tideless, its water level often mounts two feet or more on this coast during the prevalence of westerly and southerly gales. The extent of embankment may be inferred from the fact that Le Perrier occupies a surface of 200 acres, and that the Aigues Mortes salt-works extend uninterruptedly over a belt of ground ten miles long, by four broad on the average. Sea-water, which here on the Mediterranean Coast has a density equal to 35° Beaumé, is brought to the pans in a large navigable canal nine feet in depth at the works, and usually about twelve feet deep on the bar. Its depth varies, but it is not liable to be blocked up with sand or flooded with fresh water. The same canal where it enters the works is furnished with a lock, the top of which is flush with the embankments partly to regulate the admission of water and partly to keep out floods. Subsoil brine marking 12° Beaumé is found abundantly at about three feet from the surface, but is not made use of in salt manufacture. Fresh water for the use of the workpeople, &c., is obtained at a depth of 150 feet and brought to the surface by means of Artesian wells. It was ascertained when sinking these wells that the soil on which the pans rest is pure sand to a depth of forty yards. About fifty Customs officials at ten different points or stations patrol and guard these works. They are the most important salt works in the south of France.

7. On the 16th of January, I visited the salt pans of Le Berre about fifty miles northeast of Marseilles in the Department Bouches du Rhone. These works are situated on a sandy promontory on the north or inland side of the Etang du Berre. The Etang du Berre is an enormous shallow reynart, occupying a surface of 143 square miles, formed by two mountain ranges which run out from the mainland about twenty miles, inclining towards each other in their course, so as to form a semicircular sea-basin, but in by hills, the hills do not meet, however, but leave an opening or strait gate between them, so small as to be invisible from the shore. Numerous

streams and rivers, the mouths of the Rhone, discharge into this estuary, its outlet being small as described, it follows that the water must be weak; in fact it never exceeds 2° Beaumé in strength. The works are at a lower level than the sea; they are surrounded by embankments to prevent inundation, and water flows into them naturally from the lake through canals provided with sluice-gates. There are a great number of salt manufactories round the lake, of which those called Le Berre are the most extensive. They are five miles long by about three miles broad, and are probably the most important works in Provence; the Manager who showed me round these pans obtained a Silver Medal for salt at the Paris Exhibition of 1856. He gave me some specimens of the identical salt which gained the prize, which I have much pleasure in forwarding to the Board. It is hard, firm, heavy, dry, translucent and rings with a metallic sound.

8. On the 19th of January, I visited the salt works known as Les Vieux Salins d'Hyères, belonging to the Compagnie du Midi in the Department Var. These works are seven or eight miles in circumference, and are about the largest in the department. As usual, they are on sandy soil below the sea level, and surrounded by protecting embankments. The embankments are raised to keep out sea incursions, no fresh water inundations being to be feared here as in the neighbourhood of the Rhone. Sea-water averaging 35° Beaumé in density flows naturally to the pans through canals cut from the sea at different points. A navigable canal traverses the works; there is good anchorage for shipping in the near vicinity, and they enjoy perhaps the largest share of the salt export trade in the province.

9. On the 21st of January, I visited the Salins des Pêcheurs or Salins Neuf; Compagnie de M. Girard, on the Toulon or west side of the last station and about seven miles from Toulon. This is also an extensive and important salt manufactory chiefly engaged in the export trade. I had cause to admire here the extent and completeness of the mechanical arrangements for facilitating salt transport and storage: the position of the crystallizing beds with reference to the platforms, the construction of the latter, the use of tramways, piers, &c. When describing these parts of the French system, I will keep the Salins Neuf before me as a model. In other respects these pans do not differ in any way from those last mentioned.

10. On the 26th January, I visited the salt-pans of Martigues, Bouches du Rhone, about two hours railway journey from Marseilles. There are numerous salt works scattered round Martigues on the borders of creeks running towards the Etang du Berre. They are comparatively small and possess no features of special interest. That one which I examined most attentively belonged to M. Joseph Dol. It resembles in all respects those already noticed.

11. On the 27th of January, in consequence of information I received from a salt trader at Marseilles, I visited the salt-pans of Le Fos rather inaccessibly situated on the sea or outer edge of the eastern chain of hills enclosing the Etang du Berre. I was informed that the best salt obtainable in France was made there. When I arrived I found workmen busily employed in removing a thick incrustation of Calcic Sulphate from the condensers' floors, preparatory to commencing manufacture. The Manager who accompanied me kindly presented me with a fragment of the crystalline Gypsum so removed. He also gave me a specimen of salt manufactured the previous year. These specimens are herewith forwarded to the Board. I could discover no reason why salt should be made better here than elsewhere, unless it be owing to the fact, which I noticed, that there is less sand and more clay in the soil here than at the other stations I visited. This is the last station that I had time to visit, as I left Marseilles for Madras on the 31st of January. At no station had I an opportunity of seeing manufacturing operations actually in progress.

12. A French salter, such as I have seen it and heard it described, consists essentially of a large tract of waste shore-land, fifteen to twenty square miles in area, at a lower level than the neighbouring sea, protected from inundation and cultivated for salt. The salt pans are divided into *Partie Extérieure*, *Partie Intérieure*, *Avant-Pieces*, *Tables Salant* and *Reservoirs*, which I will call for the future in this report, outer condensers, inner condensers, finishing condensers

Rev. 11752 2nd
N. 3796
Pres. No. 8790.

From
The Secretary, Board of Revenue.

To
The Secretary to Government
Department

Taken 24th
Despatched 24th
Received 1st 6-11-75
B. M. L. 1750

Prices Current of Food Grains in the
several Districts of the Madras Presidency,
during the fortnight ending 1st September
1875
C. M. 2044
Copy
200/15

crystallizing or salt beds and reservoirs, respectively. There are also platforms, &c., which need not be noticed as yet. The condensers and reservoirs occupy 78 per cent. of the evaporating surface, the salt bed, the remaining 22 per cent. A canal brings brine from the sea or estuary, as the case may be, to the works, and first to the outer condensers, into which it flows naturally as they are at a lower level than the sea. At the commencement of manufacture, brine is retained, spread out in a thin sheet in the first system of condensers for seven or eight days until it reaches 8° Beaumé in strength. It is then passed into the inner condensers, generally also by natural gravitation. Here the brine, still spread out shallowly, is allowed to evaporate until it reaches about 18° Beaumé. Then it is pumped up to the finishing condensers and is passed slowly from one to another of these until it reaches the salt beds, its passage being so regulated that it shall mark 25° Beaumé by that time. These preliminaries take about fifteen days. The brine from the finishing condensers is allowed to gravitate into the salt beds, which are filled to a depth of about ten inches and replenished from time to time during salt formation with additional brine, so as to secure that its strength shall not at any time exceed 29° Beaumé. This continues until a bed of salt about two inches in thickness has formed, when the bitterns are drawn off for the supply of some less advanced bed and the salt is collected by means of wooden shovels in the dry state. The whole duration of manufacture from first to last is about five months, that is, from April to August or September. The time allowed for salt crystallization on the beds is three months.

13. The condensers are not arranged in concentric circles surrounding the salt beds nor in regular progression towards them, as might perhaps be supposed from their names and the foregoing description. Such an arrangement is seldom or ever practicable without going to great expense. Simply natural undulations of ground are made use of in salt manufacture in the best way that their circumstances will allow. A site possessing the requisite qualifications having been selected, a large portion of it, and that at the highest level, is apportioned off to the outer condensers. As all alluvial deposits or silted sands have a slope in one direction or another, and the outer condensers extend over two or three linear miles of ground, the whole of the tract that they comprise is never at the same level. They are divided, therefore, by cross bunds into communicating compartments, and sea-water is admitted first into that which is at the highest level, and from thence flows to the lowest. If the conformation or slope of the ground will allow of it, as it often does, the inner condensers, which also occupy a large tract of ground, begin where the outer end. They are also divided into compartments through which the brine flows from the highest to the lowest. Arrived at the lowest inner condenser after winding about from the sea, from one compartment to another, a long sinuous tract, in which every variation in level has been taken advantage of, the brine has usually reached the lowest level in the whole Salin or salt works. From here then it is pumped up to the first compartment of the smaller system of finishing condensers, probably at the same level or at a higher level than the first outer condenser, from whence it gravitates to the last compartment and so on to the salt beds, which are on a slope so that the brine can flow from one to another from first to last, or by means of a channel can pass by rearer beds and fill these further off. In this description it will be seen that I cannot furnish a diagram or drawing of the arrangement of parts at a French salt-work as they are not uniform. Sometimes the brine has to be pumped from the last outer to the first inner condenser, and sometimes, though not so often, as there is from the last finishing condenser to the first salt bed.

14. The floors of the condensers are not prepared in any way, and after manufacturing operations have been much excited the flow of brine through their compartments is not much checked after, the sluices being left open just manage to supply daily the amount of brine required by evaporation, that amount being maintained without trouble. This can be arranged by a gentle inclination. The brine that is left in the finishing condensers at the end of the season, called *brine de l'été*, and I suppose also the strong brine in the last few inner condensers

compartments is pumped off to reservoirs at a high level, where it remains stored to a depth of three feet throughout the winter and until the commencement of the next manufacturing season, when it is, according to its strength, transferred to the inner condensers, finishing condensers or salt beds. At the salt stations I visited in January, this brine varied from 15° to 22° Beaumé in strength. At the end of the season, the Mother liquors are got rid of by being drained off or pumped out to sea according to the level of the salt beds. There is not that amount of Mother liquor to get rid of that might be supposed from the fact that brine is not ordinarily evaporated beyond 29° Beaumé, as it is customary to make a certain amount of a comparatively inferior description of salt, in separate tables, from used brine at 29° Beaumé. This salt formed between 29° and 32° Beaumé is in great demand for fish-curing and for the manufacture of soda, and is sold exclusively for those purposes.

15. One square yard of crystallizing surface at an average salt station yields 110 lbs. of salt in thirty days, but this must not be confounded with the mean produce of the salt works per square yard. A cubic yard of the salt is said to weigh 168 lbs. The salt when collected is stored on raised platforms as in India, and stacked in heaps of from 500 to 2,000 tons each, covered usually with tiles. The cost of manufacture is nearer five than six francs a ton, and that includes everything to the completion of the heap, its covering and maintenance of establishment. There is a permanent establishment of about 100 men and 60 mules at Aigues Mortes. The platforms are flanked by tramways or canals; when salt is sold a heap is broken up, and the salt, tied up in sacks, is put on board boats or removed in wagons. I will recur to the weighing process afterwards.

16. *Embankments.*—The embankments surrounding the works at Aigues Mortes, Bouches du Rhone, are about six feet high, twenty-five yards across the base, and have six feet of pathway on top. At other stations the embankments are of less dimensions according to their wants. All were, when I examined them, covered with vegetation, although originally formed with sand, and this because clay had been brought and placed upon them; brushwood, &c., planted and encouraged to grow, burl engrafted, and every care taken to put and preserve them in good order.

17. *Canals.*—There are commonly two or three supply canals cut from the sea at different points to bring brine to the outer condensers, of which again, there may be more than one set according to the local conformation of the ground. One canal at all events larger and deeper than the others is navigable and is so arranged as to facilitate locomotion and the transport of salt. These canals have their opening sometimes blocked up with sand, sea-weed, &c., by the wind and waves as in India, but their maintenance is carefully attended to. They are provided with sluice-gates both to keep out the sea and floating debris, and are staked along their sides to keep the sand from falling in. Brush-wood, reeds, &c., of a suitable kind are planted along their slopes to consolidate and preserve them. Boats are towed in the canals by mules, for whose use a tow path is constructed at one side, and bridges are placed at different points of the canal to enable workmen, carts, mules, &c., to cross. These bridges are simply flat-bottomed boats, boarded over and tied at each end with cords to a slightly projecting pier or staging, so that when one set of cords is let go, the bridge swings to the opposite side, the side to which it is attached, giving free passage to boats coming along the canal.

18. *Channels.*—From the main supplying canal, numerous channels branch off in every direction running along the sides of the different systems of condensers and of the salt beds, crossing each other frequently, sometimes by means of wooden aqueducts of the ordinary kind, sometimes by means of what are locally termed syphons according as they may be at the same or at different levels. A syphon here means an underground wooden aqueduct and is used when two channels at the same level meet at an angle, so that one may dip under the other and come to the surface again. These channels communicate with the condensers, &c., which at different points they can either supply or drain by means of wooden sluice gates; they communicate with

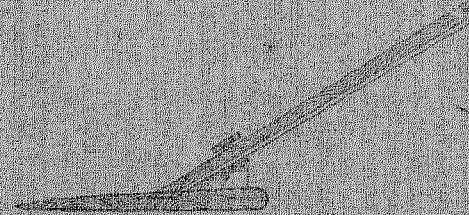
each other and with the main canal in the same way and all have a *rendevous* at the pumping station which is the centre of operations for the whole salt work. By means of these channels and a pump hereafter to be described, the Manager can pump any one of the brine receptacles, by whatever name called dry, or pump it full again with sea-water or brine from any part of the works without touching or interfering with any other part, save the two for the time being placed in communication. This is not a theoretical advantage, it is one of great practical utility and is constantly made use of. At important points, wherever in fact it is necessary, the sluice-gates are set in masonry frames. Sometimes also where two channels at the same level meet at a right angle, their point of intersection is made a waterway common to both by means of four sluice-gates, a pair to each channel, one pair being closed, the other channel possesses the way and *vice versa*; but this arrangement is not practicable where both channels are important and in constant use.

19. *Condensers*.—The condensers, lower, inner and finishing, have their sides staked and planted with brushwood to preserve them. They are but shallow sandy basins, and the brine stored in them seldom exceeds an average depth of three inches. The mean level of their floors is about eighteen inches below sea level, but they seldom approach nearer to the sea than 100 yards, and extend away from it for miles. As before stated, their floors are not prepared in any way, and I think they must leak a good deal. The Engineers say there can be no great leakage, because brine 12° Beaumé in density is found below the surface. Now it is a fact that brines of different densities being of different weights will rest one upon another, and though transfusion or dialysis takes place, this is so slow a process as to be scarcely worth considering where the top layer of brine is constantly on the move. On the other hand, subsoil brine is not found immediately in contact with the condenser floors, but in the sand from one to three feet deeper, so that brine leaking into the stratum between the two, must be removed to a certain extent by lateral drainage and ultimately lost, or effused into intersecting channels as may chance to be the case. And, again, the subsoil brine would in any case only protect the outer condensers from leakage. It would not protect those condensers containing brine at above 13° Beaumé, for as the brine increases in density and in weight, it would penetrate more readily through the sand and sink unimpeded through the subsoil brine.

20. *Salt Beds*.—The position of the salt beds in the works and their precise arrangement is not, for obvious reasons, uniform throughout the different stations, but they are always either clustered together in parallel rows and surrounded by platforms and tramways or canals, or they run in a long line along the borders of the navigable canal, separated from it by a platform. Each salt bed is usually about 80 yards long by 40 yards broad. In the first instance, the beds are levelled with great care. At some places, overlooking the sea, an ingenious method of levelling is practised which might be of use in India. It is based on the assumption that a line drawn from the horizon at sea to the level of the eye of a man stooping is horizontal, and it is so practically for the purpose of levelling a large salt bed. Two sticks are cut four feet in length, and their ends placed at right angles to their length. When these two sticks provided with plumb lines are held vertically, one by the observer and the other by his assistant a few yards nearer the sea and in the line of sight looking towards the horizon, if the observer looks over the upper edge of his stick at the horizon, the upper edge of the other stick will be just tangent to his line of vision. If the two sticks are on level ground. If the assistant's stick obstruct the view, it is on higher ground, and the portion of stick between its upper edge and the point where the horizon cuts across it, is a measure of the difference of level. If the assistant's stick is not tangent to the line of vision but below it, the observer is on higher ground, and he can measure the difference of level on his own stick by lowering his eye down along its side until the point is reached where his eye, the top of assistant's stick and the horizon are in one line. The work people fancy that this is as good a way of levelling the salt beds as any, and it is admitted on all hands to be the quickest and simplest way of doing it. Besides being levelled, the floors of the salt beds are well hardened by being trampled under foot by mules and are rolled with stone rollers drawn

by two men, at the beginning of each season. Strange to say they are not clayed, though brine at from 25° to 29° Beaumé must, I think, escape to some extent through a sand flooring, however well compressed. It is said that the larger and deeper these tables are, the better will be the salt. As a rule, they are from twelve to fifteen inches deep, and are boarded round the sides to keep the paths from falling in. Wooden sluice-gates at intervals give ingress and egress to the brine.

21. *Salt Collecting*.—When a cake of salt about two inches in thickness has formed, the Mother liquors are drained off from that bed and the salt is collected in the dry state. The hardness of the floor allows of this being done without soiling the salt. A wooden shovel sometimes tipped with tin is used for this purpose. (See diagram). It is pushed under the salt, which is lifted up and heaped on one side in small mounds as clay might be, and left there to drain for eight or ten days. This is done by skilled laborers on the permanent establishment of the works. Afterwards, the salt is carried to the platforms and heaped by contract, as this part of the work being almost purely mechanical, there is no fear of injury being done through inferior or scamped work. Salt is removed from the pans to the heaps in wheel barrows. Formerly, it was taken away in baskets as in India, but from experiments that have been lately made, it is found that barrows remove it quicker and more cheaply. Boards are laid down from the salt mounds to the platforms to enable the barrows to travel with greater facility.



22. *Platforms*.—The platforms are long narrow raised causeways from five to six feet high, and about ten yards broad on top, flanking the salt beds on one side and flanked by a navigable canal on the other. Some of them have a tiled flooring at the places marked out for salt heaps, others are boarded, and others again are merely gravelled and rolled hard. On some the position of the salt-heap is indicated by a low stone-wall forming a three-sided enclosure, on others the same thing is indicated by a similar arrangement of boards. Finally, many of them are traversed by a tramway.

23. *Salt Storage*.—The great bulk of the salt made at the pans is stored in the masonry or wooden frames open at one end, mentioned in last paragraph, within which the salt is heaped up so as to exactly resemble, when covered, a long low-tiled cottage with gable ends. Formerly, reeds, rushes and straw were used for covering the salt, but now they are discarded every where in favor of tiles, and the wastage which was formerly about 10 per cent. has been reduced almost to nothing, besides the tiles keep the salt much cleaner. So cleanly is the salt removed from the pans and preserved on the platforms, that it is taken at once from the heaps and ground down in mills, of which there are always one or two at each station, for table use, without further preparation. The tiles are two feet long by one foot broad, and are bent or curved at right angles to their length. They weigh 7 kilogrammes or 15.4 lbs. English and cost 90 francs a thousand or less than a penny, and not much more than half an Anna a piece. The number of tiles required is easily ascertained by calculation when the superficies to be covered is known. Table salt ready ground for use is stored in godowns adjoining the mills. Salt for fish-curing and for the manufacture of soda is heaped coverless on the platforms.

24. *Salt*.—The salt heaps that I examined were composed of salt very similar in appearance to that of Merkanum. A large number of firm lumps of salt made up of intercalated crystals scattered through the smaller debris of salt cakes, but, on the other hand, the crystals were in every instance larger, firmer, cleaner, more translucent and dryer than those made

curve, the centre of gravity of the mass of particles of water is displaced downwards rapidly and uniformly with consequent diminution of weight and friction. The curve is made by winding a piece of string round the edge of the inner circle or tube orifice of the tampon and unwinding it again, making a pencil score the extremity of the curve it describes. As the string unwinds, the radius of the circle described becomes longer and longer and the dimensions of the tube increases in the same ratio. By lengthening the pole or belts to which the mule or bullock is harnessed the labor may be greatly diminished, but the circle to be traversed is increased to the same extent, and ground wasted as well as time lost. An ordinary mule tampon has a diameter of about 12 feet, costs about francs 3,000 or £120, raises water 3 feet 3 inches, and discharges it at the rate of 263 cubic yards an hour. The circumference of the machine dips into the water which the chambers take up and discharge at the centre, out of which it flows into the channel at the higher level. By increasing the diameter of the machine it may be made to lift water as much as 5 feet, but this would not be necessary in India. The tampon is made of wood strengthened with iron, and there is a good deal of iron work about it, but it is not injured to any great extent by the salt water, an after the first coating of oxide has formed it protects the iron underneath from further rust. By means of the large double steam tampon at the centre of the works, at which part all the channels, &c., communicate with each other through sluice-gates, the Manager has perfect control over the flow of water throughout the works, and can empty or fill any part with brine or sea-water, at pleasure.

28. It is not easy to institute a close comparison between two methods of salt manufacture, differing so much in detail as do the French and Indian systems. It will be sufficient for my purpose, however, to compare their results, and endeavour to attribute them to their right causes. Salt of an excellent description, hard, heavy, well crystallized, clean, and almost chemically pure is produced for about five francs a ton in the south of France by the wholesale method. Salt, comparatively of an inferior description, light, friable, flaky, somewhat dirty and impure, is produced in India for a trifle more than that sum, that is, the contractors are paid on an average Rupees 10 a garce, or at the rate of 5.5 francs a ton. Now to give this comparison its true value, it must be stated that the conditions under which salt is made are not the same in both places. On the contrary, there is every reason why salt should be made better and cheaper in India than in France. Comparing notes with M. Gervais, I found that the rate of evaporation of sea-water, or in other words the rapidity of production was nearly three times greater on the Madras than on the Mediterranean Coast, and that the price of labor was about one-fourth; besides the presence of a stiff clay soil at most of our salt-pans renders it morally certain that they leak less than those in France. M. Gervais believes that the Compagnie de Midi with their system would turn out salt equal to their own in India at the rate of two francs a ton.

29. It thus appears that salt is made in India for 5.5 francs a ton of a decidedly inferior description to that made in France for five francs a ton. This again concerns the merits of the two systems in the abstract only, as the latter price includes the cost of establishment of works of construction, maintenance, repair, &c., and the coverings of the pans, &c., and the former price includes none of these things, the Madras Government supplying them as separate from the cost of manufacture. To form a correct estimate of the real merits of the comparison, I must here, therefore, compare the position of the Madras Government as proprietors of salt manufactures partly worked by contract, with that of the Compagnie de Midi making its own salt. I think that it costs the Madras Government about twenty francs a ton to make salt certainly inferior to that made in France under less advantageous meteorological conditions for five francs a ton. The cost of manufacture is made up approximately as follows: Cost of establishment reckoning it at the recognized rate of 3 Annas a mound 12.7 francs a ton, departmental works including salt coverings, &c., a little less than 6 Pies a mound or 1.7 francs a ton, payment to contractors 5.6 francs a ton, total 20 francs a ton. So that, as compared with the Compagnie du Midi, it costs in Madras four times as much to make a salt which is neither so clean, nor so pure, nor so wholesome,

which will not bear carriage as well, and which is subject to a heavier loss from wastage. The reverse of all this should be the case.

30. I will now endeavour to ascertain the cause first of the absolute cheapness of the French salt. I attribute it to the economy of a wholesale method of manufacture. At Aigues Mortes for instance, which is as large as all the salt stations on the Ennore Canal put together, there is a permanent establishment of only 100 men, and one or two Superintendents. At the Ennore Salt-stations there are hardly less than a thousand contractors, four or five thousand coolies, five Superintendents, ten assistants, five clerks, and about fifty peons who all after a fashion live upon salt. Suppose all the outlying stations on the Ennore Canal turned into condensers. The salt beds and platforms collected at Ennore under the eyes of a single Superintendent, his Assistant, and a staff proportionate to the diminished area to be looked after, and the rest of the people diverted to other industries, and we get an idea of the economies effected by the French system. Conversely, the relative dearthness of the Madras salt is due to the fact that Government gives out its manufacture on contract to petty contractors, supplies all the requisite large works, such as canals, embankments, platforms, &c., and maintains an establishment to look after the contractors and salt sufficiently strong to make the salt in a well arranged manufactory. The low level of the French salt-pans has not much to do with the cheapness of the salt, for after all the brine is pumped up to the finishing condensers and sometimes to the inner condensers, and when the pumps are not in action the mules still go on eating in the mangors. Steam pumps are of course relatively economic, but their use in this connection only serves to show that the French works are not much benefited by their low level.

31. The crystalline superiority of the French salt is no doubt due to the length of time it is allowed to form, the depth of brine under which it forms which protects it from the disturbing influence of the wind, and in a great measure also to the custom, strictly enforced, of keeping the brine in the salt beds always at or below 29° Beaumé, so that salt formation is never hurried or pressed upon by the approaching saturation of the Magnesian salts. To these reasons should be added two others, the rate of evaporation is less rapid in France than in India, and the winds as a rule are lighter there.

32. The superior clearness of the French salt is due to the gravelly hardness of the salt beds, careful handling and tile coverings, and its chemical purity to the careful exclusion from the works of brine capable of parting with its Magnesian salts. In these respects Indian salt is evidently capable of being improved up to the French standard without much trouble or expense, granted only a sympathetic state of feeling and hearty co-operation on the part of the native manufacturers.

33. Finally, there remains the question—what proposals calculated to benefit Indian salt culture are suggested by this report? In the first place, there are certain mechanical arrangements which may perhaps be advantageously introduced into this country which I will here merely enumerate and draw attention to, as before any of them could be adopted on a large scale, the question of advantage would have to be settled by limited experiments. I allude here to the pumping machine, the weighing machine, the platform arrangements for preserving the salt heaps, the tile coverings for the salt, the stone-rollers for hardening the beds, the wheel-barrow for removing the salt, the stick apparatus for levelling the beds, &c. Many of these might, I believe, be introduced with advantage, but I have returned so lately from France, that I cannot as yet speak positively about them. I have already by recommending in former reports a larger and shallower condensing area, a smaller number of salt beds collected at the end of the works nearest to the platform, deeper and stronger brine in the crystallizing beds, larger crystallizing beds well sanded, more time for crystallization and the removal of Mother Liquors &c., anticipated most of the proposals relative to improvements in the details of manufacture suggested by the French works.

34. But besides these questions of detail, there are other and more important proposals which flow naturally from an attentive consideration of the foregoing facts. One which I put

forward as a logical deduction from that consideration rather than as a serious proposal is—That Government make its own salt. As at present managed, Government pays for the construction, up-keep and establishment of the manufacturing stations, and yet pays ignorant contractors 5-6 francs a ton for manufacturing an inferior description of salt. Its total outlay is twenty francs a ton, whereas the French believe, and I also think, that they could make better salt here, everything included, for two or three francs a ton. By making the salt itself, Government could introduce those working economies and scientific improvements in the details of manufacture noticed in France. It is difficult to understand in what other way they can be introduced. The native contractors are in an independent position, and they know it. Happily ignorant, confident of their power, invincibly prejudiced and conservative, they go on making salt of the old kind in the old way, and for anything that I can see to the contrary, they will continue to do so for an indefinite number of years. At the end of 1873, I had begun to foresee this, and drew attention to it at the end of my report for that year. I can now only repeat that in so far as my efforts are directed towards improving the present method of salt manufacture, subject to existing surrounding conditions, they are not, I fear, likely to be productive of any great benefit.

35. Nothing would be better calculated to improve the salt culture of India than the excise system applied to salt, if only salt was sold by weight instead of by measure. But as the reverse is the case, as there is a premium placed on light salt by merchants at present buying by weight and selling by measure any withdrawal of Government supervision from salt manufacture would be at once followed by a decided deterioration in the quality of the salt in so far as there is room for it. On the other hand, if salt was sold by weight as well as bought by it, the excise system would, I believe, result in causing an immense improvement in the present state of salt manufacture. On the whole, I believe that the excise system, combined with an enactment compelling the sale of salt by weight, is the best proposal that can be made by one employed, as I am, in endeavouring to improve the manufacture of salt in this Presidency.

36. As long as the present state of things continues, intermediate between direct Government manufacture and excise, the best thing to do is to give or sell all new salt stations that are opened to intelligent capitalists whether Native or European, on the understanding or agreement that they will manufacture salt in an enlightened way and of a superior quality, and I know of no better test of quality apart from the cleanliness of the salt than a comparison of its weight with swamp salt. A manufactured salt, which bulk for bulk weighs as much as Vedarniem Swamp-salt for instance, is pretty sure to be well crystallized and free from Magnesium, &c. By an enlightened way of making salt, I understand the wholesale or economic method of manufacture as adopted by the French, with one restriction. In a tropical climate salt should not be left in the crystallizing beds longer than one month at most. Tropical showers come without much warning and are more copious and destructive than days of rain in France. There may be difficulty in getting men to buy or at least agree to work a whole salt station on the terms mentioned for the existing Kudivaram. I have professed to be able to make salt at a very low figure. This report contains strong evidence to show that it can be made at any rate for very much less than it costs at present and better made; but how much better and for how much less, are questions that nothing but a sufficiently extensive experiment can settle practically. If Government desire it, I am ready to undertake the conduct of an experiment, only, to be of use, it should be on a sufficiently large scale; time enough should be allowed for its completion and adequate funds provided for its conduct. The time at my disposal at Imore last year was far too limited to have enabled me to do more than show how salt may be best and most economically made in an ordinary cramped native ullam.

37. I regret to state that though I made diligent inquiries at different towns in the south of France, and from men long connected with salt manufacture, I could discover no plans, models or books likely to be of use to the Salt Department here. In fact, it is believed that nothing has been written on the subject further than such passing notices as appear in works on Chemistry under the head of Sodium Chloride. Under the circumstances, and considering also that the

French gentleman who courteously assisted me in my work are anxious to see my observations on their method of salt manufacture, I would ask the Board to send some copies of this report to M. Mion, Representative of the *Compagnie Des Salines du Midi*, Montpellier.

I have the honor to be,

Sir,

Your most obedient servant,

MADRAS,
4th March 1876.

(Signed) J. J. L. RATTON, M.D.,
Surgeon, Madras Army.

Revenue Department

Miscellaneous No. 8753

Proceedings of the Board of Revenue
1875

Read telegram from Government, Revenue Department dated 24th September 1875 requesting Board to forward twelve copies of Dr. Patton's Report on French Salines to Ootacamund.

Ordered accordingly.

(True Extract)

W. C. C.
Acting Sub-Secretary

To,

The Secretary to Government
Revenue Department,

Ootacamund
with 12 copies of Dr. Patton's
Report on French Salines

Admiral

M. V.

